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# 32<sup>nd</sup> Annual Conference of the International Society for Environmental Epidemiology

**ABSTRACT E-BOOK**

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**Advancing  
Environmental  
Health in a  
Changing World**

**ISEE  
2020**  
August 24-27, 2020



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# 32<sup>nd</sup> Annual Conference of the International Society for Environmental Epidemiology

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**ABSTRACT E-BOOK**

# E-POSTER ABSTRACTS



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## ABSTRACT E-BOOK

Theme: **Air quality health effects**

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**P-0001**

**Comprehensive approach for reducing health risks due to indoor air pollutants**

**Presenter:** Kenichi Azuma, Kindai University Faculty of Medicine, Osakasayama, Japan

**Authors:** K. Azuma<sup>1</sup>, H. Jinno<sup>2</sup>, T. Tanaka-Kagawa<sup>3</sup>, S. Sakai<sup>4</sup>;

<sup>1</sup>Kindai University Faculty of Medicine, Osakasayama, JAPAN, <sup>2</sup>Meijo University Faculty of Pharmacy, Nagoya, JAPAN, <sup>3</sup>Yokohama University of Pharmacy, Yokohama, JAPAN, <sup>4</sup>National Institute of Health Sciences, Kawasaki, JAPAN.

Individuals living in an indoor environment are typically exposed to a greater variety of air pollutants than in an outdoor environment. Numerous sources of chemical emissions are found in the indoor environment, depending on the building materials as well as the lifestyle of the occupants. The quality of the indoor environment considerably impacts public health. Japan has established Indoor Air Quality guidelines (IAQGs) for 13 chemicals, including formaldehyde, acetaldehyde, xylene, ethylbenzene, styrene, 1,4-dichlorobenzene, and toluene. However, the pollutant types and concentrations have been inconsistent over time because of altered lifestyles and the development of novel household products and building materials. Therefore, a comprehensive approach and action plan for the overall reduction of health risks because of indoor air pollutants are required for public health protection. To determine the high-risk indoor air pollutants that should be reduced, a preliminary risk assessment using data from nationwide exposure assessments and existing hazard data was conducted. As the result, 11 indoor air pollutants: 2-ethyl-1-hexanol, 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate, 2,2,4-trimethyl-1,3-pentanediol diisobutyrate, ethyl acetate, butyl acetate, propylene glycol monomethyl ether, 3-methoxy-3-methylbutanol, diethylene glycol methyl ether, diethylene glycol ethyl ether, propylene glycol monomethyl ether acetate, and methyl isobutyl ketone were identified. Subsequently, we reviewed the hazard or toxicological data for the 13 chemicals with established IAQGs and the 11 novel chemicals without established IAQGs to update their hazard assessments. The reference values for acute and chronic effects were determined from the reviewed information. The process and result of the preliminary risk assessment and the progress of the updated hazard assessments are reported.

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**P-0002**

### **Systematic Review on Untargeted Metabolomics Application in Air Pollution Health Research: Current Progress, Analytical Challenges, and Future Direction**

**Presenter:** Donghai Liang, Emory University, Atlanta, United States

**Authors:** D. Liang<sup>1</sup>, Z. Li<sup>1</sup>, J. Vlaanderen<sup>2</sup>, Z. Tang<sup>1</sup>, R. Vermeulen<sup>2</sup>, J. A. Sarnat<sup>1</sup>;  
<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Utrecht University, Utrecht, NETHERLANDS.

**Background:** Understanding the mechanistic basis of air pollution toxicity is dependent on accurately characterizing both exposure and health along a complete dose-to-response pathway. Untargeted metabolomics, an analysis of small-molecule metabolic phenotypes, may offer improved estimation to complex environmental mixtures. The field remains nascent, however, with questions concerning the coherence and generalizability of findings across study cohorts and analytical platforms. **Methods:** We conducted a systematic review to 1) summarize recent research of air pollution studies utilizing untargeted metabolomics and; 2) identify gaps in the peer-reviewed literature and opportunities for addressing these gaps in future designs. Using PRISMA guidelines, we screened articles published within MEDLINE and Web of Science between 1/1/05 and 12/21/19. Two reviewers independently screened a total of 1,074 abstracts, with discrepancies resolved by a third reviewer. **Results:** 22 studies fulfilled eligibility criteria and were included in this review. Over 300 metabolic features were associated with at least one or more air pollutant, with 52 features validated using authentic reference standards. Hypoxanthine, arginine, and histidine were among 12 metabolites consistently exhibiting associations with fine particulate matter and nitrogen dioxide exposure in at least three independent studies. Oxidative stress and inflammation related pathways, including glutathione, leukotriene and vitamin E metabolism, were the most commonly perturbed pathways reported in over 55% of studies. Challenges and gaps exist in metabolite annotation; over 80% of the reported features were not chemically annotated, limiting interpretability and generalizability of the findings. **Conclusions:** Numerous investigations have demonstrated the feasibility of using untargeted metabolomics as a platform linking exposure to internal dose and biological response. Metabolic perturbations in oxidative stress and acute inflammation pathway were associated with both short- and long- term air pollution exposure. Future directions should focus on validation of these findings via hypothesis-driven protocols and technical advances in metabolite annotation and quantification.

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**P-0003**

**Exposure to particulate matter and risk of amyotrophic lateral sclerosis: A case-control study in Northern Italy**

**Presenter:** Tommaso Filippini, University of Modena and Reggio Emilia, Modena, Italy

**Authors:** T. Filippini<sup>1</sup>, J. Mandrioli<sup>2</sup>, C. Malagoli<sup>1</sup>, A. Cherubini<sup>3</sup>, G. Maffeis<sup>3</sup>, M. Vinceti<sup>1</sup>;  
<sup>1</sup>University of Modena and Reggio Emilia, Modena, ITALY, <sup>2</sup>S. Agostino Estense Hospital, Azienda Ospedaliero Universitaria di Modena, Modena, ITALY, <sup>3</sup>TerrAria s.r.l., Milan, ITALY.

Background: Amyotrophic lateral sclerosis (ALS) is progressive neurodegenerative disease with still unknown etiology. Role of occupational and environmental risk factors has been investigated, including outdoor air pollutants, which have been recently associated to an excess disease risk. We carried out a case-control study in order to assess if environmental exposure to particulate matter  $\leq 10 \mu\text{m}$  (PM10) may increase ALS risk. Methods: We recruited patients referred to the Modena Neurology Unit between 1994-2015 and controls from the Modena province population. Using a validated geographical information system-based dispersion model, we geocoded subjects' addresses of residence at the time of diagnosis and we estimated outdoor air PM10 concentrations for each subjects. We computed odds ratio (OR) and 95% confidence interval (CI) of ALS according to increasing PM10 exposure, using an unconditional logistic regression model age- and sex-adjusted. Results: For the 132 study participants (52 cases/80 controls), mean of annual average and maximum PM10 concentrations were  $5.2$  and  $38.6 \mu\text{g}/\text{m}^3$ , respectively. Using fixed cutpoints at 5, 10 and 20 of average annual PM10 concentrations, compared with subjects  $< 5 \mu\text{g}/\text{m}^3$ , we did not find evidence for an excess ALS risk associated with PM10 exposure, since OR was 0.87 (95% CI 0.39-1.96), 0.94 (0.24-3.70), and 0.87 (0.05-15.01) at 5-10, 10-20 and  $\geq 20 \mu\text{g}/\text{m}^3$ , respectively. Using maximum annual PM10 concentrations, we found an excess ALS risk for subjects exposed at 10-20  $\mu\text{g}/\text{m}^3$  (OR=4.27, 0.69-26.51) compared with exposure below  $10 \mu\text{g}/\text{m}^3$ , although the risk tended to decrease at higher PM10 concentrations, with OR of 1.49 (0.39-5.75) at 20-50, and 1.16 (0.98-4.82) at  $\geq 50 \mu\text{g}/\text{m}^3$ . Conclusions: Our findings do not suggest that PM10 exposure is associated with ALS risk. However, some evidence of an increased risk associated with maximum annual exposure concentrations, although statistically imprecise, suggests the need of further investigations, also considering the high concentrations of particulate matter characterizing Northern Italy.

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**P-0004**

### **Short-term PM10 exposure is associated with lower severity of manic episodes in hospitalized bipolar patients**

**Presenter:** Michele Carugno, Dept. of Clinical Sciences and Community Health, University of Milan and Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy

**Authors:** M. Carugno<sup>1</sup>, D. Palpella<sup>2</sup>, A. Ceresa<sup>3</sup>, A. C. Pesatori<sup>1</sup>, M. Buoli<sup>3</sup>;

<sup>1</sup>Dept. of Clinical Sciences and Community Health, University of Milan and Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, ITALY, <sup>2</sup>International Medical School, University of Milan, Milan, ITALY, <sup>3</sup>Dept. of Pathophysiology and Transplantation, University of Milan and Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, ITALY.

Background: Bipolar Disorder (BD) alternates depressive, manic or hypomanic phases. A manic episode (ME) is the main psychopathological condition of BD and it often requires hospitalization. Air pollution is thought to play a role in onset and exacerbation of several psychiatric disorders. We thus aimed to verify the association between exposure to particulate matter  $\leq 10\mu\text{m}$  (PM10) and ME severity, assessed through the Young Mania Rating Scale (YMRS). Methods: We evaluated clinical records regarding 414 hospital admissions of 186 patients residing in Milan (Italy), hospitalized for ME in the Psychiatry Unit of the Policlinico Hospital from 2007 to 2019. Patients were assigned mean daily PM10 and apparent temperature levels of the city of Milan. Different exposure windows were considered: single days preceding hospitalization (lag 0 to 15) and their average estimates (lag 0-1 to 0-15). We applied mixed effect models, adjusted for age at hospitalization/onset, sex, smoking habit, number of cigarettes per day, year of hospitalization, season, and apparent temperature. Results: Short-term PM10 exposure was associated with a reduction in YMRS, both when considering daily lags [ $\beta$ : -0.46 (95% Confidence Interval: -0.87; -0.06) at lag0] and their average [-0.50 (-0.94; -0.07) at lag0-1]. YMRS was higher in psychotic patients (24.7 vs. 16.6,  $p < 0.001$ ) and lower when considering ME with vs. without mixed components (18.2 vs. 21.2,  $p < 0.001$ ). Interestingly, while PM10 did not influence the risk of patients being psychotic at admission, it was associated with a 34% increased risk of having a ME with mixed features (i.e. with dysphoric and/or depressive symptoms) at lag0-1 [Odds Ratio: 1.34 (1.01; 1.78)]. Conclusions: Our findings show that PM10 exposure moves the ME towards the depressive pole of the BD spectrum and increases the probability of hospitalization for ME with mixed components.

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**P-0005**

### **Attributable risk and economic cost of hospital admissions for mental disorders due to PM<sub>2.5</sub> in Beijing**

**Presenter:** Ziting Wu, Peking University, Beijing, China

**Authors:** Z. Wu<sup>1</sup>, X. Chen<sup>2</sup>, G. Li<sup>1</sup>, L. Tian<sup>1</sup>, Z. Wang<sup>1</sup>, X. Xiong<sup>1</sup>, C. Yang<sup>1</sup>, Z. Zhou<sup>1</sup>, X. Pan<sup>1</sup>;  
<sup>1</sup>Peking University, Beijing, CHINA, <sup>2</sup>Yale University, New Haven, CT.

**Background** Few studies have estimated the attributable risk and economic cost of mental disorders (MDs) due to particulate matters with aerodynamic diameter of less than 2.5  $\mu\text{m}$  (PM<sub>2.5</sub>) exposure in Beijing. **Objectives** This study aims to identify the possible correlation between PM<sub>2.5</sub> and risk of hospital admissions (HAs) for MDs in Beijing and calculate the attributable risk and economic cost. **Methods** A generalized additive model (GAM) with controlling for time trend, meteorological conditions, holidays and day of the week was used to estimate the associations. Stratified analyses were performed by age, gender and season. We further estimated the health and economic burden of HAs for MDs attributable to PM<sub>2.5</sub>. **Results** A total of 17,252 HAs for MDs were collected. A 10  $\mu\text{g}/\text{m}^3$  daily increase in PM<sub>2.5</sub> was associated with a statistically significant risk increase of 3.55% for HAs for MDs. The effects of PM<sub>2.5</sub> exposures on HAs for MDs were more pronounced in males, elderly ( $\geq 65$  years old) individuals and in cold seasons. Using WHO's air quality guidelines as the reference, 15.12% of HAs (2,609 person-times out of 17,252 person-times) and 16.19% of the related medical expenses (51.86 million CNY out of 320.3 million CNY) for MDs were attributed to PM<sub>2.5</sub> during the study period. **Conclusion** PM<sub>2.5</sub> accounts for substantial morbidity and economic burden of MDs for both the society and households, which shows environmental protections are essential to improve mental health status of the population.

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**P-0006**

**Ensemble averaging based high resolution PM<sub>2.5</sub> exposure assessment in two major Indian cities over 2010 to 2016**

**Presenter:** Siddhartha Mandal, Centre for Chronic Disease Control, New Delhi, India

**Authors:** S. Mandal<sup>1</sup>, A. Rajiva<sup>1</sup>, K. Madhipatla<sup>1</sup>, J. Menon<sup>2</sup>, K. Singh<sup>1</sup>, I. Kloog<sup>3</sup>, S. Guttikunda<sup>4</sup>, H. Ammini<sup>5</sup>, D. Prabhakaran<sup>1</sup>, J. D. Schwartz<sup>6</sup>;

<sup>1</sup>Centre for Chronic Disease Control, New Delhi, INDIA, <sup>2</sup>Public Health Foundation of India, New Delhi, INDIA, <sup>3</sup>Ben Gurion University of Negev, Beer Sheva, ISRAEL, <sup>4</sup>Urban Emissions, New Delhi, INDIA,

<sup>5</sup>University of Copenhagen, Copenhagen, DENMARK, <sup>6</sup>Harvard TH Chan School of Public Health, Boston, MA.

**Aim:** In this work, we retrospectively assessed daily average PM<sub>2.5</sub> exposure at 1 km × 1 km grids in two major Indian cities, Delhi and Chennai from 2010-2016, using multiple data sources and ensemble averaging approaches that combine machine learning algorithms.

**Methods:** We implemented a multi-stage modeling exercise involving satellite data, land use variables, reanalysis based meteorological variables and population density. The relationship between PM<sub>2.5</sub> and spatiotemporal predictors was modeled using six learners; generalized additive model, elastic net, support vector regressions, neural networks, random forests and extreme gradient boosting. Predictions from each base learner was combined under a generalized additive model framework with penalized splines and tensor product smoothing. Prediction accuracy was assessed using cross-validated(CV) R<sup>2</sup>, root mean squared error and bias.

**Results:** Predicted average annual PM<sub>2.5</sub> concentrations in Delhi ranged from 87 to 138 µg/m<sup>3</sup> over 2010 to 2016. Average CV-R<sup>2</sup> ranged from 0.69-0.92 for the ensemble averaged (EA) model across the years with annual average concentrations ranging from 104 to 139 µg/m<sup>3</sup>. The predictions were characterized by higher bias and root mean squared error in the fall and winter compared to summer and monsoon seasons. Spatial CV-R<sup>2</sup> (yearly average) varied between 0.91-0.99, while temporal CV-R<sup>2</sup> (daily variability) ranged from 0.65-0.90, showing adequate model performances. We demonstrated important seasonal and geographical differences in PM<sub>2.5</sub> particulate matter concentrations using the model outputs. Modeling for Chennai is ongoing and preliminary predictions will be shown.

**Conclusion:** We have developed a detailed exposure assessment for ambient air pollution in two distinct cities in India, with large differences in PM<sub>2.5</sub> levels, that are critical for estimating effects on health. We also demonstrate the advantages of ensemble averaging and machine learning based hybrid modeling, which can be used to scale up this exercise to the national level.

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**P-0007**

**do ultrafine particles confound studies on noise and cardiovascular disease?**

**Presenter:** Yingxin Chen, Centre for Environmental Health and Sustainability, University of Leicester, Leicester, United Kingdom

**Authors:** J. Gulliver<sup>1</sup>, Y. Chen<sup>1</sup>, G. Fuller<sup>2</sup>, A. Tremper<sup>2</sup>, L. Hibbs<sup>3</sup>, J. Soussan<sup>4</sup>, P. Vineis<sup>4</sup>, A. Hansell<sup>1</sup>;  
<sup>1</sup>Centre for Environmental Health and Sustainability, University of Leicester, Leicester, UNITED KINGDOM,  
<sup>2</sup>Environmental Research Group, King's College London, London, UNITED KINGDOM, <sup>3</sup>Reigate and  
Banstead Borough Council, Reigate, UNITED KINGDOM, <sup>4</sup>MRC-PHE Centre for Environment and Health,  
Imperial College London, London, UNITED KINGDOM.

**Background:** Ultrafine particles (UFP) are emitted by both jet engine aircraft and road traffic and may potentially confound associations between noise and health outcomes. However, neither UFP or noise are routinely measured resulting in a lack of understanding of their relationship. **Methods:** We conducted repeated short-term measurements with portable sensors (noise - Cirrus Research Optimus sound level meter (CR:171B); PNC - TSI 3007 condensation particle counter) to assess the correlation between noise and UFP number concentrations (PNC) for aircraft and road traffic. Noise and PNC were measured contemporaneously for 30-minutes at 160 sites (repeated three times at a range of site types) in Norwich, a medium size city in the east of England, and repeatedly up to 71 times per site at nine sites (501 in total) around Gatwick airport. **Results:** In Combining all measurements at Gatwick Airport the correlation between noise and PNC was very weak ( $\rho = 0.11$ ). Strongest correlations were moderate ( $|\rho| > 0.4-0.6$ ) at a residential site 1.3 km north of the runway and a site 0.6 km south of the runway. The correlation between noise and PNC in Norwich was overall moderate ( $\rho = 0.52$ ) and weak ( $\rho < 0.4$ ) for roadside sites ( $n = 55$ ) and urban background sites ( $n = 90$ ) respectively. **Conclusion:** Results suggest that PNC are unlikely to be a major confounder in epidemiological studies of aircraft or road noise and cardiovascular disease.

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**P-0008**

**A comparison of approaches to estimate traffic-related PM<sub>2.5</sub> in a study of commuters**

**Presenter:** Jenna R Krall, George Mason University, Fairfax, United States

**Authors:** J. R. Krall<sup>1</sup>, K. D. Moore<sup>1</sup>, J. Thornburg<sup>2</sup>, A. McWilliams<sup>2</sup>, M. McCombs<sup>2</sup>, A. Z. Pollack<sup>1</sup>;

<sup>1</sup>George Mason University, Fairfax, VA, <sup>2</sup>RTI International, Research Triangle Park, NC.

**Background/Aim:** Associations between exposure to traffic-related fine particulate matter (tr-PM<sub>2.5</sub>) and health are not fully understood. Exposure to tr-PM<sub>2.5</sub> while commuting may reflect an important exposure environment relevant for health. However, estimating exposure to tr-PM<sub>2.5</sub> is challenging because tr-PM<sub>2.5</sub> is a spatially heterogeneous chemical mixture that cannot generally be directly observed. We compare two approaches to estimate personal exposure to tr-PM<sub>2.5</sub> among commuters. **Methods:** We measured personal exposure to continuous PM<sub>2.5</sub> and 48-hour integrated PM<sub>2.5</sub> metals and black carbon (BC) for 49 women commuters in the DC metro area. We recorded vehicle trips across 48 hours using vehicle data loggers and dashboard cameras. We estimated tr-PM<sub>2.5</sub> using two approaches: source apportionment and vehicle monitoring. The source apportionment approach applied Positive Matrix Factorization (PMF) to integrated PM<sub>2.5</sub> constituents as in previous studies. The vehicle monitoring approach estimated average PM<sub>2.5</sub> exposure during vehicle trips identified using vehicle monitors. We compared estimates of tr-PM<sub>2.5</sub> using Spearman correlations and comparing tertile groups. We also compared vehicle monitoring tr-PM<sub>2.5</sub> with two tracers of tr-PM<sub>2.5</sub>: 48-hour integrated BC and zinc. **Results:** We fitted PMF to the integrated data and identified three sources: tailpipe emissions, salt, and road dust. Vehicle monitoring estimated personal tr-PM<sub>2.5</sub> exposure with a mean of 6.7 ug/m<sup>3</sup> (interquartile range: 2.5,7.7). The correlation between tailpipe emissions and vehicle monitoring was 0.22, with correlations for the other sources close to zero. The two approaches generally grouped commuters differently, with 62% of commuters in different tertiles for tailpipe emissions and vehicle monitoring. Results were similar when BC and zinc were used instead of estimated sources. **Conclusions:** There were substantial differences between the two approaches for estimating tr-PM<sub>2.5</sub> among commuters, indicating that using only integrated PM<sub>2.5</sub> constituents may not be representative of commute-specific exposures. Future work will combine these two approaches to better estimate exposure to tr-PM<sub>2.5</sub>.

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**P-0009**

**Ambient ozone exposure and amino acids metabolome in adolescents with overweight and obesity**

**Presenter:** Maria Luisa L Perez-Humara, Instituto Nacional de Salud Publica, Cuernavaca, Mexico

**Authors:** M. L. Perez-Humara, L. Hernández-Cadena, M. C. Escamilla-Nunez, A. Barraza-Villarreal; Instituto Nacional de Salud Publica, Cuernavaca, MEXICO.

Ambient ozone exposure and amino acids metabolome in adolescents with overweight and obesity  
Background Air pollution is a public health problem already associated with increased cardiometabolic diseases, however metabolomic pathways involved in air pollution remain not clear, especially in vulnerable population like adolescents who are at a critical period for development. Therefore, the aim of this study was to evaluate the relation between short term ozone exposure and amino acid and acyl carnitines in blood metabolome. Methods We conducted a longitudinal study on 9 to 21 years old adolescent with overweight and obesity from Mexico City. Ambient ozone exposure and other meteorological variables were estimated based on participants' residential addresses, lag and cumulative average effects were assessed. Three serum measurements were evaluated in 197 participants at different times over six years of follow-up, 40 metabolites related to beta oxidation of fatty acids and gluconeogenesis were measured. Factor analysis of the 40 metabolites was performed to identify 3 indexes: acylcarnitine index, amino acid index and a mixed index. Finally, we used mixed effects models to evaluate the associations between ozone exposure, metabolomic indexes and the individual metabolite concentrations of the first five metabolites in the index. Results Lag-1 day maximum ozone concentration was associated with lower concentrations of amino acid index. Alanine, leucine, valine and tyrosine had the higher scores in the amino acid index and each of this amino acid concentration were significant lower with lag-1 and 2 to 5-day average ozone concentration. Conclusions This study suggests that higher concentrations of ozone are associated with lower amino acid index scores and individual amino acid concentrations in adolescents with overweight and obesity.

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**P-0010**

### **Short-term Exposure to Ambient Particulate Elements and Epigenome-wide DNA Methylation in Older Men: the Normative Aging Study**

**Presenter:** Cuicui Wang, Harvard T.H. Chan School of Public Health, Boston, United States

**Authors:** C. Wang<sup>1</sup>, A. Baccarelli<sup>2</sup>, L. Hou<sup>3</sup>, E. Colicino<sup>4</sup>, J. Shen<sup>5</sup>, X. Lin<sup>1</sup>, P. Vokonas<sup>6</sup>, P. Koutrakis<sup>1</sup>, J. Schwartz<sup>1</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>2</sup>Department of Epidemiology and Environmental Health Sciences, Columbia University, New York, NY, <sup>3</sup>Department of Preventive Medicine, Feinberg School of Medicine, Northwestern University, Evanston, IL, <sup>4</sup>Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>5</sup>Family & Preventive Medicine, School of Medicine, University of Utah, Salt Lake City, UT, <sup>6</sup>School of Medicine, Boston University, Boston, MA.

**Background:** Current research suggests that short- and intermediate- term exposure to ambient particulate matter is associated with global and gene-specific DNA methylation (DNAm), but little is known regarding the changes in epigenome-wide caused by particulate elements (PEs). Additionally, the potential pathways remain unknown. **Objective:** We evaluated short- to intermediate-term associations between ambient PEs and DNAm in epigenome-wide and identified potential biological pathways. **Method:** We collected whole blood samples from 691 elderly men in the Normative Aging Study (1999-2013) and measured epigenome-wide DNAm with the Illumina Infinium HumanMethylation450 BeadChip. Ambient PEs were measured daily at a fixed monitoring station and 5 different moving averages from short- to intermediate-term (current day to 28-day) were considered. Linear quantile mixed models were used to estimate the associations between 15 elements and DNAm (N=1, 262 visits), adjusting for fine particle mass, cell type, batch effects, age, body mass index, smoking, etc. Pathway analysis was also performed to explore the potential biologic mechanisms. **Results:** Short- to intermediate-term exposure to PEs was significantly associated with epigenome-wide DNAm, especially for 28-d moving average. We observed different Bonferroni significant CpGs for different PE, most of them related with aluminum, iron, silicon, lead, and, calcium. The pathway analyses suggest that the detrimental effects might be relevant to cell cycle, biosynthetic process, and signal transduction. We also found that there were several common genes significantly associated with calcium, silicon and lead, such as, neurodegenerative disease related gene tubulin folding cofactor D. **Conclusions:** Ours is the first study that find short- to intermediate-term effects on DNAm in epigenome-wide by ambient PEs, especially elements associated with road dust, oil combustion, and wood burning. Our findings provide insight into potential mechanistic pathways.

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**P-0011**

**Transcriptome-wide analyses of the effects of ambient PM<sub>2.5</sub> and carbonaceous constituents: results of the AIRLESS project**

**Presenter:** Wu Chen, BIC-ESAT and SKL-ESPC, College of Environmental Sciences and Engineering, Center for Environment and Health, Peking University, Beijing, China

**Authors:** W. Chen<sup>1</sup>, Y. Han<sup>2</sup>, Y. Yao<sup>1</sup>, J. Liu<sup>3</sup>, Y. Wu<sup>4</sup>, K. Frank<sup>2</sup>, T. Zhu<sup>1</sup>;

<sup>1</sup>BIC-ESAT and SKL-ESPC, College of Environmental Sciences and Engineering, Center for Environment and Health, Peking University, Beijing, CHINA, <sup>2</sup>Department of Epidemiology and Biostatistics, MRC Center for Environment and Health, Imperial College London, London, UNITED KINGDOM, <sup>3</sup>Department of Epidemiology, Beijing Anzhen Hospital, Capital Medical University, Beijing Institute of Heart, Lung and Blood Vessel Diseases, Beijing, CHINA, <sup>4</sup>Peking University Clinical Research Institute, Beijing, CHINA.

**Background:** Transcriptome-wide analyses is emerging as a useful tool to investigate the unclear mechanism behind the well-documented health effects of air pollution. However, the evidence remains limited in human based studies and mainly focused on the ambient fine particles (PM<sub>2.5</sub>). **Methods:** This study investigated the changes in gene expression profiles in response to acute exposure to ambient PM<sub>2.5</sub> and its carbonaceous constituents. Based on the AIRLESS panel study, 251 nonsmoking senior participants living in urban (N=123) and rural (N=128) Beijing, China have undergone 4 times blood drawn. Total RNA was sequenced with RNA-seq technology by Hi-seq X10. Daily average concentrations of PM<sub>2.5</sub>, elemental carbon (EC), and organic carbon (OC) in ambient air were measured at a nearby monitoring site. Linear mixed-effects model was used to screen differentially expressed genes in association with exposure to air pollutants with adjustment for demographic, socio-economic and lifestyle variables, and consideration of false discovery rate (FDR) < 0.05. Pathway enrichment analyses were performed with Metacore platform. **Results:** The numbers of significantly changed genes associated with the exposure to PM<sub>2.5</sub>, EC, and OC were 1841, 1719, and 1670, respectively. Large proportions of changed genes were overlapped among the three pollutants, and the number of genes that only associated with PM<sub>2.5</sub> was 9. Top 50 significantly up-regulated genes were mostly involved in cell differentiation and inflammatory response (e.g. EVI2B, C5AR1, CD52, CSF2RB and CSF3R), while down-regulated genes mainly related to mitochondrial function and protein synthesis (e.g. UQCRC1, UQCRCB, ATP5E, COX6C and FAU). Pathway enrichment analyses suggested potential mechanisms including inflammatory response, oxidative stress, apoptosis and survival, and neurogenesis, e.g. IL-3 signaling via ERK and PI3K, were strongly associated with PM<sub>2.5</sub>, OC, and EC. **Conclusions:** EC and OC might play key roles in PM-induced health effects. Transcriptome-wide analyses helped to unveil the potential molecular mechanisms of such effects.

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## ABSTRACT E-BOOK

Theme: **Air quality health effects**

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**P-0012**

**construction and verification of air quality health index in china**

**Presenter:** Qinghua SUN, China CDC, Beijing, China

**Authors:** Q. SUN, W. SHI, H. ZHU, Y. ZHONG, T. LI;  
China CDC, Beijing, CHINA.

Background: Air Quality Health Index (AQHI) was established in several countries and areas, and has showed validity in communicating health risks of air pollution. But there is a lack of unified AQHI in China. Methods: We constructed six indexes: AQHI\_99, AQHI\_98, AQHI\_95, AQHI\_log99, AQHI\_log\_98, and AQHI\_log\_95, by summing the excess total non-accidental mortality risks associated with PM<sub>2.5</sub>, O<sub>3</sub>, NO<sub>2</sub>, and SO<sub>2</sub> and adjusting them to an arbitrary scale (1-10+). To adjust the distribution of the index, we logarithmic convert the sum of health risks. To avoid the maximum interference, we use the 99%, 98%, and 95% percentile of excess total non-accidental mortality risks of all counties in China as normalization factor. To verify the validity of communicating morbidity and morbidity risk, we calculated the relationship between the AQHIs and morbidity, amount of hospitalization, and outpatient number. According to the results, we chose the best AQHI. To test the ability of the AQHI to indicate a typical contamination event, we plotted the AQHI and air pollution concentration in several typical contamination events. And we also checked the consistency of AQHI and AQI. Results: AQHI\_98 and AQHI\_99 performed better in validity of communicating morbidity and morbidity risk than AQI and other AQHIs. Given the current state of air pollution in China, we tended to opt for stricter standards: AQHI\_98. An IQR increase of AQHI\_98 was associated with a 1.0% (95% CI: 0.6 to 1.5) increase of non-accidental mortality in China and 2.0% (95% CI: 1.8 to 2.1) increase of all causes hospital admissions in Beijing. This AQHI performs good in indicating typical contamination events and does not conflict with AQI. Conclusions: We recommend AQHI\_98 as Chinese AQHI. The AQHI is a more effective tool to communicate the health risk of air pollution in China.

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**P-0013**

**Investigating potential associations between O<sub>3</sub> exposure and lipid profiles: A longitudinal study of older adults in Beijing**

**Presenter:** Ang Li, Chinese Academy of Medical Science, Beijing, China

**Authors:** A. Li, Y. Mei, M. Zhao, J. Xu, Q. Xu;  
Chinese Academy of Medical Science, Beijing, CHINA.

Background: Little information exists on the lipidemic effects of ozone exposure. Few studies have focused on the different patterns of the association among older adults population, and little attention has been given to comprehensive lipid indices when evaluating the effect of O<sub>3</sub> exposure on the metabolism. Methods: We conducted a longitudinal study involving 201 older adults in Beijing, China between 2016-2018. A mixed regression model was applied with random effects to investigate the relationship between O<sub>3</sub> and lipid profiles. Results: O<sub>3</sub> exposure positively correlated with TC, LDL-C, CRI-I, CRI-II and AC at short-term and medium-term exposure periods. The largest increases in TC, LDL-C, CRI-I and CRI-II were found in the 28-days moving average indicating accumulative effects over prolonged exposure period. A 10µg/m<sup>3</sup> increase of O<sub>3</sub> at the 28-days moving average was associated with a significant increase of 3.9% (95% CI: 1.0, 6.9) in TC, 8.2% (95% CI: 4.2, 12.4) in LDL-C, 4.8% (95% CI: 1.1, 8.5) in CRI-I and 7.0% (95% CI: 2.7, 11.5) in CRI-II. Stratification by health status and characteristics revealed different patterns of lipid changes among older adults, lipid status, age, sex and BMI may modify the relationship between O<sub>3</sub> exposure and lipid profiles. Conclusions: Our findings suggest that short-term and medium-term O<sub>3</sub> exposure is associated with lipid profiles abnormalities among the older adults. Evidence also suggests there are patterns within population which differ according to both health status and demographic characteristics.

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**P-0014**

**Cognitive impact of polluted landscape and its neural basis: Evidence based on an Event-related Potential study**

**Presenter:** Jianxun Yang, Nanjing University, Nanjing, China

**Authors:** J. Yang<sup>1</sup>, M. Liu<sup>1</sup>, B. v. Berg<sup>2</sup>, J. Bi<sup>1</sup>;

<sup>1</sup>Nanjing University, Nanjing, CHINA, <sup>2</sup>University of Groningen, Groningen, NETHERLANDS.

Background Abundant studies suggest that long-term exposure to air pollution such as particulate matter (PM) can impair cognitive functions. Systemic and brain inflammation induced by pollutants are recognized as the major cause. Recently, new evidence emerged that even “mild” exposure to air pollution, for instance the visual impact of air pollutants can influence mental health and cognitive performance. Such effect is hard to capture but may lead to lowered productivity in daily life. Methods We utilized the event-related potential (ERP) technique to prove the existence of cognitive impact caused by polluted landscape. Thirty-two undergraduate students from Nanjing, China participated the experiment. A dot-probe task was designed as follows. Two horizontal or two vertical dots were presented at the left or right visual field. This target was preceded by a cue (i.e., clean or polluted pictures) at either the target location (valid trials) or at the opposite location (invalid trials). Participants were asked to respond to the target (vertical or horizontal) as soon and accurate as possible. We hypothesized invalid trials and trials cued by polluted pictures would cause participants longer reaction time. Meanwhile, averaged electroencephalogram signals, i.e. the event-related potential, of four trial types (clean-valid, polluted-valid, clean-invalid, polluted-invalid) were extracted to reveal the underlying neural cognitive basis. Results There is a significant positive effect of invalidation, pollution and their interactions on response time, which means visual impact of pollution distracts attention and slows decision-making process. ERP data shows a frontal negativity for pollution trials after 1600-2000ms cue onset. This may serve as the neural basis of how human brain reacts to polluted landscapes. Conclusions To our knowledge, this is the first study adopting ERP technique to investigate the cognitive impact of visual impact caused by air pollution. The findings call for attention to this subtle phenomenon especially in developing countries.

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**P-0015**

### **Outdoor Air Quality and Antibioqram Characteristics of Bacterial Isolates of Akure City Abattoirs, Nigeria**

**Presenter:** Olubukola O Olusola-Makinde, Federal university of technology akure, Akure, Nigeria

**Authors:** O. O. Olusola-Makinde;  
Federal university of technology akure, Akure, NIGERIA.

Normal 0 false false false EN-US X-NONE X-NONE /\* Style Definitions \*/ table.MsoNormalTable {mso-style-name:"Table Normal"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-parent:""; mso-padding-alt:0in 5.4pt 0in 5.4pt; mso-para-margin-top:0in; mso-para-margin-right:0in; mso-para-margin-bottom:10.0pt; mso-para-margin-left:0in; line-height:115%; mso-pagination:widow-orphan; font-size:11.0pt; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin;} Air sampling of Onyearugbulem and FUTA abattoirs was carried out to evaluate their quality. Air sampling was done using the open-settling method on general and selective agar media of the gutter, sleeping bench, slaughtering floor dumpsite, slaughtering table and roof of the abattoirs. Using standard methods, Presumptive identification of the bacterial isolates was carried out. An array of ten (10) conventional antibiotics was used to assay the antibiotic susceptibility characteristics of the bacterial isolates. Multiple antibiotic sensitivity index (MARI) was determined for isolated bacteria. At Onyearugbulem abattoir, the total Escherichia coli count ranged from  $3.6 \times 10$  cfu/ml from the gutter and slaughtering table to  $6.5 \times 10$  cfu/ml from the slaughtering floor, while the total bacterial count ranged from  $1.34 \times 10^2$  cfu/ml from dumpsite to  $2.55 \times 10^2$  cfu/ml from the gutter, the total coliform count ranged from  $2.8 \times 10$  cfu/ml from slaughtering floor to  $4.1 \times 10$  cfu/ml from sleeping bench. Several bacteria were presumptively isolated. These include: Micrococcus sp., Bacillus sp., Staphylococcus aureus, Escherichia coli, Proteus sp., Enterobacter aerogenes and Aeromonas sp. Ciprofloxacin (10  $\mu$ g) had an inhibitory effect on all the Gram positive bacterial isolates with the highest inhibitory activity on S. aureus at 24.00 mm, and the Gram negative bacteria with the highest inhibitory activity on E. coli at 21.00 mm. Micrococcus sp. had the highest MARI of 0.8. These findings reveal the presence of multiple-antibiotic resistant bacteria in Onyearugbulem and FUTA abattoirs' atmosphere. There is therefore need for routine environmental sanitation of the slaughterhouses.

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**P-0016**

### **Bayesian Predictive Modeling of Household Air Pollution Concentrations for 25,000 Rural Households across 8 Countries in the PURE-AIR Study**

**Presenter:** Matt Shupler, University of British Columbia, Vancouver, Canada

**Authors:** M. Shupler<sup>1</sup>, P. Hystad<sup>2</sup>, P. Gustafson<sup>1</sup>, M. Brauer<sup>1</sup>;

<sup>1</sup>University of British Columbia, Vancouver, BC, CANADA, <sup>2</sup>Oregon State University, Corvallis, OR.

**Background/Aim:** Global quantitative estimation of household air pollution (HAP) exposure is critical for assessing associated health impacts. Previous global HAP modeling studies have aggregated published measurements, which can introduce bias by combining data from various study protocols. **Methods:** The Prospective Urban and Rural Epidemiology (PURE)-AIR study, one of the largest HAP measurement studies to-date, included 48-hour fine particulate matter (PM<sub>2.5</sub>) kitchen concentrations in a stratified-sample (2,541 households) proportional to primary cooking fuel type across 120 rural communities within eight countries (Bangladesh, Chile, China, Colombia, India, Pakistan, Tanzania, Zimbabwe). Additionally, survey data captured detailed information on household cooking characteristics/behaviors. Random forest modeling was used to rank predictors of measured PM<sub>2.5</sub> concentrations. Selected factors and weakly informative priors from a previous global model using PM<sub>2.5</sub> measurements available in the WHO Global HAP database were included in a Bayesian hierarchical predictive model of PM<sub>2.5</sub> concentrations. Model performance was assessed via leave-one-out cross-validation. The chosen model was then applied to 26,197 households in the eight countries, with available survey data but no PM<sub>2.5</sub> monitoring. **Results:** Primary cooking fuel type, heating fuel type, roofing material, primary drinking water source, household size, household income and kitchen ventilation (windows) were the most important predictors of household PM<sub>2.5</sub> concentrations; an R<sup>2</sup> of 0.49 and mean absolute error of 49 µg/m<sup>3</sup> resulted from the Bayesian model. Modeled global average 48-hour PM<sub>2.5</sub> concentrations among households using gas as a primary cooking fuel (46 µg/m<sup>3</sup>; 95%CI:[32,64]) were lower than those using coal (68 µg/m<sup>3</sup>; 95%CI:[37,124]), wood (72 µg/m<sup>3</sup>; 95%CI:[65,80]), grass/shrubs (81 µg/m<sup>3</sup>; 95%CI:[45,147]) and animal dung (98 µg/m<sup>3</sup>; 95%CI:[50,194]).

**Conclusions:** HAP monitoring in a strategic sub-sample of households alongside detailed survey data collection provides a feasible, multinational quantitative assessment of HAP exposure. Improved global estimates of PM<sub>2.5</sub> concentrations can be used to improve risk assessment models and epidemiological analyses of HAP.

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**P-0017**

**Particulate matter air pollution, neighborhood socio-economic status, and leukocyte telomere length**

**Presenter:** Elise Grace Elliott, Brigham and Women's Hospital and Harvard Medical School; Harvard TH Chan School of Public Health, Boston, United States

**Authors:** E. G. Elliott, N. V. DeVille, I. DeVivo, F. Laden, J. E. Hart; Brigham and Women's Hospital and Harvard Medical School; Harvard TH Chan School of Public Health, Boston, MA.

**Background:** Telomeres cap and protect chromosomes from degradation and risk factors for telomere attrition include aging and environmental factors. Although exposure to some air pollutants and neighborhood socio-economic factors (nSES) have been associated with telomere length, evidence of associations between exposure to particulate matter (PM) air pollution, nSES, and the interaction between the two in relation to telomere length is limited and inconclusive. Our objective was to examine the associations between exposure to short-, intermediate-, and long-term (1-, 3-, and 12-month) exposure to different size fractions of PM (<2.5 microns [PM<sub>2.5</sub>], 2.5-10 microns [PM<sub>10-2.5</sub>], and <10 microns [PM<sub>10</sub>]) and nSES at blood draw, and leukocyte telomere length.

**Methods:** We used generalized linear regression models to examine the associations between each of the PM exposure metrics, nSES, and z-scores of log-transformed telomere length in 10,212 female participants of the nationwide Nurses' Health Study, after adjusting for demographics and telomere attrition risk factors. Using participants' address history, we applied spatio-temporal prediction models to estimate monthly PM exposures. **Results:** In adjusted models, PM<sub>2.5</sub> exposure per 10 µg/m<sup>3</sup> increase was not associated with relative telomere length: 1-month exposure: β: 0.01, standard error (SE): 0.01, p: 0.40; 3-month exposure: β: 0.01, SE: 0.01, p: 0.37; 12-month exposure: β: 0.01, SE: 0.01, p: 0.34. Results for exposure to PM<sub>10-2.5</sub>, and PM<sub>10</sub> were similar. nSES at blood draw was also not associated with telomere length: β: -0.001, SE: 0.001, p: 0.28. We observed no multiplicative interactions between 1-, 3-, and 12-month PM exposures and nSES. **Conclusions:** In this study of U.S. women, short-, intermediate-, and long-term PM exposures were not associated with telomere attrition for any size fraction of PM; nSES was also not associated with telomere length. Additionally, we observed no interactions between PM exposures and nSES in association with telomere length.

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**P-0018**

**Determinants of exposure to ultrafine particles (PUF) and black carbon (BC) inside Parisian taxi vehicles: the PUF-TAXI project**

**Presenter:** Melissa Hanna Hachem, Paris University, Paris, France

**Authors:** M. H. Hachem<sup>1</sup>, L. Bensefa-Colas<sup>1</sup>, N. Saleh<sup>2</sup>, I. Momas<sup>1</sup>;  
<sup>1</sup>Paris University, Paris, FRANCE, <sup>2</sup>Lebanese University, Beyrouth, LEBANON.

**Background** In the last decades, traffic related air pollutants (TRAP) have decreased in response to the implementation of stricter emission standards and to new technologies in automobile fleet. Despite these improvements, taxi drivers remain highly exposed to TRAP due to their proximity to the “traffic source” and the significant amount of time spent in traffic. Thus, we aimed to identify the determinants of Parisian taxi drivers’ exposure to ultrafine particles (UFP) and black carbon (BC), pollutants of recent interest, inside their vehicles. **Methods** In this cross-sectional study, we studied 499 trips conducted by 50 Parisian taxi drivers from PUF-TAXI project. UFP and BC were measured inside taxis by Diffusion Size Classifier Miniature® and microAeth® AE51, respectively, for 9 hours during normal service. Data on vehicles and trips characteristics were collected by questionnaires and face to face interviews. Associations between pollutants levels and their determinants were analyzed using Generalized Estimating Equations (GEE) model adjusting for potential confounders. **Results** UFP ( $32.3 \pm 37.5$  pt/cm<sup>3</sup>) and BC ( $3.3 \pm 2.3$  µg/m<sup>3</sup>) mean concentrations per trip inside taxi vehicles were moderately correlated ( $r= 0.3$ ,  $p < 0.001$ ). The analyses showed that levels of UFP and BC inside taxi vehicles were greatly influenced by ventilation settings. The use of air-conditioning (A/C) with closed windows reduced UFP and BC by 53% and 19%, respectively. However, maximum air protection was obtained when both A/C and air recirculation were on. Vehicles speed, trips destinations were also significant determinants of in-taxis UFP and BC levels. In addition, the variability of BC levels inside taxis depended significantly on ambient air pollution, humidity and trip duration. **Conclusions** Our results suggest that exposure to UFP and BC inside vehicles can be reduced significantly through simple preventative measures likely to be adopted by professional drivers as well as by all commuters.

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**P-0019**

### **Vale of Tears: The Dangerous Health Effects of Tear Gas Used in the Hong Kong Pro-Democracy Movement**

**Presenter:** Wai Ho Chak, University of California, Davis, Davis, United States

**Authors:** W. Chak<sup>1</sup>, C. Ko<sup>2</sup>, A. Li<sup>3</sup>, B. Lau<sup>4</sup>, K. Yuen<sup>5</sup>, & The Citizens' Press Conference<sup>2</sup>;

<sup>1</sup>University of California, Davis, Davis, CA, <sup>2</sup>The Citizens' Press Conference, Hong Kong, HONG KONG,

<sup>3</sup>Toronto Rehabilitation Institute, University Health Network, Toronto, ON, CANADA, <sup>4</sup>Hong Kong Shue Yan University, Hong Kong, HONG KONG, <sup>5</sup>Johannes Gutenberg University Medical Center, Mainz, GERMANY.

#### Background

Throughout the second half of 2019, the use of tear gas by the Hong Kong Police Force on protesting crowds has yielded much debate. Previous international studies have recognised the significant and pervasive health effects of tear gas.

#### Methods

Researchers at the Citizens' Press Conference, a citizen-initiated broadcast platform, collected 17766 valid responses from their large-scale online survey on the participants' roles in the Hong Kong pro-democracy movement, the locations of their homes and workplaces, and any adverse symptoms suffered from tear gas exposure.

#### Results

Severe medical symptoms induced directly by tear gas, some of which unseen in previous studies elsewhere, have been recorded. Results from our structural equation modelling analysis show significant associations between the respondents' symptom scores and their roles in protests, the number of geographical districts in which they have come into direct contact with tear gas, a gender bias, and the amount and types of protective gear used (albeit a measure of their involvement in street protests and on the frontline). The respondents' roles in protests and the gender bias are also significantly correlated with their symptom scores for indirect exposures to tear gas, i.e. when they are not actively participating in protests.

#### Conclusions

Our findings suggest that adverse medical symptoms from tear gas exposure are pervasive across both protesting and non-protesting demographics, and specific susceptible subpopulations of note have been identified. Inter-district spread of irritants originating from areas where episodes of tear gas overuse by the police have occurred has also been denoted in our results. Future modelling studies of the geographical flow of tear gas chemicals and subsequent analyses on the health risk this brings to residents should be pursued for a fuller understanding of the whole picture of the adverse effects of tear gas on the health of the Hong Kong population.

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**P-0020**

**Assessment of multipollutant ambient air composition on type 2 diabetes mellitus using machine learning.**

**Presenter:** Naomi Oiwa Riches, University of Utah, Salt Lake City, United States

**Authors:** N. O. Riches;  
University of Utah, Salt Lake City, UT.

Type 2 diabetes mellitus (DM) is a complex multifactorial disease affecting over 30 million people in the United States (9.4% of the population). The last two decades have seen an increasing volume of research on the effects of air pollution (AP) on numerous health outcomes, including DM, with varied results. To address this, we employed an unsupervised ML algorithm, k-means clustering, to assess multiple AP components, which may show interactions between the constituents on health that traditional regression models don't capture. K-means was performed on 53,284 observations collected by the US Environmental Protection Agency during 2003-2012 and downloaded from their website. The following are the AP constituents used for partitioning: carbon monoxide (CO), nitrogen oxide (NO), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>), sulfur dioxide (SO<sub>2</sub>), particulate matter with a diameter of 10µm or less and 2.5µm or less (PM<sub>10</sub> and PM<sub>2.5</sub>, respectively). Change in annual DM incidence, data from the US Center for Disease Control and Prevention, was calculated by subtracting annual DM incidence from the following year for each US county, then matched to AP by year. The k-means analysis resulted in six clusters. The change in annual DM incidence was statistically different in all but two clusters. The cluster with the greatest change in DM incidence (0.19 per 1000) also had the highest concentrations of CO, NO, NO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub>. Additionally, the mean SO<sub>2</sub> level was greater than twice the mean SO<sub>2</sub> for all observations. The cluster with the largest decrease in DM incidence (-0.19 per 1000) also had the lowest levels of CO, NO, NO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, and SO<sub>2</sub>. Using an unsupervised k-means algorithm, we showed multiple AP components were related to increased incidence of DM even when average concentrations were below the National Ambient Air Quality Standards.

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**P-0021**

**Long-term particulate matter 2.5 exposure, insulin resistance and type 2 diabetes risk in Mexican adults: results from GEA study.**

**Presenter:** Citlalli Osorio-Yáñez, Instituto de Investigaciones Biomedicas UNAM, Mexico City, Mexico

**Authors:** C. Osorio-Yáñez<sup>1</sup>, M. A. Sánchez-Guerra<sup>2</sup>, J. L. Texcalac-Sangrador<sup>3</sup>, P. Ostrosky-Wegman<sup>1</sup>, G. Vargas-Alarcon<sup>4</sup>, R. Posadas-Sanchez<sup>4</sup>;

<sup>1</sup>Instituto de Investigaciones Biomedicas UNAM, Mexico City, MEXICO, <sup>2</sup>Instituto Nacional de Perinatología, Mexico City, MEXICO, <sup>3</sup>Instituto Nacional de Salud Publica, Mexico City, MEXICO, <sup>4</sup>Instituto Nacional de Cardiología Ignacio Chavez, Mexico City, MEXICO.

**Background/Aim.** Type two diabetes mellitus (T2DM) is a leading cause of morbidity and mortality in Mexico. The aim of this study was to examine associations between particulate matter 2.5 (PM<sub>2.5</sub>) exposure and T2DM risk. **Methods.** This study comprised 1478 individuals belonging to the Genetics of Atherosclerotic Mexican Study (GEA) in Mexico City. Type 2 diabetes mellitus was defined by the American Diabetes Association criteria and insulin resistance (IR) was considered when the HOMA-IR (Homeostatic Model Assessment of Insulin Resistance) values were more than 75 percentile. PM<sub>2.5</sub> concentrations for long-term periods (1 to 9 years) were assigned by inverse distance weighted (IDW) of data from air quality monitors. Linear regression models or logistic regression models were employed to assess long-term PM<sub>2.5</sub> exposure and continuous variables (HOMA-IR or glycosylated hemoglobin [Hb1Ac]) or binary outcomes (T2DM or IR), respectively. All models were adjusted for age, sex, body mass index, socioeconomic status, marital status, smoking, physical activity and total calories intake. **Results.** The prevalence of T2DM was 13.2% and for IR was 57.9%. PM<sub>2.5</sub> exposure at year 1, 3, and 5 years before the baseline visit were significantly associated with higher HOMA-IR and IR. Each 10 ug/m<sup>3</sup> of PM<sub>2.5</sub> at year 1 was associated with 16% (95% CI: 1.01-1.33) higher odds of IR, and year 5 with 20% (95%CI: 1.05-1.36) higher odds of IR. Each 10 ug/m<sup>3</sup> PM<sub>2.5</sub> increased at year 2 (0.4% [95% CI: 0.04-0.74]) and 7 (0.5% [95% CI: 0.14-0.80]) were associated with increased HbA<sub>1c</sub>. Finally, no significant associations were observed between PM<sub>2.5</sub> exposure at any time point and type 2 diabetes mellitus risk. **Conclusions.** The association between long-term exposure to PM<sub>2.5</sub> and insulin resistance is relevant in the context of high obesity rate and poor glycemic control characteristic of Mexican adults.

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**P-0022**

**Short-term exposure to indoor PM<sub>2.5</sub> on depressive symptoms: Ko-CHENS Mom study**

**Presenter:** Eun-Hee Ha, Ewha Woman's University, Seoul, Korea, Republic of

**Authors:** J. Oh<sup>1</sup>, Y. Kwag<sup>1</sup>, S. Ye<sup>2</sup>, D. Lee<sup>3</sup>, W. Yang<sup>4</sup>, Y. Kim<sup>5</sup>, E. Ha<sup>1</sup>;

<sup>1</sup>Ewha Woman's University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Occupational Safety and Health Research institute, Korea Occupational Safety and Health Agency, Incheon, KOREA, REPUBLIC OF, <sup>3</sup>Department of Preventive Medicine, Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>4</sup>Department of Occupational Health, Catholic University of Daegu, Daegu, KOREA, REPUBLIC OF, <sup>5</sup>Department of Occupational and Environmental Medicine, Ulsan University Hospital, University of Ulsan College of Medicine, Ulsan, KOREA, REPUBLIC OF.

**Background/Aim** The results of previous studies evaluating the associations between short-term PM exposure and depressive symptoms were inconsistent. However, no studies have evaluated on the relationship between indoor particulate matters and depressive symptoms in housewives. Most housewives spend a lot of time at home and do housework, which can generate indoor particulate matter, such as cleaning and cooking. Therefore, we investigated the impact of short-term exposure to indoor PM on depressive symptoms among Korean housewives in Ko-CHENS Mom study. **Methods** We recruited a total of 306 housewives (from January 2018 to February 2020) in Seoul and Ulsan, Republic of Korea. The indoor PM concentrations of each participant were measured by sensors for consecutive 7-days before completing health questionnaire. In addition, indoor PM concentration, two days before completing health questionnaire, was measured by gravimetric analysis. The Korean version of Center for Epidemiologic Studies Depression Scale (KCES-D) was used to evaluate depressive symptom during the study. The CES-D cut-off score was 16 or higher. We analyzed the association between indoor PM and CES-D by logistic regression adjusting for BMI, income level, education level, regions, smoking status, job status, time of stay at home and meteorological data (daily mean temperature and relative humidity). **Results** A total of 138 housewives included in this study. The average (SD) indoor PM<sub>2.5</sub> and PM<sub>10</sub> concentrations was 27.6 (17.4) µg/m<sup>3</sup> and 43.8 (23.9) µg/m<sup>3</sup>. 26 (18.8%) out of total housewives were a CES-D score of 16 or higher. The 10 µg/m<sup>3</sup> increase in concentration of indoor PM<sub>2.5</sub> (OR=1.42, 95% CI: 1.06, 1.88) measured by gravimetric analysis was statistically associated with in CES-D. Exposure-response curve was used to capture linear relationship between indoor PM and depressive symptom. **Conclusion** Our study has found evidence that short-term exposure to indoor PM<sub>2.5</sub> levels is related to the depressive symptoms in housewives.

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Theme: **Air quality health effects**

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**P-0023**

**Disease vulnerability and PAH biomonitoring in urban population exposed to air-borne particulate matter**

**Presenter:** Faiza Naseem, Rawalpindi Women University, Rawalpindi, Pakistan

**Authors:** F. Naseem<sup>1</sup>, I. Uddin<sup>2</sup>, A. Rashid<sup>3</sup>;

<sup>1</sup>Rawalpindi Women University, Rawalpindi, PAKISTAN, <sup>2</sup>PMAS Arid Agriculture University, Rawalpindi, PAKISTAN, <sup>3</sup>University of Gujrat, Gujrat, PAKISTAN.

This study was conducted in urban area of Rawalpindi city with an aim to analyze population exposure to particulate matter (PM) and Polycyclic Aromatic Hydrocarbons (PAHs) in relation to their vulnerability for diseases. Biomonitoring study using serum naphthalene, pyrene and urinary 1-hydroxypyrene was also conducted to quantify PAH exposure. The health risks based on self-reported health status was also noted using a questionnaire. Results of HPLC based serum analysis showed that mean concentration of blood naphthalene was  $106 \mu\text{g L}^{-1}$  which had significant correlation with cigarette smoking ( $r=0.49$ ;  $p<0.01$ ). However, pyrene body burden (mean  $19.18 \mu\text{g L}^{-1}$ ) appeared to be a significant predictor of urinary 1-hydroxypyrene pyrene ( $69.9 \mu\text{mol mol}^{-1}$  creatinine). Among people associated with petroleum related occupations, there was fairly high significant effect of daily work-hours and job duration on serum pyrene levels. Urban population exposed to 6 hour per day or more had significantly high prevalence of physical disorders (OR=2.79, 95% CI=1.28-6.09). Neurasthenic symptoms were found in 65% of the subjects and were associated with years of involvement in job. Ten years or more occupational work at petrol pumps attributed substantial development of neurasthenic effects (OR=2.80, 95% CI=1.23-6.34). We conclude that subjects associating disturbances in physical and neurological behavior with petrol related occupation rated their overall health and functional capacity significantly poorer than that of urban area general population. A direct relationship between exposure to PM with population illness was observed especially during winter. To promote health of occupational groups, reduction in work hours and provision of masks and gloves could be introduced as health interventions.

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Theme: **Air quality health effects**

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**P-0024**

**Clinical outcomes associated with long-term exposure to airborne particulate pollution in kidney transplant recipients**

**Presenter:** Ejin Kim, Seoul National University, Seoul, Korea, Republic of

**Authors:** E. Kim<sup>1</sup>, Y. Kim<sup>2</sup>, H. Kim<sup>1</sup>, J. Lee<sup>3</sup>;

<sup>1</sup>Seoul National University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Seoul National University Hospital, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Department of Internal Medicine, Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF.

We aimed to evaluate the relationship of 10- $\mu$ m particulate matter (PM<sub>10</sub>) with the risk of graft failure, mortality, and decline of graft function in kidney transplant recipients (KTRs). Air pollutant data were obtained from the Korean National Institute of Environmental Research and linked to those of 1,532 KTRs who underwent kidney transplantation in tertiary hospital from 2001 to 2015. Survival models were used to evaluate the association of PM<sub>10</sub> concentrations and the risk of death-censored graft failure (DCGF), all-cause mortality, and biopsy-proven rejection (BPR) over a median follow-up of 6.31 years. The annual average PM<sub>10</sub> exposure after KT was  $27.1 \pm 8.0 \mu\text{g}/\text{m}^3$ . Based on the 5-year baseline exposure, a 1- $\mu\text{g}/\text{m}^3$  increase in PM<sub>10</sub> concentration was associated with increased risk of DCGF and BPR. All-cause mortality was significantly associated with 5-year average PM<sub>10</sub> concentrations before the event in fully adjusted models. Long-term PM<sub>10</sub> exposure has a significant association with respect to the risk of BPR, DCGF, and all-cause mortality.

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**P-0027**

### **Daily Variation of Air Pollutants Near an Elevated Highway System**

**Presenter:** Shelby Zangari, SUNY ESF, Syracuse, United States

**Authors:** S. Zangari<sup>1</sup>, M. Kong<sup>2</sup>, J. Zhang<sup>2</sup>, J. E. Mirowsky<sup>1</sup>;  
<sup>1</sup>SUNY ESF, Syracuse, NY, <sup>2</sup>Syracuse University, Syracuse, NY.

I-81 is an elevated viaduct and goes through the heart of Syracuse, with local businesses and communities located underneath it. The safety limit of the viaduct is ending, and the NY Department of Transportation (DOT) is looking for recommendations to rebuild the roadway using its current elevated design or lower the highway to ground level creating a community grid. People living below I-81 are concerned about increases in air pollution if I-81 is lowered. With no knowledge of current air quality levels in this community, assessing how lowering the highway would impact the neighborhood is impossible. We began an air quality monitoring campaign to measure pollutant levels simultaneously near the highway and on the ground below. Models generated by the DOT suggest traffic levels will not change if the highway is lowered. By monitoring air quality at highway and ground levels, results will offer a glimpse of potential air quality problems that could arise. To assess daily variation in traffic-related particulate matter (PM) near this highway, a site adjacent to I-81 was selected. Two high-volume cascade impactors were placed at ground and highway levels of a building to collect daily PM samples for two weeks over two seasons. Two real-time PM monitors measured PM number concentration with elevation. For fine PM at the rooftop location, the average number of particles was 1.2 times higher with a maximum of 10 times higher. Three days in summer had exceptionally high vehicle flow and had PM concentrations ranging from 4.5 to 10 times higher at highway level. Results from gravimetric analyses agreed with measured number concentrations. This data shows particle count and PM concentration are variable with elevation and suggests that vehicle emissions may be more influential at highway level, implying air quality may be affected if the community grid option is pursued.

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**P-0028**

**The Saliva Metabolome for Monitoring the Impact of Air Pollution Exposure on Human Health**

**Presenter:** Zhenjiang Li, Emory University, Atlanta, United States

**Authors:** Z. Li<sup>1</sup>, C. Chang<sup>1</sup>, R. Golan<sup>2</sup>, S. Ebelt<sup>1</sup>, R. Greenwald<sup>3</sup>, A. G. Russell<sup>4</sup>, D. P. Jones<sup>1</sup>, H. H. Chang<sup>1</sup>, J. A. Sarnat<sup>1</sup>, D. Liang<sup>1</sup>;

<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Ben-Gurion University of the Negev, Beersheba, ISRAEL, <sup>3</sup>Georgia State University, Atlanta, GA, <sup>4</sup>Georgia Institute of Technology, Atlanta, GA.

**Background.** Blood metabolomics is a sensitive tool for measuring complex environmental mixtures and biological responses. It is possible that saliva, a filtrate of blood, may serve as an alternative, non-invasive biospecimen to blood plasma, although its use for specific metabolomic applications requires validation. **Methods.** To compare metabolomic features in saliva and plasma, we examined longitudinal biospecimens from 53 college students living at various distances to a traffic hotspot over four months, as well as their exposure to traffic-related air pollutants (TRAP). All samples were analyzed using liquid chromatography with high-resolution mass spectrometry. We compared metabolic features detected in saliva and plasma and examined the impacts of TRAP on saliva and plasma metabolome using an advanced untargeted Metabolome Wide Association Study workflow. **Results.** Using hydrophilic interaction liquid chromatography with positive electrospray ionization, we extracted a total of 13,604 metabolic features from 156 pairs of saliva and plasma samples, with 5,699 in plasma and 7,905 in saliva. We detected 1,975 unique metabolic features in both plasma and saliva, with a Pearson's correlation coefficient of the overlapping features of 0.53. Using linear mixed effect models, 727 and 466 overlapping features were found to be associated with at least one or more TRAP indicators in plasma and saliva, respectively, with 81 features consistently significant in both biometrics. Four and eight biological pathways were independently associated with TRAPs among saliva and plasma features, respectively, where carnitine shuttle and lysine metabolism are the commonly perturbed pathway in both biometrics. **Conclusions.** With moderate-to-strong correlation with plasma metabolome, and similar patterns of perturbed metabolic pathways, we found saliva to serve as a moderately sensitive, non-invasive biometric for short-term exposure to elevated air pollution. While providing a less comprehensive signal of response, these results are promising and supportive of future validation for its use in environmental exposure applications.

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**P-0030**

**Exposure to ambient PM<sub>2.5</sub> and cognitive function in older adults in Mexico**

**Presenter:** Karla Mariana Valdez-Trejo, Instituto Nacional de Salud Publica, Cuernavaca, Mexico

**Authors:** K. M. Valdez-Trejo<sup>1</sup>, H. Riojas-Rodríguez<sup>1</sup>, M. Cortez-Lugo<sup>1</sup>, J. C. Cruz de la Cruz<sup>1</sup>, J. L. Texcalac-Sangrador<sup>1</sup>, R. Wong<sup>2</sup>, S. Mejia-Arango<sup>3</sup>;

<sup>1</sup>Instituto Nacional de Salud Publica, Cuernavaca, MEXICO, <sup>2</sup>The University of Texas Medical Branch, Galveston, TX, <sup>3</sup>El Colegio de la Frontera Norte, Tijuana, MEXICO.

Background: Recent observational studies have shown that chronic exposure to fine particulate matter (PM<sub>2.5</sub>) is associated with a poorer cognitive function in older adults. However, evidence of the association with cognitive test performance has not always been consistent. Furthermore, most of the available studies are cross-sectional and have been carried out in developed countries. Objective: To evaluate the association between exposure to ambient PM<sub>2.5</sub> and cognitive function in adults participating in the Mexican Health and Aging Study (MHAS), in 2012 and 2015. Methods: Measures of cognitive function, sociodemographic and health data were obtained for each MHAS participant in 2012 and 2015 waves. A total of 1544 for 2012 and 693 for 2015 adults aged 50 years and older, who had exposure and cognitive test data, composed the preliminary analytical samples. Cognitive function was assessed using a modified version of the screening portion of the Cross-Cultural Cognitive Examination (CCCE), including tests of orientation, verbal learning memory, verbal recall memory, visual scanning, visuospatial abilities, visual memory, verbal fluency, and numeracy. Long term exposures to PM<sub>2.5</sub> were estimated by a spatial analysis using concentrations from monitors and the Inverse Distance Weighting (IDW) method, 1, 2 and 5 years preceding cognitive testing of each participant. Association between exposure to PM<sub>2.5</sub> and cognitive function was estimated using linear regression models. Preliminary Results: Adjusted linear regression models for 2012, showed statistically significant lower scores in 2nd and 3rd PM<sub>2.5</sub> exposure tertiles, compared with lower exposure tertiles, for verbal learning memory (-0.175 to -0.184), visual scanning (-2.26 to -2.64) and visual memory (-0.23 to -0.39) tests. Conclusions: Environmental exposure to PM<sub>2.5</sub> seems to affect neurocognitive functioning in Mexican adults 50 years and older, a complementary analysis will be performed and presented.

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**P-0032**

**Long-term estimates of ambient air pollution and perturbations in the peripheral blood transcriptome in a large Dutch twin cohort**

**Presenter:** Jelle Vlaanderen, Utrecht University, Utrecht, Netherlands

**Authors:** J. Vlaanderen<sup>1</sup>, R. Vermeulen<sup>1</sup>, M. Whittaker<sup>2</sup>, M. Chadeau-Hyam<sup>2</sup>, A. Ori<sup>3</sup>, J. Hottenga<sup>4</sup>, E. de Geus<sup>4</sup>, G. Willemsen<sup>4</sup>, B. Penninx<sup>5</sup>, R. Jansen<sup>5</sup>, D. Boomsma<sup>4</sup>;

<sup>1</sup>Utrecht University, Utrecht, NETHERLANDS, <sup>2</sup>Imperial College London, London, UNITED KINGDOM,

<sup>3</sup>University Medical Centre Groningen, Groningen, NETHERLANDS, <sup>4</sup>Vrije Universiteit, Amsterdam, NETHERLANDS, <sup>5</sup>Amsterdam UMC, Amsterdam, NETHERLANDS.

**Background/Aim** Studying the internal exposome has the potential to provide insight into the biological pathways through which air pollutants affects disease risk. In this study we linked long-term estimates for seven air pollutants and their elemental composition to transcriptomics data collected in the Dutch Twin Register (NTR) cohort. In addition to standard regression techniques we exploited the twin design by comparing gene expression among pairs of monozygotic and dizygotic twins. Replication of findings will be conducted in the Dutch NESDA cohort. **Methods** In both discovery (NTR, n= 2438) and replication (NESDA, n= 2341) cohorts, long-term land use regression model estimates were generated for nitrogen oxides (NO<sub>2</sub>, NO<sub>x</sub>), particulate matter (PM<sub>2.5</sub> (including elemental composition), PM<sub>2.5abs</sub>, PM<sub>10</sub>, PM<sub>coarse</sub>) and ultrafine particles (UFP). Other covariates were assessed using geospatial methods or questionnaires. Gene expression was assessed using Affymatrix U219 arrays (n=44,241 probes). Multi-variable univariate mixed-effect models were used to assess the association between these air pollutants and the transcriptome. Functional analysis was conducted using DAVID (v6.8). **Results** In the NTR cohort long-term exposure to PM<sub>2.5</sub> (and few of the other pollutants) was associated with 374 transcripts (Benjamini- Hochberg p<0.05). Elemental Copper and Sulphur in PM<sub>2.5</sub> significantly contributed to this signal. Associations were stronger among residents of less urban areas, with lower exposure levels, and weaker among men. Results were robust in a series of sensitivity analyses. Genes most significantly differentially expressed were ZNF791, BTBD1 and OSBPL8 (upregulated), and WIPF2 (downregulated). We observed strong evidence for enrichment of phosphoprotein and alternative splicing pathways. Twin-only models did not yield strong associations. **Replication analyses** in the NESDA cohort are ongoing. **Conclusions** Results from our analyses in the NTR cohort suggest a distinct PM<sub>2.5</sub> signal in the peripheral blood transcriptome, primarily occurring in phosphoprotein and alternative splicing pathways.

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**P-0033**

**Lower placental iodine concentrations are linked with higher concentrations of ambient PM<sub>2.5</sub> exposure during the last trimester of pregnancy.**

**Presenter:** Kristof Y. Neven, Hasselt University, Diepenbeek, Belgium

**Authors:** K. Y. Neven<sup>1</sup>, C. Wang<sup>1</sup>, A. Ruttens<sup>2</sup>, T. S. Nawrot<sup>1</sup>;  
<sup>1</sup>Hasselt University, Diepenbeek, BELGIUM, <sup>2</sup>Sciensano, Tervuren, BELGIUM.

**Background** - The essential trace element iodine is needed for an optimal (neuro)-development of the fetus via the production of thyroid hormones. Recent findings indicate that exposure to ambient air pollution was linked with mild thyroid dysfunction during pregnancy. We hypothesize that air pollution might alter the placental iodine concentrations during gestation. **Methods** -We determined the placental iodine concentrations in 470 mother newborn pairs included in the ENVIRONAGE birth cohort. Maternal residential PM<sub>2.5</sub> (particulate matter with a diameter < 2.5 µm), NO<sub>2</sub>, and black carbon concentrations were determined during the pregnancy using a high-resolution air pollution model. Using distributed lag nonlinear models (DLNM), we modeled the gestational week-specific association between placental iodine concentrations and air pollutants. **Results** - Significant inverse associations were observed between gestational exposure to PM<sub>2.5</sub> at weeks 28 to 35 and placental iodine concentrations. Cumulative estimates over the trimesters of pregnancy showed that in the third trimester of pregnancy (week 27 until delivery) an increase of 5 µg/m<sup>3</sup> in PM<sub>2.5</sub> exposure was associated with a decrease of 0.85 µg/kg in placental iodine concentration (95%CI: -1.56 to -0.14). These associations were adjusted for maternal pre-pregnancy BMI, gestational weight gain, household smoking behavior, maternal alcohol consumption, maternal education, maternal age, vitamin use, gestational age, date and season at delivery, and newborns' sex. No significance was found between placental iodine load and the ambient NO<sub>2</sub> or black carbon exposure. **Conclusions**- Gestational exposure to PM<sub>2.5</sub> is linked with a lower placental iodine concentration. This decrease indicates that ambient air pollution might interfere with the normal uptake mechanisms of iodine, which could result in worse neurocognitive health outcomes later in life.

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**P-0034**

### **Short-Term Exposure to Fine Particulate Air Pollution and Emergency Department Visits for Renal Diseases in the Atlanta Metropolitan Area**

**Presenter:** Jianzhao Bi, Emory University, Atlanta, United States

**Authors:** J. Bi, E. J. Weil, V. Barry, S. Ebel; Emory University, Atlanta, GA.

**Background:** Emerging toxicological evidence has shown that inhaled fine particulate matter (PM<sub>2.5</sub>) may directly or indirectly affect distant organs including kidneys. However, there is limited epidemiologic evidence about the impacts of short-term exposure to PM<sub>2.5</sub> on kidneys. **Objectives:** We investigated the associations between short-term exposure to PM<sub>2.5</sub>, major PM<sub>2.5</sub> components, and criteria gases and emergency department (ED) visits for renal disease outcomes during 2002-2008 in Atlanta, Georgia.

**Methods:** Poisson time-series models with unconstrained distributed lags were run to estimate the acute effects of air pollutants on counts of ED visits for renal disease outcomes (all renal diseases and acute renal failure [ARF]), controlling for meteorology (air temperature and dew-point temperature) and time (season, day of week, holidays, and long term trend).

**Results:** For all renal diseases, significant associations were observed for 8-day (lag 0-7) exposure to CO (rate ratio [RR] = 1.025, [95% CI: 1.009, 1.042]), NO<sub>2</sub> (1.021, [1.002, 1.040]), NO<sub>x</sub> (1.019, [1.002, 1.035]), organic carbon (OC) (1.019, [1.006, 1.033]), and elemental carbon (EC) (1.014, [1.000, 1.029]) per interquartile-range (IQR) increase. For ARF, significant associations were shown for 8-day exposure to O<sub>3</sub> (1.081, [1.012, 1.156]), PM<sub>2.5</sub> (1.035 [1.007, 1.063]), nitrate (1.039, [1.006, 1.074]), OC (1.035, [1.009, 1.063]), and EC (1.032, [1.004, 1.061]) per IQR increase. The estimated associations were stronger for ARF than all renal diseases. Single-day exposures showed a specific lag pattern, where lags 2 and 3 had the strongest associations for all renal diseases and lag 7 was an additional peak for ARF.

**Conclusions:** Robust associations between short-term exposure to fine particulate air pollution and renal disease outcomes, particularly ARF, were observed. This study adds to the growing epidemiologic evidence that fine particles may impact distant organs. In particular, the air pollution-related impacts on renal disease may be experienced over the short term.

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**P-0035**

**Spatial Decomposition of NO<sub>2</sub> and PM<sub>2.5</sub> National Exposure Disparity in the United States, 2000-2010**

**Presenter:** Jiawen Liu, University of Washington, Seattle, United States

**Authors:** J. Liu, J. D. Marshall;  
University of Washington, Seattle, WA.

Introduction: US outdoor concentrations and racial-ethnicity disparities of criteria pollutants have declined on average during the decades since the 1990 Clean Air Act Amendments. We investigate how much different spatial levels contribute to overall racial-ethnicity disparity in US. Methods: We determine state-level decomposition with land-use regression model data, dividing overall disparity into inter-state and intra-state disparity. Inter-state disparity is used to determine disparity caused by living in different states. It's calculated by population-weighted average for each racial-ethnicity group by setting all population in the same state with the same pollutant concentration, i.e. the state weighted average concentration. Intra-state disparity determines disparity caused by living in different places within the same state and it's the difference between overall disparity and inter-state disparity. Another decomposition is based on spatial decomposition model at census block level, dividing pollution concentration into short, short-medium, medium-long and long range. Disparities at different ranges are population-weighted average of demographic data and range-specified air pollution data at the block level. Results: Black experience more intra-state disparity for CO, PM<sub>2.5</sub>, PM<sub>10</sub> and NO<sub>2</sub> from 1990 to 2010. Inter-state disparity contributed more for CO, PM<sub>10</sub>, and NO<sub>2</sub> for Hispanic and Asian in 1990, while intra-state disparity became more dominated for PM<sub>10</sub> and NO<sub>2</sub> for Hispanic in 2000 and 2010. Hispanic and Asian both experience an advantage from inter-state disparity for SO<sub>2</sub>. Short-medium and medium-long range contribute most to overall disparity for all four race-ethnic groups for NO<sub>2</sub> while long-range disparity contributes most for all groups besides White for PM<sub>2.5</sub>. Conclusions: Racial-ethnicity group can experience both advantage and disadvantage at different spatial levels. Overall disparity for NO<sub>2</sub> comes mostly from locally (intra-state; medium range) while PM<sub>2.5</sub> disparity related more with regional sources (inter-state; long-range). Temporal disparity decomposition showed NO<sub>2</sub> becomes more local-impacted and PM<sub>2.5</sub> becomes more regional-impacted from 2000 to 2010.

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**P-0036**

**Air Quality and sick building syndrome symptoms in a public building in Athens, Greece**

**Presenter:** Olga I Kalantzi, University of the Aegean, Mytilene, Greece

**Authors:** I. Nezis<sup>1</sup>, G. Biskos<sup>2</sup>, K. Eleftheriadis<sup>3</sup>, P. Fetfatzis<sup>3</sup>, O. Popovicheva<sup>4</sup>, N. Sitnikov<sup>5</sup>, O. I. Kalantzi<sup>1</sup>;  
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Air Quality and sick building syndrome symptoms in a public building in Athens, Greece  
Ioannis Nezis<sup>1</sup>, George Biskos<sup>2,3</sup>, Konstantinos Eleftheriadis<sup>4</sup>, Prodromos Fetfatzis<sup>4</sup>, Olga Popovicheva<sup>5</sup>,  
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**Background:** The objective of this study was to investigate the concentrations of particulate matter (PM<sub>2.5</sub>) and Black Carbon (BC) and the prevalence of sick building syndrome (SBS) symptoms of civil servants working in a public building in the center of Athens, Greece.  
**Methods:** Continuous air measurements were carried out from March until May 2016 (24 hours, 7 days per week) in four different types of rooms, including an office, a printer room and two filing rooms, representing both high and low exposure environments. Data on SBS symptoms was collected from 73 employees.  
**Results:** Indoor PM<sub>2.5</sub> and BC concentrations in the office ranged from 5.9 to 14.3 µg/m<sup>3</sup> and 1.1 to 1.9 µg/m<sup>3</sup>, respectively. During working hours the indoor PM<sub>2.5</sub> and BC to outdoor ratio (I/O) was higher than 1. The most commonly reported SBS symptoms were irritation of the eyes, a stuffy or runny nose, headache and drowsiness. These symptoms occurred "often" or "always" and subsequently disappeared after leaving the building. Female employees were more likely to report SBS symptoms than male employees ("Unusual tiredness or fatigue" OR = 5.4; "feeling depressed" OR = 4.1).  
**Conclusions:** PM<sub>2.5</sub> and BC concentrations varied substantially between the different rooms depending on the ventilation, construction characteristics and indoor activities.

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**P-0037**

**Developing an air pollution exposure surveillance system in England; a new national vulnerability indicator**

**Presenter:** Tony Fletcher, London School of Hygiene and Tropical Medicine, London, United Kingdom

**Authors:** O. Adedire<sup>1</sup>, H. Crabbe<sup>1</sup>, R. Hams<sup>2</sup>, C. Mitsakou<sup>1</sup>, A. Doutsis<sup>1</sup>, T. Fletcher<sup>1</sup>, G. Leonardi<sup>1</sup>, M. Reacher<sup>2</sup>;

<sup>1</sup>Public Health England, Didcot, UNITED KINGDOM, <sup>2</sup>Public Health England, Cambridge, UNITED KINGDOM.

Background: Air pollution is a serious public health issue. Providing better information on vulnerabilities to poor air quality will help stakeholders (local authorities) focus on protecting those most at risk. Public Health England was tasked to develop enhanced vulnerability surveillance for air pollution, as part of the Environmental Public Health Tracking programme, which includes surveillance of hazards (such as air pollution), exposures (concentrations of PM<sub>2.5</sub> and NO<sub>2</sub>) and susceptibility (pre-existing health conditions). Aims: 1) To scope and develop pilots to demonstrate feasibility of air pollution exposure surveillance for stakeholders in England, 2) To agree potential new indicators to represent human vulnerabilities to air pollution, and 3) to help identify areas with populations who are sensitive, i.e. by age or socio-economic status (SES). Methods: We formed a working group which included several surveillance experts. In developing a new model for England, the vulnerability indicator development was split into two stages: 1) choice of exposure data and susceptibility indicator, and 2) linkage of the exposure and susceptibility indicators to produce population-vulnerability that can be provided in a useful output format, e.g. map, rating index or indicator. Results: Initially, we focused on susceptibility to ambient air pollution: age, SES and location, and related these to air pollution (PM<sub>2.5</sub> and NO<sub>2</sub>) concentrations. We combined the exposure data and susceptibility to derive the vulnerabilities indicator. We scoped out different methodologies, practicalities, constraints and their application to pilot areas. Conclusions: An air pollution exposure surveillance system is being designed for England. The priority was showing where exposure needs to be tackled to reduce health effects including mortality associated with exposure to outdoor air pollution. Next, the indicator needs to reflect the impact of interventions where changes in air pollution occur.

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## ABSTRACT E-BOOK

Theme: **Air quality health effects**

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**P-0038**

### **The Gut Microbiome Contributes to the Association Between Ozone Exposure and Fatty Acid Oxidation**

**Presenter:** Farnaz Fouladi, University of North Carolina at Charlotte, Charlotte, United States

**Authors:** F. Fouladi<sup>1</sup>, W. Patterson<sup>2</sup>, E. Kazemian<sup>2</sup>, A. Fodor<sup>1</sup>, R. Knight<sup>3</sup>, F. Gilliland<sup>4</sup>, J. Kim<sup>4</sup>, F. Lurmann<sup>5</sup>, L. Chatzi<sup>4</sup>, Z. Chen<sup>4</sup>, T. Alderete<sup>2</sup>;

<sup>1</sup>University of North Carolina at Charlotte, Charlotte, NC, <sup>2</sup>University of Colorado Boulder, Boulder, CO,

<sup>3</sup>University of California San Diego, San Diego, CA, <sup>4</sup>University of Southern California, Los Angeles, CA,

<sup>5</sup>Sonoma Technology, Petaluma, CA.

**Background:** Our prior work has shown that ambient ozone (O<sub>3</sub>) is associated with the human gut microbiome. Given that up to 66% of circulating metabolites are associated with at least one gut bacterial taxon, this study aimed to explore the hypothesis that O<sub>3</sub> exposure is associated with circulating metabolites via the gut microbiome.

**Methods:** This study was performed in 93 young adults (18-21 years) from the Southern California Children's Health Study who had available data for prior year 24-hour O<sub>3</sub> exposure estimated from central site monitors, the gut microbiome via shotgun sequencing, and fasting serum concentrations of 64 metabolites. Principal component (PC) analysis identified the top three metabolite clusters that represented short- and medium-chain acylcarnitines (PC1), non-esterified fatty acids and its oxidation by-products (PC2) and branched-chain amino-acid catabolism (PC3). FDR adjusted p-values are shown for Kendall correlations and results from mediation analyses are reported.

**Results:** Higher O<sub>3</sub> was associated with a lower relative abundance of 434 gut bacterial genera and 318 gut bacterial species (p<0.10). O<sub>3</sub> was only associated with PC1 (p=0.046, r=0.21) and PC2 (p=0.046, r=-0.20). Among bacterial genera associated with O<sub>3</sub>, 14 were negatively associated with PC1 metabolites (C8, C10:1, C10:2, C10:3, C12, C14:1-OH). One gut bacterial pathway, dTDP-L-rhamnose biosynthesis I, was enriched with higher O<sub>3</sub> (p=0.059, r=0.24) and was correlated with C14:1-OH (p=0.04, r=0.28) and C12 (p=0.068, r=0.26). Lastly, these taxa appeared to mediate associations between O<sub>3</sub> and PC1 (p<0.05). Potential confounders (body mass index, socioeconomic status, energy intake) were not associated with both the gut microbiome and PCs.

**Conclusion:** This preliminary analysis suggests that greater O<sub>3</sub> exposure could potentiate adverse effects on mitochondrial fatty acid metabolism among young adults, which may increase the risk for metabolic diseases. While this effect may be mediated by alterations to the gut microbiome, additional work integrating multi-omics measures is needed.

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Theme: **Air quality health effects**

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**P-0039**

**Risk of air pollution on daily mortality in a suburban district is different from a urban district**

**Presenter:** Jinliang Zhang, Center for Environmental Health Risk Assessment and Research, Chinese Research Academy of Environmental Sciences, Beijing, China

**Authors:** Jinliang Zhang, corresponding author, Center for Environmental Health Risk Assessment and Research, Chinese Research Academy of Environmental Sciences, Beijing 100012, China  
Yaya Gu, Center for Environmental Health Risk Assessment and Research, Chinese Research Academy of Environmental Sciences, Beijing 100012, China  
Han Zhang, Center for Environmental Health Risk Assessment and Research, Chinese Research Academy of Environmental Sciences, Beijing 100012, China  
Zhanlu Lv, Center for Environmental Health Risk Assessment and Research, Chinese Research Academy of Environmental Sciences, Beijing 100012, China

**Background/Aim** Almost all studies on the effect of air pollution on mortality in China focus on large or medium-sized cities. There was rarely report for suburban areas. However, there were enormous differences between them, including green space, per capita disposable income, density of population, coal consumption and education years. This will affect or modify the risk of mortality. In order to find a clue for further research, we tend to compare the effect of air pollution on daily mortality between urban and suburban populations.

**Methods** A suburban district(Shunyi) and a urban district(Chaoyang) in Beijing was selected. Data on mortality, air pollution and weather were collected from 2012 to 2016, and ecological environment and social-economy in 2016. The GAM was applied to established model.

**Results** The air quality was very similar in two districts. The levels of PM<sub>2.5</sub>, PM<sub>10</sub> and O<sub>3</sub>max-1h were 81.1ug/m<sup>3</sup>, 101.1ug/m<sup>3</sup>, 111.8ug/m<sup>3</sup> in Shunyi, and 83.6ug/m<sup>3</sup>, 113.2ug/m<sup>3</sup>, 111.1ug/m<sup>3</sup> in Chaoyang. For every 10μg/m<sup>3</sup> PM<sub>2.5</sub> increasing non-accidental mortality and mortality caused by cardiovascular disease increased by 0.56% and 0.60% in Shunyi, which were 2.24 and 2.00 times as in Chaoyang. Meanwhile every 10μg/m<sup>3</sup> PM<sub>10</sub> increasing was associated with increase of 0.48% for non-accidental mortality and 0.52% mortality caused by cardiovascular disease in Shunyi, which were 2.00 and 2.20 times as in Chaoyang. Corresponding risks for ozone were very similar. The increase for non-accidental mortality were 0.59% in Shunyi and 0.52% in Chaoyang with 10μg/m<sup>3</sup> increase, while mortality caused by cardiovascular disease increased by 0.56% and 0.67%.

**Conclusions** The risks of ambient particles on non-accidental mortality and mortality caused by cardiovascular disease were great different between suburban and urban populations, while these of ozone were similar. All suggested that we should pay more attention to the study on rural population.

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**P-0040**

**Comparison of PM<sub>2.5</sub> exposure estimates in the REGARDS cohort: understanding differences by community type and exposure assignment choices**

**Presenter:** Tara P McAlexander, Drexel University Dornsife School of Public Health, Philadelphia, United States

**Authors:** T. P. McAlexander<sup>1</sup>, D. L. Long<sup>2</sup>, S. A. De Silva<sup>1</sup>, M. A. Meeker<sup>1</sup>, L. A. McClure<sup>1</sup>;

<sup>1</sup>Drexel University Dornsife School of Public Health, Philadelphia, PA, <sup>2</sup>The University of Alabama at Birmingham, Birmingham, AL.

**Background:** There is biologic rationale for associations between ambient PM<sub>2.5</sub> exposure and type 2 diabetes. However, studies of these associations demonstrate mixed results, potentially due to differences in: PM<sub>2.5</sub> estimation by community types and regions; PM<sub>2.5</sub> estimation methods that optimize temporal vs. spatial variability; and exposure lags and durations assigned to individuals for evaluation with diabetes outcomes. **Methods:** We evaluated several PM<sub>2.5</sub> data sources and exposure assignment choices for 10,332 participants free of diabetes at baseline (2003-2007) and with follow-up data on diabetes in the REasons for Geographic and Racial Differences in Stroke (REGARDS) cohort. We calculated exposure durations of 2-weeks, 30-days, and 1-year; lagged 1-day, 6-months, and 1-year prior to baseline, and evaluated these by: US region (Northeast, South, Midwest, and West); community type (high density urban, low density urban, suburban and small town, and rural); and year for two sources of PM<sub>2.5</sub>: CDC EPA Downscaler model and CDC Wonder data modeled from NASA satellite observations and EPA monitor data. **Results:** Participants in the analysis had a mean (SD) age of 63.0 (8.5) years, were 55.8% female; 32.4% black. The mean (SD) PM<sub>2.5</sub> estimates from CDC Wonder were 13.5 (4.2) µg/m<sup>3</sup>, 13.5 (3.6) µg/m<sup>3</sup>, and 13.3 (2.0) µg/m<sup>3</sup>, for 2-week, 30-day, and 1-year exposure periods, respectively. One-way analysis of variance (ANOVA) of PM<sub>2.5</sub> exposure estimates of all durations showed significant differences ( $p \leq 0.01$ ) by community type, region, and year. Differences by region and community type became more pronounced with longer exposure durations. Analysis of additional exposure lags and durations is in progress. **Conclusions:** These results suggest that exposure assignment choices can either exacerbate or mitigate underlying spatial differences in this cohort, which can lead to differential associations between PM<sub>2.5</sub> and diabetes. Future work should focus on better exposure classification in order to more clearly estimate this association.

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**P-0041**

**The effect of visual and auditory biophilic design interventions on cognitive performance in office workers: A multiple cohort crossover study in a living lab**

**Presenter:** Kunjoon Byun, Well Living Lab, Rochester, United States

**Authors:** K. Byun<sup>1</sup>, S. Aristizabal<sup>1</sup>, P. Porter<sup>2</sup>, C. Campanella<sup>3</sup>, N. Clements<sup>1</sup>, L. Li<sup>1</sup>;

<sup>1</sup>Well Living Lab, Rochester, MN, <sup>2</sup>University of Michigan - Ann Arbor, Ann Arbor, MI, <sup>3</sup>Delos Living LLC, New York, NY.

Background: People spend most of their time indoors, limiting exposure to natural environments that negatively impact occupants, including cognition. Biophilic design is one strategy to integrate natural elements to indoor environments, though the research has focused predominantly on the impact of visual biophilic elements, like plants. The current study measured the impact of both visual and auditory biophilic design elements on cognitive performance. Auditory biophilic elements consisted of regionally specific nature sounds (e.g. running water, wind, local birds) played from overhead speakers. Visual biophilic elements included physical plants and rotating digital images of natural landscapes. Methods: Thirty-seven office-workers across three cohorts relocated to the lab, where they performed their regular work duties for 10 weeks in a simulated office environment. After a two-week acclimation period, participants experienced each condition (baseline, visual-only, audio-only, and multimodal) for a one-week period twice in a randomized order. Impacts on cognition were measured through executive function tasks, including working memory (WM), response inhibition (RI), and task switching (TS). Results: Linear mixed effects models were used to assess the relationship between each condition and cognitive performance. Compared to control, WM score improved in the visual ( $B = 0.056$ ,  $p = .003$ ), audio ( $B = 0.070$ ,  $p < .001$ ), and multimodal ( $B = 0.061$ ,  $p = .001$ ) conditions. The RI task response time improved in all biophilia conditions (visual  $B = -17.255$ , audio  $B = -34.594$ , multimodal  $B = -21.604$ ,  $p < .001$  for all). TS response time was faster in the audio condition ( $B = -14.135$ ,  $p = .006$ ), but slower in the multimodal condition ( $B = 10.599$ ,  $p = .032$ ). Conclusion: In sum, there were differential improvements in cognitive performance across the three biophilic conditions, suggesting both audio and visual elements can improve aspects of cognition and should be explored for future building design.

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**P-0042**

**Assessment of economic and health impacts caused by fine particulate matter and ozone to 2050 in China under typical climate change scenarios**

**Presenter:** YIYI WANG, Nanjing university of information science and technology, Nanjing, China

**Authors:** Y. WANG<sup>1</sup>, J. Hu<sup>1</sup>, M. Wang<sup>2</sup>;

<sup>1</sup>Nanjing university of information science and technology, Nanjing, CHINA, <sup>2</sup>State University of New York at Buffalo, Buffalo, NY.

Assessment of Economic and Health Impacts Caused by Fine Particulate Matter and Ozone to 2050 in China under Typical Climate Change Scenarios  
Abstract: Reducing the adverse effects of PM<sub>2.5</sub> and O<sub>3</sub> on public health and economic impact in the future still a challenge. Few studies quantify the future harmful consequences caused by PM<sub>2.5</sub> and O<sub>3</sub> intensively in China. In this paper, The Goddard Earth Observing System chemical transport model (GEOS-Chem) was used to predict PM<sub>2.5</sub> and O<sub>3</sub> concentrations in 2000-2050 under representative concentration pathway scenarios (RCPs). Then, PM<sub>2.5</sub> and O<sub>3</sub>-related premature mortality and years of life lost (YLL) were calculated based on population change in the Shared Socioeconomic Pathway scenarios (SSPs) in 2000-2050. Further, medical expenses (ME) and value of statistical life (VSL) were calculated in 2000-2050. The results showed that in the RCP 4.5 scenario, more health and economic losses could be avoided in 2050. Under RCP4.5 scenario, 0.94-1.04 million deaths and 52.81-59.13 million YLL can be avoided by PM<sub>2.5</sub>, while 22099-24414 deaths and 65280-213354 YLL can be avoided by O<sub>3</sub> in 2050. In 2050, PM<sub>2.5</sub> pollution could result in a loss of \$50.56-75.04 billion for ME and a loss of \$476.19-659.33 billion for VSL. O<sub>3</sub> pollution could result in a loss of \$0.03-0.04 billion for ME and a loss of \$2.27-3.15 billion for VSL. The Chinese government can reduce the health hazards and economic impact of PM<sub>2.5</sub> and ozone pollution by controlling air pollution and changing the demographics through climate change.

**KEY WORDS:** PM<sub>2.5</sub>; O<sub>3</sub>; premature mortality; China; future

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**P-0043**

### **Does Low Socioeconomic Status Areas Have Less Greenspace? Inequity in Accessibility to Urban Parks in Seoul, South Korea**

**Presenter:** Seulkee Heo, School of Forestry and Environmental Health Studies, Yale University, New Haven, United States

**Authors:** S. Heo<sup>1</sup>, A. Nori-Sarma<sup>2</sup>, S. Kim<sup>3</sup>, J. Lee<sup>4</sup>, M. L. Bell<sup>1</sup>;

<sup>1</sup>School of Forestry and Environmental Health Studies, Yale University, New Haven, CT, <sup>2</sup>Center for Environmental Health and Technology & School of Public Health, Department of Epidemiology, Brown University, Providence, CT, <sup>3</sup>Department of Public Health Science, Graduate School, Korea University, Seoul, KOREA, REPUBLIC OF, <sup>4</sup>Department of Public Health Policies and Management, Korea University, Seoul, South Korea, Seoul, KOREA, REPUBLIC OF.

Greenspace provides ecosystem services that can improve health and well-being and contribute to climate change adaptation. The distribution of greenspace is unequal in populations, however, little is known regarding type, size, and accessibility of parks among different socioeconomic groups. This study explored inequities of urban parks by socioeconomic status in Seoul, South Korea. Demographic and socioeconomic data for 23,004 Seoul residents were obtained from the 2015 Community Health Survey. The park provision was measured by total park area per capita, distance to the closest park, and park accessibility index determined by size and proximity of parks for each study district using the 2015 geographical park data. Regression analyses estimated the relationships between individual's socioeconomic status and the park provision metrics. Results showed different implications among the considered metrics: people with household income  $\geq$  the high-income threshold (\$5,000/month) had lower district-level accessibility index values by -20.18 km (95% CI: -27.42, -12.94) but larger total park area per capita by 0.16 km<sup>2</sup>/person (95% CI: 0.07, 0.25), compared to people below the high-income threshold. The average size of parks in 1-km buffers aggregated for each district was larger for persons with higher education level ( $\geq$  Bachelor's degree) by 3324 m<sup>2</sup> (95% CI: 2263, 4385) and for people with  $\geq$ \$5,000 monthly household income by 1672 m<sup>2</sup> (95% CI: 632, 2713). Persons supported by government subsistence (-3808 m<sup>2</sup>, 95% CI: -7105, -511) and those with multiracial families (-5040 m<sup>2</sup>, 95% CI: -9964, -115) had smaller park size. These results differed by park types. This study indicates that simply metrics may obscure differences among park provisions. This may bias estimation of park inequity and in turn affect estimation of health impacts of greenspace. We suggest that park accessibility based on detailed metrics should be considered in urban planning and health impact assessments for greenspace.

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**P-0044**

**Chronic infections are associated with an increased composite inflammation index in adult residents of central North Carolina**

**Presenter:** Andrey I Egorov, United States Environmental Protection Agency, Chapel Hill, United States

**Authors:** A. I. Egorov<sup>1</sup>, S. Griffin<sup>2</sup>, J. Styles<sup>1</sup>, E. Klein<sup>1</sup>, L. Wickersham<sup>1</sup>, R. Ritter<sup>1</sup>, J. Kobylanski<sup>1</sup>, J. Scott<sup>1</sup>, E. Sams<sup>1</sup>, E. Hudgens<sup>1</sup>, T. J. Wade<sup>1</sup>;

<sup>1</sup>United States Environmental Protection Agency, Chapel Hill, NC, <sup>2</sup>United States Environmental Protection Agency, Cincinnati, OH.

**Background.** Our previously presented results of the ongoing epidemiological study in North Carolina showed that residential tree cover was associated with a reduced composite index of chronic inflammation in individuals who spent at least 30 min per day outdoors. The objective of present analysis was to assess the effects of chronic infections on the same outcome. **Methods.** This cross-sectional study involved 335 adults residing in the Raleigh-Durham-Chapel Hill, NC urban area. Blood samples were tested for biomarkers of immune, neuroendocrine, and metabolic functions. Serum immunoglobulin G responses to *Toxoplasma gondii*, *Helicobacter pylori* and cytomegalovirus were measured using diagnostic ELISA assays. A Poisson-distributed index of immune function activation/chronic inflammation was estimated as a sum of potentially unhealthy values of the following biomarkers: interferon (IFN)- $\gamma$ , interleukin (IL)-1 $\beta$ , IL-4, IL-6, IL-8, IL-10, IL-17, tumor necrosis factor (TNF)- $\alpha$ , C-reactive protein, myeloperoxidase, serum amyloid A, chromogranin A, vascular cell adhesion molecule (VCAM)-1, intracellular adhesion molecule (ICAM)-1, eosinophils, monocytes, and neutrophils. **Results.** Each chronic infection had an independent effect on the immune function index. Preliminary results show that individuals who were seropositive to one, two or three chronic infections had 24% (95% confidence interval: 0%, 55%), 71% (32%, 122%), and 135% (60%, 247%) greater mean inflammation index compared to individuals who were seronegative to all three pathogens, respectively, after adjusting for sociodemographic and behavioral variables, and body mass index. In the same model, self-reported sleep problems and daily screen time greater than 2 hours were associated with 22% (1%, 47%) and 40% (14%, 73%) greater inflammation index, respectively, while greater amounts of time spent outdoors had significant protective effects. **Conclusions.** Adjusting for the effects of chronic infections on chronic inflammation is important in epidemiological research on health effects of chronic stress and the community environment. This abstract does not represent EPA policy.

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**P-0045**

### **Green Cover and Direct Health Care Costs**

**Presenter:** Stephen K Van Den Eeden, Kaiser Permanente Northern California, Oakland, United States

**Authors:** S. K. Van Den Eeden<sup>1</sup>, M. Browning<sup>2</sup>, D. A. Becker<sup>3</sup>, J. Shan<sup>1</sup>, S. E. Alexeeff<sup>1</sup>, T. Ray<sup>1</sup>, C. P. Quesenberry<sup>1</sup>, M. Kuo<sup>3</sup>;

<sup>1</sup>Kaiser Permanente Northern California, Oakland, CA, <sup>2</sup>Clemson University, Clemson, SC, <sup>3</sup>University of Illinois, Urbana-Champaign, IL.

**Background/Aims** Prior studies have shown higher green cover levels to be associated with numerous beneficial health outcomes. We sought to determine if residential green cover was associated with direct health care costs. **Methods** We studied 5,189,303 members of Kaiser Permanente Northern California (KPNC), linking Normalized Differentiated Vegetation Index (NDVI) satellite data to direct health care costs for 2013-2017. Using generalized linear regression to adjust for demographic, socioeconomic and environmental factors, we examined the association between direct health care costs and green cover within 250, 500, and 1000 meters (m) of an individual's residence. Direct health care costs were determined from the KPNC Cost Management Information System, which captures administrative and patient care costs for each clinical encounter. **Results** We observed a significant trend between higher levels of residential green cover and lower direct health care costs, with the bulk of this association occurring in the top five deciles of green cover. The relative rate of total cost for the highest compared to the lowest decile of NDVI was 0.86 (95% CI 0.85-0.87). The association was robust to adjustment from a broad array of confounders and was largely driven by costs associated with hospitalization, outpatient visits, and emergency department visits. Individuals in the top decile of residential green cover had adjusted health care costs of approximately \$300 per person per year less than individuals residing in the bottom or least green decile. Sensitivity analyses related to buffer size and an alternative measure of green space (tree canopy cover, yielded consistent findings. Analyses that included adjustment for comorbidity were consistent with the hypothesis that green cover reduces health care costs by improving health status. **Conclusion** Above-median green cover was associated with lower direct health care costs, raising the possibility that residential greening can have a significant healthcare cost impact across the population.

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**P-0046**

**Outdoor artificial light at night, non-Hodgkin lymphoma, and the California Teachers Study cohort**

**Presenter:** Charlie Zhong, University of Southern California, Los Angeles, United States

**Authors:** C. Zhong<sup>1</sup>, M. Franklin<sup>1</sup>, J. Wiemels<sup>1</sup>, R. McKean-Cowdin<sup>1</sup>, N. T. Chung<sup>2</sup>, J. Benbow<sup>2</sup>, S. S. Wang<sup>2</sup>, J. V. Lacey Jr<sup>2</sup>, T. Longcore<sup>3</sup>;

<sup>1</sup>University of Southern California, Los Angeles, CA, <sup>2</sup>City of Hope, Los Angeles, CA, <sup>3</sup>University of California, Los Angeles, Los Angeles, CA.

Background: Circadian disruption has been implicated in a growing number of adverse health outcomes. Circadian disruptions due to outdoor artificial light at night (ALAN) have been associated with increased circulating levels of inflammation; a hallmark of cancer. We examined the association between outdoor ALAN and a cancer strongly associated with autoimmune and inflammatory conditions, non-Hodgkin lymphoma (NHL), in the prospective California Teachers Study (CTS) cohort. Methods: The CTS is a large prospective cohort of 133,477 women that were active or retired teachers and members of the California State Teachers Retirement System in 1995-96. Outdoor ALAN was assigned to participant addresses reported at study baseline through use of the New World Atlas of Artificial Night Sky Brightness. Among 105,937 women followed from 1995-2015, linkage to the California Cancer Registry identified 873 incident cases of NHL. Age-stratified Cox proportional hazards models were used to calculate hazard ratios (HR) and 95% confidence intervals (95% CI) for overall NHL and the most common NHL subtypes; diffuse large B-cell lymphoma (DLBCL), follicular lymphoma (FL) and chronic lymphocytic leukemia/small lymphocytic lymphoma (CLL/SLL). In multivariate analyses, we adjusted for subtype specific covariates (e.g. body mass index (BMI) for DLBCL). Results: Compared to residents in the lowest quintile, participants residing in the highest quintile of outdoor ALAN were more likely to develop NHL overall (HR 1.32, 95% CI 1.07-1.63), and, in particular, DLBCL (HR 1.87, 95% CI 1.16-3.02). The elevated risk for DLBCL remained statistically significant after adjusting for age, race/ethnicity, BMI, and socioeconomic status (DLBCL:HR 1.70, 95% CI 1.03-2.79, NHL:HR 1.32, 95% CI 1.06-1.65). There was no association between ALAN and FL or CLL/SLL. Conclusions: Increased DLBCL risk was observed among women residing in neighborhoods with higher levels of outdoor ALAN. Future research in circadian disruption and DLBCL may clarify potential biological processes implicated in this association.

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**P-0047**

**Impact of neighborhood socioeconomic status on the association between occupational radiation exposure and circulatory disease**

**Presenter:** Gabriela Bustamante, University of Minnesota, Minneapolis, United States

**Authors:** G. Bustamante<sup>1</sup>, T. L. Osypuk<sup>1</sup>, M. R. Ramirez<sup>1</sup>, R. F. MacLehose<sup>1</sup>, C. M. Kitahara<sup>2</sup>, M. S. Linet<sup>2</sup>, B. H. Alexander<sup>3</sup>;

<sup>1</sup>University of Minnesota, Minneapolis, MN, <sup>2</sup>National Cancer Institute, Rockville, MD, <sup>3</sup>Colorado State University, Fort Collins, CO.

Background: Exposure to ionizing radiation, even at low-to-moderate doses, increases the risk of circulatory disease (CD) incidence and mortality. The risk of CD is also influenced by an individual's social environment, and this may modify the effect of occupational exposures like ionizing radiation. Aim: We examined the effect of neighborhood socioeconomic status (nSES) on incidence and mortality from overall CD, ischemic heart disease (IHD) and cerebrovascular disease (CeVD) in the US Radiologic Technologists Study (USRT) between 1994 and 2012. Additionally, we assessed whether nSES confounds and/or modifies the association between occupational radiation exposure and CD outcomes. Methods: Cumulative radiation dose (mGy) was estimated for each participant. We created tertiles of nSES combining six items from the 1990 Census (household income, housing value, % households with interest/income, % adults who completed high school, % adults who completed college, % of persons in managerial occupations). Using discrete time hazard models, we estimated HR and 95%CI for the association between radiation, nSES and CD outcomes. Results: Compared to residents from the top nSES tertile, technologists from low-nSES areas had an elevated risk of overall CD mortality, IHD mortality and incidence, and CeVD incidence (HRs ranging from 1.18 to 1.25, 95%CI:1.07-1.42), but not for CeVD mortality (HR: 0.92, 95%CI: 0.75-1.15) adjusting for radiation and individual education. We found no evidence of confounding by nSES on the association between radiation and any CD outcomes. There was evidence of a multiplicative interaction between nSES tertiles and radiation exposure for all mortality outcomes (p-value for interaction: <0.001 for overall CD, 0.003 for IHD and 0.004 for CeVD), but not for incidence. Conclusion: nSES is independently associated with CD mortality and incidence in a group of US radiologic technologists occupationally exposed to radiation. Additionally, nSES modifies (but does not confound) the association between radiation and CD mortality outcomes.

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2020  
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## ABSTRACT E-BOOK

Theme: **Built environment**

**P-0048**

### **Chemical Speciation and Source Apportionment of Fine Particulate Matter PM<sub>2.5</sub> in Central Addis Ababa, Ethiopia**

**Presenter:** Worku Tefera, Addis Ababa University School of Public Health, Addis Ababa, Ethiopia

**Authors:** W. Tefera<sup>1</sup>, A. Kumie<sup>1</sup>, K. Berhane<sup>2</sup>, F. D. Gilliland<sup>3</sup>, A. Lai<sup>4</sup>, P. Srirachoenvech<sup>4</sup>, S. Fruin<sup>3</sup>, J. Patz<sup>5</sup>, J. M. Samet<sup>6</sup>, J. J. Schauer<sup>7</sup>;

<sup>1</sup>Addis Ababa University School of Public Health, Addis Ababa, ETHIOPIA, <sup>2</sup>Columbia University, New York, NY, <sup>3</sup>Keck School of Medicine, University of Southern California, Los Angeles, CA, <sup>4</sup>Environmental Chemistry and Technology Program, University of Wisconsin, Madison, WI, <sup>5</sup>University of Wisconsin-Madison, Madison, WI, <sup>6</sup>University of Colorado, Denver, CO, <sup>7</sup>University of Wisconsin-Madison; Wisconsin State Hygiene Laboratory, University of Wisconsin-Madison, Madison, WI.

**Background/Aim:** The infrastructure developments, a growing population, and urbanization have led to growing air pollution challenges in Addis Ababa City. Previous investigations into the air pollution have not adequately addressed the sources of atmospheric particulate matter in the city. This study aims to identify the seasonal contributions of major sources of fine particulate matter (PM<sub>2.5</sub>) in city of Addis Ababa, Ethiopia. **Methods:** Composites of 24-hour average daily samples of fine particulate matter collected every 6<sup>th</sup> day from November 2015 to November 2016, were analyzed for chemical analysis including particle-phase organic traces for source apportionment, and were used in a chemical mass balance receptor model to estimate source contributions to fine particulate matter organic carbon (OC) and PM<sub>2.5</sub> mass. **Results:** Vehicles are the predominant sources of OC and total PM<sub>2.5</sub> mass, accounting for 28% of the PM<sub>2.5</sub> mass. Vehicular sources, biomass-burning plus soil dust were found to make up two-third of the total PM<sub>2.5</sub> mass concentration followed by sulfate, which accounted for 6.5%. The main wet season (June-September) show the highest mean monthly concentration of PM<sub>2.5</sub>, and hence, sources vary by seasonality during wet (June-September) and dry seasons (February-April): from motor vehicles, (31.0±2.6%) vs. (24.7±1.2%), from biomass burning, (21.5±5%) vs. (14±2%), and from soil dust, (11±6.4%) vs. (22.7±8.4%). **Conclusions:** These three components are the major sources of ambient PM<sub>2.5</sub> in the City with clear seasonality. We suggest policy measures that focus on mass transportation, move towards cleaner energy sources, and increasing awareness on the health and environmental impacts of solid fuel use, including burning wastes and control locally sourced dust to curve air pollution and help improve the health of Addis Ababa city residents.

**Keywords:** Air pollution; Ambient PM<sub>2.5</sub>; Source apportionment; EC/OC; Sulfate.

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**P-0049**

**Association of childhood neighborhood disadvantage with young adult DNA methylation**

**Presenter:** Aaron Reuben, Duke University, Durham, United States

**Authors:** A. Reuben<sup>1</sup>, K. Sugden<sup>1</sup>, L. Arsenault<sup>2</sup>, D. Corcoran<sup>1</sup>, A. Danese<sup>2</sup>, H. L. Fisher<sup>2</sup>, T. E. Moffitt<sup>1</sup>, J. B. Newbury<sup>2</sup>, C. Odgers<sup>3</sup>, J. Prinz<sup>1</sup>, L. J. Rasmussen<sup>1</sup>, B. Williams<sup>1</sup>, J. Mill<sup>4</sup>, A. Caspi<sup>1</sup>;  
<sup>1</sup>Duke University, Durham, NC, <sup>2</sup>King's College - London, London, UNITED KINGDOM, <sup>3</sup>University of California - Irvine, Irvine, CA, <sup>4</sup>University of Exeter, Exeter, UNITED KINGDOM.

**Abstract Importance:** DNA methylation has been proposed as an epigenetic mechanism by which the childhood neighborhood environment may influence the genome to compromise adult health. **Objective:** To determine whether childhood neighborhood disadvantage is associated with differences in DNA methylation by age 18 years. **Design:** Longitudinal-prospective study of a 1994-95 birth cohort, followed to age 18 years (until September, 2014; 93% retention). Data analysis was performed from March to June 2019. **Setting:** United Kingdom. **Participants:** The nationally representative Environmental-Risk Longitudinal Study (N=2,232). **Exposures:** High-resolution neighborhood data (indexing deprivation, dilapidation, disconnection, and dangerousness) collected across childhood. **Main Outcomes and Measures:** DNA methylation in whole blood was drawn at age 18. Neighborhood-to-methylation associations were tested using three prespecified approaches: (1) testing probes annotated to candidate genes involved in biological responses to growing up in disadvantaged neighborhoods and investigated in previous epigenetic research (i.e., stress-reactivity and inflammation-related genes), (2) polyepigenetic scores indexing differential methylation in phenotypes associated with growing up in disadvantaged neighborhoods (i.e., obesity, inflammation, and smoking), and (3) a theory-free Epigenome-Wide Association Study (EWAS). **Results:** 1,619 participants (72.5% of cohort, 806[50%] female) had complete neighborhood and DNA methylation data. Children raised in disadvantaged neighborhoods exhibited differential DNA methylation in genes involved in inflammation ( $\beta=.12$ , 95%CI: .06, .19,  $p<.001$ ) and exposure to tobacco-smoke ( $\beta=.18$ , 95%CI: .11, .25,  $p<.001$ ) but not obesity ( $\beta=.05$ , 95%CI: -.01, .11,  $p=.123$ ). EWAS identified multiple CpG sites at an array-wide significance level of  $p< 1.16 \times 10^{-7}$  in genes involved in the metabolism of hydrocarbons. Neighborhood-to-methylation associations were small but robust to family-level socioeconomic factors and to individual-level tobacco smoking. **Conclusions and Relevance:** Children raised in disadvantaged neighborhoods enter young-adulthood epigenetically distinct from their more advantaged peers. This may be one mechanism by which the childhood neighborhood environment influences adult health.

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**P-0050**

### **Associations of residential greenness exposures with age at natural menopause in the Nurses' Health Study II Cohort**

**Presenter:** Huichu Li, Department of Environmental Health, Harvard T.H.Chan School of Public Health, Boston, United States

**Authors:** H. Li<sup>1</sup>, J. E. Hart<sup>2</sup>, R. C. Nethery<sup>3</sup>, S. Mahalingaiah<sup>1</sup>, P. James<sup>4</sup>, E. Bertone-Johnson<sup>5</sup>, F. Laden<sup>1</sup>;  
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**Background** Age at natural menopause is an important indicator of reproductive aging for women and has been suggested to be affected by environmental factors. However, there is little evidence of the impact of greenness on menopausal age, or possible effect modification by physical activity. **Methods** We followed 105,665 premenopausal participants from the Nurses' Health Study II, an ongoing nationwide female cohort, from age 40. Self-reported menopausal status and physical activity were obtained on follow-up questionnaires. Women who reported a hysterectomy, oophorectomy, cancer diagnosis, or death were excluded at baseline or censored during the follow-up. We calculated physical activity levels using metabolic equivalent task hours per week (MET hour/week). Residential greenness was measured using the Normalized Difference Vegetation Index in July of each year at 1 km spatial resolution, and was calculated as cumulative average from age 40, ages 40 to 45, and in the previous year. A time-varying Cox proportional hazard model was used to obtain the hazard ratio of natural menopause at any age adjusting for calendar year, region, lifestyle and reproductive factors, neighborhood socioeconomic status, and residence-level PM<sub>2.5</sub>. **Results** A total of 64,251 participants reported natural menopause during 1,054,109 person years. Exposure to residential greenness was not associated with age at natural menopause in any exposure time window (HR=1.01-1.02 comparing the highest to the lowest quartile). No statistically significant effect modification was observed with physical activity. However, among women with very low physical activity (less than 3 MET hours/week), there was a suggestion of earlier menopause with higher exposure to greenness from age 40 (HR=1.09, 95%CI=1.01, 1.18) and from age 40-45 (HR=1.08, 95%CI=1.01, 1.17). **Conclusion** Our data showed residential greenness was not associated with menopausal age in general. However, we observed suggestive associations between greenness and earlier menopause among women with low levels of physical activity.

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**P-0051**

### **Human Waste Processing and Usage: A Renewable Energy Source for Cooking at Kibera Community Biocenters in Nairobi, Kenya**

**Presenter:** Bolanle Waheed Wahab, University of Ibadan, Ibadan, Nigeria

**Authors:** B. W. Wahab<sup>1</sup>, Y. M. Mathenge<sup>2</sup>;

<sup>1</sup>University of Ibadan, Ibadan, NIGERIA, <sup>2</sup>Department of Environment, Natural Resources and Solid Waste Management, County Government of Nyeri, Nyeri, KENYA.

#### Abstract

Background: Urban informal communities are characterized by lack of access to sanitation facilities, inefficient management of human waste and excessive use of fossil fuel as energy source. A bio-center (BC) provides improved public toilets and biogas energy from human waste generated in the community. The study identified available cooking energy sources in Kibera, examined the operations and challenges of BCs, and elicited residents' perception of BC systems and usage of biogas energy for cooking. Methods: Descriptive survey research design, using structured questionnaire, interview guide and personal observation as the primary instruments of data collection, was adopted. 6 (33.3%) of the 18 BCs in the 6 villages hosting functional BCs were randomly selected. Ethical protocols were followed and informed consents were obtained from respondents. A pretested structured questionnaire was administered to 394 (2.9%) household heads and a self-administered questionnaire was served on 15 (83.3%) bio-centre managers. Descriptive statistics were used for data analysis. Results: 81.7% of respondents had no toilet in their houses; 31.6% used communal pit latrine, while 16.4% practiced wrap and throw. With BCs system in place, 61.4% households had access to biogas toilets, biogas and pour flush toilet (23.9%), biogas and communal pit latrine (14.0%). 70.8% households preferred biogas toilet over other systems. Daily toilet users averaged 176 per toilet and paid Ksh.5 per use. 53.3% of BCs produced biogas used by 58.9% of residents for cooking. Despite some challenges of maintenance and framework, user-respondents were very satisfied (39.3%), satisfied (41.2%), preferred biogas toilets (57.9%), and demanded for more BCs (86.4%). Conclusions: The BCs presented a preferred sanitation and renewable energy systems in the study community. With improvement in their management systems and public awareness, bio-centre facilities portend ample evidence for public policies and strategies to reduce energy poverty, generate income for community groups and mitigate climate change.

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**P-0052**

**Novel Method for Measuring Neighborhood Walkability and the Relationship to Childhood Obesity**

**Presenter:** Katharina Kowalski, Colorado State University, Fort Collins, United States

**Authors:** K. Kowalski;  
Colorado State University, Fort Collins, CO.

Childhood obesity is a growing phenomenon and concern, associated with health problems throughout life and obesity in adulthood. Understanding the contributing factors to childhood obesity can guide interventions and built environments to promote healthy weights. Evidence shows that “walkable” neighborhoods are associated with less obesity in adults, but it remains unclear what the relationship is between walkability and childhood obesity. Walkability can be defined as neighborhoods with mixed land-use (i.e. many destinations to walk to), network connectivity (i.e. contiguous sidewalks), and perceptions of safety and comfort. Studies have concluded that neighborhood walkability is associated with increased physical activity in children but have been inconclusive on this relationship with obesity. Additionally, most studies measuring childhood walkability studies rely on methods utilized for adult walkability studies. My current research on childhood walkability and its association with obesity explores the built environment and factors that promote neighborhood walkability for children. Geospatial data from children in the Health Start Cohort in Denver was created in ArcGIS with weighted destinations to reflect the likelihood that children will walk to that destination. An index of 14 destinations was created, divided by 4 categories; food, neighborhood amenities and services, recreation, and transportation. The development of these weights was informed by WalkScore’s method of measuring walkability but differ in that they are tailored specifically with children in mind. For example, schools and parks are weighted more heavily than restaurants or grocery stores. While closer proximity of a child’s address to a destination (within 400-800 meters) does not increase the child specific walk score, the type of destination does. The network analyst tool in ArcGIS will determine sidewalk and trail connectivity to these weighted destinations. This research will explore if increased physical activity due to a walkable neighborhood is protective against childhood obesity.

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**P-0053**

**Modification of CO models with factors related to CO uptake and elimination and comparison of the simulations with experimental observations**

**Presenter:** KE-TING PAN, UCL, London, United Kingdom

**Authors:** K. PAN;  
UCL, London, UNITED KINGDOM.

Background/Aim: Carbon monoxide (CO) poisoning is an important public health issue globally. Mathematical models for predicting the uptake and elimination of CO could help assess exposure scenarios. We aim to study CO kinetics from pulmonary function test data and provide a predicted model of  $DL_{CO}$ . Then, we investigate a simplified version of the compartment model for CO by comparing its predictions against observed data. Methods: We collected 419 patients' data from June 2017 to May 2018 from Tri-Service General Hospital (TSGH) in Taipei and analysed demographic variables and CO diffusion capacity ( $DL_{CO}$ ). After obtaining the predicted model for  $DL_{CO}$ , we used the predicted model to input new values for CO models, including the Coburn, Forster and Kane (CFK) model (Coburn et al. 1965) and the modified CFK model (Gosselin et al. 2009). Then, using Excel and Python to simulate the CO uptake and elimination data from models, and a comparison was made with data from CO-rebreathing and exhaled CO experiments. Results and Conclusions: The predictive model for  $DL_{CO}$  was  $-3.856-0.119*\text{age}(\text{yr})+0.133*\text{height}(\text{cm})+0.125*\text{weight}(\text{kg})$  for female and  $-1.321-.210*\text{age}(\text{yr})+0.165*\text{height}(\text{cm})+0.102*\text{weight}(\text{kg})$  for male. We compared the simulated data with measured COHb% data in blood and exhaled CO at 30 min after CO exposure. For the CO-rebreathing experiment, the results showed that the COHb% predicted data from the CFK model (Mean $\pm$ SE: 6.01 $\pm$ 0.51%) and the CFK model with new input (5.43 $\pm$ 0.51%) have no significant difference with the observations (6.41 $\pm$ 0.42%). For the exhaled CO experiment, the measured COHb% data was 2.29 $\pm$ 0.11% and the predicted data from CFK model was lower at 1.77 $\pm$ 0.01%; the CFK model with new input was closer at 2.32 $\pm$ 0.07%. The Scheffe test shows the measured data has a significant difference with the predicted data from CFK model. The next step in the research will simulate the CFK model used for different scenarios.

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**P-0054**

**Long-term effect of residential greenness on mortality in the French Gazel Cohort: examining urban - rural disparities**

**Presenter:** Emeline Lequy, CRCHUM, Montreal, Canada

**Authors:** J. Yang<sup>1</sup>, M. Sakhvidi<sup>1</sup>, M. Goldberg<sup>2</sup>, M. Zins<sup>2</sup>, P. Dadvand<sup>3</sup>, E. Lequy<sup>4</sup>, B. Jacquemin<sup>1</sup>;  
<sup>1</sup>Inserm - Irset, Rennes, FRANCE, <sup>2</sup>Inserm - UMS 011, Villejuif, FRANCE, <sup>3</sup>ISGlobal, Barcelona, SPAIN,  
<sup>4</sup>CRCHUM, Montreal, QC, CANADA.

Background: There is growing interest in the relationship between exposure to greenness and health. However, very few studies have evaluated the potential modification of this relationship by the degree of urbanity. We aimed to examine the association between exposure to greenness and mortality in a French cohort, according to urban and rural areas. Methods: We used data from the population-based Gazel cohort with a follow up of 26 years, which enrolled 20,625 participants in 1989. We assigned the satellite-derived Normalised Difference Vegetation Index (NDVI) in different buffers (100, 300, 500 and 1000m) around participants' residential addresses during follow up. We used the extended Cox proportional hazard model to estimate the association between long-term exposure to greenness and natural mortality with a 10-year lag, after adjusting for relevant covariates including sex, age, alcohol use, smoking status, BMI... Stratified analyses were conducted by urban-rural areas and sex. Results: Among the 19,851 participants eligible in this study [mean age at enrollment 43.7 years (SD 3.5), 73% males], we registered 1847 deaths. Each 0.1 increase in NDVI at 100m was associated with 6% higher mortality rate regardless the type of area [Hazard Ratio (HR)=1.06, 95%CI: 1.03-1.10]. Within population subsets, we found 23% higher mortality rate in rural areas (HR=1.23, 95%CI: 1.15-1.31), but 2% lower mortality rate in urban areas (HR=0.98, 95%CI: 0.93-1.04), with a significant difference of the estimates (P<0.001). These urban-rural differences were slightly amplified by sex, with higher HRs for males in rural areas and lower in urban areas. Results were similar for the other buffers. Conclusions: Greenness exposure was associated with higher mortality risk in rural areas with some indications of a potentially protective association in urban areas. Our study suggests a potential effect modification by urban-rural areas, which may provide relevant information for future research and policy developments.

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**P-0055**

### **Nature and Well-Being: Estimating the Effects of Exposure to Green Space on Health Disparities across Washington, DC**

**Presenter:** Margaret Nelson, Milken Institute School of Public Health, Washington, United States

**Authors:** M. Nelson, S. Anenberg, M. D. Castillo;  
Milken Institute School of Public Health, Washington, DC.

Background: Expanding green space can help mitigate climate change and improve public health in urban settings. Epidemiological meta-analyses have demonstrated that increased exposure to green space improves health outcomes by increasing physical activity, improving mental health, and decreasing all-cause mortality. Washington, DC, has a large degree of environmental and health inequality, with life expectancy by neighborhood ranging from 68.2 to 89.3 years, for example. The objective of this study is to assess current neighborhood-level disparities in exposure to green space, as well as the differences in associated health impacts, across Washington, DC. Methods: We utilize green space databases and communication with governmental agencies to estimate exposure to green space across DC neighborhoods. We estimate associated health impacts using exposure-response relationships from epidemiological meta-analyses, and life expectancy and physical activity, mapped by statistical-neighborhood in the 2018 DC Health Equity Report. Results: Preliminary results suggest that the effect of green space exposure on all-cause mortality in DC is consistent with meta-analysis studies' exposure-response relationship: pooled hazard ratio of all-cause mortality is 0.96 (95% CI 0.94-0.97) for each increment of 0.1 NDVI in residential buffer zones. Quantitative estimates of the degree of population exposure to green space and associated health impacts across DC neighborhoods will be determined and presented in the following months. Conclusion: Understanding the health benefits of exposure to green space in cities will help policymakers understand the local improvements in public health and health inequality that can be achieved via urban sustainability planning. Results of our study will help integrate the health impacts of green space into urban climate action planning at the local scale through Sustainable DC and the DC Office of Health Equity, as well as through international agencies like C40 Cities.

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**P-0057**

### **Assessment of Pathogenic Microorganisms in Soils and Dust and its Implication for the Health of Urban Dwellers in Warri, Southern Nigeria**

**Presenter:** Elishama B Yomi-Agbajor, Department of Environmental Management and Toxicology, College of Environmental Resources Management, Federal University of Agriculture, Abeokuta, Nigeria

**Authors:** E. B. Yomi-Agbajor, A. M. Gbadebo;  
Department of Environmental Management and Toxicology, College of Environmental Resources Management, Federal University of Agriculture, Abeokuta, NIGERIA.

Background/Aim: Anthropogenic contamination alters soil and dust microbial characteristics and long-term exposure to such environmental media can cause chronic human health disorders. This research was aimed at assessing the occurrence, abundance and distribution of pathogenic microorganisms in soils and dust of an urban area, Warri. Methods: Ten sampling sites were selected using stratified-random sampling method and a total of forty soil and twenty dust samples were collected. Soil samples were collected from four depths (25, 50, 75 and 100 cm) and dust samples were collected in duplicates per site. Total bacterial and fungal counts were estimated using pour plate technique and microbial isolates were identified by their cultural, morphological and biochemical characteristics. Results: The microbial load in the dust samples ranged from  $1.0 \times 10^6$  -  $6.9 \times 10^6$  CFU/g for bacteria and  $1.1 \times 10^6$  -  $6.0 \times 10^6$  CFU/g for fungi. In soil, it ranged from  $1.0 \times 10^6$  -  $6.9 \times 10^6$  CFU/g for bacteria and  $2.0 \times 10^6$  -  $9.0 \times 10^6$  CFU/g for fungi. Total bacterial counts were at highest levels in agricultural areas while the highest fungal counts were recorded in market areas. Top soil samples revealed relatively higher microbial counts compared to those from the second depth, with a further increase noted at the third and fourth depths. Statistical analysis using t-test revealed a significant difference ( $P < 0.05$ ) in the total bacterial count from soil and dust samples. Predominant bacteria such as *Staphylococcus* sp., *Sphingomonas* sp., *Pseudomonas* sp., *Bacillus subtilis* and *Escherichia coli*, and fungi, such as *Penicillium* sp and *Aspergillus* sp. were identified. Conclusion: Varied isolated species of bacteria and fungi were peculiar to different anthropogenic environments and soil depths. The average microbial count indicates that bacterial abundance was lower in dust than soil and surface soil is rich in bacterial population. Extensive monitoring of soil and dust microbial quality is needed to maintain optimal health conditions for urban dwellers.

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**P-0058**

**Does green-blue space visibility improve physical activities and human health a systematic review**

**Presenter:** S M Labib, University of Manchester, Manchester, United Kingdom

**Authors:** S. Labib;  
University of Manchester, Manchester, UNITED KINGDOM.

Background Research suggests that exposure to green and blue space (GBS) is significantly associated with improved health and wellbeing; however, the relationship between GBS visibility and health is still poorly understood. Objectives Conduct a systematic review to understand the strength and adequacy of the associations between GBS visibility and health. Identify the strengths and limitations of different approaches for measuring GBS visibility. Methods Following the PRISMA protocol, three databases (PubMed, Web of Science, and Scopus) were searched systematically to identify relevant studies published up to August 15, 2019. Based on a critical selection process and carefully selected eligibility and exclusion criteria, 17 studies were included in the review and synthesised. Results The reviewed studies showed strong, significant positive relationships between GBS visibility and health and wellbeing. Increasing GBS visibility improved mental health (e.g., reduced depression) and wellbeing (e.g., increased happiness). Physical health evidence was mixed, as visibility did not significantly reduce body mass index values for males and children, but visibility did significantly increase physical activities in adults and reduce body mass index values in females. Few studies identified associations between the variables based on age, gender, and socioeconomic conditions. The review indicated heterogeneity in the measurement of health outcomes and visibility (e.g., viewshed, street-view-image analysis). No single method of measuring visibility showed absolute strengths over the other methods. Conclusion The association between visibility and improved health and wellbeing is positive and significant, but the evidence was inadequate. Future studies should focus on (i) associations between GBS visibility and health in diverse populations and different geographic locations, (ii) the development of better visibility measurement methods, (iii) the use of a more objective measurement for health outcomes.

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**P-0059**

**Can stormwater control measures decrease the vectors of mosquito borne diseases in areas surrounding combined sewer overflows?**

**Presenter:** Alisha Y Chan, Yale University, New Haven, United States

**Authors:** A. Y. Chan, M. L. Bell;  
Yale University, New Haven, CT.

Background: Combined sewer systems (CSS) are used by over 750 cities in the United States. They collect storm and sewer water into the same pipes for transport to a wastewater treatment plant. Combined sewer overflows (CSOs) occur during large storm events, when increased volume and flowrate of stormwater runoff cause CSS pipes to exceed capacity. Waterbodies affected by CSOs are organically rich and lack enough oxygen for larger organisms to survive, making them favorable breeding environments for mosquitoes. Stormwater control measures (SCMs), also commonly known as best management practices, utilize retention, infiltration, and/or phytoremediation techniques to decrease the flow rate and volume of stormwater runoff that flows into CSS pipes, thereby decreasing CSOs. Methods: We are researching whether SCM located within a sub-sewershed can decrease the number of mosquitoes surrounding the respective CSO outfall. Mosquitoes caught in our study site, Washington DC, included 850 in the genus *Aedes*, known to spread Chikungunya, Dengue Fever, West Nile, Yellow Fever, and Zika, and 1,159 in the Genus *Culex*, known to spread encephalitis and West Nile. Preliminary Results: Based on preliminary results, sub-sewersheds that have a higher density of SCMs have fewer *Aedes* and *Culex* mosquitoes at the respective CSO outfalls. SCMs in the sub-sewersheds may have a larger impact on *Culex* than *Aedes* mosquitoes, possibly because of a reduction in *Culex* mosquitoes' preferred breeding environment, waters containing high amounts of organic matter. Though SCMs may decrease mosquitoes at the CSO outfall, we also studied whether pooling utilized by SCMs contributes to the number of surrounding mosquitoes. Conclusion: Findings from this study may help inform cities of the benefits and drawbacks of using SCMs including decreasing the vectors of mosquito borne diseases in areas with CSOs.

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**P-0060**

**Associations between surrounding residential greenness and intelligence quotient in 6 year old children**

**Presenter:** Kyung-Shin Lee, Seoul National University, Seoul, Korea, Republic of

**Authors:** K. Lee<sup>1</sup>, B. Kim<sup>2</sup>, Y. Jang<sup>1</sup>, Y. Choi<sup>1</sup>, W. Lee<sup>1</sup>, C. Han<sup>3</sup>, Y. Lim<sup>4</sup>, J. Kim<sup>5</sup>, C. Shin<sup>6</sup>, Y. Lee<sup>6</sup>, Y. Hong<sup>1</sup>;

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**Background:** Residential greenness has been reported to be positively associated with children health benefit including improved cognitive functions. We investigated the association between surrounding greenness during pregnancy and at age of 6 years old and intelligence quotient(IQ) of 6-year-old children in Seoul, South Korea. We also aimed to analyze whether these effects differed by the type of greenness such as natural or artificial greenness. **Method:** This study was based on 190 mother-child participants, who have lived in Seoul at prenatal and 6-year-old period in the Environment and Development of Children Cohort study. We defined surrounding greenness using Landsat image data from the Korean Arirang satellite images with buffers within 30m - 2000m of the radius from each participant's residential address. We separately analyzed for two type of greenness such as natural or artificial greenness. A children's IQ (total IQ, verbal and performance IQ) in 6-year-old children was measured using the Korean Educational Developmental Institute's Wechsler Intelligence Scale for Children. **Result:** Prenatal exposure to greenness in 30m of buffer was associated with a total children's IQ in a full model [difference IQ (95% CI): 1.39(0.28, 2.50) per 10% increase in greenness proportion]. Postnatal exposure to greenness from 80m to 1800m buffer was also associated with a total children's IQ [difference IQ (95% CI): 1.62(0.12, 3.12) to 5.72(0.39, 11.04) per 10% increase in greenness proportion]. We found stronger association between residential greenness and performance IQ than a total IQ. In addition, we found that artificial greenness affects children's IQ more effectively than natural greenness. **Conclusion:** We found that children living in greener neighborhoods tended to score higher for total IQ at 6-year-old children. Future studies are warranted for further evaluation of relationship between children's greenness exposure and their health outcome with various mediators or covariates such as children's utilization and accessibility.

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## ABSTRACT E-BOOK

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**P-0061**

**Redlines and greenspace: The relationship between historical redlining and 2010 greenspace across the United States**

**Presenter:** Anthony Louis Nardone, University of California-San Francisco, San Francisco, United States

**Authors:** A. L. Nardone<sup>1</sup>, K. E. Rudolph<sup>2</sup>, R. Morello-Frosch<sup>3</sup>, J. A. Casey<sup>2</sup>;

<sup>1</sup>University of California-San Francisco, San Francisco, CA, <sup>2</sup>Columbia University Mailman School of Public Health, New York, NY, <sup>3</sup>University of California-Berkeley, Berkeley, CA.

**Introduction:** Redlining, a racially discriminatory mortgage appraisal practice in the latter half of the 1930s, established and exacerbated racial segregation boundaries. Investment risk grades, including redlining, assigned >80 years ago through Security Maps by the Home Owners' Loan Corporation (HOLC) are associated with current socioeconomic factors, increased diesel exhaust production, hotter ambient temperatures, and adverse health outcomes. We sought to assess whether HOLC investment grades across the US are associated with recent measures of greenspace, a health-promoting neighborhood resource. **Methods:** We accessed Security Maps through the University of Richmond's Mapping Inequality Project. Neighborhood investment grades included A ('best', green), B (blue), C (yellow), and D ('hazardous', red, i.e., redlined). We used 2010 satellite imagery to calculate the average normalized difference vegetation index (NDVI) for each HOLC neighborhood in four seasons. Our main outcomes were 2010 annual average NDVI and summer NDVI. We also assigned 1940 census measures to each HOLC neighborhood boundary using areal apportionment. To limit model extrapolation and reduce confounding, we used propensity score restriction and matching and compared HOLC grades as follows: grade B vs. A, C vs. B, and D vs. C. **Results:** Across the 71 cities from 24 states included in analyses, HOLC neighborhood annual average NDVI was 0.47 (SD=0.09), 0.042 (SD=0.09), 0.38 (SD=0.09), and 0.36 (SD=0.10) in grades A-D, respectively. In analyses adjusted for ecoregion, census region, and 1940s Census measures of socioeconomic status, HOLC grades B, C, and D were associated with 9.4% (95%CI:-10.8%,-8.0%), 5.7% (95%CI:-7.1,-4.3%), and 5.1% (95%CI:-7.9%,-2.2%) decreases in annual average NDVI compared to grade A, B, and C, respectively. Similar decrements were observed in summer. **Discussion:** Though redlining is now illegal, the institutional and structural racism outlined on Security Maps appears to persist. We observed that worse HOLC grade assignments in the 1930s were associated with reduced present day greenspace.

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**P-0062**

### **Indoor dust microbiota and residential surrounding greenness**

**Presenter:** Yinthe Dockx, Hasselt University, Diepenbeek, Belgium

**Authors:** Y. Dockx<sup>1</sup>, T. Nawrot<sup>1</sup>, M. Täubel<sup>2</sup>, E. Bijmens<sup>1</sup>, K. Witters<sup>1</sup>, J. Hogervorst<sup>1</sup>, L. Casas<sup>3</sup>;

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<sup>3</sup>Leuven University (KU Leuven), Leuven, BELGIUM.

Background: Green spaces are associated with better health. Among others, the environmental microbiome may be a mechanism explaining these associations. However, the impact of outdoor green spaces in shaping the indoor microbial communities has scarcely been investigated. We investigate residential greenness as a potential determinant of the indoor microbiota. Methods: Settled dust was collected from 174 homes from the Belgian ENVIRONAGE birth cohort and bacterial and fungal measures (Chao1 richness, Shannon and Simpson diversity indices) were calculated from Illumina MiSeq sequencing data. The greenness indicators were defined using high-resolution land-cover data with multiple residential buffers (50m, 100m, 500m and 1000m). Total surrounding greenness was stratified in low (height < 3m) and high greenness (height > 3m) and land use data was used to calculate the total surrounding nature. We run linear regression models adjusting for the number of sampling days, average temperature and black carbon concentrations during the sampling period, pet ownership and use of passive ventilation. Results are expressed as units change for an interquartile range (IQR) increase in surrounding greenness and their 95% confidence intervals (CI). Results: After adjustment, we observed significant associations of the diversity indices with surrounding greenness within 50m and 100m around the home. For bacteria, Shannon was positively associated with surrounding nature (e.g. 0.07 units increase (CI: 0.02, 0.13) per IQR increase in nature within a 50m buffer). Fungal diversity was positively associated with high surrounding greenness and inversely with low greenness. For example, an IQR increase in high greenness within a 50m buffer was associated with increases in 0.16 (CI: 0.04, 0.3) and 0.02 (CI: 0.01, 0.04) units in the Shannon and Simpson indices, respectively. No statistically significant results were observed for richness and larger buffers. Conclusions: In this urban cohort, the close surrounding environment impacts indoor microbial diversity. Further research is needed to investigate how green spaces determine the specific characteristics of these microbial communities.

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**P-0063**

**airborne fungi spore distribution in two hospitals in Kabale district-Uganda**

**Presenter:** Adeyinka Odebode, Kabale University, Uganda, kabale, Uganda

**Authors:** A. Odebode, G. Niwamanya;  
Kabale University, Uganda, kabale, UGANDA.

Fungi are an increasing public health problem worldwide. Fungi infection are a serious threat to quality of human life. Hospital environments contain different types of microorganisms such as airborne fungi which causes fungal diseases. In the present study, the total count and diversity of airborne fungi were investigated in indoor air of selected wards of two major hospitals in Uganda. The study also examined the proportion in fungal infection cases most commonly reported in the two hospitals. Samples of indoor air from Outpatient ward, Maternity, Pediatrics and Emergency wards were collected by open plate technique on Potato dextrose agar media once a week. Samples were collected in triplicates. The cultures were examined and evaluated for genotypic identifications. The obtained results were analyzed by SAS and Plotly software. In this study, a total of 22 different fungi species were isolated from the two hospitals with *Aspergillus flavus* (17.9%) followed by *Aspergillus fumigatus* (12.3%), yeast (9.6%), *penicillium citrinum* (8.5%), as the most abundant and frequently surveyed fungal species in the two hospital while *Trichoderma*, *Nigrospora* and *P. marneffeii* had the least values of spore count in all locations. All the wards showed high rates of contamination by various fungi. However, the analysis of the data showed that indoor air of OPD department (28.4%) had the highest number of fungi colonies in Kabale hospital while maternity ward (31.1%) had the highest for Rugarama hospital with the highest fungal pollution. Females also had more asthma cases for Kabale hospital with patient's ages 6-59 years visiting the hospital for fungi infection cases while for Rugarama hospital, fungi infection cases was more prevalent. Rainfall and relative humidity were positively correlated with high fungi load in the atmosphere of the two hospitals. Data on the abundance/prevalence of fungi spores in hospital environment of sub-Saharan Africa is limited.

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**P-0064**

### **Minute-level smartphone GPS-derived exposure to greenness and consumer wearable-derived physical activity in the Nurses' Health Study 3**

**Presenter:** Peter James, Harvard Medical School and Harvard Pilgrim Health Care Institute; Harvard TH Chan School of Public Health, Boston, United States

**Authors:** P. James<sup>1</sup>, R. Fore<sup>2</sup>, M. P. Jimenez<sup>3</sup>, J. E. Hart<sup>4</sup>, C. Choirat<sup>5</sup>, J. E. Chavarro<sup>6</sup>, F. Laden<sup>6</sup>;  
<sup>1</sup>Harvard Medical School and Harvard Pilgrim Health Care Institute; Harvard TH Chan School of Public Health, Boston, MA, <sup>2</sup>Harvard Medical School and Harvard Pilgrim Health Care Institute, Boston, MA, <sup>3</sup>Harvard TH Chan School of Public Health, Boston, MA, <sup>4</sup>Brigham and Women's Hospital and Harvard Medical School; Harvard TH Chan School of Public Health, Boston, MA, <sup>5</sup>Swiss Data Science Center; ETH Zurich and EPFL, Zurich, SWITZERLAND, <sup>6</sup>Harvard TH Chan School of Public Health; Brigham and Women's Hospital and Harvard Medical School, Boston, MA.

#### Background

Growing research finds that exposure to natural vegetation, or greenness, is associated with physical activity. However, many studies have been limited to residence-based exposure to greenness and self-reported, time-aggregated measures of physical activity.

#### Methods

The Nurses' Health Study 3 (NHS3) Mobile Health Substudy includes a subset of participants in the US-based, nationwide prospective NHS3 cohort who were asked to use a smartphone application and consumer wearable device (Fitbit) for seven-day periods, four times over a year. The smartphone application measured global positioning systems (GPS) data every ten minutes and the consumer wearable measured minute-level steps and heart rate. We estimated momentary exposure to greenness from Landsat satellite data using the Normalized Difference Vegetation Index (NDVI) in the 270m area around each smartphone GPS coordinate. Physical activity based on average steps and heart rate were measured based on wearable data in the ten-minute period prior to each GPS coordinate. We constructed generalized additive mixed models to examine nonlinear relationships and to account for correlations of observations within person. Analyses were adjusted for age, race, marital status, smoking status, and BMI.

#### Results

Based on data from 407 participants, comprising over 538,156 observations of steps, heart rate, and GPS data, we observed an average of 6.6 steps per minute and an average heart rate of 76.2 beats per minute. We observed adjusted nonlinear relationships between greenness and both steps and heart rate suggesting that between NDVI of 0.0 to 0.2, NDVI was positively associated with steps and heart rate, but above this point, NDVI was inversely related with both outcomes.

#### Conclusions

Using mobile health measures embedded into a prospective cohort, this study demonstrated complex nonlinear relationships between greenness and physical activity, suggesting that participants were less likely to be physically active above a certain threshold of greenness.

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**P-0065**

### **Neighborhood Deprivation and Preterm Birth in a North Carolina Birth Cohort**

**Presenter:** Kristen M Rappazzo, U.S. Environmental Protection Agency, Research Triangle Park, United States

**Authors:** K. M. Rappazzo<sup>1</sup>, M. P. Jimenez<sup>2</sup>, L. C. Messer<sup>3</sup>, T. J. Luben<sup>1</sup>;

<sup>1</sup>U.S. Environmental Protection Agency, Research Triangle Park, NC, <sup>2</sup>University of North Carolina - Chapel Hill, Chapel Hill, NC, <sup>3</sup>OHSU-PSU School of Public Health, Portland, OR.

Background: Residing in deprived areas can have health impacts beyond individual level deprivation and may increase vulnerabilities to other exposures. Adverse pregnancy outcomes, including preterm birth, have previously been associated with various indicators of area-level deprivation. Methods: We examined associations between neighborhood deprivation and preterm birth in the North Carolina birth registry cohort from 2006 - 2011 (n=653,887). The neighborhood deprivation index (NDI) was developed at the census tract level using principle components analysis with American Community Survey 5-year estimates representing 5 socio-demographic domains: income/poverty, education, employment, housing, and occupation. Risk ratios (RR) (95% confidence intervals) were estimated using multilevel (random-intercept) binomial regression models adjusted for individual-level gestational parent race/ethnicity, marital status, Medicaid status, and age; race-stratified models were also examined. Results: The adjusted RR for preterm birth for each standard deviation increase in NDI in the unstratified analysis was 1.07 (1.06, 1.08). RRs in race-stratified analyses were highest for white parents (1.11 (1.09, 1.13)), followed by black (1.05 (1.04, 1.07) and Hispanic parents (1.03 (1.00, 1.05)). Conclusions: Increases in neighborhood deprivation were associated with increased risk of preterm birth, while the magnitude of association differed by race/ethnicity. In the future, we will explore interactions between neighborhood deprivation and environmental exposures, such as air pollution. The views expressed in this abstract are those of the authors and do not necessarily represent views or policies of the U.S. Environmental Protection Agency.

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**P-0066**

**Local Improvements in Greenspace Decrease Cardiovascular Hospital Admissions**

**Presenter:** Lucas M Neas, US EPA, Chapel Hill, United States

**Authors:** L. M. Neas<sup>1</sup>, A. Rappold<sup>1</sup>, S. Hoffman<sup>2</sup>, A. Patel<sup>3</sup>, A. Egorov<sup>1</sup>, A. Weaver<sup>1</sup>, C. Ward-Caviness<sup>1</sup>;  
<sup>1</sup>US EPA, Chapel Hill, NC, <sup>2</sup>University of North Carolina, Chapel Hill, NC, <sup>3</sup>Oak Ridge Affiliated Universities, Oak Ridge, TN.

**Background:** Comparisons of greenspace between metropolitan areas generally reflect regional differences in soil characteristics and climatic zone, while greenspace differences within a metropolitan area at the postal code level avoid these regional differences. We examined local differences and trends in greenspace as determinants of local differences and trends in cardiovascular health. **Methods:** We calculated annual age-adjusted cardiovascular hospital admission rates (admissions per 100,000 person-years at risk, CHR) among Medicare beneficiaries aged 65 years and older for 2002-2013 across 10,097 ZIP codes (postal codes) in 123 major metropolitan core-based statistical areas (CBSA). We obtained monthly normalized difference vegetative index (NDVI) from the Terra satellite (1km grid) mapped to metropolitan ZIP code, determined the month with maximum NDVI for each metropolitan area, and finally assigned maximum-month values of NDVI for each ZIP code and year. Finally, we modeled the associations scaled to the interquartile range (IQR) both for centered means and for 12-year trends in CHR and NDVI, adjusting for CBSA and for levels and trends in adjusted gross income, proportion White and population density.

**Results:** Across 123 major US metropolitan areas for 2002-2013, CHR had a mean of 5,903 admissions per 100,000 person-years at risk and a trend of -122 per year. An IQR increment of 0.121 in the mean NDVI was associated with a 52.4 lower CHR (95% CI 20.4, 84.3), while an IQR increment of 0.018 in the annual trend in NDVI was associated with a 6.4 per year greater decrease in CHR (95% CI 4.5, 8.3).

**Conclusion:** Thus, after adjustment for metropolitan area characteristics and for cardiovascular risk factors, we have shown that local improvements in greenspace (NDVI) lead to local improvements in cardiovascular health among Medicare beneficiaries.

This abstract does not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

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**P-0067**

**Greenspace Spatial Characteristics and Human Health in an Urban Environment at Osogbo, Nigeria**

**Presenter:** Akinleye Isaac Oyegbami, Federal University of Agriculture, Abeokuta, Abeokuta, Nigeria

**Authors:** A. I. Oyegbami<sup>1</sup>, O. H. Adedeji<sup>1</sup>, M. O. Adeyinka<sup>2</sup>;

<sup>1</sup>Federal University of Agriculture, Abeokuta, Abeokuta, NIGERIA, <sup>2</sup>International Institute of Tropical Agriculture, Ibadan, Ibadan, NIGERIA.

Background/Aim: Urbanization amongst other anthropogenic factors is a major cause of unprecedented loss of urban forest and green spaces over time. The changes in urban forest pattern has affected biodiversity, urban-ecology, human health, quality of life and urban sustainability, therefore, this study examined the spatial characteristics and human health as indicator of improved residential environment in Osogbo, Nigeria. Methods: Semi-structured questionnaire were randomly administered to 405 residents to elicit information on urban forest services and management. Changes in vegetation cover was examined by the Normalized Difference Vegetation Index (NDVI) and Land Use Land Cover (LULC) change of the study area was derived from Landsat imageries of 1987, 1997, 2007 and 2017. These spatial metrics were computed using FRAGSTAT interfaced with ArcGIS to explain the landscape dynamics of the area. The data obtained from the administered questionnaire were subjected to descriptive statistical tools. Results: The LULC analysis revealed that 2017 had the highest amount of built up area (7.26 km<sup>2</sup>) compared to 1987 when built up area was 56.29 km<sup>2</sup>. Dense vegetation was highest in 1987 (113.40 km<sup>2</sup>) when compared to 2017 (53.80 km<sup>2</sup>). NDVI value for 1987 was highest (-0.206 - 0.418) due to presence of dense vegetation while the value for 2017 (-0.009 - 0.299) indicated loss of vegetation. The number of patches decreases from 66.31 Km<sup>2</sup> in 1987 to 22.24 Km<sup>2</sup> in 2017. These values indicate that the health status was lower in 1987 than in 2017. The residents strongly agreed that forest trees could provide products and services (92.8%), protect against environment hazards (87.4%) and improve health and wellbeing of humans (89.6%). Conclusion: The study concluded that urbanization had negative effects on the health state of the environment.

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## ABSTRACT E-BOOK

Theme: **Built environment**

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**P-0068**

**Neighbourhood and trip-based greenspace in four European areas: Associations with physical activity**

**Presenter:** Will Mueller, Institute of Occupational Medicine, Edinburgh, United Kingdom

**Authors:** W. Mueller<sup>1</sup>, S. Steinle<sup>1</sup>, J. Pärkkä<sup>2</sup>, E. Parmes<sup>3</sup>, L. Cluitmans<sup>2</sup>, E. Kuijpers<sup>4</sup>, A. Pronk<sup>5</sup>, D. Sarigiannis<sup>6</sup>, S. Karakitsios<sup>6</sup>, D. Chapizanis<sup>6</sup>, T. Maggos<sup>7</sup>, A. Stamatelopoulou<sup>7</sup>, P. Wilkinson<sup>8</sup>, J. Milner<sup>8</sup>, J. Milner<sup>8</sup>, S. Vardoulakis<sup>9</sup>, M. Loh<sup>1</sup>;

<sup>1</sup>Institute of Occupational Medicine, Edinburgh, UNITED KINGDOM, <sup>2</sup>VTT Technical Research Centre of Finland, Espoo, FINLAND, <sup>3</sup>VTT Technical Research Centre of Finland, Tampere, FINLAND, <sup>4</sup>TNO, Utrecht, NETHERLANDS, <sup>5</sup>TNO, Zeist, NETHERLANDS, <sup>6</sup>Aristotle University of Thessaloniki, Thessaloniki, GREECE, <sup>7</sup>National Centre for Scientific Research 'Demokritos', Athens, GREECE, <sup>8</sup>London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM, <sup>9</sup>Australian National University, Canberra, AUSTRALIA.

**Background/Aim:** Residential greenspace has been associated with beneficial health in many contexts. An important pathway to health may be opportunities for outdoor physical activity (PA). We used data from the HEALS study, which was conducted in four European areas (Edinburgh, UK; Netherlands; Athens and Thessaloniki, Greece), to examine pathways between greenspace and outdoor PA. **Methods:** We included three greenspace indicators (Normalised Difference Vegetation Index [NDVI], tree cover density [TCD], and green land use [GLU]) and used personal PA data collected from the Fitbit flex and the 'Moves' mobile phone app to assign daily minutes of moderate to vigorous physical activity (MVPA) and metabolic equivalent task (MET)-minutes of individual trips, respectively. We employed mixed-effects models to assess 1) residential greenspace at buffers of 300 m and 1,000 m with daily MVPA-minutes and 2) average trip-based greenspace with MET-minutes. Models included data from individuals with at least four valid days of data and were adjusted for bluespace, age, sex, car ownership, dog ownership, season, weekday/weekend day, and local meteorology; we assessed effect modification by activity (i.e., walking or cycling). **Results:** The analysis of residential greenspace and MVPA-minutes (n=118 subjects) did not produce any consistent associations at either the 300 m or 1,000m buffer. Greenspace coefficients based on individual trip averages were positive and statistically significant in fully adjusted models (n=60 subjects; n= 1,014 trips): NDVI=7.34 MET-minutes (95% CI = 2.25 to 12.44) per 0.1-unit increase; TCD=9.16 MET-minutes (95% CI = 2.63 to 15.69) per 10 percentage point increase; GLU=3.15 MET-minutes (95% CI = 0.12 to 6.17) per 0.1 unit increase. Associations appeared to be greater with cycling compared to walking. **Conclusions:** Our interpretation is that more strenuous or longer walking and cycling trips occurred in environments with more greenspace, but residential greenspace did not have a clear link with physical activity.

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**P-0069**

**Indoor levels and personal exposures to traffic pollution and environmental noise among retired adults in urban Colombia**

**Presenter:** Kabisha Velauthapillai, McGill University, Montreal, Canada

**Authors:** K. Velauthapillai<sup>1</sup>, M. Herrera<sup>2</sup>, S. Vasquez<sup>2</sup>, K. Magara Gomez<sup>3</sup>, S. Weichenthal<sup>1</sup>, J. Baumgartner<sup>1</sup>, E. Carter<sup>4</sup>;

<sup>1</sup>McGill University, Montreal, QC, CANADA, <sup>2</sup>Universidad Autónoma de Bucaramanga, Bucaramanga, COLOMBIA, <sup>3</sup>Pontificia Bolivariana University, Bucaramanga, COLOMBIA, <sup>4</sup>Colorado State University, Fort Collins, CO.

Background: Exposures to traffic-related air pollution and urban environmental noise are poorly understood in low and middle-income countries, where vehicle fleets, road conditions, and housing differ from high-income settings. We characterized exposures to air pollutants and noise among retired adults in urban Bucaramanga, Colombia. Methods: We selected 4 neighbourhoods that represented a range of traffic settings: high traffic/high diesel, high traffic/low diesel, low traffic/low diesel, and low traffic/low diesel/high braking. In each neighbourhood, we measured outdoor PM<sub>2.5</sub> and black carbon (BC) for 6 days and selected ~20 homes with retired adults and measured indoor levels and exposures to PM<sub>2.5</sub> and black carbon (BC), and indoor noise. Results: Indoor concentrations and exposures to PM<sub>2.5</sub> and BC ranged from (in ug/m<sup>3</sup>) 10.2-17.7 and 2.2-3.0, respectively, and BC comprised 12-29% of PM<sub>2.5</sub>. The high traffic/high diesel neighbourhood had the highest PM<sub>2.5</sub> levels (ug/m<sup>3</sup>): outdoor=15.1 (± 7.1), indoor=17.3 (± 6.8), personal=17.7 (± 5.6). The low traffic/low diesel neighbourhood had the lowest indoor PM<sub>2.5</sub> and exposures but the highest BC. Indoor noise levels did not vary much between neighbourhoods and ranged from 54.5-57.1 dBA. Correlations between indoor concentrations and exposures to PM<sub>2.5</sub> were moderate-to-strong and positive in all neighbourhoods, while for BC, correlations varied from near 0 to moderate and positive. Weak inverse correlations were observed between air pollution (indoor and exposure) and noise. Conclusion: Average exposures to PM<sub>2.5</sub> were lower than the WHO's 24-h guideline (25 ug/m<sup>3</sup>), though indoor noise levels exceeded the WHO Europe's guideline (35 dBA). The low correlations between indoor and exposure levels of BC may indicate additional sources of BC exposure. Similarly, while traffic is a major source air pollutants and noise in urban areas, we observe that these variables are weakly (and inversely in some cases) related, which may be related to other local sources of these pollutants.

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**P-0070**

### **Predictors, Prevalence and Spatial Distribution of Lassa Virus from Household Rodents in Low Socio-economic Community in Akure, Nigeria**

**Presenter:** Godson Rowland Ana, University of Ibadan, Ibadan, Nigeria

**Authors:** G. R. Ana;  
University of Ibadan, Ibadan, NIGERIA.

Background Lassa fever is a disease of public health importance and an acute viral illness that is endemic in West Africa. However, studies on its household determinants and geographical distribution is lacking. Hence we assessed and identified markers of Lassa fever transmission and carried out a spatial analysis of the disease in a low socioeconomic community in Akure, Southwestern Nigeria. Methods The study employed a descriptive cross sectional design with field and laboratory components of which 35 households were systematically sampled. Traps were placed in each of the households sampled for four weeks and rodents captured were morphologically identified using standard methods. Viral screening was done on rodents gathered from each of the households using reverse transcriptase polymerase chain reaction (RT-PCR) for detection of lassa virus and spatial maps were generated using ArcMap 10.1 to show rodent infested areas and areas prone to outbreak of the disease. Results Three species of rodents were trapped from the selected households with *Rattus rattus* (43.2%) being the dominant species in the homes of the study area followed by *Rattus fuscipes* (38.6%) and *Rattus norvegicus* (18.2%). Two species of *Rattus rattus* tested positive followed by *Rattus fuscipes* and *Rattus norvegicus* which had one rodent species each respectively testing positive for the strain. Spatial maps were generated to show rat infestation density and areas prone to an outbreak of the disease. *Mastomys*, the rodent vector for Lassa fever was not found among the captured rodents but the species of rodents captured in the study had positive strains of lassa virus showing that *Mastomys natalensis* is not the only reservoir for the virus. Conclusion Therefore, there should be effective awareness campaigns on Lassa fever transmission and regular environmental health surveillance to check and control possible outbreaks.

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**P-0072**

**Open streets in Latin-America: Health impacts related to physical activity**

**Presenter:** David Rojas-Rueda, Colorado State University, Fort Collins, United States

**Authors:** D. Rojas-Rueda<sup>1</sup>, D. Velazquez-Cortez<sup>2</sup>, M. Nieuwenhuijsen<sup>2</sup>;

<sup>1</sup>Colorado State University, Fort Collins, CO, <sup>2</sup>Barcelona Institute for Global Health (ISGlobal), Barcelona, SPAIN.

**Introduction.** Open streets (OS)(also called “Ciclovías Recreativas” in Spanish), are city streets temporarily repurpose into car-free spaces for leisure activities. OS had a quick expansion in Latin America (LA), arriving to cover 77 Latin American cities in 2019. **Aim.** This study aims to quantify the health of OS related to physical activity (PA), in 15 Latin American cities. **Methods.** Quantitative Health Impact Assessment approach, estimating annual deaths, disease incidence (ischemic heart disease (IHD), ischemic stroke, type 2 diabetes (DM2), colon cancer, breast cancer, and dementia), disability-adjusted life years (DALYs) and economic values (on mortality), related to PA. Health and demographic data from each city and country were collected from official records and scientific publications. An OS survey was designed and distributed to city authorities through the Americas Open Street network. **Results.** This study found that the OS in the 15 LA cities included has an estimated benefit of 1,101 annual deaths avoided due to the increment of PA, with an annual economic impact of \$1,575 million USD, and an annual reduction of 3,070 DALYs. In terms of the type of PA, the most benefits between the 15 cities were derived from cyclists (1648 DALYs), followed by pedestrians (359 DALYs). **Conclusion.** This study found that OS in Latin America can provide important health and health-economic benefits related to physical activity. In those cities where OS already exist, increase the number of OS events, kilometers, and duration could result in a greater number of users, OS related PA, and their health benefits.

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**P-0073**

### **Sleep quality of the residents living in an apartment-type building in Bangkok area-A preliminary study**

**Presenter:** Kraiwuth Kallawicha, Chulalongkorn University, Bangkok, Thailand

**Authors:** K. Kallawicha<sup>1</sup>, S. Boonvisut<sup>2</sup>, T. Nitmetawong<sup>2</sup>, H. J. Chao<sup>3</sup>;

<sup>1</sup>Chulalongkorn University, Bangkok, THAILAND, <sup>2</sup>Chulabhorn Graduate Institute, Bangkok, THAILAND,

<sup>3</sup>Taipei Medical University, Taipei, TAIWAN.

**Background** Good sleep quality is important for human health. It can also increase the productivity of individual. Sleep quality may affect by the improper living condition, especially the indoor environmental condition in bedroom. The apartment-type residence become more popular due to the life style of people in an urban area and financial limitation. However, the limited space and ventilation of the room may affect the sleep quality of the occupants. **Methods** This preliminary study aimed to investigate the sleep quality status among the occupants of apartment-type building in Bangkok area. The participants were recruited through the poster and online announcement. Pittsburg Sleep Quality Index questionnaire (PSQI) was distributed to each participant. **Results** In total, 93 participant replied the questionnaires to the researcher. According to the collected data, global PSQI score ranged from 1-16 scores with the median  $\pm$  SD of  $5 \pm 2.81$ . Although participants tended to have appropriate sleep duration at  $7.00 \pm 1.18$  hours/night (median  $\pm$  SD) but 64.4% of participant still had poor sleep quality (PSQI score  $>5$ ), while 36.6% of participant had good sleep quality (PSQI score  $< 5$ ). The common sleep disturbances which occurred at least once a week during the past month are bad dream (36.6%), body pain (35.5%), the temperature was too hot (35.5%), and toilet (35.5%). There were 9 participants reported the used of sleeping medication but only 3 reported the used more than 3 times/week. Our results showed that poor sleep quality affected the daytime dysfunction of the participants as 7.5% reported as a big problem. **Conclusions** Further study is needed in order to investigate the association between sleep quality and residential characteristics. Thus, proper indoor environmental management could be made to enhance the sleep quality and reduce the health consequence of poor sleep quality.

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**P-0074**

**Gene-Environment Interaction of Residential Greenness and FOXO on Mortality among Older Adults**

**Presenter:** Linxin Liu, Duke Kunshan University, Kunshan, China

**Authors:** L. Liu<sup>1</sup>, J. S. Ji<sup>1</sup>, A. Zhu<sup>1</sup>, C. Shu<sup>2</sup>, Y. Zeng<sup>3</sup>;

<sup>1</sup>Duke Kunshan University, Kunshan, CHINA, <sup>2</sup>Yale University, New Haven, CT, <sup>3</sup>Peking University, Beijing, CHINA.

**Background** The Forkhead box O (FOXO) gene is a candidate longevity gene. Residential greenness is an important built environment factor strongly associated with mortality. There was no previous study on the interaction between FOXO and residential greenness based on our knowledge. **Methods** We studied 3,179 participants aged 65 and older from the Chinese Longitudinal Healthy Longevity Survey (CLHLS). We measured residential greenness by satellite derived Normalized Difference Vegetation Index (NDVI) using a 500-m radius around each residential address. We calculated contemporaneous NDVI, cumulative NDVI and changes in NDVI over time. We used adjusted Cox-proportional hazard regression models to assess main effects and interaction of FOXO SNPs and residential greenness on mortality risk. **Results** We found participants with two minor allele copies of FOXO3A SNPs had lower mortality risk than those with zero copy (HR: 0.803 95% CI: 0.654, 0.987 for rs4946936, HR: 0.807 95% CI: 0.669, 0.974 for rs2802292, HR: 0.803 95%CI: 0.666, 0.968 for rs2253310). We found no mortality difference among different genotypes for FOXO1A SNPs rs17630266, rs2755209 and rs2755213. Higher contemporaneous NDVI was associated with lower mortality risk (HR: 0.887 95% CI: 0.863, 0.911 for 0.1 unit of NDVI). The protective effect of NDVI was stronger among participants with two minor allele copies of rs2802292 SNP compared with the ones with zero copy (Interaction term  $P < 0.05$ ), while not different between participants with one copy and zero copy. **Conclusions** We found gene-environment interaction between FOXO and residential greenness on mortality in this population study. A higher level of greenness may interact with FOXO pathways.

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**P-0076**

### **Evaluation of indoor temperature distribution in densely populated institutions using engineering analysis**

**Presenter:** yung-ling sun, National Taiwan University, taipei, Taiwan

**Authors:** y. sun, j. Chen;  
National Taiwan University, taipei, TAIWAN.

[Purpose]For controlling the rising temperature, there are more institutions using air-conditioning. However, the indoor temperature is often too low to protect the health of residents. The aim of the study is to investigate the temperature distribution within a chosen institution filled with patients. There are three main objectives: 1. To assess whether the internal temperature of the environment is appropriate; 2. Establish an indoor airflow model to analyze the main factors of temperature distribution; 3. Consider possible engineering intervention.[Method]After measuring the space for evaluation and drawing a CAD model, we used CFD steady-state to analysis the velocity and temperature field. We use the AeroBox\_2019 complex weather observation box to monitor temperature and humidity. After calculating the flow field distribution, the temperature and velocity obtained from simulation are used to calculate the thermal comfort index. Last, we compare our simulation data with the measured one.[Result]The current simulation shows that when the air conditioner is set to 23 ° C in the ward, the temperature near the human body is about 26-27 ° C while it is distributed unevenly in the rest of the space. In the corner of the ward, there's 2° C higher than the sickbed near the door. The calculation results of the thermal comfort show that the ambient temperature of the environment is too low. [Conclusion]The poor design of the ventilation system used in this long-term care institution results in uneven flow field distribution, and the air conditioning design will cause uneven temperature distribution. The range of the deviation between the simulation and the measured data is about 0.05 showing our model is reliable. Thermal comfort results show that the temperature is too low and adjusting the air conditioner temperature is necessary. A ventilation system will be designed to improve such results.

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**P-0077**

**Burden of air pollution exposure on mortality and hospital admissions in Greece by region and urbanization level**

**Presenter:** Klea Katsouyanni, National and Kapodistrian University of Athens, Athens, Greece

**Authors:** K. Katsouyanni, E. Samoli, S. Zafeiratou, A. Stergiopoulou, M. Kasdagli, D. Evangelopoulos; National and Kapodistrian University of Athens, Athens, GREECE.

### Background/Aim

Several air pollutants concentrations in Greece exceed standards and guidelines. We estimated the burden on health from short and long-term exposure to pollutants in Greece, for the 13 administrative Departments, by degree of urbanization.

### Methods

We used measurements from fixed monitors operating in 12 cities, for 2012-2018, and modelled concentrations from a nationwide dispersion model for the year 2012. Based on the WHO Air Quality Guidelines (AQG), concentration-response functions from WHO reports or large meta-analysis and baseline rates for health outcomes for the years 2014-16, we calculated the attributable number of events to PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub> and O<sub>3</sub> exposure.

### Results

In major Greek cities daily PM<sub>2.5</sub> and PM<sub>10</sub> concentrations exceed WHO AQG. The annual average exceeds the AQG in all cities and non-urban areas. NO<sub>2</sub> exceeds the WHO AQG only in Athens, whilst O<sub>3</sub> concentrations exceedances are observed in many areas outside the city centers. If PM<sub>2.5</sub> and PM<sub>10</sub> annual levels complied with the WHO AQG, 6487 and 4933 premature deaths annually would be prevented in urban areas respectively, of which 58% and 69% concern the area of Athens and 13% that of Thessaloniki and 2115 and 773 in non-urban areas. In Athens, if NO<sub>2</sub> levels were <40 µg/m<sup>3</sup>, 159 deaths annually would be prevented. Similar results are provided for hospital admissions and lung cancer incidence. The impact of short-term exposures is also considerable in large cities.

### Conclusions

Particulate pollution constitutes a major public health problem and policy should target the reduction of concentrations. O<sub>3</sub> is a health concern as the sunny climate contributes to its formation and long range transport. NO<sub>2</sub> is a problem in urban centers and should be monitored as diesel cars are forming a larger proportion of the car fleet after 2012.

**Acknowledgement:** Supported by the National Center for the Environment and Sustainable Development

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**P-0079**

**Greenspace, gentrification, and urban development in the United States: A longitudinal, multi-city analysis**

**Presenter:** Leah H Schinasi, Drexel University, Philadelphia, United States

**Authors:** L. H. Schinasi<sup>1</sup>, J. A. Hirsch<sup>1</sup>, G. B. Hamra<sup>2</sup>, S. Melly<sup>1</sup>, F. Bayer<sup>1</sup>, G. S. Lovasi<sup>1</sup>, J. E. Clougherty<sup>1</sup>;  
<sup>1</sup>Drexel University, Philadelphia, PA, <sup>2</sup>Johns Hopkins University, Baltimore, MD.

**Background:** Gentrification is a neighborhood change process characterized by sociodemographic shifts and increasing property values in previously low-income neighborhoods. This process might impact distributions of environmental assets, including greenspace.

**Objective:** To estimate the relationship between gentrification and greenspace in the 43 largest metropolitan areas of the United States.

**Methods:** We used U.S. census data to identify census tracts that gentrified between years 1990 - 2000, and 2000 - 2010, and data from the national landcover database to calculate % greenspace within each census tract in 1992, 2001, and 2011. We used random slope, random intercept models, adjusting for population density and change in population density, to estimate whether: (a) % greenspace in 1992 predicted gentrification from 1990 to 2000; (b) % greenspace in 2001 predicted gentrification from 2000 to 2010; and (c) gentrification from 2000 to 2010 predicted changes in % greenspace from 2001 to 2011. We compared census tracts that gentrified to those that did not, and excluded those that were too wealthy to gentrify at baseline.

**Results:** From 1990 to 2000, and from 2000 to 2010, 7,834 and 9,522 census tracts in our dataset experienced gentrification, respectively. From 2000 to 2010, on average, % greenspace cover decreased by -0.02 units (range: -0.98, 0.14). In unadjusted models, higher greenspace percentages in 1992 were associated with higher odds of gentrification from 1990 to 2000 [OR = 2.05 (95% CI: 1.56 - 2.66)]. This effect was attenuated after adjusting for population density [OR = 1.25 (95% CI: 0.94 - 1.67)]. Gentrification from 2000 to 2010 was associated with a 0.13-unit decrease in greenspace cover from 2001 - 2011, after adjustment for changes in population density (95% CI: 0.94 - 1.67).

**Discussion:** Greener areas may be more prone to gentrification. However, development processes related to gentrification may reduce greenspace cover over time.

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**P-0080**

**Attributing School Air Pollution Levels to Features of the Built Environment in New York City**

**Presenter:** Stephanie Lovinsky-Desir, Columbia University, New York, United States

**Authors:** K. Jung, J. W. Quinn, J. Bruzzese, S. N. Chillrud, M. S. Perzanowski, A. G. Rundle, S. Lovinsky-Desir;  
Columbia University, New York, NY.

**Background:** Exposure to traffic-related air pollution (TRAP) has been linked to asthma prevalence and exacerbations. Children spend a significant portion of their day in school where exposure to pollutants can be high based on geographic features of the built environment. The study objective was to determine the distributions of geographic indicators of traffic and built environment features and the association with school-based TRAP exposure in New York City (NYC). **Methods:** Spatial data on the proximity and density of roadways and built environment features were examined for a 250-meter buffer around NYC elementary and middle schools (N=1184). Annual average levels of particulate matter <2.5 microns (PM<sub>2.5</sub>), black carbon (BC), and nitrogen dioxide (NO<sub>2</sub>) were determined based on land use regression models of street-level pollution measured by the New York City Community Air Survey. Spatial data were categorized using k-means cluster analysis and clusters were associated with air pollution using analysis of variance. **Results:** Based on significant correlations with air pollutants, three geographic indicators were included for cluster analysis: number of bus stops; truck route density (total km route/km<sup>2</sup> land); and percentage of area covered with trees (i.e. tree canopy). Four clusters were identified: 1. Higher truck route density (n=103 schools); 2. Higher number of bus stops (n=378); 3. Higher tree canopy (n=250); and 4. Lower in all 3 indicators (n=453). In general, the levels of PM<sub>2.5</sub>, BC, and NO<sub>2</sub> were highest among schools with higher truck route density, followed by higher number of bus stops, and lowest with higher tree canopy (p=0.001). **Conclusions:** School-aged children may experience higher levels of air pollution based on their school's proximity to geographic indicators of diesel vehicle emission. Geographic indicators may serve as surrogates of chronic school exposure to air pollution. Future studies will determine if clusters are associated with school asthma prevalence.

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**P-0081**

**The urban lead burden in humans, animals and plants**

**Presenter:** Ronnie Levin, Harvard TH Chan School of Public Health, Boston, United States

**Authors:** R. Levin;  
Harvard TH Chan School of Public Health, Boston, MA.

Urban residence is a risk factor for children's elevated lead exposures. Evidence from domesticated and wild animals shows that the phenomenon crosses species lines. Plants also suffer under lead's phytotoxicity. The Industrial Revolution lured and drove more than half of the US populations from the countryside into cities. Leaded paint, lead in public water systems and later, leaded gasoline, were the principal contributors to lead contamination of US cities. Lead's incredible utility has resulted in thousands of commercial applications in electronics, hardware, paints and pigments, many types of glass, ceramic glazes and coatings, cable sheaths, machinery and manufacturing, light industry, radiation protection, post and telecommunications, metallurgy, chemical production, transportation (rail, automobile and aviation), construction, weapons, aerospace, oil, plastics and petrochemicals, plumbing, pesticides, hair products, etc. Historically, commercial and industrial activities occurred coterminously to habitation, so the beginnings of all these uses occurred within urban areas. Consequently, urban areas have high lead pollution levels. Lead toxicosis in urban areas is evident across animal species, including pets (Zook et al 1998, Langlois et al 2017), feral pigeons (Cai and Calisi 2016), wild raccoons (Hamir et al 1995) and foxes (Dip et al 2000) and gazing animals (Ward and Savage 1994). Indeed, in 1970, pigeons were considered a sentinel for urban lead pollution (Tansy and Roth); society has continued to use children. Plants in urban areas are also significantly affected by high lead levels (EPA 1984). We used an integrated One Health approach to assess lead's urban burden in humans, animals and plants. In the future, we will develop conceptual and pragmatic guidance for urban planners and decision makers to address the urban lead burden in humans, animals and plants.

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**P-0082**

### **Association Between Outdoor Light at Night and Risk of Coronary Heart Disease among 60,229 Older Adults: A Prospective Cohort Study**

**Presenter:** Wangnan CAO, Brown University, Providence, United States

**Authors:** W. CAO<sup>1</sup>, S. SUN<sup>2</sup>, Y. GE<sup>3</sup>, F. SUN<sup>4</sup>, J. RAN<sup>5</sup>, Q. ZENG<sup>6</sup>, R. LEE<sup>7</sup>, L. TIAN<sup>5</sup>;

<sup>1</sup>Brown University, Providence, RI, <sup>2</sup>Boston University, Boston, MA, <sup>3</sup>University of Georgia, Georgia, GA,

<sup>4</sup>Peking University, Beijing, CHINA, <sup>5</sup>University of Hong Kong, Hong Kong, CHINA, <sup>6</sup>Huazhong University of Science and Technology, Wuhan, CHINA, <sup>7</sup>Department of Health, HKSAR, Hong Kong, CHINA.

Background Light at night (LAN) is the most important environmental cue for circadian misalignment, which may increase risk of coronary heart disease through impairing circadian rhythms. We aimed to estimate the association between exposure to outdoor LAN and coronary heart disease (CHD) in elders. Methods We followed 60,229 Hong Kong elders free of CHD from 1998 through 2011. Annual LAN exposure was estimated using time-varying satellite data for a composite of persistent nighttime illumination at ~1 km<sup>2</sup> scale for each residence. We used Cox proportional hazard models to calculate hazard ratios (HRs) and 95% confidence intervals (CIs) for the association between exposure to outdoor LAN and risk of CHD. Results Over 10 to 13 years of follow-up, we identified 3,772 incident CHD cases and 1,695 CHD deaths. Annual levels of LAN at participants' residential addresses ranged from 2.2 to 233.1 nW/cm<sup>2</sup>/sr. The concentration-response functions for the association between LAN and CHD incidence and mortality were approximate linear with the slopes becoming flat when LAN above 110 nW/cm<sup>2</sup>/sr. Per interquartile range (IQR) (60.0 nW/cm<sup>2</sup>/sr) increase in outdoor LAN, the HR was 1.09 (95% CI: 1.03, 1.17) for CHD incidence and 1.10 (95% CI: 1.01, 1.22) for CHD mortality after adjusting for both individual and area-level risk factors. Conclusions Exposure to outdoor light at night was associated with higher risk of coronary heart disease among Hong Kong elders. Our findings highlight the need to regulate light pollution for the potential coronary heart disease benefits.

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**P-0083**

### **The Green Heart Project: Study Design and Baseline Observations**

**Presenter:** Ray Yeager, University of Louisville, Christina Lee Brown Envirome Institute, Louisville, United States

**Authors:** R. Yeager<sup>1</sup>, R. J. Keith<sup>1</sup>, D. W. Riggs<sup>1</sup>, J. L. Hart<sup>2</sup>, K. L. Walker<sup>2</sup>, B. Bucknum<sup>3</sup>, S. N. Rai<sup>1</sup>, J. Turner<sup>4</sup>, A. Bhatnagar<sup>1</sup>;

<sup>1</sup>University of Louisville, Christina Lee Brown Envirome Institute, Louisville, KY, <sup>2</sup>University of Louisville, Department of Communication, Louisville, KY, <sup>3</sup>Hyphae Design Laboratory, Oakland, CA, <sup>4</sup>Washington University, Department of Energy, Environmental and Chemical Engineering, St. Louis, MO.

**Background/Aim:** Although several studies report an association between residential proximity to greenness and health, direct effects of increasing greenness have not been studied. We designed The Green Heart Project to test the hypothesis that increasing area greenness diminishes cardiovascular disease (CVD) risk by decreasing exposure to air pollution.

**Methods:** The Green Heart Project is designed as a pragmatic clinical trial to assess the impact of greening intervention on CVD risk in a community. Baseline data on CVD risk were acquired by an in-person exam to measure arterial stiffness, blood pressure, circulating lipids and biomarkers of thrombosis and endothelial function. Mental stress, anxiety, depression, social cohesion, and health behaviors were evaluated using validated questionnaires. Both stationary and mobile monitoring is to be used to develop high resolution maps of air pollution in the area. Individual-level exposure to volatile organic compounds (VOCs) will be assessed by measuring their urinary metabolites. Baseline data were acquired and 8 target clusters will receive 8,000 mature trees and shrubs. The surrounding 8 control clusters receive no greenery. Two years after planting, air pollutants, VOC metabolites, cardiovascular and psychosocial parameters will be remeasured.

**Results:** The 4 square mile study area is home to 36,000 residents. The mean age of 735 participants recruited was 51 years, with a median income of \$33,000. Nearly 77% of participants were White, 52% were women. The mean NDVI within 300 m of the residence of study participants was 0.33. Participants with lower residential NDVI were more likely to be younger, Black, with lower income, and living closer to major roadways.

**Conclusions:** Baseline evaluation of participants of the Green Heart Study uncovers significant association between residential greenness and socioeconomic status. Assessments after intervention will evaluate to reveal whether CVD risk and air pollution levels are altered by increasing area greenness.

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**P-0084**

**'Green walkability' and physical activity in UK Biobank**

**Presenter:** Charlie Roscoe, Centre for Environment and Health, Imperial College London, London, United Kingdom

**Authors:** C. Roscoe<sup>1</sup>, J. Gulliver<sup>2</sup>, D. Fecht<sup>1</sup>;

<sup>1</sup>Centre for Environment and Health, Imperial College London, London, UNITED KINGDOM, <sup>2</sup>Centre for Environment, Sustainability and Health, University of Leicester, Leicester, UNITED KINGDOM.

Background: Urban design features, such as walkable neighbourhoods and greenspace, might protect human health by enabling healthy behaviours, including increased physical activity. By definition, neighbourhoods that are 'walkable' are high density, whereas green spaces (e.g., parks) are inherently low density environments. We aimed to assess the impact of greenspace cover on associations of neighbourhood walkability and physical activity. Methods: We created a novel 'green walkability' score that integrated greenspace cover (within a 1000m walkable network buffer) with standard walkability metrics – population density, street junction density and destination density. We applied the green 'walkability score' to the residential addresses of UK Biobank participants living in Greater London (n= 58,587). We used logistic regression models to assess associations of 'green walkability' versus standard walkability scores with physical activity outcomes, adjusted for age, sex, household income and neighbourhood deprivation. Results: Higher 'green walkability' was beneficially associated with active commuting behaviour, active non-commute transport, International Physical Activity Questionnaire (IPAQ) responses, and achieving weekly UK physical activity guideline recommendations. Associations of 'green walkability' with physical activity outcomes, however, were attenuated compared to standard walkability score associations. For example, difference in odds of walking for non-commute transport between the least walkable and most walkable quintile in UK Biobank were smaller for 'green walkability' (odds ratio (OR) 4.46; 95% CI 4.12, 4.84) than standard walkability (OR 6.37; 95% CI 5.85, 6.94). Conclusion: Our 'green walkability' approach highlights the need to account for environmental correlates of physical activity (e.g., density of features) in greenspace and physical activity assessments, and might partially explain inconsistencies in direction and size of effect in the greenspace-physical activity literature. Prioritising neighbourhood density and greenspace exposure, which are inversely related in space, to support active, healthy lifestyles, is an important urban design challenge.

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**P-0085**

### **Greenspace exposure and non-injury mortality in UK Biobank**

**Presenter:** Charlie Roscoe, Centre for Environment and Health, Imperial College London, London, United Kingdom

**Authors:** C. Roscoe<sup>1</sup>, S. Cai<sup>2</sup>, J. Gulliver<sup>3</sup>, D. Fecht<sup>1</sup>;

<sup>1</sup>Centre for Environment and Health, Imperial College London, London, UNITED KINGDOM, <sup>2</sup>George Institute for Global Health, University of Oxford, Oxford, UNITED KINGDOM, <sup>3</sup>Centre for Environment, Sustainability and Health, University of Leicester, Leicester, UNITED KINGDOM.

**Background:** Some cohort studies have shown a protective association of greenness and non-injury mortality, after adjustment for personal contextual and area-level confounding factors, though evidence in the UK is predominantly from ecological studies. We aimed to assess the association of greenspace and non-injury mortality in the UK, using rich confounder data available in the UK Biobank cohort. **Methods:** We used Ordnance Survey MasterMap Greenspace data, categorized into 18 greenspace functions (e.g., private garden, public park, allotment, cemetery, playing field, etc.) to assess associations of survival and total greenspace cover (18 categories combined) in multiple buffer sizes (100 m, 500 m, 1000 m) surrounding UK Biobank residential addresses ( $n = 277,236$ ). We used Cox-proportional hazards models, with age as the underlying timescale, adjusted for sex, household income, pack years smoking, alcohol consumption and neighbourhood deprivation. **Results:** We showed protective associations for UK Biobank participants living in the most green compared to the least green quintile of total greenspace cover in a 100 m circular distance buffer for non-injury mortality (HR = 0.91; 95% CI = 0.84, 0.99). Results were consistent with previous studies, which have shown a small protective association, after adjustment for confounders. Function-specific analyses showed that protective associations of private (residential) garden and mortality remained when other functional greenspace categories were excluded from analysis. Across all buffer sizes, over 50% of total greenspace cover was classified as private (residential) garden, which has important implications for environmental equality. **Conclusion:** Further analyses of greenspace categories, grouped by function (e.g., private (residential) gardens versus public parks, playing fields and sports facilities) will offer novel insight into specific mechanistic pathways connecting greenspace and health (e.g., the contribution of physical activity), which is critical for designing and/or retrofitting urban environments for health.

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**P-0088**

### **Leveraging Urban Planning and Building Design to Reduce Ambient Combustion Ultra-Fine Particles Exposure**

**Presenter:** Pilar Botana Martinez, Stantec, Boston, United States

**Authors:** P. Botana Martinez;  
Stantec, Boston, MA.

Of all modern human settlements today, cities have the most potential to accommodate population growth in a sustainable and healthy manner. Water supply, sanitation, and mass-transit can be efficiently managed in well-functioning dense cities, where the compact urban tissue promotes healthy active transportation opportunities such as walking, biking or jogging. Unfortunately, most American cities today are burdened with increased traffic pollution, leading to ambient combustion ultra-fine particles (UFP) exposure, a significant public health problem.

The growing body of evidence-based research in urban planning and building strategies can help to mitigate traffic-related UFP exposure for people living near highways. For environmental scientists and policy-makers to incorporate these strategies in future urban and building developments, they need to leverage the key tools and strategies of architectural practice that address outdoor and indoor air quality in cities. This poster illustrates regulations, strategies and tools used in urban planning and architectural practices in America, with the goal to facilitate the collaboration between environmental scientists and designers towards devising, implementing and evaluating tactics to reduce UFP exposure in cities. The poster describes how evidence-based UFP mitigation tactics can be integrated: (i) at the urban planning level (i.e. landscaped buffers, vegetated and wall barriers or decked highways) with different regulations such as land use, performance or sustainable zoning. (ii) at the building level (i.e. facade sealing, MERV and HEPA filtration, or green facades and roofs) with building codes for indoor air quality. Finally, the poster also explores the most widespread voluntary sustainable building standards (i.e. LEED, WELL, Fitwel or Passive House), and how they compare to evidence-based UFP mitigation strategies at the building scale.

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**P-0089**

### **Outdoor Light at Night and Breast Cancer Incidence in the Danish Nurse Cohort Study**

**Presenter:** Youn-Hee Lim, University of Copenhagen, Copenhagen, Denmark

**Authors:** R. B. Clarke<sup>1</sup>, H. Amini<sup>1</sup>, P. James<sup>2</sup>, J. T. Jørgensen<sup>1</sup>, A. Mehta<sup>1</sup>, T. Cole-Hunther<sup>3</sup>, R. Westendorp<sup>1</sup>, L. H. Mortensen<sup>4</sup>, S. Loft<sup>1</sup>, J. Brandt<sup>5</sup>, O. Hertel<sup>5</sup>, C. Backalarz<sup>6</sup>, Z. J. Andersen<sup>1</sup>, Y. Lim<sup>1</sup>; <sup>1</sup>University of Copenhagen, Copenhagen, DENMARK, <sup>2</sup>Harvard University, Boston, MA, <sup>3</sup>University of Sydney, Sydney, DENMARK, <sup>4</sup>Denmark Statistics, Copenhagen, DENMARK, <sup>5</sup>Aarhus University, Aarhus, DENMARK, <sup>6</sup>DELTA Acoustics, Hørsholm, DENMARK.

**Introduction:** Breast cancer is the most common cancer type, and the most common reason for cancer-related deaths among women worldwide. Animal and epidemiologic studies suggest that exposure to light at night may contribute to increased breast cancer risk through circadian disruption, which involves a decrease in the nocturnal secretion of melatonin followed by disturbed estrogen regulation, however, epidemiological evidence is limited. In this study, we examined the association between exposure to residential outdoor light at night (LAN) and breast cancer incidence in the Danish Nurse Cohort Study. **Methods:** We followed 20,404 Danish nurses from 1993 or 1999 through 2012. LAN exposure was estimated using the US Defense Meteorological Satellite Program's (DMSP) Operational Linescan System. We collected LAN data (nW/cm<sup>2</sup>/sr) for 1996, 1999, 2000, 2002, 2004, 2005, and 2010, assigned at the subject's residence during the follow-up. Data on the incidence of breast cancer was obtained from the Danish Cancer Registry. We used time-varying Cox regression models to estimate hazard ratios (HRs) and 95% confidence intervals (CIs), adjusting for reproductive, lifestyle and environmental factors such as residential air pollution, road traffic noise, and greenspace. **Results:** Of the 20,490 women, 1,081 developed breast cancer in total during 339,633 person-years of follow-up. Based on the fully adjusted model of LAN exposure divided into quintiles, where the lowest LAN quintile was reference (0-13.6 nW/cm<sup>2</sup>/sr), we found an increase in breast cancer incidence at higher LAN levels: HR: 1.01 (95% CI: 0.83-1.23, p = 0.92), 1.08 (95% CI: 0.88-1.33, p = 0.44), 1.04 (0.83-1.30, p = 0.74), and 0.87 (95% CI: 0.66-1.15, p = 0.32) for the 2nd, 3rd, 4th, and 5th quintiles, respectively. **Conclusion:** There was a tendency, that higher levels of exposure to LAN were associated with a higher risk of breast cancer although the statistical significance was not observed.

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## ABSTRACT E-BOOK

Theme: **Built environment**

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**P-0090**

**Association of trees and other vegetation near homes with asthma exacerbation in children**

**Presenter:** Yun-Ting Yen, Drexel University, Philadelphia, United States

**Authors:** Y. Yen<sup>1</sup>, A. J. De Roos<sup>1</sup>, C. C. Kenyon<sup>2</sup>, K. Moore<sup>1</sup>, S. Melly<sup>1</sup>, L. H. Schinasi<sup>1</sup>;

<sup>1</sup>Drexel University, Philadelphia, PA, <sup>2</sup>Children's Hospital of Philadelphia, Philadelphia, PA.

**Background.** Vegetated landscapes (i.e., greenspace) may increase or decrease risk of asthma exacerbation through effects on pollen levels, localized climates (e.g., heat islands), air pollution, or child's behaviors. **Methods.** We investigated the association between neighborhood greenspace and pediatric asthma exacerbation (age <18 years) in the City of Philadelphia, by conducting a case-control study based on electronic health records (EHR) from the Children's Hospital of Philadelphia (CHOP) Care Network. Our study included cases from 8017 outpatient clinic visits, 5953 emergency department (ED) visits, and 4401 inpatient encounters, with controls selected from non-exacerbation clinical encounters for asthma. We studied various greenspace measures, including overall greenness (i.e., vegetation density), tree canopy, grass/shrub coverage, and impervious landcover, within various buffer sizes surrounding the child's residence. We used logistic regression to estimate odds ratios (OR) and 95% confidence intervals (CI), adjusting for child- and neighborhood level sociodemographic factors. **Results.** Lower odds of asthma exacerbation were observed in association with high levels of greenspace near the home (>75<sup>th</sup> percentile vs. ≤25<sup>th</sup> percentile) for ED cases, such as reduced odds of ED visits by 29% with high tree canopy coverage (OR=0.71, 95% CI= 0.61, 0.83), and 16% with high grass/shrub coverage (OR=0.84, 95% CI: 0.74, 0.97). Impervious surface landcover near the home was associated with greater odds of asthma exacerbation for ED (high vs. low: OR=1.50, 95% CI: 1.28, 1.75) and inpatient cases (OR=1.20, 95% CI: 1.02, 1.42). Small reductions in risk of outpatient clinic cases or inpatient cases in association with greater amounts of vegetation near the home were not statistically significant in the best-fitting models. **Conclusions.** Our findings suggest a protective effect of residential neighborhood greenspace against asthma exacerbation; however, differing results among treatment settings requires further assessment of confounding by indication and effect modification.

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**P-0091**

### **Associations between ventilation, indoor air quality, and health in residential buildings**

**Presenter:** Ah-Young Lim, Sungkyunkwan University School of Medicine, Suwon, Korea, Republic of

**Authors:** A. Lim<sup>1</sup>, M. Yoon<sup>1</sup>, H. Kim<sup>2</sup>, M. Lee<sup>2</sup>, H. Cheong<sup>1</sup>;

<sup>1</sup>Sungkyunkwan University School of Medicine, Suwon, KOREA, REPUBLIC OF, <sup>2</sup>IT & Zero Energy Architecture Center, College of Architecture, Myongji University, Yongin, KOREA, REPUBLIC OF.

**Background:** While there is an increasing interest in zero-energy buildings, limited evidence is available on how building characteristics affect the level of indoor air quality and occupants' health status. This study aimed to compare the indoor air quality between the zero-energy building and general apartment in Nowon-gu, Seoul, South Korea and to investigate the relationship between occupants' behavior, indoor air quality, and level of symptoms.

**Methods:** We recruited twenty-five households for case (zero-energy house) and control group (general apartment) respectively. Self-reported questionnaires were conducted on demographic profiles, general housing conditions, occupants' behaviors and disease history at the baseline. The severity of symptoms including headache, cough, and allergic symptoms, and subjective stress level were asked using a Likert scale on a weekly basis through a web survey tool. Exposure variables including particulate matter (PM), Carbon dioxide (CO<sub>2</sub>), and Volatile organic compounds (VOCs) were measured using a real-time monitor (Airguard K) on every minute. Regression analysis and a generalized additive model (GAM) will be used to estimate the relative risk for each subgroup.

**Results:** Case and control group showed difference in building age, residence period (23.2 vs. 48.3 months,  $p < 0.001$ ) and the housing size (55.0 vs. 81.8m<sup>2</sup>,  $p < 0.001$ ). Nearly half (48% vs. 40%) of occupants responded they ventilate the house every day. A majority of occupants (64%) used kitchen ventilator while cooking. Hourly mean levels of PM<sub>10</sub>, PM<sub>2.5</sub>, CO<sub>2</sub> and VOCs between November to February were significantly low in zero-energy building ( $p < 0.001$ ). Frequency of self-reported symptoms were not significantly different between two groups.

**Conclusions:** The results of this study would contribute to finding physical housing conditions and occupants' behaviors that are associated with occupants' health and quality of life. It will also provide guidelines for the management of indoor air quality at home.

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**P-0092**

**Neighborhood social cohesion and sleep health among White, Black, and Hispanic/Latino men and women in United States: Findings from the National Health Interview Survey**

**Presenter:** Ariel Neece, Social & Scientific Systems Inc., Bethesda, United States

**Authors:** A. Neece<sup>1</sup>, W. Jackson II<sup>2</sup>, S. A. Gaston<sup>3</sup>, C. L. Jackson<sup>4</sup>;

<sup>1</sup>Social & Scientific Systems Inc., Bethesda, MD, <sup>2</sup>Social & Scientific Systems Inc., Durham, NC,

<sup>3</sup>Epidemiology Branch, National Institute of Environmental Health Sciences, National Institutes of Health, Department of Health and Human Services, Research Triangle Park, NC, <sup>4</sup>Epidemiology Branch, National Institute of Environmental Health Sciences, National Institutes of Health, Department of Health and Human Services., Research Triangle Park, NC.

Background: Social environmental factors such as unfavorable neighborhood cohesion may contribute to poor sleep by, for example, activating stress pathways. Methods: Using pooled cross-sectional data from 144,776 participants of the 2013-2017 National Health Interview Survey (NHIS), we examined overall and race/ethnicity-specific associations between neighborhood social cohesion and sleep health among White, Black, Hispanic/Latino, and Asian adults. Neighborhood social cohesion score (NSC) was measured based on self-reported responses to four questions related to trust and support, which were categorized into low, medium, and high groups. Very short sleep duration was defined as <6 hours; short sleep <7 hours, recommended sleep 7-8 hours, and long sleep  $\geq 9$  hours. Sleep difficulties were assessed based on “trouble falling asleep 3+ days,” “trouble staying asleep 3+ days,” “waking up feeling rested 4+ days,” and “took sleep medication  $\geq 1$  times” all in the previous week. Adjusting for sociodemographics, health behaviors, and health indicators, Poisson regression with robust variance was used to estimate prevalence ratios (PRs) and 95% confidence intervals (CIs) for sleep duration and difficulty by low vs. high NSC and medium vs. high NSC. Results: Among 144,776 adults, mean age was  $47 \pm 0.1$  years, 48% were men, and 69% white. Overall, low vs. high NSC was associated with a higher prevalence of very short (PR=1.32; 95% CI: 1.25-1.40) and short (PR=1.19; 95% CI: 1.16-1.22) sleep duration. Low vs. high NSC was positively associated with very short sleep duration among Whites (PR=1.37; 95% CI: 1.28-1.47), Blacks (PR=1.13; 95% CI: 1.01-1.28), and Hispanics/Latinos (PR=1.30; 95% CI: 1.11-1.53). Among Asians, low NSC was associated with short sleep duration (PR=1.19; 95% CI: 1.06-1.32). Conclusions: Sleep difficulties were more prevalent among all racial/ethnic groups with less than high NSC. Low neighborhood social cohesion was associated with shorter sleep duration and sleep difficulty across racial/ethnic groups, and more research is warranted.

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**P-0093**

### **Use of Low-cost Sensors to Develop Land Use Regression Models for PM<sub>2.5</sub> of 6 Urban Areas in the US**

**Presenter:** Tianjun Lu, Virginia Tech, Blacksburg, United States

**Authors:** T. Lu<sup>1</sup>, M. J. Bechle<sup>2</sup>, Y. Wan<sup>3</sup>, A. A. Presto<sup>3</sup>, S. Hankey<sup>1</sup>;

<sup>1</sup>Virginia Tech, Blacksburg, VA, <sup>2</sup>University of Washington, Seattle, CA, <sup>3</sup>Carnegie Mellon University, Pittsburgh, PA.

**Background/Aim:** Existing national Land Use Regression (LUR) models are mainly developed based on ground-level regulatory monitors to predict and assess ambient exposure of air pollution at unmonitored locations. Emerging Low-cost sensors have improved network density and coverage that may refine the LUR model development.

**Methods:** We retrieved and calibrated annual average PM<sub>2.5</sub> concentrations from the low-cost sensors (i.e., PurpleAir sensors) of 6 urban areas in the US. Our independent variables included 11 categories (n = 339) of geographic features (e.g., traffic, population, land use, and satellite air pollution measurements). We developed PurpleAir LUR models (using only the PurpleAir sensors) and hybrid LUR models (using both the regulatory and low-cost monitors) for predicting annual average PM<sub>2.5</sub> concentrations; we applied a partial least squares-universal kriging approach. We compared the exposure assessment of different LUR-derived population-weighted predictions.

**Results:** LUR models using only the PurpleAir sensors showed reasonable performance: 10-fold CV R<sup>2</sup> = 0.66, mean absolute error [MAE] = 2.01 µg/m<sup>3</sup>. However, the external evaluation using the EPA monitors suggested that the PurpleAir-only LUR models may consistently over-predict PM<sub>2.5</sub> concentrations. We observed that the hybrid LUR models (R<sup>2</sup>: 0.85, MAE: 1.02 µg/m<sup>3</sup>) performed better as compared to the PurpleAir-only LUR indicating that regulatory monitors and low-cost sensors could be integrated to refine LUR models. We also noticed that the PurpleAir and hybrid LUR were spatially correlated with the regulatory-based LUR (e.g., Los Angeles: R<sup>2</sup>: 0.82, MAE: 0.77 µg/m<sup>3</sup>). The LUR-derived population-weighted predictions suggested that integrating low-cost sensors into LUR may help catch hot spots.

**Conclusions:** LUR model development using low-cost sensor network is feasible to capture spatial variability that maybe missed by the regulatory monitors and obtain promising performance where regulatory monitors are unavailable. Future low-cost sensor-based LUR can be expanded nationally to track exposures more accurately and inform health policies.

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**P-0094**

**Using latent class modeling to jointly characterize economic stress and multi-pollutant exposure**

**Presenter:** Alexandra E Larsen, Duke University School of Medicine, Durham, United States

**Authors:** A. E. Larsen<sup>1</sup>, V. Kolpacoff<sup>1</sup>, K. McCormack<sup>1</sup>, V. Seewaldt<sup>2</sup>, T. Hyslop<sup>1</sup>;

<sup>1</sup>Duke University School of Medicine, Durham, NC, <sup>2</sup>Beckman Research Institute, Duarte, CA.

**INTRODUCTION:** Work is needed to better understand how joint exposure to environmental and economic factors influence cancer. **OBJECTIVE:** We hypothesize that environmental exposures vary with socioeconomic status (SES) and urban/rural locations, and that areas with minority populations coincide with high economic disadvantage and pollution. **METHODS:** To model joint exposure to pollution and SES, we develop a latent class mixture model (LCMM) with three latent variables (SES-Advantage, SES-Disadvantage and Air Pollution) and we compare the LCMM fit to K-means clustering. We ran an ANOVA to test for high exposure levels in non-Hispanic black populations. The analysis is at the census tract level for the entire state of North Carolina (NC). **RESULTS:** The LCMM was a better and more nuanced fit to the data than K-means clustering. Our LCMM had two sub-levels (low, high) within each latent class. The worst levels of exposure (high SES disadvantage, low SES advantage, high pollution) are found in 22% of the census tracts, while the best levels (low SES disadvantage, high SES advantage, low pollution) are found in 5.7%. Overall, 34.1% of the census tracts exhibit high disadvantage, 66.3% have low advantage and 59.2% have high mixtures of toxic pollutants. We found that high levels of pollution exposure exist in some rural areas. Areas with higher SES disadvantage had significantly higher non-Hispanic black population density ( $p < 0.001$ ) and non-Hispanic black population density was higher in areas with higher pollution ( $p < 0.001$ ). **CONCLUSIONS:** Joint exposure to air toxins and SES varies with rural/urban location and coincides with minority populations. Our model can be extended to provide a holistic modeling framework for estimating disparities in cancer survival.

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**P-0095**

### **Analyzing the Relationship between Indoor Temperatures and 911 Calls through a Case-Control Study in New York City, NY**

**Presenter:** Elaina Gonsoroski, Florida State University, Tallahassee, United States

**Authors:** E. Gonsoroski, C. Uejio;  
Florida State University, Tallahassee, FL.

The frequency and intensity of extreme heat events are expected to increase with climate change. Understanding the ways in which heat influences health outcomes is critical to mitigating its effect both now and in the future through targeted interventions and adaptations. However, few studies have been able to analyze the role of indoor conditions in influencing health therefore missing a critical component of the environment. In addition, previous studies have not focused on heat-specific health outcomes. This study will fill this information gap through a case-control study design and regression analyses. Working with the New York City Fire Department Emergency Medical Services we compiled the Patient Care Reports and indoor temperatures for patients receiving emergency care during the summer of 2016. In order to collect indoor data, paramedics carried portable sensors into buildings while responding to 911 calls which passively measured indoor conditions. We compared 55 heat-specific health outcomes and 1611 controls through a case-control study and propensity score matching. Indoor temperatures over 28°C resulted in a significant increase (OR=3.88 CI[1.83, 8.25]) in chance of heat-related 911 calls. Current heat warnings are for outdoor temperatures are issued at two or more days between 35-37°C or any length of time above ~38°C. However, our results indicate the threshold at which people become sick due to indoor exposure is actually lower. Therefore these results could inform policy regarding indoor temperature safety standards.

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**P-0096**

**Residential Greenspace is Associated with CRP levels in Older Adults**

**Presenter:** Trenton Honda, University of Utah, Salt Lake City, United States

**Authors:** T. Honda<sup>1</sup>, J. Manjourides<sup>2</sup>, H. Suh<sup>3</sup>;

<sup>1</sup>University of Utah, Salt Lake City, UT, <sup>2</sup>Northeastern University, Boston, MA, <sup>3</sup>Tufts University, Medford, MA.

**Introduction:** Environmental pollutants have been previously associated with increased biomarkers of inflammation. Little is known however about how, and to what extent, neighborhood greenspace and urbanicity may impact inflammation.

**Methods:** We used mixed effects multiple regression models to evaluate contemporaneous neighborhood greenspace and C-reactive protein (CRP) levels among 4,121 individuals >57 years of age enrolled in the National Social Life, Health, and Aging Project. We also examined for effect modification by race/ethnicity, socioeconomic status, health status, BMI, and age. Secondary analyses examined whether associations were mediated by PM<sub>2.5</sub>, NO<sub>2</sub>, and physical activity. Greenspace estimates were based upon the Normalized Difference Vegetative Index (NDVI) obtained from NASAs Moderate Resolution Imaging Spectroradiometer satellites within a 1 km buffer around each participants residence. CRP levels were measured from dried blood spots. All models were adjusted for demographic, socioeconomic, health behavior, medical history, and current medications which have been previously shown to affect CRP levels.

**Results:** Each IQR increase in NDVI was associated with an 14.9% (95% CI -19.9, -9.5) decrease in CRP levels. Significant dose response was observed, such that those in the highest quartile of neighborhood greenspace had 23.4% lower CRP than those in the lowest quartile ( $P_{\text{trend}} < 0.001$ ). In effect modification models, the associations were found to be strongest among Hispanics (-30.9%, 95% CI: -46.4, -10.9) and Asians (-55%, 95% CI: -76.4, -14.2). No significant effect modification was observed for other investigated variables. In mediation analyses, borderline significant mediation of the association between neighborhood greenness and CRP was observed by physical activity (% mediated: 8.3%,  $p = 0.073$ ).

**Conclusions:** In a cohort of older US men and women, neighborhood greenness was significantly associated with CRP, with differential effects by race/ethnicity. These associations suggest that neighborhood may be important determinants of health in older adults.

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**P-0098**

**Spatial-temporal levels, variations and sources of NO<sub>2</sub>/NO<sub>x</sub> in the sub-Saharan African city of Accra, Ghana**

**Presenter:** Jiayuan Wang, Department of Environmental Health Sciences, School of Public Health and Health Sciences, Amherst, United States

**Authors:** J. Wang<sup>1</sup>, A. Alli<sup>1</sup>, S. Clark<sup>2</sup>, J. Nimo<sup>3</sup>, J. Bedford-Moses<sup>3</sup>, S. Terkper<sup>3</sup>, M. Ezzati<sup>2</sup>, M. Ezzati<sup>4</sup>, M. Brauer<sup>5</sup>, J. Baumgartner<sup>6</sup>, J. Baumgartner<sup>7</sup>, A. Hughes<sup>3</sup>, J. Vallarino<sup>8</sup>, S. Agyei-Mensah<sup>9</sup>, E. Agyemang<sup>9</sup>, F. Kelly<sup>10</sup>, B. Barratt<sup>10</sup>, A. Beddows<sup>10</sup>, S. Beevers<sup>10</sup>, R. Arku<sup>1</sup>;

<sup>1</sup>Department of Environmental Health Sciences, School of Public Health and Health Sciences, Amherst, MA, <sup>2</sup>Department of Epidemiology and Biostatistics, School of Public Health, Imperial College, London, UNITED KINGDOM, <sup>3</sup>Department of Physics, University of Ghana, Legon, GHANA, <sup>4</sup>MRC-PHE Center for Environment and Health, Imperial College London, London, UNITED KINGDOM, <sup>5</sup>School of Population and Public Health, The University of British Columbia, Vancouver, BC, CANADA, <sup>6</sup>Institute for Health and Social Policy, McGill University, Montreal, QC, CANADA, <sup>7</sup>Department of Epidemiology, Biostatistics, and Occupational Health, McGill University, Montreal, QC, CANADA, <sup>8</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>9</sup>Department of Geography and Resource Development, University of Ghana, Legon, GHANA, <sup>10</sup>Department of Analytical, Environmental and Forensic Sciences, King's College London, London, UNITED KINGDOM.

**Background.** As the world's fastest urbanizing region, rapid economic growth in Sub-Saharan Africa (SSA) is raising levels of urban air pollution from diverse local and regional sources. While measurement data are now emerging from SSA on particulate matter pollution, there is limited information on major combustion related gaseous pollutants. We examined the levels, spatial, seasonal, and socioeconomic patterns as well as sources of oxides of nitrogen (NO<sub>x</sub>: NO<sub>2</sub>/NO) in Accra, Ghana's capital and one of SSA's largest metropolitan cities. **Methods.** We collected weekly integrated ambient NO<sub>2</sub> and NO<sub>x</sub> samples using OGAWA passive samplers at 150 sites, consisting of a year-long (n=10) and week-long (n=140) averages which included a range of land-uses and emissions sources (traffic, biomass). **Results.** Annual mean NO<sub>2</sub> across all sites was 52 µg/m<sup>3</sup>. Both NO<sub>2</sub> and NO<sub>x</sub> concentrations were highest between November and February, the 'Harmattan' period when local and regional meteorology is altered, with means of 73 and 218 µg/m<sup>3</sup>, respectively, comparing to 47 and 116 µg/m<sup>3</sup> during non-Harmattan period. The mean NO<sub>2</sub> and NO<sub>x</sub> levels were highest at roadside sites (82 and 285 µg/m<sup>3</sup>), followed by residential (46 and 102 µg/m<sup>3</sup>) and sub-urban background sites (27 and 67 µg/m<sup>3</sup>). There was no difference between high-density (i.e. low-income and high biomass use) and low-density (i.e. high-income and low biomass use) residential sites. The overall sample mean NO<sub>2</sub>/NO<sub>x</sub> ratio was 0.53, varying from 0.35 at roadside sites to 0.63 at residential sites.

**Conclusions.** Traffic is the most important contribution for NO<sub>x</sub> in Accra, while contribution from biomass burning shows no difference at high- and low-income neighborhoods. NO<sub>2</sub>/NO<sub>x</sub> ratios are significantly lower than in North American, European and East Asian cities, indicating a less oxidative atmospheric condition in Accra, especially among traffic sites. "Harmattan" increases local pollution level significantly, possibly by altering local and regional meteorology conditions.

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**P-0100**

**Health and environmental co-benefits of city urban form: the case of Latin American cities**

**Presenter:** Ione Avila-Palencia, Drexel University, Philadelphia, United States

**Authors:** I. Avila-Palencia<sup>1</sup>, B. N. Sanchez<sup>1</sup>, D. A. Rodriguez<sup>2</sup>, C. Perez Ferrer<sup>3</sup>, J. Miranda<sup>4</sup>, N. Gouveia<sup>5</sup>, U. Bilal<sup>1</sup>, A. Useche<sup>6</sup>, M. Wilches<sup>6</sup>, O. Sarmiento<sup>6</sup>, A. Diez-Roux<sup>1</sup>;

<sup>1</sup>Drexel University, Philadelphia, PA, <sup>2</sup>University of California - Berkeley, Berkeley, CA, <sup>3</sup>Instituto Nacional de Salud Publica (INSP), Mexico City, MEXICO, <sup>4</sup>Universidad Peruana Cayetano Heredia, Lima, PERU,

<sup>5</sup>Universidade de Sao Paulo, Sao Paulo, BRAZIL, <sup>6</sup>Universidad de los Andes, Bogota, COLOMBIA.

Background: Urban design features are often studied in relation to health and behavioral outcomes. They can also have major implications for environmental outcomes. Yet the impact of these features on both health and environmental outcomes (co-benefits) are rarely examined. We investigated how urban landscape and street design profiles are related to jointly occurring health and environmental outcomes in Latin America cities. Methods: The SALURBAL project has compiled and harmonized data on built environment, environmental exposures, and health outcomes for 370 cities in 11 countries: Argentina, Brazil, Chile, Colombia, Costa Rica, El Salvador, Guatemala, Mexico, Nicaragua, Panama, and Peru. Eight city profiles were identified using finite mixture models. Four urban landscape profiles were defined measuring patch (contiguous area of urban development) fragmentation, shape, and isolation. Additional four street design profiles were defined using street connectivity, length, and directness. Multilevel regression models were used to assess associations between the city profiles and several health and environmental outcomes. Results (preliminar): As compared to the urban landscape profile labelled 'scattered pixels' (low fragmentation, compact shape, high isolation), the 'proximate stones' profile (moderate fragmentation, irregular shape, moderate isolation) had significantly higher levels of PM<sub>2.5</sub> and NO<sub>2</sub>, and the 'proximate inkblots' profile (moderate-high fragmentation, complex shape, moderate isolation) had significantly higher violence related deaths. As compared to the street design profile labelled 'labyrinthine' (low connectivity, moderate length, moderate directness), the 'semi-hyperbolic grid' (moderate connectivity, moderate length, moderate directness) and the 'spiderweb' (high connectivity, low length, moderate directness) profiles had significantly higher levels of PM<sub>2.5</sub> and NO<sub>2</sub>. While the 'hyperbolic grid' profile (moderate connectivity, high length, low directness) had significantly higher levels of NO<sub>2</sub> and lower levels of obesity. Conclusion: Identifying how city profiles are related to environment and health outcomes can shed light on the urban policies that could have the greatest environment and health co-benefits.

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**P-0101**

### **Smartphone Mobile Sensing and Geospatial Physical Activity Space Analytics in the PASTA-LA study**

**Presenter:** jonah michael lipsitt, UCLA, Los Angeles, United States

**Authors:** j. m. lipsitt;  
UCLA, Los Angeles, CA.

Physical activity is intimately linked to the built environment and health. Major on-going efforts are being made to increase physical activity rates in urban settings. One such effort, quickly becoming prevalent across many global cities, is the implementation of bike sharing programs. In October 2017, UCLA launched the Bruin Bike Share program. It provided a unique opportunity to conduct a before-and-after natural intervention study, the Physical Activity through Sustainable Transport Approaches in Los Angeles (PASTA-LA) study, to assess the health-related outcomes of bike-sharing programs. During the 2016-2018 study period, the PASTA-LA study enrolled 440 physically-capable participants from the UCLA-Westwood area. Participants were administered online questionnaires and a smartphone app (MOVES) was deployed on their phones for location and activity tracking. A nested sample of 140 participants were also outfitted with research grade GPS and accelerometers for comparison. Across all participants, over 30 million observations of location and activity were recorded. Using these 'big data', we can address our specific research questions: (1) can smartphones be used instead of expensive research-grade devices without sacrificing measurement validity, and (2) can these 'big data' be used to model Physical Activity Spaces (PASs) to better quantify environmental context. We have addressed these research questions using advanced geospatial and geostatistical approaches. To evaluate context variable allocation for individuals, we have used location and activity levels (steps) to demonstrate the predictive accuracy of four approaches to defining physical activity space: (1) circular home buffers, (2) directional ellipses, (3) machine learning route allocation models, and (4) kernel density ranking. These models can be used to quantify variables such as exposure to green space, dose of air pollution, and other neighborhood-based statistics that are instrumental for spatial models of association (e.g. such as the impact of heat exposure on physical activity rates, as moderated by green space access.)

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## ABSTRACT E-BOOK

Theme: **Built environment**

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**P-0103**

### **Modeling of Residential Indoor Concentrations of Ambient PM<sub>2.5</sub>, Ozone for the Catheterization Genetics (CATHGEN) Study**

**Presenter:** Michael S Breen, US EPA, Research Triangle Park, United States

**Authors:** M. S. Breen<sup>1</sup>, Y. Xu<sup>2</sup>, M. Breen<sup>3</sup>, V. Isakov<sup>1</sup>, R. Devlin<sup>1</sup>;

<sup>1</sup>US EPA, Research Triangle Park, NC, <sup>2</sup>ORAU/US EPA, Research Triangle Park, NC, <sup>3</sup>ORISE/US EPA, Research Triangle Park, NC.

Air pollution epidemiological studies of ambient fine particulate matter (PM<sub>2.5</sub>) and ozone (O<sub>3</sub>) often use outdoor concentrations from central-site monitors as exposure surrogates, which can add bias or uncertainty in health effect estimates. The goal of this study was to improve exposure assessments of ambient PM<sub>2.5</sub> and O<sub>3</sub> for a 10-year epidemiological study with 2,271 participants with coronary artery disease in central North Carolina called the Catheterization Genetics (CATHGEN) study. We developed an exposure modeling approach to estimate three tiers of individual-level exposure metrics for ambient PM<sub>2.5</sub> and O<sub>3</sub>. We used a hybrid outdoor air quality model (based on satellite- and ground-based air pollution measurements, chemical transport and land-use models) linked to a residential air exchange rate model (based on building characteristics, indoor-outdoor temperatures, wind speed) and mass-balance infiltration model to determine residential air exchange rates (AER, Tier 1), infiltration factors (F<sub>inf</sub>, Tier 2), and indoor concentrations (C<sub>in</sub>, Tier 3). For each of the 2,271 participant homes, we applied the exposure model to determine daily house-specific PM<sub>2.5</sub> and O<sub>3</sub> exposure metrics (Tiers 1-3) for the 365 days before each participant's cardiac catheterization date. The daily modeled exposure metrics for all 828,915 participant-days showed considerable temporal and house-to-house variability of AER, F<sub>inf</sub> and C<sub>out</sub> (Tiers 1-3). Our study demonstrates the ability to apply an outdoor air quality model linked to a residential infiltration model to determine individual-level ambient PM<sub>2.5</sub> and O<sub>3</sub> exposure metrics for a large, long-term epidemiological study, in support of improving risk estimation.

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**P-0104**

**There's no place like home? The physiological and psychological effects of going outside from the indoor home environment to urban environments, a field experiment on women from two ethnic groups**

**Presenter:** Keren Agay-Shay, The Azrieli Faculty of Medicine, Bar Ilan University, Safed, Israel

**Authors:** D. Saadi<sup>1</sup>, I. Schnell<sup>1</sup>, E. Tirosh<sup>2</sup>, X. Basagaña<sup>3</sup>, K. Agay-Shay<sup>4</sup>;

<sup>1</sup>Tel Aviv University, Tel AVIV, ISRAEL, <sup>2</sup>Bnei Zion Medical Center, (Emeritus) the Rappaport Family Faculty of Medicine, The Technion, Israel Institute of Technology, Haifa, ISRAEL, <sup>3</sup>ISGlobal, Centre for Research in Environmental Epidemiology (CREAL), Barcelona, SPAIN, <sup>4</sup>The Azrieli Faculty of Medicine, Bar Ilan University, Safed, ISRAEL.

**Background:** Previous field studies evaluated the effects of visit to different outdoor urban environments on short-term psychological, cognitive and physiological responses. Less is known on the effect of going outside from the indoor home environment to these urban environments. **Aim:** To evaluate whether visits to different urban and ethnic environments, in comparison to home indoor environment, leads to short-term responses and whether these are independent of ethnicity. **Methods:** The participants, 20-35 year-old healthy women (N=72, 48 Arab and 24 Jewish), started the experiment at their home and visited six different outdoor urban environments in predominantly ethnic Arab or Jewish cities, in Israel. First they visited intra-ethnic city and afterward inter-ethnic city environments. In each city they visited an urban park, a residential neighborhood and the city center. In each environment (including home) the following measures were evaluated: mood (measured as positive and negative emotions, cheerfulness, relaxed, natural and discomfort feelings), working memory (measured with backwards digit-span task) and autonomic nervous system (assessed using heart rate variability (HRV)). Several potential mediators were measured: carbon monoxide (CO), heat, noise, social aspects, and the self-perceived restoration scale. **Results:** Going outside from home, to both intra and inter-ethnic parks, was associated with beneficial psychological, physiological, and cognitive responses, and the strongest effects were found for the intra-ethnic park. The results for the other urban environments were different between Jewish and Arab women. The self-perceived restoration, the social aspects and reduced CO, heat and noise exposures during the visits did not explain the observed changes between the outdoor environments and home. **Conclusions:** Visits to urban parks compared to the home demonstrated short-term beneficial changes in the outcomes that could not be attributed to the investigated mediators. Women should be encouraged to go outdoors and specifically visit parks to improve their psycho-physiological health.

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**P-0105**

**Assessing the relationship between outdoor light at night (using International Space Station photographs) and risk of breast cancer in Vancouver, British Columbia**

**Presenter:** Jennifer Ritonja, Queen's University, KINGSTON, Canada

**Authors:** J. Ritonja<sup>1</sup>, C. C. Kyba<sup>2</sup>, M. A. Mclsaac<sup>3</sup>, J. J. Spinelli<sup>4</sup>, K. J. Aronson<sup>1</sup>;

<sup>1</sup>Queen's University, KINGSTON, ON, CANADA, <sup>2</sup>GFZ German Research Centre for Geosciences, Potsdam, GERMANY, <sup>3</sup>University of Prince Edward Island, Charlottetown, PE, CANADA, <sup>4</sup>University of British Columbia, Vancouver, BC, CANADA.

**Background/Aim:** Chronobiological and epidemiologic studies suggest that exposure to light at night (LAN) disrupts circadian rhythms, which in turn may increase breast cancer risk. The aim of this study is to investigate how different spectral parameters of outdoor LAN, as measured by the International Space Station (ISS), are associated with breast cancer risk, particularly in terms of the blue part of the spectrum. **Methods:** A population-based case-control study was conducted in Vancouver, BC, Canada with incident breast cancer cases and controls frequency matched by age. This analysis was restricted to 687 cases and 719 controls who provided lifetime residential histories. Using time-weighted average duration at each home 5-20 years prior to study entry, measures of cumulative average outdoor LAN exposure were estimated using ISS photographs, with a total of six LAN measures of intensity and varying spectra. Outdoor LAN measures were categorized into tertiles, and logistic regression was used to estimate the associations between outdoor LAN and breast cancer risk and potential interactions by menopausal status and night shift work. **Results:** Most participants lived at one or two residences during the 5-20 year time period of interest prior to study enrolment (median of two residences, maximum of eight residences). Preliminary results do not suggest an association between the various spectral LAN measures and breast cancer risk, and there is no clear interaction by menopausal status or past/current night work status. **Conclusions:** Our preliminary findings are consistent with no relationship between spectra and intensity of outdoor LAN measured using ISS photographs of Vancouver and risk of breast cancer. Strengths include the use of images with higher resolution around residences, and analysis of outdoor LAN using various biologically relevant parameters. More work is needed to understand the specific mechanisms linking LAN to breast cancer risk, particularly in terms of blue light exposure.

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**P-0106**

**Urbanization and greenness in HBSC survey: association with overweight and obesity in adolescents**

**Presenter:** Valeria Bellisario, University of Turin, Turin, Italy

**Authors:** V. Bellisario<sup>1</sup>, R. Bono<sup>1</sup>, G. Squillacioti<sup>1</sup>, M. Caputo<sup>2</sup>, I. Gintoli<sup>1</sup>, A. Borraccino<sup>1</sup>, P. Lemma<sup>1</sup>, P. Dalmasso<sup>1</sup>;

<sup>1</sup>University of Turin, Turin, ITALY, <sup>2</sup>Asl CN1, Cuneo, ITALY.

### Background

Health Behaviour in School-aged Children (HBSC) is an international school-based survey collecting data through self-completion questionnaires administered to children (11-15 years old) at school. Childhood obesity is an important public health issue that can affect health. Environmental settings and greenness availability may contrast obesogenic lifestyles promoting physical activity, whereas, urbanization and traffic may worsen childhood health. The aim of this project is to analyse if environmental setting could upregulate childhood weight status. **Methods** This project involved students from HBSC survey of the Piedmont Region (Italy). Data were collected in 2018, following the previously published protocols. School-based exposures to greenness and vehicular traffic were calculated using remote sensing. Greenness exposure was quantified by Normalised Difference Vegetation Index (NDVI) within buffers around geocoded schools, using satellite imagery. Vehicular traffic was determined within the same buffers, using thematic maps. Exposures to air pollution concentration (obtained from different local sampling stations) were provided by the Regional Agency for the Protection of the Environment. **Results** Overall, 3022 subjects were included, with amount 50% male/female and 30% for each age group (11-13-15 years old). Concerning weight status above 14% of the all sample is obese or overweight, 20% and 11% among boys and girls, respectively. Preliminary analyses showed an association between weight status and population density (rural vs urbanized areas). Currently, we are calculating greenness and urbanization to analyse their association with weight status. **Conclusion** Our preliminary findings suggest that high urbanization levels impact health implementing affecting weight in children. We are testing the hypothesis that greenness positively influences weight status and reduce negative effects of urbanization and air pollution. The managing of these risk factors must be deepened and corroborated by active preventive Public Health strategies for children health improvement.

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**P-0107**

**Association of urban green space with general health and wellbeing in adults from Greece**

**Presenter:** Olga I Kalantzi, University of the Aegean, Mytilene, Greece

**Authors:** A. A. Kanelli, O. I. Kalantzi;  
University of the Aegean, Mytilene, GREECE.

Association of urban green space with general health and wellbeing in adults from Greece  
Kanelli, Argyro Anna<sup>1</sup>, Kalantzi, Olga-Ioanna<sup>1</sup>

<sup>1</sup> Department of Environment, University of the Aegean, Mytilene, 81100, Greece

Background: Despite the mounting evidence of health benefits of green spaces, their quantitative and qualitative attributes in the way they influence health responses are poorly understood. The purpose of this study was to evaluate the short-term changes in physiological and psychological responses upon exposure to an urban green space, and explore the mediators that affect exposure. Methods: Twenty-four participants were exposed to an urban (downtown Athens) and a green space (Tatoi forest) in November 2019. Systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate (PR), salivary cortisol (SC) and Profile of Mood States (POMS) were measured before and after a 60-minute walk. Post intervention, the participants filled an open-ended question of their sensory experience, and their positive or negative emotions/reactions. A multiple linear regression analysis was performed to assess the correlation between the health outcomes and moderators of exposure. Results: Green space exposure significantly reduced all physiological responses (SBP:  $p < 0.01$ , DBP:  $p < 0.05$ , PR:  $p < 0.01$ , SC:  $p < 0.01$ ), while urban exposure only reduced salivary cortisol levels ( $p < 0.01$ ). Green space exposure resulted in a significant decrease of all negative POMS subscales and the Total Mood Disturbance (TMD), and an increase in all positive subscales. Post intervention results between the urban and green space showed a significant decrease for PR ( $p < 0.05$ ), SC ( $p < 0.05$ ), and TMD ( $p < 0.01$ ), in favor of the natural environment. All five senses were engaged in the forest, provoking positive reactions, in comparison to the city where four senses were reported, causing mostly negative feelings. Conclusions: Exposure to green spaces can alleviate stress and improve overall mood, while helping individuals experience their surroundings with all senses, compared to urban areas.

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**P-0109**

**Light at night exposure and cancer: A cancer hazard evaluation**

**Presenter:** Pamela J. Schwingl, Integrated Laboratory Systems, Morrisville, United States

**Authors:** P. J. Schwingl<sup>1</sup>, S. S. Mehta<sup>2</sup>, W. Arroyave<sup>1</sup>, R. M. Lunn<sup>2</sup>;

<sup>1</sup>Integrated Laboratory Systems, Morrisville, NC, <sup>2</sup>National Institute of Environmental Health Sciences, RTP, NC.

**Background:** Modern electric lighting practices have transformed our society into one in which people work, sleep, and receive goods and services 24/7. As the light-dark cycle is the major stimulus for coordinating the circadian system, exposure to light at night (LAN) can lead to circadian disruption (CD) and potential adverse health effects.

**Methods:** The U.S. National Toxicology Program (NTP) conducted a cancer hazard evaluation of exposure to LAN that included a systematic review of epidemiology studies of female breast cancer. The human studies assessed LAN exposure in the sleeping area (i.e., "indoor light") or from outdoor light, mostly by using satellite imaging methods (e.g., "environmental LAN"). We characterized all identified studies as low or moderate quality based on our bias and sensitivity evaluation.

**Results and discussion:** The 10 studies of indoor LAN provided inconsistent findings due to heterogeneity in methods used to measure LAN levels and the lack of specificity regarding LAN levels. Cohort or case-control studies of environmental LAN consistently found an increased risk of breast cancer among women in the highest category of overall LAN or blue-light LAN exposure. Whether these measurements provide a relevant direct measure of light or are surrogates for other activities enabled by light is not clear. Furthermore, whether low light levels observed in these studies are sufficient to disrupt circadian rhythms remains a question. NTP concluded the epidemiological database was inadequate to evaluate the relationship between exposure to LAN and female breast cancer.

**Conclusions:** Mechanistic and toxicological data studies provide strong evidence that certain lighting conditions (excessive LAN and insufficient daylight) can cause CD, biological effects characteristic of carcinogens, and promote breast or mammary tumor growth, thus providing moderate confidence of carcinogenicity in humans. Additional studies precisely measuring exposure to all sources of LAN and characterizing LAN intensities and spectral characteristics are needed.

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**P-0110**

**PM<sub>2.5</sub> air pollution exposure and nonalcoholic fatty liver disease in the United States**

**Presenter:** Trang VoPham, Epidemiology Program, Fred Hutchinson Cancer Research Center, Seattle, United States

**Authors:** T. VoPham<sup>1</sup>, K. Berry<sup>2</sup>, J. A. Mendoza<sup>3</sup>, J. D. Kaufman<sup>4</sup>, G. N. Ioannou<sup>5</sup>;

<sup>1</sup>Epidemiology Program, Fred Hutchinson Cancer Research Center, Seattle, WA, <sup>2</sup>Research and Development, Veterans Affairs Puget Sound Healthcare System, Seattle, WA, <sup>3</sup>Center for Child Health, Behavior and Development, Seattle Children's Research Institute; Department of Pediatrics and Nutritional Sciences Program, University of Washington; Cancer Prevention Program, Fred Hutchinson Cancer Research Center, Seattle, WA, <sup>4</sup>Departments of Epidemiology and Environmental and Occupational Health Sciences, University of Washington, Seattle, WA, <sup>5</sup>Division of Gastroenterology, Department of Medicine, Veterans Affairs Puget Sound Healthcare System and University of Washington, Seattle, WA.

**Background:** Nonalcoholic fatty liver disease (NAFLD) is the most common cause of chronic liver disease. Upwards of 30% of NAFLD cases occur among people who are non-obese (i.e., "lean NAFLD") and up to 52% among people without diabetes. Particulate matter air pollution <2.5 µm in diameter (PM<sub>2.5</sub>) is a ubiquitous exposure primarily produced from fossil fuel combustion. Once inhaled, PM<sub>2.5</sub> particles can enter the bloodstream and induce lipid accumulation, oxidative damage, inflammation, and fibrosis in the liver of mice. Previous epidemiologic research has been limited by small study areas with little exposure variability. Our aim was to conduct the first nationwide study to examine the association between ambient PM<sub>2.5</sub> exposure and NAFLD.

**Methods:** We conducted cross-sectional analyses of hospitalizations between 2001 and 2011 from the Nationwide Inpatient Sample (NIS), the largest nationally representative all-payer inpatient care administrative database in the United States. Average annual PM<sub>2.5</sub> exposure was estimated using NIS ZIP Codes linked with the Environmental Protection Agency Downscaler Model, which incorporates data from atmospheric modeling and point air pollution measurements. NAFLD hospitalizations were identified using International Classification of Diseases discharge diagnosis codes excluding unrelated liver diseases. Multilevel logistic regression accounting for the complex survey design with a random effect for hospital was used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) adjusted for age, sex, race/ethnicity, year, obesity, diabetes, smoking, hypertension, dyslipidemia, obstructive sleep apnea, and individual- and area-level socioeconomic status.

**Results:** The prevalence of NAFLD hospitalizations was 3.4% from 2001-2011 (unweighted 122,913 cases/36,065,973 hospitalizations). Preliminary results show that higher ambient PM<sub>2.5</sub> exposure was associated with increased odds of NAFLD hospitalizations (adjusted OR 1.17, 95% CI 1.03-1.32 per 10 µg/m<sup>3</sup> increase).

**Conclusions:** PM<sub>2.5</sub> may be a novel risk factor for NAFLD. Future analyses will examine potential effect modification by age, race/ethnicity, sex, and geography.

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**P-0111**

**Metals and breast cancer risk: a prospective study using toenail metal biomarkers**

**Presenter:** Nicole M Niehoff, National Institute of Environmental Health Sciences, Research Triangle Park, United States

**Authors:** N. M. Niehoff<sup>1</sup>, K. M. O'Brien<sup>1</sup>, A. P. Keil<sup>2</sup>, K. E. Levine<sup>3</sup>, C. R. Weinberg<sup>1</sup>, A. J. White<sup>1</sup>;  
<sup>1</sup>National Institute of Environmental Health Sciences, Research Triangle Park, NC, <sup>2</sup>University of North Carolina at Chapel Hill, Chapel Hill, NC, <sup>3</sup>RTI International, Research Triangle Park, NC.

Background: Certain metals are known or suspected carcinogens and have been found in breast tissue samples. Toenails are a stable matrix that reflect exposure 6-12 months before collection and measurements correlate well over time. We prospectively examined a large panel of toenail metals in relation to breast cancer risk and were the first to consider whether multiple metal biomarkers jointly influence risk. Methods: The Sister Study is prospective cohort of 50,884 women who enrolled between 2003-2009 with follow-up for breast cancer through September 2016. We measured 15 metals in toenails collected at enrollment using a case-cohort design of 1,495 cases and a randomly-selected sub-cohort of 1,605 women. For individual metals, multivariable-adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) were estimated using Cox regression with robust variance. We examined associations overall and stratified by race, estrogen receptor (ER), and menopausal status. Quantile g-computation was used to examine joint associations between multiple metals and breast cancer risk. Results: In individual metal models, arsenic was associated with a non-linear increase in breast cancer risk (2<sup>nd</sup> vs. 1<sup>st</sup> tertile, HR=1.22; 95% CI: 1.01-1.49). This association was stronger for ER+ breast cancer (HR=1.31; 95% CI: 1.06-1.62). In non-Hispanic Blacks, zinc was associated with an elevated risk (3<sup>rd</sup> vs. 1<sup>st</sup> tertile, HR=1.40; 95% CI: 0.97-2.02). Molybdenum was inversely associated with breast cancer overall (3<sup>rd</sup> vs. 1<sup>st</sup> tertile, HR=0.83; 95% CI: 0.68-1.00) and particularly for ER- breast cancer (3<sup>rd</sup> vs. 1<sup>st</sup> tertile, HR=0.57; 95% CI: 0.37-0.87). A simultaneous increase in multiple metals was not associated with breast cancer risk. Conclusions: In this prospective study considering multiple toenail metals in relation to breast cancer, we found that individual metals and metal mixtures were not consistently associated with a higher risk. However, a few metals appeared to be related to breast cancer risk in certain subgroups.

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**P-0112**

**Induction of mitochondrial-mediated apoptosis by methanol extract of *Cajanus cajan***

**Presenter:** Olajumoke Olufunlayo Alao, Lead City University, Ibadan, Nigeria

**Authors:** O. O. Alao, O. O. Alao, O. O. Alao, O. O. Alao;  
Lead City University, Ibadan, NIGERIA.

Induction of mitochondrial-mediated apoptosis by methanol extract of *Cajanus cajan* Alao O O<sup>a,b</sup> and Olorunsogo O.O<sup>a</sup>

<sup>a</sup>Department of Biochemistry, University of Ibadan, Nigeria <sup>b</sup>Department of Biochemistry, Lead City University, Ibadan, Nigeria.

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Background: Attention has recently focused on mitochondrial-mediated apoptosis as a signaling pathway that is disrupted during carcinogenesis. The chemopreventive effects of dietary phytochemicals can be explored in order to combat conditions emanating from dysregulation of mitochondria-mediated apoptosis. *Cajanus cajan* is a medicinal plant commonly used in Nigeria for the traditional treatment of many diseases such as jaundice, measles dysentery and tumours. This study aims to investigate the effects of *Cajanus cajan* on the opening of the mitochondrial membrane permeability transition (MMPT) pore, ATPase activities, liver enzyme activities and immunohistochemical expression of apoptotic biomarkers in rat liver. Methods: Eighteen male Wistar rats (150±2.00 g) were assigned into three groups of six animals each and orally administered corn oil (control), 100 and 200 mg/kg MECC once daily for thirty consecutive days. Mitochondrial membrane permeability transition and ATPase activity were determined spectrophotometrically. Caspase 3, caspase 9 and cytochrome C release were determined by immunohistochemistry. Results: In vitro, at 10 and 30 µg/mL pore opening was not observed, however at 50 and 70 µg/mL MECC induced pore opening by 7 and 13 folds. Similarly, enhancement of ATPase activities was also observed. In the in vivo studies; the MECC induced opening at 200 mg/kg bwt. There was a significant increase in the activities of AST, ALT and ALP and caspase 3, caspase 9 and cytochrome C were activated Conclusion: Methanol extract of *Cajanus cajan* induced mitochondrial-mediated apoptosis in normal rat liver. Hence *Cajanus cajan* can be used in the management of conditions associated with dysregulation of apoptosis.

Keywords: Mitochondria membrane permeability transition pore : apoptosis and *Cajanus cajan*

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**P-0113**

**A Systematic Review of Epidemiologic Evidences on Lead and Cancers, 2003 - 2019**

**Presenter:** Cynthia Jones, Cdc/atsdr, Atlanta, United States

**Authors:** C. Jones, Z. Li;

Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry, Atlanta, GA.

Background: While lead has known adverse health effects, the evidence for its carcinogenicity in human is limited. The National Toxicology Program (NTP) classified lead and lead compounds as reasonably anticipated to be human carcinogens in 2004. The International Agency for Research on Cancer (IARC) classified them as “probably carcinogenic” (group 2A) its 2006 assessment. Both classifications were based on limited evidence in humans and sufficient evidence in animals. Since then, epidemiologic studies have investigated the association of lead exposure and a variety of cancers. We aim to review recent epidemiologic evidence on the carcinogenicity of lead among studies that were published after the NTP and IARC assessments. Method: A systematic literature review was conducted to identify relevant papers based on key terms, ‘lead’ and ‘cancer’, using PubMed and restricting to articles from 2003 to present. Studies/publications were excluded if they were irrelevant to the aim of this review, were not epidemiologic in nature, did not report site-specific information, or contained major study design concerns that may bias the findings. Included studies were categorized based on the specific cancer sites, and the study findings were summarized by cancer site. Results and Conclusions: The keyword search identified 195 articles published between January 1, 2003 and January 31, 2020. After evaluation based on the exclusion criteria, 43 publications were selected for this review. A variety of specific cancer sites have been studied, including biliary tract (7 studies), brain and nerve (11 studies), breast (8 studies), digestive tract (12 studies), head and neck (5 studies), hematologic (7 studies), mesothelial (3 studies), reproductive (6 studies), respiratory (16 studies), skin (3 studies), thyroid (1 study), and urinary tract (16 studies). The results from these published epidemiologic studies will be reviewed and summarized with regards to the reported association between lead and cancer outcomes.

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**P-0114**

**Publicly available UV irradiance data in the contiguous United States and its applications**

**Presenter:** Ying Zhou, CDC, Atlanta, United States

**Authors:** Y. Zhou;  
CDC, Atlanta, GA.

Background: Skin cancer is the most common type of cancer in the United States. The majority of skin cancer is caused by overexposure to ultraviolet (UV) light. National Environmental Public Health Tracking Program at CDC has collaborated with partners to develop and disseminate county-level daily UV irradiance (2005 to 2015) data for the contiguous United States. Methods: UV dataset was derived based on measurements from the Ozone Monitoring Instrument (OMI) during 2005-2015. UV irradiance data were first calculated at the census tract level; then daily population-weighted UV irradiance were calculated at the county level. We analyzed the spatial distributions and long-term trends of UV irradiance, and ratio of UV irradiance to solar irradiance. We also have used the newly developed dataset in a few applications to improve characterization of UV exposure. Results: The UV dataset is currently the only publicly-available, spatially-resolved, and long-term UV radiation dataset covering the contiguous United States. The national averages across all years available is 2,700 J/m<sup>2</sup> for erythemally weighted daily dose of UV irradiance (EDD). UV irradiance increased toward the South and the West. The ratio of UV to solar irradiance mainly increased toward the South and in some areas with high altitude. This spatial variation suggests that using solar irradiance as indicator of UV irradiance in studies covering large geographic regions may bias the true pattern of UV exposure. National annual average daily UV irradiance increased significantly over the years by about 0.5% per year. In addition, we identified hotspots of skin cancer vulnerability, which took into consideration demographic, social risk factors and UV exposure intensity. We also examined state laws allowing sunscreen use in schools in the context of state average UV irradiance. Finally, we are currently studying the association between UV irradiance and cutaneous melanoma incidence rates among white US residents.

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**P-0115**

### **Blood lead levels and lung cancer mortality in the United States: an updated analysis using the National Health and Nutrition Examination Survey (NHANES) II and III**

**Presenter:** Jongeun Rhee, National Institutes of Health/National Cancer Institute, Rockville, United States

**Authors:** J. Rhee, B. I. Graubard, M. P. Purdue;  
National Institutes of Health/National Cancer Institute, Rockville, MD.

Background: Elevated blood lead levels (BLLs) have been associated with lung cancer in occupational studies. To assess whether this relationship extends to the general population (with lower BLLs) and with full adjustment for smoking (given that lead is a tobacco constituent), we conducted analyses within the National Health and Nutrition Examination Survey (NHANES) II (1976-1980) and III (1988-1994) cycles. Methods: We included 4,293 and 15,671 participants in NHANES II and III, respectively, aged  $\geq 20$  with BLL measurements and mortality follow-up through 2014. We fit multivariable Cox models adjusting for smoking and other potential confounders to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for BLL associated with mortality for lung cancer. Results: We observed a suggestive association between BLLs and lung cancer mortality in both NHANES II (189 deaths; HR 1.8, 95% CI 0.7, 4.7 for BLL  $\geq 20.0$   $\mu\text{g/dl}$  vs  $< 10.0$   $\mu\text{g/dl}$ ,  $P_{\text{trend}} = 0.12$ ) and NHANES III (363 deaths; HR 1.4, 95% CI 0.9, 2.0 for BLL  $\geq 10.0$   $\mu\text{g/dl}$  vs  $< 2.5$   $\mu\text{g/dl}$ ,  $P_{\text{trend}} = 0.08$ ). These associations were stronger among women (NHANES II: HR 2.7, 95% CI 0.7, 10.0,  $P_{\text{trend}} = 0.07$ ; NHANES III: HR 2.7, 95% CI 1.2, 6.5,  $P_{\text{trend}} = 0.03$ ). After stratifying on smoking status, the NHANES II association for women was present among both current smokers (HR 1.3, 95% CI 0.6, 2.7 for 90<sup>th</sup> vs 10<sup>th</sup> BLL percentile) and never/former smokers (HR 2.1, 95% CI 0.7, 6.2 for 90<sup>th</sup> vs 10<sup>th</sup> BLL percentile). In NHANES III, however, the association for women was observed only among current smokers (HR 1.8, 95% CI 1.2, 2.7). Conclusions: We observed a suggestive association between BLLs and lung cancer mortality among women. While residual confounding from tobacco use may explain the NHANES III finding, the NHANES II finding appears to be independent of smoking.

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## ABSTRACT E-BOOK

Theme: **Cancer risks**

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**P-0116**

**Cytochrome P4501A1 genetic polymorphisms breast cancer risk**

**Presenter:** Fatima Abubaker Hamad, Gezira University, Wad-Madani, Sudan

**Authors:** F. A. Hamad;  
Gezira University, Wad-Madani, SUDAN.

The CYP1A1 gene is highly polymorphic in human populations and ethnic differences in the distribution of these polymorphisms have been reported in various populations. Aims: The aim of the study to evaluate the association of three polymorphic variants in the CYP1A1 gene with breast cancer susceptibility in Sudanese women. Methods: 100 patients and 100 controls were studied after written consent. A questionnaire extracted sociodemographic data, family history of breast cancer and gynecological history. Clinical examination was performed including weight and heights. Blood was drawn for PCR and RFLP analysis for CYP1A1 genotyping. Results: Premenopausal age and later age at menopause, education levels, family history of breast cancer and BMI had significant associations with breast cancer risk in Sudanese women. The CYP1A1 M1 genotype was not associated with the risk of breast cancer in Premenopausal and postmenopausal ages neither were the CYP1A1 M3 genotypes in this respect. There were no homozygous CYP1A1 M1 (C/C) and the CYP1A1 M3 (C/C) genotypes in our study subjects. The homozygous CYP1A1 M2 (A/A) genotype had a significant association with risk reduction of breast cancer in premenopausal women. The heterozygous CYP1A1 M2 (A/G) and the homozygous (G/G) were associated with a significant increased risk of breast cancer. Conclusion: This study has shown that the CYP1A1 M2 polymorphism has an association with the risk of developing breast cancer among Sudanese patients.

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**P-0117**

### **Residential proximity to animal feeding operations and risk of solid tumors in the Agricultural Health Study cohort**

**Presenter:** Rena R. Jones, National Cancer Institute, Rockville, United States

**Authors:** R. R. Jones<sup>1</sup>, J. A. Fisher<sup>1</sup>, D. N. Medgyesi<sup>1</sup>, J. N. Hofmann<sup>1</sup>, A. Blair<sup>1</sup>, C. G. Parks<sup>2</sup>, P. S. Thorne<sup>3</sup>, M. H. Ward<sup>1</sup>, L. E. Beane Freeman<sup>1</sup>;

<sup>1</sup>National Cancer Institute, Rockville, MD, <sup>2</sup>National Institute of Environmental Health Sciences, RTP, NC,

<sup>3</sup>University of Iowa, Iowa City, IA.

**Background:** Occupational exposure to animals has been associated with several types of cancers, but little is known about risk associated with living near intensive animal farming. **Methods:** We evaluated associations between residential proximity to animal feeding operations (AFOs) and cancer risk in the Agricultural Health Study, a prospective cohort of pesticide applicators (mostly male farmers) and their spouses. We linked enrollment (1993-1997) addresses for participants in Iowa (33,340 applicators and 20,186 spouses) to a database of permitted AFOs that included animal units (AUs), counts standardized by animal size and manure production. We computed an inverse distance-weighted AU metric that reflects exposure proximity and intensity within 5km of residences. We estimated risk of major solid tumor sites associated with AU metric quintiles using Cox regression (hazard ratio, HR; 95% confidence interval, 95%CI), adjusting for demographics, farming-related factors (occupational pesticide use, direct animal contact), and cancer site-specific potential confounders (e.g., reproductive history). Associations were also estimated separately by animal type (swine, poultry, cattle) and self-reported occupational animal contact. **Results:** There were 6,137 incident solid tumors diagnosed during follow-up 1993-2015. Among applicators, testicular cancer risk increased with AU quintiles within 5km of the home (HR<sub>Q5vsQ1</sub>=3.3, 95%CI=1.0-11.0; p<sub>trend</sub>=0.03). Prostate cancer risk was significantly elevated in the highest AU quintile (HR<sub>Q5vsQ1</sub>=1.3; 95%CI=1.1-1.5; p<sub>trend</sub>=0.0001). For lung cancer, there was an inverse, but non-significant trend with increasing AUs (HR<sub>Q5vsQ1</sub>=0.80; 95%CI=0.50-1.2; p<sub>trend</sub>=0.09). Among spouses, uterine cancer risk was elevated (HR<sub>Q5vsQ1</sub>=1.9, 95%CI=1.2-2.9; p<sub>trend</sub>=0.03). Risk of breast cancer increased with cattle AUs (p<sub>trend</sub>=0.01), but not for other animal types. We observed no effect modification by animal-related work for any cancer site. **Conclusions:** Our results suggest that residential proximity to AFOs may influence risk of certain solid tumors, even after consideration of farming activities and other risk factors. These findings are novel, but further evaluation is needed to identify etiologic agents.

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Theme: **Cancer risks**

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**P-0118**

**Ambient Air Pollutants and Skin Cancer: Epidemiological Evidence from UK Biobank**

**Presenter:** Minyi Zhang, Southern Medical University, Guangzhou, China

**Authors:** M. Zhang<sup>1</sup>, W. Hu<sup>2</sup>, Q. Chen<sup>1</sup>, Z. Li<sup>1</sup>, C. Mao<sup>1</sup>;

<sup>1</sup>Southern Medical University, Guangzhou, CHINA, <sup>2</sup>Queensland University of Technology, Brisbane, AUSTRALIA.

**Background and aim:** The impacts of air pollutants on skin cancer remain controversial due to different results of studies. The research aims to investigate the association between exposure to traffic-related pollutants and skin cancer in the United Kingdom (UK). **Methods:** The UK Biobank is a large population-based, prospective study with over half a million participants aged 40 to 60 years recruited from 2006 to 2010. Data on air pollutants including particulate matter (PM), nitrogen dioxide (NO<sub>2</sub>), and nitrogen oxides (NO<sub>x</sub>) between 2005 and 2010 were obtained. Binary logistic regression models were used to assess the association between the concentration of air pollutants and skin cancer after controlling for various confounders. Furthermore, a non-parametric classification tree model was used to evaluate the interactive effect of risk factors on the occurrence of skin cancer. **Results:** A total of 320,264 participants (48.7% men) aged 64±8 years were included in this study. During a median of 7.8 years of follow-up, 9164 cases of skin cancer occurred in UK. Our results showed that the concentration of air pollutants was a significantly negative correlation with skin cancer. For PM with an aerodynamic diameter of less than 2.5µm (PM<sub>2.5</sub>) and 10µm (PM<sub>10</sub>), the odds ratios (OR) were 0.953 (95% confidence interval [CI]: 0.927-0.979) and 0.937 (95%CI: 0.913-0.962) per interquartile range (IQR) increase, respectively. Similar results were observed on NO<sub>2</sub> (OR: 0.923, 95%CI: 0.898-0.950) and NO<sub>x</sub> (OR: 0.940, 95%CI: 0.915-0.964) per IQR increase. The classification tree model showed interactive associations between risk factors and skin cancer. **Conclusions:** The research demonstrated that air pollutions may lower the risk of skin cancer in UK. However, further research is needed for examining the interactive relationship between air pollutants, ultraviolet index and skin cancer.

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**P-0119**

**Polycyclic organic matter and invasive breast cancer**

**Presenter:** Larisa M Gearhart-Serna, Duke University, Durham, United States

**Authors:** L. M. Gearhart-Serna, K. Hoffman, G. R. Devi;  
Duke University, Durham, NC.

p.p1 {margin: 0.0px 0.0px 0.0px 0.0px; font: 12.0px 'Helvetica Neue'} Background: Emerging evidence suggests that environmental endocrine disrupting chemicals, such as polycyclic aromatic hydrocarbons (PAHs), increase breast cancer risk. Polycyclic organic matter (PAHPOM) is a USEPA Environmental Quality Index (EQI) air domain factor, which includes PAHs and PAH-derivatives present in the atmosphere in particulate form. Sources include tobacco smoke, vehicle exhaust, residential heating, coal and tar burning, and grilling meat. Methods: Herein, we investigated associations between polycyclic organic matter exposure and invasive breast cancer. Breast cancer diagnoses were obtained from the North Carolina Central Cancer Registry (2009-2014), and county of residence at diagnosis was linked with the quartiled PAHPOM variable. We first constructed generalized linear models to assess county-level breast cancer incidence by stage in counties of high versus low PAHPOM exposure, adjusted for mammography screening rates, %African American, and %Smokers. Next, we constructed generalized estimating equations to evaluate the odds of individual patients having localized, regional, or distant invasive breast cancer versus non-invasive carcinoma in situ in counties of high versus low PAHPOM exposure, adjusted for age, BMI, smoking status, and race. We further evaluated the odds of patients having hormone receptor positive versus hormone receptor negative invasive breast cancer. All models were stratified by urbanicity. Results: High PAHPOM exposure was associated with increased total and localized breast cancer incidence (total estimate 22.36, 95% CI 6.77-37.95,  $p=0.006$ ; localized estimate 12.43, 95% CI 3.36-21.5,  $p=0.008$ ), as well as increased odds of having hormone receptor positive versus hormone receptor negative invasive breast cancer (OR 1.04; 95% CI: 1.00, 1.08,  $p=0.0187$ ) in urban counties. Conclusions: Our results suggest that high polycyclic aromatic compound exposure is associated not only with increased breast cancer incidence, but also increased odds of having hormone receptor positive invasive breast cancer, especially in urban areas.

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**P-0120**

**Air pollution and breast cancer risk in the Black Women's Health Study**

**Presenter:** ALEXANDRA JAYNE WHITE, NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES, DURHAM, United States

**Authors:** A. J. WHITE<sup>1</sup>, A. Gregoire<sup>1</sup>, N. M. Niehoff<sup>1</sup>, K. A. Bertrand<sup>2</sup>, J. R. Palmer<sup>2</sup>, P. F. Coogan<sup>2</sup>, T. Bethea<sup>3</sup>;

<sup>1</sup>NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES, DURHAM, NC, <sup>2</sup>Slone Epidemiology Center, Boston University, Boston, MA, <sup>3</sup>Lombardi Comprehensive Cancer Center, Georgetown University, Washington, DC.

**Background.** Air pollution contains numerous carcinogens and endocrine disruptors which may be relevant for breast cancer risk. Previous research on air pollution and breast cancer risk has predominately been conducted in white women; however, Black women may have higher exposure to air pollution. **Methods.** Using land-use regression models, we estimated annual average ambient levels of particulate matter < 2.5  $\mu\text{m}$  ( $\text{PM}_{2.5}$ ), nitrogen dioxide ( $\text{NO}_2$ ) and ozone ( $\text{O}_3$ ) at the 1995 residence of 41,325 participants in the Black Women's Health Study who resided in 56 metropolitan areas across the United States. Cox proportional hazards regression was used to estimate adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) for an interquartile range (IQR) increase in each pollutant. We evaluated whether the association varied by menopausal status at diagnosis, invasiveness, and estrogen receptor (ER) status of the tumor and by geographic region of residence. **Results.** With follow-up through 2015 (mean=18.3 years), 2,216 incident cases of breast cancer were confirmed. Higher exposure to  $\text{PM}_{2.5}$ ,  $\text{NO}_2$ , or  $\text{O}_3$  was not significantly associated with breast cancer risk overall or by ER status. However, an IQR increase in  $\text{NO}_2$  (10 ppb) was associated with a higher risk of premenopausal breast cancer (N=571, HR=1.15, 95% CI: 1.02-1.31). For the association between  $\text{PM}_{2.5}$  and invasive breast cancer, we observed significant modification by geographic region (p for heterogeneity=0.02). Among women living in the Midwest, but not other geographic regions, an IQR increase in  $\text{PM}_{2.5}$  (2.87  $\mu\text{g}/\text{m}^3$ ), was associated with a higher risk of invasive breast cancer (HR=1.27, 95% CI: 1.04-1.55). **Conclusions.** These results support the hypothesis that higher exposure to specific air pollutants may be a risk factor for breast cancer among Black women, particularly for premenopausal women and women living in the Midwest.

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**P-0121**

**Association between air cadmium exposure and prostate cancer aggressiveness at diagnosis**

**Presenter:** Jyotsna Jagai, University of Illinois at Chicago, Chicago, United States

**Authors:** V. Vijayakumar, M. R. Abern, A. Kajdacsy-Balla, J. Jagai;  
University of Illinois at Chicago, Chicago, IL.

**Background:** There is conflicting evidence of an association between cadmium exposure and prostate cancer (PC) mortality in the general population. Since most PCs are indolent, low grade and low stage tumors may mask associations. We assessed associations between ambient exposure to air cadmium and PC aggressiveness at diagnosis in the US. **Methods:** We collected outcome data from the 2010 – 2014 Surveillance, Epidemiology, and End Results (SEER). Aggressiveness at diagnosis was defined as stage categorized as either metastatic or localized and Gleason grade as high or low. The 2011 National Air Toxics Assessment database provided county-level air cadmium concentrations. Odds Ratios (OR) and 95% confidence intervals (CI) were estimated using multivariable logistic regression comparing the 80<sup>th</sup> to 20<sup>th</sup> percentile of cadmium exposure and adjusted for age at diagnosis, sociodemographic status, smoking prevalence and overall air quality at the county-level and were stratified by race and degree of urbanization defined by Rural-Urban Continuum Codes (RUCC). **Results:** The study cohort consisted of 230,540 cases from 493 counties. Overall, higher air cadmium exposure was associated with an increased likelihood of metastatic PC compared to localized PC (OR 1.02, CI 1.01–1.03) and higher Gleason grade at diagnosis (OR 1.01, CI 1.00–1.02). The strongest associations were observed in nonmetropolitan areas with urban populations of 20,000 to 250,000 (RUCC2 counties): (OR 1.26, CI 1.14–1.39) for metastatic vs. localized PC, and (OR 1.36, CI 1.25–1.49) for high vs. low grade cases. **Discussion:** The strongest associations between air cadmium exposure and tumor aggressiveness were found among nonmetropolitan counties, where 40 million Americans reside. Research is necessary to identify air cadmium pollution sources in these communities and to rule out additional confounding factors. Air cadmium exposure in the general population may be a more important factor in prostate cancer and its progression than previously recognized.

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**P-0122**

### **Increased Cancer Risk in a Small Korean Village near a Fertilizer Factory**

**Presenter:** Ho-Jang Kwon, Department of Preventive Medicine, College of Medicine, Dankook University, Cheonan, Korea, Republic of

**Authors:** H. Kwon<sup>1</sup>, Y. Lee<sup>1</sup>, S. Bae<sup>2</sup>, D. Ko<sup>3</sup>, J. Kim<sup>3</sup>, M. Yoon<sup>4</sup>, B. Lee<sup>4</sup>;

<sup>1</sup>Department of Preventive Medicine, College of Medicine, Dankook University, Cheonan, KOREA, REPUBLIC OF, <sup>2</sup>Department of Preventive Medicine, College of Medicine, Catholic University of Korea, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Institute for Environmental Safety and Health, Seoul, KOREA, REPUBLIC OF, <sup>4</sup>National Institute of Environmental Research, Ministry of Environment, Incheon, KOREA, REPUBLIC OF.

**Objectives** The Jang-jeom Village is a small rural village in the Republic of Korea where about 80 people live. The purpose of this study is to investigate whether the cancer risk has been increased since 2001 when a fertilizer factory was established in the village.

**Methods** Using the national population data and cancer registration data of Korea, we calculated cancer standardized incidence ratio (SIR) in the village to investigate whether more cancers occurred in the villages compared to other regions. In order to investigate whether living in the village increases the risk of cancer, a retrospective cohort was constructed using the Korean National Health Insurance data. We calculated cancer hazard ratio (HR) by using the Cox proportional hazard model, comparing the exposure area and control area. We considered potential confounding factors such as age, sex and income.

**Results** In the 2001-16, 23 cancer cases were identified. In the 2010-16, the SIRs of the all cancers (ICD-10 code; C00-96), all cancers except thyroid cancer (C00-72, 74-96), skin cancer except melanoma (C44) in the village were 2.05 (95%CI: 1.09-3.31), 2.22 (95%CI: 1.18-3.59), and 16.01 (95%CI: 1.51-45.88), respectively. The HRs of the all cancers, all cancers except thyroid cancer, skin cancer except melanoma, gastric cancer (C16), hepatic cancer (C22), gallbladder and biliary cancer (C23-4) of the living in the village were 1.99 (95%CI: 1.14-3.45), 2.20 (95%CI: 1.26-3.84), 11.60 (95%CI: 1.51-45.88), 3.29 (95%CI: 1.14-9.53), 6.63 (95%CI: 1.77-24.88), and 15.24 (95%CI: 3.84-60.48), compared to the living in the control area, respectively.

**Conclusion** The results of this study suggest the increased cancer risk in the Jang-jeom village near the fertilizer factory since 2001.

**Acknowledgement** This work was supported by a grant from the National Institute of Environment Research (NIER), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIER-2017-03-02-053).

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## ABSTRACT E-BOOK

Theme: **Cancer risks**

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**P-0123**

**Risk assessment and prediction for lung cancer among Hong Kong Chinese men**

**Presenter:** Shelly Lap Ah TSE, The Chinese University of Hong Kong, Shatin, Hong Kong

**Authors:** S. L. TSE<sup>1</sup>, J. S. Au<sup>2</sup>, F. Wang<sup>1</sup>, I. T. Yu<sup>1</sup>;

<sup>1</sup>The Chinese University of Hong Kong, Shatin, HONG KONG, <sup>2</sup>Hong Kong Adventist Hospital, Kowloon, HONG KONG.

**Objective:** The discriminatory power of previous risk prediction models for all lung cancers generally ranged from 0.57 to 0.72. We constructed individual risk prediction models for all lung cancers and its specific histological subtypes among Hong Kong general male population. **Methods:** Epidemiological data of 1069 male lung cancer cases confirmed by histology and 1208 community controls were included in this analysis. Community controls were randomly selected from the general male population frequency-matched by age and sex. Annual concentration of ambient PM<sub>2.5</sub> and PM<sub>10</sub> air pollution were retrospectively reconstructed based on individual household location and the nearest monitoring station data. LASSO-model was used to select optimal risk factors for each specific prediction model. Receiver-operator characteristic curves (ROC) and the area under the curve (AUC) was used to demonstrate the model performance and the ability to differentiate cases from non-cases. **Results:** AUC for all lung cancers was 0.782 (95%CI: 0.762-0.801) and the discriminatory power increased to 0.824 (95%CI: 0.807-0.841) after PM<sub>10</sub> was included into the prediction model, and this improvement was consistently shown in prediction models stratified by smoking status. When the prediction models included ambient PM<sub>10</sub> and were further specified by histological subtypes, a notably higher AUC was demonstrated for squamous cell lung cancer (0.878, 95%CI: 0.857-0.898) than that of the adenocarcinoma (0.778, 95%CI: 0.751-0.804). **Conclusion:** Lung cancer risk assessment tool in Hong Kong Chinese men based on LASSO selection is promising, which shows a relatively higher discriminative accuracy than those developed in many other populations. Risk model is improved after including PM<sub>10</sub> air pollution, indicating the importance of addressing ambient PM air pollution in risk prediction. However, external validation of this model in an independent population is recommended to be the next necessary step. [Funding source: Research Grant Council, HKSAR, Project no. CUHK4460/03M]

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## ABSTRACT E-BOOK

Theme: **Cancer risks**

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**P-0125**

**Occupational heat exposure and breast cancer risk (MCC-Spain study)**

**Presenter:** Michelle C Turner, Barcelona Institute for Global Health (ISGlobal), Barcelona, Spain

**Authors:** A. Hinchliffe<sup>1</sup>, M. Kogevinas<sup>1</sup>, G. Castano-Vinyals<sup>1</sup>, A. Marcos-Delgado<sup>2</sup>, M. Pollan<sup>3</sup>, G. Fernandez-Tardon<sup>4</sup>, B. Perez-Gomez<sup>3</sup>, P. Amiano<sup>5</sup>, V. Moreno<sup>6</sup>, J. Alguacil<sup>7</sup>, R. Marcos-Gragera<sup>8</sup>, E. Ardanaz<sup>9</sup>, N. Aragonés<sup>10</sup>, Y. Benavente<sup>11</sup>, D. Salas<sup>12</sup>, J. Llorca<sup>13</sup>, M. C. Turner<sup>1</sup>;

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<sup>3</sup>Carlos III Institute of Health, Madrid, SPAIN, <sup>4</sup>Institute of Health Research of the Principality of Asturias

(ISPA), Oviedo, SPAIN, <sup>5</sup>Biodonostia Health Research Institute, San Sebastian, SPAIN, <sup>6</sup>Bellvitge Biomedical Research Institute (IDIBELL), Barcelona, SPAIN, <sup>7</sup>Universidad de Huelva, Huelva, SPAIN,

<sup>8</sup>Catalan Institute of Oncology, Girona, SPAIN, <sup>9</sup>IdiSNA, Pamplona, SPAIN, <sup>10</sup>Department of Health of Madrid, Madrid, SPAIN, <sup>11</sup>Institut Català d'Oncologia, Barcelona, SPAIN, <sup>12</sup>FISABIO, Valencia, SPAIN,

<sup>13</sup>University of Cantabria, Santander, SPAIN.

Objective Occupational heat exposure (OHE) has been linked with a variety of adverse health effects, however knowledge regarding potential associations with cancer risk is limited. In this study, associations of OHE and breast cancer risk were evaluated in a Spanish population-based case-control study. Methods We enrolled 1,380 breast cancer cases and 1,428 frequency-matched population controls from 10 regions of Spain. A Spanish job exposure matrix, MatEmEsp, was used to assign estimates of OHE as the proportion of workers exposed ( $P \geq 25\%$  for at least one year) and proportion of work time with heat stress (according to the wet bulb globe temperature ISO 7243) for each occupation reported over the lifetime. We used three main exposure indices: ever vs. never exposed, lifetime cumulative exposure (heat stress years) and duration of exposure (years). We estimated odds ratios (ORs) and 95% confidence intervals (CIs) applying a lag-period of 5 years, adjusting for potential confounders. Results Approximately 27% of cases and 22% of controls ever had OHE. Highest exposed occupations included industrial workers, miners and laundry workers. For all analyses the reference category was participants who never had OHE. Ever OHE was associated with a higher risk of breast cancer (OR 1.23; 95% CI 1.02, 1.48). Participants in the medium and high tertiles of lifetime cumulative exposure had a higher risk of breast cancer (ORs of 1.22; 95% CI 0.92, 1.63 and 1.41; 95% CI 1.06, 1.87 respectively,  $p$  trend = 0.01) as did those with OHE for longer than 10 years (OR 1.36; 95% CI 1.02, 1.81). A stronger association was found for pre-menopause and for hormone receptor positive disease. Conclusion In this large population-based study we found an increased risk of breast cancer associated with OHE. Further research including at other cancer sites is also warranted.

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**P-0126**

**Additional burden of cancers due to the exposure to ultraviolet radiation: A spatial analysis and economic implications in health care in Newfoundland and Labrador, Canada**

**Presenter:** Arifur Rahman, Memorial University of Newfoundland, St John's, Canada

**Authors:** M. Rahman<sup>1</sup>, F. McCrate<sup>2</sup>, A. Sarkar<sup>1</sup>;

<sup>1</sup>Memorial University of Newfoundland, St John's, NL, CANADA, <sup>2</sup>Eastern Health Authority, St John's, NL, CANADA.

Background: People living in the province of Newfoundland and Labrador (NL), Canada, are exposed to ultraviolet radiation (UVR) despite prolonged foggy weather. NL cancer statistics report a high number of skin cancer cases. However, there is no population-level data on any association between skin cancers and exposure to UVR. This study is aimed to estimate the risk of skin cancers due to exposure to UVR and additional financial burden due to an excessive number of cancer cases. Methods: Daily UV index (UVI) monitoring data (March 2013-January 2019) for 37 meteorological centers of NL were collected from the Environment and Climate Change Canada. Monitoring centers having UVI 6 or more for 600 days (~100 days/year) and above were considered as high-risk centers, and the rest were selected as low-risk centers. Communities located within a 50-km radius of each center were selected for the study. Cancer data were extracted from the NL Cancer Registry for cases diagnosed between 2007-2016. Histology and topography of cancers and demographic information of cases (sex, year of birth, and residence at the time of diagnosis) were extracted. Risk ratios (RR) of prevalence rates of cancer in both areas, an excess number of cancer cases in high-risk areas, and average cost of cancer care (hospitalization and intervention) were calculated. Results: Relative to low-risk areas, people in the high-risk areas had a higher prevalence of skin cancers (RR 1.63, 95% CI 1.55-1.73). The average cost of care for each cancer case associated with exposure to UVR was C\$16,100, and the total estimated financial burden for the excess number of cancer cases was more than C\$16 million. Conclusion: Results suggested a modest elevation in skin cancer in high-risk areas associated with exposure to UVR and additional financial burden to the province's already stretched health budget, though the estimates were imprecise.

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**P-0127**

### **Validation of self-reported tobacco use with urinary NNAL among LCS-eligible population from the 2007-2014 National Health and Nutrition Examination Survey (NHANES)**

**Presenter:** Weixin Li, Graduate School of Biomedical Science, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** W. Li<sup>1</sup>, B. Liu<sup>2</sup>;

<sup>1</sup>Graduate School of Biomedical Science, Icahn School of Medicine at Mount Sinai, New York, NY,

<sup>2</sup>Department of Population Health Science and Policy, Institute for Translational Epidemiology, Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY.

**Background** As a major metabolite of tobacco-specific carcinogen, 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL) has been used as a biomarker for tobacco smoking exposure. Among current or former smokers, accurate self-reported smoking status is critical for determining the eligibility for lung cancer screening (LCS). This study used NNAL to verify self-reported smoking status among LCS-eligible population from a nationally representative sample in the National Health and Nutrition Examination Survey (NHANES). **Methods** We utilized NHANES data from 2007-2014 that included both urine total NNAL and self-reported smoking behavior to select the LCS-eligible population. We applied four cutpoints of NNAL (10pg/ml, 20pg/ml, 30pg/ml, 40pg/ml) as the gold standard to assess the performance of self-reported smoking status. To determine the validity and reliability of self-reported smoking status, we calculated the sensitivity (Se), specificity (Sp), positive predictive value (PPV), negative predictive value (NPV), accuracy, and reliability (Kappa). **Results** We found approximately 3.7% (n=985, equivalent to 8.5 million weighted population) of adults eligible for LCS according to the United States Preventive Services Task Force guideline. Validity and reliability of self-reported smoking status increased with increasing cutpoints of NNAL. Against NNAL-based smoking status with a cutpoint of 40pg/ml, self-reported smoking status showed the highest Se (88.8%), lowest Sp (99.4%); the corresponding PPV and NPV, respectively, was 99.5% and 85.5%; the accuracy was 93.0% and kappa was 0.86. The self-reported smoking status tended to be more valid and reliable among females than males across all NNAL cutpoints evaluated. Using the established 40pg/ml cutpoint as the gold standard, we found the accuracy was lowest among the non-Hispanic black (90.1%) and highest among the other race/ethnicity groups (93.9%). **Conclusion** Utilizing urine NNAL as the biochemical verification reference, we found that self-reported smoking status among people who are at risk of lung cancer is reasonably reliable.

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## ABSTRACT E-BOOK

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**P-0128**

### **Cancer Education Interventions for Adolescents: A Systematic Review of Structure, Content, and Effectiveness**

**Presenter:** Amelia Grant-Alfieri, University of Michigan, Ann Arbor, United States

**Authors:** A. Grant-Alfieri<sup>1</sup>, K. Burke<sup>2</sup>, N. Zeinomar<sup>2</sup>, M. Delgado<sup>2</sup>, M. Terry<sup>2</sup>;  
<sup>1</sup>University of Michigan, Ann Arbor, MI, <sup>2</sup>Columbia University, New York, NY.

Given the long induction time of many cancers and the fact that modifiable risk factors (e.g. initiation of cigarette smoking) including preventive factors (e.g. uptake of the HPV vaccine, healthy dietary and physical activity patterns) are influenced in adolescence, educating adolescents about cancer causation and risk reduction may have a large impact on reducing the cancer burden. We conducted a systematic review of literature evaluating the impact of cancer education interventions on adolescent knowledge of cancer risk-reduction. We searched for articles published from 2000-2019 and identified 33 studies meeting our criteria. Given the methodological heterogeneity across studies, we focused on examining the design of the intervention and study. The majority of studies took place outside of the U.S. (67%) and addressed skin or cervical cancer (70%). Only 12% of the interventions discussed multiple cancer types. Few studies (21%) discussed lifestyle and environmental risk factors such as diet and exposure to secondhand smoke. Only 9% of the studies designed culturally-appropriate interventions tailored to a vulnerable or understudied population. The majority of interventions were a single session (55%) and were evaluated using a pre-test and a single post-test (61%); some studies administered multiple post-tests. The majority of included studies (88%) reported improvement in student knowledge following an intervention. However, our review revealed wide methodological variation and a deficit of research evaluating interventions about multiple cancer types and both lifestyle and environmental risk factors. Our review highlighted a need to robustly test whether comprehensive cancer education for adolescents can reduce the cancer burden, particularly in communities with major cancer health disparities.

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**P-0129**

### **Exposure to Natural Vegetation in relation to Mammographic Density**

**Presenter:** Lyndsey K Blair, Department of Epidemiology, University of Louisville, School of Public Health and Information Sciences, Louisville, United States

**Authors:** L. K. Blair<sup>1</sup>, J. D. Newton<sup>1</sup>, J. E. Hart<sup>2</sup>, P. James<sup>3</sup>, T. VoPham<sup>4</sup>, M. Barnard<sup>5</sup>, F. Laden<sup>2</sup>, E. T. Warner<sup>6</sup>, R. M. Tamimi<sup>7</sup>, N. C. DuPre<sup>1</sup>;

<sup>1</sup>Department of Epidemiology, University of Louisville, School of Public Health and Information Sciences, Louisville, KY, <sup>2</sup>Brigham and Women's Hospital and Harvard Medical School; Harvard TH Chan School of Public Health, Boston, MA, <sup>3</sup>Harvard Medical School and Harvard Pilgrim Health Care Institute; Harvard TH Chan School of Public Health, Boston, MA, <sup>4</sup>Epidemiology Program, Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, Seattle, WA, <sup>5</sup>Department of Population Health Sciences, Huntsman Cancer Institute, University of Utah, Salt Lake City, UT, <sup>6</sup>Department of Medicine, Mongan Institute, Clinical Translational Epidemiology Unit, Massachusetts General Hospital, Boston, MA, <sup>7</sup>Department of Population Health Sciences, Weill Cornell Medical, New York, NY.

Background: Exposure to natural vegetation or “greenness” promotes breast cancer risk-reduction behaviors (e.g. greater physical activity and lower BMI) and three epidemiologic studies reported inverse associations with breast cancer risk; however, it remains unknown whether this is due to direct biological effects on breast tissue or indirect impacts on lifestyle. We examined the association between greenness and mammographic density—a strong risk factor for breast cancer—to determine whether greenness directly influences breast tissue composition. Methods: We included 2,323 women without a history of breast cancer who underwent mammographic screening at the Brigham and Women's Hospital from 2007-2014. Normalized Difference Vegetation Index (NDVI) satellite data at 1 km<sup>2</sup> scale at participants' residential address was used to estimate 5-, 3- and 1-year cumulative average annual and summer greenness prior to the mammogram. We used multivariable linear regression to estimate differences in log transformed volumetric percent density for a 0.1 unit increase in NDVI adjusted for breast density predictors and stratified by menopausal status. Results: Overall, associations were null for NDVI measures and mammographic density. Among 1,108 premenopausal women, 5-year annual average NDVI was non-significantly inversely associated with percent mammographic density ( $\beta=-0.01$  95% CI -0.03, 0.02; p-value=0.52) after adjustment for age, BMI, race/ethnicity, parity, family history of breast cancer, and benign breast disease; results were similar for other NDVI measures. Among 1,215 postmenopausal women, 5-year annual average NDVI was non-significantly inversely associated with percent mammographic density ( $\beta=-0.02$  95% CI -0.04, 0.01; p-value=0.18) after adjustment for aforementioned variables and hormonal therapy use; results were similar for other NDVI measures. Conclusions: While in the expected direction, findings suggest that greenness does not have a direct role on breast tissue composition. Future work will explore if the potential benefit of greenness is more relevant to subgroups of women based on race/ethnicity, BMI, and physical activity.

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**P-0130**

### **Exposure to Polychlorinated Biphenyls and Organochlorine Pesticides and Risk of Thyroid Cancer in Women**

**Presenter:** Nicole C. Deziel, Yale School of Public Health, New Haven, United States

**Authors:** N. C. Deziel, J. L. Warren, H. Huang, H. Zhou, Y. Zhang;  
Yale School of Public Health, New Haven, CT.

Background: Both polychlorinated biphenyls (PCB) and organochlorine pesticides (OCP) have been associated with thyroid hormone disruption, but their relationship to thyroid cancer is not known. Methods: We investigated the relationship between serum PCB and OCP concentrations and papillary thyroid cancer (PTC) in 250 incident female PTC cases and 250 female controls frequency-matched on age, all residing in Connecticut. Interviews and serum samples were collected from 2010-2013. Samples were analyzed for 32 different chemicals using gas chromatography with isotope dilution high resolution mass spectrometry. We calculated odds ratios (OR) and 95% confidence intervals (CI) using single pollutant logistic regression models for concentrations (per interquartile range) of individual PCB/OCP and summed groups of structurally or biologically similar PCB/OCP, adjusted for education, family history of cancer, alcohol consumption, and body mass index. Sub-analyses included stratification by tumor size ( $\leq 1$  cm and  $> 1$  cm) and birth cohort (born before or in 1960 and born after 1960). We also applied three multi-pollutant approaches (standard multi-pollutant regression, hierarchical Bayesian modeling, principal components regression analysis) to investigate associations with exposures to multiple PCB/OCPs. Results: No PCB/OCPs were positively associated with PTC risk in primary analyses. Statistically significant associations were observed for 9 of the 32 chemicals and 3 summed groups of similar chemicals in the younger birth cohort based on single-pollutant models. Multi-pollutant analyses suggested null associations overall. Conclusions: Our results using single and multi-pollutant modeling do not generally support an association between PCB or OCP exposure and PTC risk, but some associations in the younger birth cohort suggest that additional investigation into early-life exposures and subsequent thyroid cancer risk may be warranted.

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**P-0131**

### **Concentration levels, Carcinogenic and Mutagenic risks of PM<sub>2.5</sub>-bound Polycyclic Aromatic Hydrocarbons in an urban-industrial area in South Africa**

**Presenter:** Oyewale Mayowa Morakinyo, Tshwane University of Technology, Pretoria, South Africa

**Authors:** O. M. Morakinyo, M. S. Mukhola, M. I. Mokgobu;  
Tshwane University of Technology, Pretoria, SOUTH AFRICA.

**Background:** Concerns over the health effects of exposure to particulate matter of aerodynamic diameter of less than 2.5  $\mu\text{m}$  (PM<sub>2.5</sub>) led the South African Government to establish the national standard for PM<sub>2.5</sub> in the year 2012. However, there is currently no exposure limit for polycyclic aromatic hydrocarbons (PAHs) and PM<sub>2.5</sub>-bound PAHs. The understanding of the concentration levels and potential health risks of exposure to PM<sub>2.5</sub>-bound PAHs is important in ensuring a suitable risk assessment and risk management plan. This study, therefore, determined the concentration levels, carcinogenic and mutagenic health risks of PM<sub>2.5</sub>-bound PAHs. **Methods:** A hundred and forty-four PM<sub>2.5</sub> samples were collected over four months during the winter and summer seasons of 2016 in an industrial area. The concentrations of 16 PAHs were analysed by gas chromatography-mass spectrometry, and their carcinogenic and mutagenic risks determined using the Human Health Risk Assessment model. **Results:** The mean winter ( $38.20 \pm 8.4 \mu\text{g}/\text{m}^3$ ) and summer ( $22.3 \pm 4.1 \mu\text{g}/\text{m}^3$ ) concentrations of PM<sub>2.5</sub> levels were lower than the stipulated  $40 \mu\text{g}/\text{m}^3$  daily limit. The main PAHs in PM<sub>2.5</sub> were the lower molecular weight compounds accounting for 59.0% of the total concentration. The daily inhalation and ingestion exposure to PAHs for all age groups were higher than the daily exposure through the dermal contact. Children and adults are more likely to inhale and ingest PAHs in PM<sub>2.5</sub> than infants. The excess cancer risks and excess mutagenic risk values were below the priority risk level ( $10^{-4}$ ). There is a potential risk of 1 to 8 per million persons developing cancer from exposure to Benzo[a]anthracene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene, and Dibenz[a,h]anthracene over a lifetime of 70 years. **Conclusions:** The measured PAHs presented a seasonal variation, with higher concentrations observed in winter. These findings can equip relevant stakeholders and policymakers with the knowledge to institute strategies and plans for further emissions control.

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**P-0132**

**Lung cancer mortality in China: a comparison analysis based on the Global Burden of Disease Study 2017**

**Presenter:** Ning Wang, QUT, Brisbane, Australia

**Authors:** N. Wang<sup>1</sup>, K. Mengersen<sup>1</sup>, S. Tong<sup>1</sup>, M. Kimlin<sup>1</sup>, M. Zhou<sup>2</sup>, W. Hu<sup>1</sup>;

<sup>1</sup>QUT, Brisbane, AUSTRALIA, <sup>2</sup>Chinese Center for Diseases Control and Prevention, Beijing, CHINA.

Background: China has a large population and is experiencing a transition period. Comparing lung cancer (LC) deaths and population attributable fractions (PAFs) of risk factors between China and other countries/regions are essential to inform effective control. Global Burden of Disease (GBD) study provides a unique opportunity for the comparison. Methods: We extracted the number of LC deaths, age-standardized death rates (ASDRs), and the PAFs of risk factors between 1990 and 2017 from the GBD 2017. The annual percentage change (APC) was used to quantify the trends of ASDRs in China and other regions. The relationships of the APC with Socio-demographic Index and baseline of ASDRs were assessed among China and other countries. Results: In 2017, LC ASDRs were 35.38 (95% uncertainty interval (UI): 34.39 to 36.35) and 13.94 (95% UI: 13.53 to 14.36) per 100,000 person-years in men and women worldwide, respectively. It decreased significantly in men (APC: -0.66%, 95% confidence interval (CI): -0.69 to -0.62) but increased significantly in women (APC: 0.31%, 95% CI: 0.26 to 0.36) from 1990 to 2017. LC ASDRs in China increased significantly among both men (APC: 1.12%, 95% CI: 1.03 to 1.2) and women (APC: 0.80%, 95% CI: 0.70 to 0.89). The increased LC deaths among men (312,798) and women (139,115) in China accounted for 59.39% and 43.01% of global increases. The risk factors with the highest PAFs in China were smoking and ambient particulate matter (PM) pollution. The PAF of ambient PM pollution in China ranked 2<sup>nd</sup> globally. Conclusions: The trends of LC ASDRs and the PAFs of risk factors varied markedly by region, which calls for tailored measures to reduce disease burden and improve health equality. China's LC death rates were among the highest worldwide and remained on the rise. PM and tobacco control should be China's intervention priorities.

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**P-0133**

**Toluene concentrations in the blood and risk of thyroid cancer from National Industrial Complexes: a population-based cohort study**

**Presenter:** Seyoung Kim, National Cancer Center, Goyang, Korea, Republic of

**Authors:** S. Kim<sup>1</sup>, E. Park<sup>1</sup>, E. Park<sup>1</sup>, C. Lee<sup>2</sup>, M. Lim<sup>1</sup>, Y. Won<sup>1</sup>, K. Jung<sup>1</sup>, B. Kim<sup>1</sup>;

<sup>1</sup>National Cancer Center, Goyang, KOREA, REPUBLIC OF, <sup>2</sup>National Institute of Environmental Research, Incheon, KOREA, REPUBLIC OF.

**Background/Aim** Although monocyclic aromatic hydrocarbons are classified as definite or possible carcinogen, studies on toluene with thyroid cancer risk are limited. This study was conducted to examine potential associations between blood toluene and the incidence risk of thyroid cancer, and the effect modification of living environment among residents living near industrial complex.

**Methods** We conducted a prospective cohort study using data from the Industrial Monitoring Project of South Korea. Study participants in living near National Industrial Complexes were recruited from January 2003 to 2010. Incidence and mortality cases of thyroid cancer (C73, ICD-10 code) was identified through National Cancer Registry and Statistics Korea, respectively. Blood toluene was measured by gas chromatography mass spectrometry. We used Cox proportional hazards regression models to estimate incidence rate ratios (IRRs) and 95% confidence intervals (CI) between blood toluene and thyroid cancer risk.

**Results** The geometric means of the toluene concentration in blood were 0.62 µg/L for cases and 0.29 µg/L for noncases. During the follow-up (median 8.7 years), 32 incident cases of thyroid cancer were diagnosed. After adjusting for potential confounders, a positive association between blood toluene and thyroid cancer was found (IRR=3.38, 95% CI = 1.12-10.24 in the highest tertile vs. the lowest tertile, p-value=0.03). This positive association was stronger in people living near a road (≤50 meters) (IRR= 5.14, 95% CI = 1.12-23.67 in the highest tertile vs. the lowest tertile, p-value=0.04).

**Conclusions** Blood toluene may be positively associated with the incidence risk of thyroid cancer. Moreover, this association of blood toluene with thyroid cancer risk may also be stronger in people living near a road.

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**P-0134**

**Environmental exposure to cadmium and risk of thyroid cancer from National Industrial Complexes: a population-based cohort study**

**Presenter:** Eunjung Park, National Cancer Center, Korea, Goyang-si, Korea, Republic of

**Authors:** E. Park<sup>1</sup>, S. Kim<sup>1</sup>, E. Park<sup>1</sup>, C. Lee<sup>2</sup>, J. Kwon<sup>2</sup>, M. Lim<sup>1</sup>, Y. Won<sup>1</sup>, K. Jung<sup>1</sup>, B. Kim<sup>1</sup>;  
<sup>1</sup>National Cancer Center, Korea, Goyang-si, KOREA, REPUBLIC OF, <sup>2</sup>National Institute of Environmental Research, Incheon-si, KOREA, REPUBLIC OF.

**Background** Cadmium is known to act as a thyroid disruptor and carcinogen in human. Recent evidence suggests cadmium may play a role in thyroid cancer because of its estrogenic activity, but the role of cadmium as a human thyroid carcinogen is still unclear. Our aim was to investigate the association between urinary cadmium and primary thyroid cancer in a prospective design and the modifying effect of hypertension on this association. **Methods** This study was conducted to collect and analyze the pollutant data comprehensively collected from eight National Industrial Complexes areas including Ulsan, Pohang, Gwangyang, Yeosu, Chungju, Gangneung, Cheongju and Daesan from 2003 to 2010. We included 4195 participants aged over 19 years with measured urinary cadmium for analysis. Urine samples collected at enrollment into the cohort were analyzed for cadmium and creatinine. Incident thyroid cancer patients were identified in the Korea Central Cancer Registry. We estimated incidence rate ratios (IRRs) for thyroid cancer in Cox proportional hazards models with random effects, using follow-up time as time scale and calculated 95% confidence intervals (CIs). In addition, we conducted stratified analysis by hypertension. **Results** Higher urinary cadmium was associated with increased risk for thyroid cancer (HR<sub>Tertile 3 vs Tertile 1</sub> 1.44, 95% CI = 1.03 to 5.14, P trend < 0.001; HR<sub>2.7-fold increase</sub> 1.47, 95% CI = 1.02 to 2.11 per mg/g). After stratification by hypertension, there was a positive association between urine cadmium and thyroid cancer in participants with hypertension (HR = 5.37, 95% CI = 1.13 to 25.64 per mg/g) but not in participants without hypertension (p for interaction 0.03). **Conclusion** This prospective study showed positive association between urinary concentration of cadmium and risk for development of thyroid cancer. The results also show that hypertensive patients are particularly vulnerable to the effects of cadmium exposure.

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**P-0136**

**Work-related lung cancer concentrate among lower status workers: a quantification approach**

**Presenter:** Emilie Counil, Ined - French Institute for Demographic Studies, Aubervilliers, France

**Authors:** W. Ismail<sup>1</sup>, D. Luce<sup>2</sup>, C. Paris<sup>2</sup>, E. Counil<sup>1</sup>;

<sup>1</sup>Ined - French Institute for Demographic Studies, Aubervilliers, FRANCE, <sup>2</sup>Inserm - IRSET, Rennes, FRANCE.

**Background/Aim:** Although the concentration of carcinogenic exposures within specific socio-occupational groups is widely acknowledged, most burden of disease (BOD) approaches focus on the general population, missing the dimension of occupational health inequities. This raises social justice issues as those quantification tools are increasingly used for discussing cancer prevention priorities and occupational disease compensation rules. Our general aim was to explore ways by which population health metrics could integrate occupational inequities, and to identify eventual data gaps. Our specific aim was to compare the burden of work-related lung cancer between different socio-economic groups taking into account three known occupational carcinogens (asbestos, silica and DME) and smoking. **Methods:** We conducted a secondary analysis of the population-based case-control study ICARE (Investigation sur les Cancers Respiratoires et l'Environnement). The study included 2926 lung cancer cases and 3555 frequency-matched controls covering 13% of the French population. Lifelong occupational exposures were assessed by job-exposure matrices and self-report. We compared sources of variation in the attributable fractions (AF) estimates, including interaction with socio-economic position (SEP) and SEP indicator (education or occupation-based), using STATA. **Results:** The analysis was based on men-only due to the limited number of exposures among women. The AF for the combined indicator of asbestos, silica and DME exposures was 29.4% (95%CI [23.9-34.4]) overall, while the AF for exposed blue-collar workers compared to non-exposed groups regardless of SEP was 26.9% (95%CI [21.9- 31.7]). AFs were slightly higher when capturing SEP through education. Our results provide quantified evidence that the burden of work-related lung cancer attributable to these 3 known carcinogens concentrates massively (over 90%) among manual workers. **Conclusion:** They exemplify the need for integrating indicators of occupation and industry sector into BOD estimates to inform decision-making in cancer prevention and compensation. More broadly, they plead for information systems linking SEP, environmental and occupational health.

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**P-0137**

**Exposure to polycyclic aromatic hydrocarbons (PAH) and breast cancer incidence: Evaluating the state of the science**

**Presenter:** Whitney M. Arroyave, ILS, Morrisville, United States

**Authors:** W. M. Arroyave<sup>1</sup>, P. J. Schwingl<sup>1</sup>, S. S. Mehta<sup>2</sup>, A. Wang<sup>2</sup>, R. M. Lunn<sup>3</sup>;

<sup>1</sup>ILS, Morrisville, NC, <sup>2</sup>National Institute of Environmental Health Sciences, Morrisville, NC, <sup>3</sup>National Institute of Environmental Health Sciences, RTP, NC.

**Background:** Exposure to mixtures of PAHs can occur in certain occupations, from tobacco smoke, specific foods, and contaminated air. Some PAHs exhibit estrogenic activity and links between female breast cancer (BC) and specific PAH exposure sources have been reported. We conducted a state of the science review of epidemiological studies assessing PAH exposure and BC.

**Methods:** We searched PubMed for analytical epidemiology studies and BC incidence or mortality. We mapped, evaluated study quality issues, and summarized findings by type of exposure assessment. Three prospective and 10 case-control studies reported effect estimates specific for PAH exposure. PAH exposure was assessed either (1) across multiple exposures using biomarkers like PAH-DNA adducts in breast tissue (N=2) or blood (N=1), PAH-albumin adducts in blood (N=1), and urinary biomarkers (N=2); or from (2) specific sources, including occupations (N=2), air pollution (N=2), and diet (N=3).

**Results:** Adduct studies showed positive associations with BC; adducts assess a combination of recent exposure (months) and susceptibility and may be subjected to reverse causality. Similarly, all occupational exposure and air pollution studies reported positive associations in overall or subset analyses with stronger associations for higher PAH exposure intensity, exposure from a specific occupational source, or during a specific exposure window. Most studies assessed exposure over long time periods although they suffer from imprecise assessments and potential confounding from co-exposure to other carcinogens. Conflicting findings were observed in urinary biomarkers, which assess very recent exposure, and food intake studies, which are prone to measurement error.

**Discussion:** Most studies across this wide variety of exposure scenarios reported elevated risks in overall and/or in subgroup analyses. However, interpretation of the findings is complicated considering accuracy and specificity of exposure assessment methods, relevant exposure windows, and potential confounding. Studies capturing lifetime exposure, integrating multiple sources, and examining source apportionment will elucidate this evidence base.

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**P-0138**

**Portrayal of sunscreen in traditional and social media**

**Presenter:** Cheryl E Peters, Alberta Health Services, Calgary, Canada

**Authors:** E. K. Quinn<sup>1</sup>, S. Fazel<sup>1</sup>, C. Ford-Sahibzada<sup>1</sup>, S. Szarka<sup>1</sup>, J. McWhirter<sup>2</sup>, C. E. Peters<sup>1</sup>;  
<sup>1</sup>Alberta Health Services, Calgary, AB, CANADA, <sup>2</sup>University of Guelph, Guelph, ON, CANADA.

Background News and social media provide a valuable channel for communicating health information to the public, recommending methods of prevention, and decreasing risk of illness or disease by influencing public behavior. The aim of this study was to understand public perception towards sunscreen by determining the content and context of sunscreen information portrayed in traditional and social media (Twitter). Methods We extracted and analyzed all English tweets containing the word sunscreen, inclusive of #sunscreen, in the United States and Canada from May to August 2019. We used content and sentiment analysis to compare the engagement, accuracy, sentiment, and tweet features of tweets. Additionally, we collected all Canadian news articles on the subject of sunscreen published between January 2009 and June 2019, and analyzed for themes and tone. Results Traditional media demonstrated an overall positive representation of sunscreen (450 articles, 77% of the total), mainly providing tips on safe usage and application. Articles that negatively portrayed sunscreen (68, 12%) focused on sunscreen recalls or adverse effects. The majority (486, 83%) of articles were published in summer months and were focused on seasonal context. Among the verifiable tweets (395 of 8,924 total), 70% contained accurate information and 30% contained inaccurate information. Most (84%) of the tweets showed positive sentiment towards sunscreen, 11% had mixed sentiment, and 5% showed negative sentiment. The most common theme among the accurate tweets was 'tips and recommendations' (56%) while the most common theme among inaccurate tweets was 'personal story' (62%). Inaccurate tweets received twice the engagement of accurate tweets. The most common hashtags were #summer, #skincare, #sunburn, #beach, and #sunshine. Conclusions The frequency of sunscreen misinformation on Twitter and in traditional media is not as large of a problem as for other topics, although misinformation received twice the engagement of accurate information on Twitter.

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**P-0139**

### **Urine Arsenic and All-cause and Cancer Mortality among U.S. Adults: the 2003-2014 National Health and Nutrition Examination Survey (NHANES)**

**Presenter:** Yawen Liu, Johns Hopkins Bloomberg School of Public Health, Baltimore, United States

**Authors:** Y. Liu, M. R. Jones;  
Johns Hopkins Bloomberg School of Public Health, Baltimore, MD.

**Background:** Inorganic arsenic (iAs) is an established human carcinogen. Studies on the relationship of low to moderate exposure to iAs with all-cause and cancer mortality are limited. We investigated the association of exposure to iAs, measured by urinary dimethylarsinate (DMA), with all-cause and cancer mortality in U.S. adults.

**Methods:** We studied 9,244 adults aged  $\geq 20$  years who participated in NHANES 2003-2014 and were assessed for urine arsenic analysis. Participants were followed for mortality through December 31, 2015. We estimated adjusted hazard ratios (HR) for all-cause and cancer mortality endpoints comparing tertiles of urinary DMA concentrations.

**Results:** The median (IQR) urinary DMA concentration was 2.5  $\mu\text{g/L}$  (1.4-4.1). After a mean of 6.7 years of follow-up, there were 876 deaths (203 cancer deaths). The HR (95% CI) comparing the highest DMA tertile ( $>3.42 \mu\text{g/L}$ ) to the lowest tertile ( $<1.08 \mu\text{g/L}$ ) were 1.09 (0.59, 2.02) for cancer mortality and 1.04 (0.82, 1.34) for all-cause mortality. For cancer mortality, urine DMA concentration was associated with increased risk among female participants (HR: 2.49, 95% CI: 1.07, 5.79). There was increased risk for cancer mortality among participants who were non-Black or White race/ethnicities, never and former smokers, overweight and without a history of cancer at baseline, although these findings were not statistically significant. For all-cause mortality, urine DMA concentration was associated with increased risk among non-Black or White race/ethnicities (HR: 2.24, 95% CI: 1.09, 4.60). There was a non-statistically significant increased risk for all-cause mortality among females, never and former smokers and overweight participants.

**Conclusions:** In this representative sample of the U.S. population exposed to low-moderate arsenic levels, urinary DMA concentrations were not associated with all-cause or cancer mortality in the overall population. There was evidence of increased risk for all-cause mortality among participants of non-Black or White race/ethnicities and for cancer mortality among female participants.

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**P-0140**

### **Ambient particulate matter and females breast cancer survival after breast cancer diagnosis: The French E3N study**

**Presenter:** Nasser Laouali, Inserm U1018, Gustave Roussy, Villejuif, France

**Authors:** N. Laouali<sup>1</sup>, M. Kvaskoff<sup>1</sup>, E. Faure<sup>1</sup>, P. Sheridan<sup>2</sup>, M. Boutron-Ruault<sup>1</sup>, Y. Oulhote<sup>3</sup>, T. Benmarhnia<sup>2</sup>, A. PAUNESCU<sup>1</sup>;

<sup>1</sup>Inserm U1018, Gustave Roussy, Villejuif, FRANCE, <sup>2</sup>University of California, San Diego, San Diego, CA,

<sup>3</sup>University of Massachusetts at Amherst, Amherst, MA.

Background: While breast cancer (BC) is associated with long-term survival, especially in early stage cases, factors influencing BC progression and survival are not perfectly understood. Residential exposure to ambient particulate matter  $<2.5 \mu\text{g}/\text{m}^3$  (PM<sub>2.5</sub>) has been associated to increased BC incidence; but only three studies focused on BC survival, with no consistent findings. Objective: To assess the associations between mean annual PM<sub>2.5</sub> exposure after diagnosis, and total and BC specific mortality. Methods: A total of 4,804 women from the French E3N cohort study and diagnosed with BC between 1990 and 2008 were followed through December 2011. Mean residential PM<sub>2.5</sub> exposure was derived from Europe-wide hybrid land use regression models at a 100 m spatial grid (ELAPSE project). Cox regression analysis was used to estimate hazard ratios (HR) and 95% confidence intervals (CI) of total and BC-specific mortality per increase in annual PM<sub>2.5</sub> exposure, controlling for BC risk factors. We also evaluated possible non-linear dose-response relationship by using restricted cubic splines, and investigated potential effect modification by clinical and lifestyle factors. Results: A total of 608 women died over the follow-up (among whom 52% of BC-specific deaths). Mean annual PM<sub>2.5</sub> concentration was  $3.6 \mu\text{g}/\text{m}^3$  (inter-quartile range=  $19.6 \mu\text{g}/\text{m}^3$ ). Overall, a  $10 \mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub> was associated with modest increased total (HR= 1.18; 95% CI: 0.85-1.63) and BC-specific (HR= 1.17; 95% CI: 0.74-1.84) mortality. Associations per  $10 \mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub> were stronger among stage 1 BC cases [HR= 1.57 (95% CI: 0.95-2.60) and HR= 2.43 (95% CI: 1.17-5.08), respectively] with total and BC-specific mortality, respectively, than in higher stage BC ( $P_{\text{interaction}} = 0.05$  and  $0.02$ , respectively). There was no evidence of a non-linear relationship. Conclusion: Our findings suggest that exposure to high levels of PM<sub>2.5</sub> could reduce long-term survival after diagnosis of a good-prognosis BC.

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**P-0141**

**Environmental exposure to microplastics: a scoping review on human health effects**

**Presenter:** Om Prakash Yadav, Memorial University of Newfoundland, St John's, Canada

**Authors:** O. Yadav, M. Rahman, A. Sarkar;  
Memorial University of Newfoundland, St John's, NL, CANADA.

Background: Microplastics are omnipresent environmental contaminants leading to unavoidable human exposure. However, little is known about the health effects of microplastics exposure on humans. This review explored the existing evidence for the potential adverse effects of microplastics and research gaps. Methods: An electronic search of published articles was conducted in PubMed, Scopus, EMBASE, Cochrane databases, and Google Scholar using a combination of subject heading and text word terms for microplastics and human health effects with specific inclusion and exclusion criteria. Letters, comments or notes, conference abstracts, and editorials were excluded. Additional keywords were developed after the preliminary screening to incorporate relevant articles. Google Scholar search, followed by a focused search, was performed to gather grey literature. The initial search resulted in 16,983 and 23 published articles and grey literature, respectively. A total of 4,817 unique citations were retrieved after filtering out duplicates. The title and abstract screening process resulted in 119 articles. After full article review and investigating their references, 63 articles were finalized. Every document was reviewed by at least two of the researchers. Results: Literature has reported that exposure to microplastics might occur through ingestion, inhalation, and dermal contact due to its presence in foods, air, and consumer products. Microplastics exposure might cause particle toxicity through oxidative stress, inflammatory lesions, and increased uptake or translocation. Failure of the immune system to eliminate synthetic particles might lead to chronic inflammation and increase cancer risk. Moreover, microplastics have been found to release their constituents, pathogenic organisms, and adsorbed contaminants. Conclusion: Knowledge regarding microplastic toxicity is still limited and primarily influenced by exposure concentration, particle components, adsorbed contaminants, organs involved, and individual susceptibility. Further research is warranted to understand the risk of human health due to exposure to microplastics, which requires human exposure assessment, understanding of pathogenesis, and quantifying the effects.

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**P-0142**

**Prevalence of tobacco use and its determinants among adults aged 18 years and above in urban slum of Lahore, Pakistan: WHO STEPS survey**

**Presenter:** Shama Razaq, Jinnah Medical and Dental College, Karachi, Pakistan

**Authors:** S. Razaq<sup>1</sup>, T. Kazmi<sup>2</sup>, U. Athar<sup>2</sup>;

<sup>1</sup>Jinnah Medical and Dental College, Karachi, PAKISTAN, <sup>2</sup>Shalamar Medical and Dental College, Lahore, PAKISTAN.

Background: Despite stringent tobacco control policies, implementation has always been a challenge and thus tobacco epidemic is increasing environmental health concerns especially respiratory disease burden. The objective of the study was to find out the prevalence of tobacco use and its predictors among adults  $\geq 18$  years residing in the urban slum of Lahore, Pakistan. Methods: A community-based cross-sectional survey was conducted among randomly selected 607 participants  $\geq 18$  years belong to urban, Lahore. The WHO STEP wise approach questionnaire was adapted and used. The outcome of interest was "current use of smoke and smokeless tobacco on a daily basis". We performed logistic regression analysis to determine the independent factors behind tobacco use. Results: The mean ( $\pm$  SD) age of participants was 45.2 ( $\pm$  12.7) years and 64% were females. The prevalence of smoking and smokeless tobacco was 10.5% and 8.6% respectively. Both smoking and smokeless tobacco use was more likely among age group 50 to 59 years (AOR: 5.6, 95% CI: 1.6-19) and (AOR: 3.6, 95% CI: 1.1-12.2), respectively and more likely among unemployed (AOR: 6.6, 95% CI: 2.9-14.9) and (AOR: 3.6, 95% CI: 1.1-12.2) respectively. Tobacco use is more likely among those with no media exposure related to warning (AOR: 5.1, 95% CI: 1.8-17.4). Conclusion: There is a dire need to consider a multi-pronged approach in light of local contexts for enhancing employment opportunities and increasing awareness through multiple media channels for effective implementation of tobacco policy measures.

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**P-0145**

**Lifetime exposure to disinfection by-products and risk of cancer at six anatomic sites in Iowa, USA**

**Presenter:** Rena R. Jones, National Cancer Institute, Rockville, United States

**Authors:** R. R. Jones<sup>1</sup>, M. Hildesheim<sup>1</sup>, L. E. Beane Freeman<sup>1</sup>, C. Lynch<sup>2</sup>, P. J. Weyer<sup>2</sup>, M. H. Ward<sup>1</sup>, S. W. Krasner<sup>3</sup>, G. L. Amy<sup>4</sup>, K. P. Cantor<sup>1</sup>;

<sup>1</sup>National Cancer Institute, Rockville, MD, <sup>2</sup>University of Iowa, Iowa City, IA, <sup>3</sup>Independent Scholar, La Verne, CA, <sup>4</sup>Clemson University, Clemson, SC.

**Background:** Disinfection by-products (DBPs) are suspected risk factors for multiple cancers. In our population-based case-control study in Iowa, we previously found moderate risks of bladder, brain, and rectal (but not colon, kidney, or pancreatic) cancers with duration of use of chlorinated surface water, known to have elevated DBP levels. We reanalyzed these data using quantitative estimates of lifetime DBP exposure.

**Methods:** We identified 1,225 bladder, 586 colon, 566 rectal, 311 brain, 334 kidney, and 302 pancreatic cancer cases and 2,106 controls (1986-1989). We developed historical annual estimates of total trihalomethanes (TTHM) and the sum of five haloacetic acids (HAA5) levels for Iowa public water supplies. Using residential water source histories for each participant, we computed lifetime average exposure ( $\mu\text{g/L}$ ) and exposure years above the U.S. maximum contaminant levels (MCL) for TTHM ( $>80 \mu\text{g/L}$ ) and HAA5 ( $>60 \mu\text{g/L}$ ); private well users were assumed to have no DBP exposure. We estimated odds ratios (ORs) and 95% confidence intervals (CI) for exposure quantiles from logistic regression models adjusted for potential confounders.

**Results:** Rectal cancer risk was associated with lifetime average TTHM exposure above the 93.5<sup>th</sup> percentile ( $\geq 51.7 \mu\text{g/L}$ ; OR=1.56, 95%CI=1.0-2.6; p-trend=0.02) and with 25+ years of exposure to levels above the MCL (OR=1.65, 95%CI=1.0-2.7; p-trend=0.05) but not with shorter duration; results were similar for men and women. Lifetime average TTHM exposure was not significantly associated with other cancers. 25+ years of exposure  $\geq 80 \mu\text{g/L}$  TTHM was associated with increased odds of colon (OR=1.96, 95%CI=1.1-3.5), bladder (OR=1.38, 95% CI=1.0-2.0), and brain (OR=2.59, 95%CI=1.0-6.4) cancer among men, but not women or for shorter duration of exposure at this level. We observed sporadic positive associations with HAA5 exposures across cancer sites.

**Conclusions:** Our findings contribute new quantitative evidence of associations between high levels of TTHM and rectal, colon, bladder, and brain cancers.

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**P-0146**

**Influence of Distance to Road on Ovarian Cancer Mortality**

**Presenter:** Carolina Villanueva, University of California, Irvine, Irvine, United States

**Authors:** C. Villanueva, J. Chang, A. Ziogas, R. Bristow, V. M. Vieira;  
University of California, Irvine, Irvine, CA.

**Background/Aim:** Each year, approximately 14,000 U.S. women die of ovarian cancer (OC). Evidence suggests that residing in areas with greater community disadvantage and higher exposure to ozone and particulate matter 2.5 is associated with worse OC survival. This study's objective is to examine the influence of residential distance to roads on OC-specific survival in California. **Methods:** Cases of incident epithelial OC were identified through the California Cancer Registry between 1996 and 2014, with follow-up obtained through 2016. All cancer stages were included in the analysis. We calculated distance to primary and secondary roads using ArcGIS. Cox proportional hazards models were used to examine the association between distance to roads and OC-specific survival, both as an independent predictor and controlling for race, socioeconomic status (SES), cancer characteristics, quality of care, and treating hospital. **Results:** A total of 29,844 women were included in the analysis, with 67.4% diagnosed in late stages. Among all women, 50% survived up to 2.9 years. The median distance between women's residence and a primary or secondary road was 0.93km, ranging from <0.01km to 42.3km. An interquartile range (IQR) increase in log distance from roads was associated with a 2.0% decrease in hazards of mortality ( $p=0.027$ ). After adjusting for important predictors, including SES and treatment, distance to road remained marginally significant (IQR hazard ratio, 0.98; 95% IQR Confidence Interval, 0.97-1.00). **Conclusions:** This study suggests that greater distances from major roads may be protective among women in California diagnosed with OC.

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**P-0147**

**Endocrine disruptive chemicals and thyroid cancer: a review**

**Presenter:** Maaïke van Gerwen, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** M. Alsen, M. van Gerwen, C. Little, E. Taioli, E. Genden;  
Icahn School of Medicine at Mount Sinai, New York, NY.

**Background/Aim:** Endocrine disruptive chemicals (EDCs) are known to alter thyroid hormone function and have been associated with increased risk of certain cancers. The present study aims at providing a comprehensive review of available epidemiologic studies on the association between EDC exposure and thyroid cancer.

**Methods:** A PubMed search was performed including the following terms in different combinations: thyroid cancer, endocrine disrupting chemicals or endocrine disruptors, pesticides, and specific EDCs including but limited to heavy metals, flame retardants, polychlorinated biphenyls (PCBs), phthalates, perfluoroalkyl acid (PFAS) and bisphenol A (BPA), to identify relevant publications.

**Results:** The most consistent association was found between heavy metal exposure and thyroid cancer; multiple studies reported a positive association between high levels of cadmium and thyroid cancer. There were some indications for an association with lead. Although multiple studies have been reporting on pesticide exposure and thyroid cancer, the inclusion of different pesticides and mixtures impedes a conclusion. A suggestive association between flame retardants and thyroid cancer has been reported, however the number of studies is limited. Although PCB exposure has been associated with breast cancer, thyroid cancer has not been well researched. To date, some studies suggested an association between phthalate or BPA exposure and thyroid cancer however studies had limitations and results were conflicting. Although PFAS has been associated with thyroid disruption, studies on the association with thyroid cancer are still lacking.

**Conclusion:** Overall, there is a suggestive association between exposure to certain EDCs and thyroid cancer. The lack of and the conflicting results highlight the importance of additional research needed to investigate the role of EDC exposure in in thyroid carcinogenesis and underlying mechanisms.

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**P-0148**

**Prostate Cancer Incidence in U.S. Counties and Low Levels of Arsenic in Drinking Water**

**Presenter:** Steven H. Lamm, CEOH, Washington, United States

**Authors:** S. H. Lamm<sup>1</sup>, J. Ahn<sup>2</sup>, I. J. Boroje<sup>1</sup>, H. Ferdosi<sup>1</sup>, Z. J. Kramer<sup>1</sup>;

<sup>1</sup>CEOH, Washington, DC, <sup>2</sup>Georgetown University, Washington, DC.

**Background:** Although inorganic arsenic in drinking water at high levels (100s–1000s ug/L [ppb]) increases cancer risk (skin, bladder, lung, and possibly prostate), the evidence at lower levels is limited. **Methods:** We conducted an ecologic analysis of the dose-response relationship between prostate cancer incidence and low arsenic levels in drinking water in a large study of U.S. counties (N = 710). County arsenic levels were < 200 ug/L with median < 100 ug/L and dependency greater than 10%. Groundwater well usage, water arsenic levels, prostate cancer incidence rates (2009–2013), and co-variate data were obtained from various U.S. governmental agencies. Poisson and negative-binomial regression analyses and stratified analysis were performed. **Results:** The best fitting polynomial analysis yielded a J-shaped linear-quadratic model. Linear and quadratic terms were significant ( $p < 0.001$ ) in the Poisson model, and the quadratic term was significant ( $p < 0.05$ ) in the negative binomial model. This model indicated a decreasing risk of prostate cancer with increasing arsenic level in the low range and increasing risk above. **Conclusions:** This study of prostate cancer incidence in US counties with low levels of arsenic in their well-water arsenic levels finds a j-shaped model with decreasing risk at very low levels and increasing risk at higher levels.

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**P-0149**

**Socio-environmental exposures explaining the opposites spatial patterns of mortality due to breast and cervical cancer in Argentinean women**

**Presenter:** Sonia Alejandra Pou, Instituto de Investigaciones en Ciencias de la Salud (INICSA), CONICET y Facultad de Ciencias Médicas, Universidad Nacional de Córdoba, Córdoba, Argentina

**Authors:** S. Pou, C. Niclis, N. Tumas, M. Butinof, M. P. Díaz;  
Universidad Nacional de Córdoba, Córdoba, ARGENTINA.

Background: This work aimed to characterize the spatial patterns of breast (BC) and cervix (CC) cancer mortalities in Argentina (2013-2015) and to propose a socio-environmental model explaining the observed differences. Methods: An ecological multigroup design (n=511 counties nested in 24 provinces) were carried out in Argentina. Age-standardized mortality rates (SMR) of BC and CC by county were estimated. Using the 2013-2015 average rates, a Getis-Ord analysis was performed to identify spatial clusters of high (hot spots) and low (cold spots) values of SMRs. A two-level logistic regression model was fixed to assess the relationship between the presence of hot and cold spots of each cause, accounting for the spatial variability. Finally, mixed-effects Poisson models were fitted using BC or CC SMRs as outcomes, and agricultural activity -AA- level (null/intermediate/high), urban scale (big cities/middle-sized or small cities/towns) and % households with unsatisfied basic needs (UBN) as fixed effects-covariates, including a random intercept (province as clustering variable). Interaction terms between AA and UBN levels were included. Results: Mortality spatial patterns were opposite between CC and BC. The presence of BC hot spot was significantly associated with the presence of CC cold spot. Increased risk of BC mortality was associated with a higher AA level. This effect was not independent of UBN, given that in the intermediate AA areas, UBN was inversely associated with BC mortality. Besides, lower BC mortality risk was linked to the smallest urban scales (vs. big cities). An opposite effect of the urban scale was observed for CC mortality. Significant interaction terms between AA and UBN levels were found, showing that in areas with high AA, increasing NBI was associated with higher CC SMR. Conclusions: Concomitant socio-environmental exposures linked to socioeconomic conditions, anthropic exposures and urbanization could explain the differences between BC and CC mortality spatial patterns in Argentina.

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**P-0150**

### **Relationship of leukemias with long-term ambient air pollution exposures in the adult Danish Population**

**Presenter:** Robin Puett, Maryland Institute for Applied Environmental Health  
School of Public Health  
University of Maryland, College Park, United States

**Authors:** R. Puett<sup>1</sup>, A. Harbo Poulsen<sup>2</sup>, T. Taj<sup>2</sup>, M. Ketzel<sup>3</sup>, C. Geels<sup>3</sup>, J. Brandt<sup>3</sup>, J. Christensen<sup>3</sup>, M. Sørensen<sup>2</sup>, N. Roswall<sup>2</sup>, U. Hvidtfeldt<sup>2</sup>, O. Raaschou-Nielsen<sup>2</sup>;  
<sup>1</sup>UMD, College Park, MD, <sup>2</sup>Danish Cancer Society Research Center, Copenhagen, DENMARK, <sup>3</sup>Aarhus University, Roskilde, DENMARK.

**Background:** Few population-based epidemiological studies of adults have examined the potential relationship between ambient air pollution and leukemias. **Methods:** Using Danish National Cancer Registry data and Danish DEHM-UBM-AirGIS system-modelled air pollution exposures, we examined whether particulate matter 2.5 (PM<sub>2.5</sub>), black carbon (BC), nitrogen dioxide (NO<sub>2</sub>), and ozone (O<sub>3</sub>), were associated with adult leukemia in general or by subtype. We included 14,986 adult cases diagnosed from 1989 to 2014 and 51,624 population-based controls matched by age, sex and calendar time. Relationships of exposure to each pollutant with total and subtype leukemias were assessed in separate conditional logistic regression models, adjusted for socio-demographic factors. **Results:** Fully-adjusted models showed higher risk of leukemia with higher 10 year average exposure to PM<sub>2.5</sub> (ORs per 10µg/m<sup>3</sup>: 1.17, 95% CI: 1.03, 1.32). We also found a positive relationship with BC averaged over the year prior to diagnosis and higher positive associations with PM<sub>2.5</sub> exposures averaged over one and five years prior to diagnosis. Higher one year average PM<sub>2.5</sub> exposures were associated with higher risks for acute myeloid and chronic lymphoblastic leukemia. Relationships with other pollutants were not observed. **Conclusions:** This study showed higher risk for adult leukemia in association with higher PM<sub>2.5</sub> concentration at the residence.

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**P-0151**

**Scoping review of polycyclic aromatic hydrocarbons (PAH) human and experimental animal cancer studies**

**Presenter:** Whitney Arroyave, ILS, Morrisville, United States

**Authors:** A. Wang<sup>1</sup>, W. Arroyave<sup>2</sup>, A. Ewens<sup>2</sup>, P. Schwingl<sup>2</sup>, S. Atwood<sup>2</sup>, S. Garner<sup>2</sup>, R. M. Lunn<sup>3</sup>;  
<sup>1</sup>National Institute of Environmental Health Sciences, Morrisville, NC, <sup>2</sup>ILS, Morrisville, NC, <sup>3</sup>National Institute of Environmental Health Sciences, RTP, NC.

**Background:** The carcinogenicity of some PAHs has not been evaluated. To gauge feasibility of a potential systematic review of PAH cancer hazard, we conducted a scoping review on PAH cancer studies. **Methods:** We searched PubMed for human cancer studies and mapped them by exposure source and cancer type. For animal studies, we searched three databases for PAHs in general and 35 specific PAHs, excluding PAH listed in the Report on Carcinogens; studies were mapped by PAH, exposure route, and cancer sites. **Results:** Human cancer studies assessed exposure to PAH mixtures or surrogates from (1) the workplace using expert assessment or job exposure matrices, (2) the environment by measuring or modeling indoor or outdoor PAH exposure, or (3) all sources by measuring PAH biomarkers. Occupational studies reported lung and urinary bladder cancers most often, but also head and neck, pancreas, and other cancers. Environmental studies reported breast cancer, childhood leukemia, and others. Biomonitoring studies using PAH urinary biomarkers reported lung and breast cancers. Biomonitoring studies using PAH adducts, some including gene-environment interaction, reported lung, breast, and liver cancers. We selected animal studies using physiologically relevant exposures (oral, dermal, inhalation, intratracheal instillation, or IP injection). Laboratory animals were tested with individual PAHs. Most were mouse studies with dermal applications, and many reported skin cancer. The similar study of different PAHs could facilitate PAH comparisons. IP studies in mice reported lung and liver cancer. Anthracene, benzo[ghi]perylene, chrysene, cyclopenta[cd]pyrene, fluoranthene, and pyrene had increased cancer at two or more sites. Anthracene, chrysene, and benzo[c]fluorene has increased cancer via two exposure routes. No cancer sites were reported from the three rat studies with relevant exposures. **Discussion:** Both human and animal cancer literature are sufficient for systematic review of PAH cancer hazard. Integrating human cancer evidence across exposure scenarios will inform future assessments.

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**P-0152**

**Ambient fine particulate matter exposure after a lung cancer diagnosis and lung cancer survival**

**Presenter:** Paige Sheridan, University of California San Diego, La Jolla, United States

**Authors:** P. Sheridan, T. Benmarhnia;  
University of California San Diego, La Jolla, CA.

Lung cancer is the leading cause of cancer death worldwide and approximately 55% of people die within one year of being diagnosed. Small advances in lung cancer survival to date are primarily attributable to individual-level interventions in tobacco use, early diagnosis and improved treatment. Persistent poor survival suggests that new approaches are needed to identify modifiable risk factors to improve lung cancer survival. While there is strong evidence for the relationship between long term exposure to ambient fine particulate matter (PM<sub>2.5</sub>) and lung cancer risk, relatively little is known about how air pollution affects survival after a lung cancer diagnosis. Recent studies have reported associations between exposure to ambient air pollution after diagnosis and poor cancer survival. However, the number of studies is limited, and the specific etiologic mechanism remains unknown. Distributed lag models (DLM) can be particularly robust for considering exposures with both cumulative and delayed exposure effects. These models allow for the identification of specific exposure windows of increased sensitivity that may be informative for identifying etiologic mechanisms and creating targeted interventions. In the context of lung cancer survival, DLMs can be used to estimate the time-varying association between continuous PM<sub>2.5</sub> exposure following diagnosis and lung cancer survival, while allowing for the identification of exposure periods that contribute differentially to survival. PM<sub>2.5</sub> exposure can be modeled as a smooth function of the exposure period using natural cubic splines, which allows for the estimation of the impact of specific exposure periods as well as the cumulative exposure effect. To the best of our knowledge, no studies have utilized DLMs to examine the association between ambient air pollution and lung cancer survival. The objective of this study is to assess the association between PM<sub>2.5</sub> and lung cancer survival in the California Cancer Registry from 2000-2013 (n=164,346).

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**P-0153**

**Occupational exposures and lung cancer risk - an analysis of the CARTaGENE study**

**Presenter:** Saeedeh Moayedi-Nia, Department of Social and Preventive Medicine, University of Montréal, Montréal, Canada

**Authors:** S. Moayedi-Nia, R. Pasquet, J. Lavoué, J. Siemiatycki, A. Koushik, V. Ho; Department of Social and Preventive Medicine, University of Montréal, Montréal, QC, CANADA

**Objective:** To investigate the possible associations between selected occupational agents and lung cancer risk. **Methods:** A case-cohort design was nested within the CARTaGENE study. Cases included all participants with an incident diagnosis of lung cancer occurring during the follow-up from 2009 to 2015 (N=178). For comparison, a sub-cohort of 1033 individuals was established based on a stratified sample of the cohort at baseline. Information on participants' longest-held job was collected at baseline and coded by an occupational hygienist according to the International Standard Classification of Occupations 1968 (ISCO-68). The job codes were then linked to the Canadian Job Exposure Matrix (CANJEM) to determine the probability of exposure to a list of 258 agents. This analysis was restricted to the 28 most prevalent agents with at least 5 exposed cases. Separate multivariable logistic regression models with robust variance estimators were used to estimate odd ratios (OR) and 95% confidence intervals (95% CI) for the associations between each agent and lung cancer risk while controlling for established lung cancer risk factors, notably smoking. **Results:** Increased lung cancer risk was found among those exposed to ashes (OR=3.8; 95% CI: 1.5-9.5), hydrogen chloride (OR=4.4; 95% CI: 1.2-16.0), formaldehyde (OR=2.3; 95% CI: 1.3-4.2), cooking fumes (OR=2.4; 95% CI: 1.1-5.3), paints and varnishes used on surfaces other than metal and wood (OR=3.2; 95% CI: 1.0-9.8), alkanes (OR=2.6; 95% CI: 1.2-5.5), aliphatic aldehydes (OR= 2.9; 95% CI: 1.3-4.3), and cleaning agents (OR=1.6; 95% CI: 1.0-2.5). A reduced lung cancer risk was observed among participants exposed to gasoline engine emissions (OR=0.5; 95% CI: 0.2-1.0) and polycyclic aromatic hydrocarbons (PAHs) from petroleum (OR=0.3; 95% CI: 0.1-0.9). **Conclusion:** Our preliminary findings provide support for the role of several occupational agents, for which we have limited knowledge, in contributing to lung cancer risk.

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**P-0154**

**Ambient ultraviolet radiation and major salivary gland cancer in the United States**

**Presenter:** Zhi-Ming Mai, National Cancer Institute, Rockville, United States

**Authors:** Z. Mai, M. Sargen, R. Pfeiffer, M. Tucker, E. Cahoon;  
National Cancer Institute, Rockville, MD.

Background: Risk of major salivary gland cancer (SGC) increases dramatically following a diagnosis of skin cancer, suggesting a shared risk factor such as exposure to ultraviolet radiation (UVR). We examined the association between ambient UVR and risk of primary SGC by histological subtype and race/ethnicity using data from the Surveillance, Epidemiology, and End Results (SEER) cancer registry program linked to United States county-level, satellite-based ambient UVR. Methods: A total of 18,168 primary SGC cases were reported from 2000 to 2016 to 16 SEER registries. Satellite-based ambient UVR was derived from the Total Ozone Mapping Spectrometer database. Incidence rate ratios (IRRs) and 95% confidence intervals (CIs) were computed using mixed-effects Poisson regression with adjustment for age, sex, calendar year, and a random effect for cancer registry. Results: Incidence of squamous cell carcinoma of the SGC (SCCSGC) in non-Hispanic whites was significantly higher than incidence in other races/ethnicities. SCCSGC risk was significantly higher for UVR quartile (Q) 4 in all races/ethnicities (Q4 vs Q1 IRR = 1.44; 95% CI = 1.17-1.77), and in non-Hispanic whites (Q4 vs Q1 IRR = 1.47; 95% CI = 1.18-1.82). However, no association with UVR was found for other subtypes or in other races/ethnicities. Discussion: This association between UVR and SCCSGC suggests that a subset of SCCSGC may represent metastases from cutaneous squamous cell carcinoma. If this is confirmed through UV mutational signature analysis, patients with SCCSGC may benefit from skin cancer surveillance to search for an occult primary cutaneous squamous cell carcinoma and to screen for additional skin cancers. Skin cancer patients may also benefit from oral screening for symptoms like dry mouth and pain to enable early detection of salivary gland metastases.

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## ABSTRACT E-BOOK

Theme: **Cancer risks**

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**P-0155**

**ETS exposure, mental and physical health and oxidative stress parameters in a sample of Slovak women**

**Presenter:** Lubica Argalasova, Comenius University Faculty of Medicine, Institute of Hygiene, Bratislava, Slovakia

**Authors:** L. Argalasova<sup>1</sup>, M. Simko<sup>2</sup>, I. Zitnanova<sup>3</sup>, D. Vondrova<sup>1</sup>, J. Babjakova<sup>1</sup>, J. Jurkovicova<sup>1</sup>, M. Samohyl<sup>1</sup>, M. Weitzman<sup>4</sup>;

<sup>1</sup>Comenius University Faculty of Medicine, Institute of Hygiene, Bratislava, SLOVAKIA, <sup>2</sup>Comenius University Faculty of Medicine II<sup>nd</sup> Gynecology and Obstetrics Clinic, Bratislava, SLOVAKIA, <sup>3</sup>Comenius University Faculty of Medicine Institute of Medical Chemistry, Bratislava, SLOVAKIA, <sup>4</sup>Department of Pediatrics, New York University, New York, USA, New York, NY.

**Background.** Exposure to environmental risk factors has a negative impact on health, especially in vulnerable population groups, which include the children, mothers and pregnant women. **Aim.** The aim of the study was to investigate the association of ETS with mental and physical health and oxidative stress parameters in a sample of Slovak women based on the bilateral American-Slovak project. **Methods.** Researchers from the Comenius University's Obstetrics and Gynecology (OB/Gyn) Department and Institute of Hygiene in Bratislava, Slovakia distributed surveys to non-smoking mothers and pregnant women in the 36<sup>th</sup>-41<sup>st</sup> week of pregnancy being seen for the follow-up at the OB/Gyn Department of the Faculty Hospital and Clinic. The major endpoints were physical and mental health of non-smoking mothers (n=544) and the urine antioxidant capacity and oxidative lipid damage by monitoring the levels of 8-isoprostanes in pregnant women in the third trimester of pregnancy (n=80). **Results.** The results show that living with a smoker is independently associated with worse physical health in a selected sample of non-smoking women AOR = 1.9 (95% CI = 1.0-3.6); p = 0.047) and worse mental health (SF-12) in pregnant women (AOR = 2.2 (95% CI = 1.01-4.85); p = 0.047). The harmful effect of current and passive smoking on detected oxidative stress parameters (urine antioxidant capacity - AC, 8-isoprostanes concentration) in the pilot sample of pregnant women has been indicated. ETS exposed non-smoking pregnant women had significantly reduced AC compared to ETS not exposed group even to the smoker group (p < 0.05). ETS exposed nonsmokers had significantly lower levels of 8-isoprostane than smokers (p < 0.01) and ETS not exposed nonsmokers (p < 0.05). **Conclusion.** These data represent an important argument for intervention in families. To avoid negative effects of ETS on pregnancy outcomes a total smoking ban in the household should be introduced.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0156**

### Targeted Analyses of Lipid Peroxidation in Response to Drastic Changes in Air Pollution Exposure

**Presenter:** Kexin Zhu, Department of Epidemiology and Environmental Health, School of Public Health and Health Professions, University at Buffalo, State University of New York, Buffalo, United States

**Authors:** K. Zhu<sup>1</sup>, R. W. Browne<sup>2</sup>, R. Hageman Blair<sup>3</sup>, M. R. Bonner<sup>1</sup>, M. Tian<sup>3</sup>, Z. Niu<sup>1</sup>, F. Deng<sup>4</sup>, Z. Farhat<sup>1</sup>, M. Swanson<sup>1</sup>, L. Mu<sup>1</sup>;

<sup>1</sup>Department of Epidemiology and Environmental Health, School of Public Health and Health Professions, University at Buffalo, State University of New York, Buffalo, NY, <sup>2</sup>Department of Biotechnical and Clinical Laboratory Sciences, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, State University of New York, Buffalo, NY, <sup>3</sup>Department of Biostatistics, School of Public Health and Health Professions, University at Buffalo, Buffalo, NY, <sup>4</sup>Department of Occupational and Environmental Health, School of Public Health, Peking University, Beijing, CHINA.

**Background:** Lipid peroxidation has been hypothesized to play an important role in biological responses to air pollution exposure; however, limited human studies have examined such association. The interactions among lipid peroxidation and antioxidant enzymes or systemic inflammation in response to air pollution also remain unclear.

**Methods:** This study included a subset of participants (n=53) from the Beijing Olympics Air Pollution (BoaP) study in which blood samples were collected before, during and after the Beijing Olympics. Using a targeted approach, we measured metabolites including 12-hydroxyeicosatetraenoic acid (12-HETE), hydroxyoctadecadienoic acids (HODEs), and hydroperoxyoctadecadienoic acids (HpODEs) by liquid chromatography/mass spectrometry (LC/MS). Changes of levels in metabolites over the three time points were examined using linear mixed-effect models and generalized estimating equation (GEE) models, adjusting for age, sex, body mass index (BMI) and smoking status. Pearson correlation coefficients were calculated to explore the relationships of lipid peroxides with inflammation biomarkers and antioxidants biomarkers. P values were corrected using the Benjamini-Hochberg procedure.

**Results:** 12-HETE declined by 50.5% (95%CI: 34.5, 66.5;  $p < 0.0001$ ) when air quality improved during the Olympics and increased by 119.4% (95%CI: 36.4, 202.3;  $p < 0.0001$ ) in response to the elevated air pollution levels after the Olympics. In contrast, 13-HODE increased significantly ( $p = 0.023$ ) during the Olympics and decreased nonsignificantly after the games ( $p = 0.104$ ). 12-HETE presented a moderate and positive correlation with IL-8 ( $r = 0.399$ , corrected  $p = 0.011$ ) and RANTES ( $r = 0.544$ , corrected  $p < 0.0001$ ) over the three time periods, and was correlated to IL-8 during the Olympics ( $r = 0.583$ , corrected  $p = 0.006$ ). 13-HODE exhibited a moderate correlation with IL-8 before the Olympics ( $r = 0.543$ , corrected  $p = 0.027$ ), while 13-HpODE was positively related to RANTES during the games ( $r = 0.545$ , corrected  $p = 0.024$ ).

**Conclusion:** Lipid peroxides including 12-HETE and 13-HODE were involved in the air pollution-induced oxidative process and might interact with systemic inflammation in response to air pollution exposure.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0157**

### **Association between exposure to polycyclic aromatic hydrocarbons and stroke among adults in the United States**

**Presenter:** Sericea Stallings-Smith, University of North Florida, Jacksonville, United States

**Authors:** S. Stallings-Smith, B. Peterson, J. C. Gellers;  
University of North Florida, Jacksonville, FL.

**Background:** Polycyclic aromatic hydrocarbons (PAHs) are environmental pollutants released through multiple processes including manufacturing, automotive emissions, and tobacco smoking. Previous evidence has shown that exposure to PAHs is associated with diabetes, cardiovascular disease, and cancer, but the association with stroke has not specifically been examined. **Aim:** The aim of this study was to investigate the association between urinary biomarkers of PAHs and self-reported, physician-diagnosed stroke among a representative sample of adults ages  $\geq 20$  years in the United States.

**Methods:** Data were obtained from the National Health and Nutrition Examination Survey for years 2005-2014. Multivariable logistic regression was utilized to investigate the association between exposure to PAHs and an outcome of stroke. Each exposure variable was corrected for urinary creatinine to account for differences in urine sample volume. The exposure distribution for each PAH was divided into quintiles with the lowest level of exposure designated as the reference group. All statistical models were adjusted for potential confounders that have the capacity to influence both the exposure and outcome: age, sex, race, poverty-income ratio, and serum cotinine.

**Results:** The study population included 8,650 participants of whom 51.6% were female, 68.3% were Non-Hispanic White, and 85.6% earned an income above the U.S. federal poverty level. When compared with the lowest quintiles of exposure, the highest quintiles of exposure to 1-hydroxynaphthalene (aOR = 2.46; 95% CI: 1.43-4.21), 2-hydroxynaphthalene (aOR = 2.26; 95% CI: 1.28-4.01), 2-hydroxyfluorene (aOR = 1.80; 95% CI: 1.06-3.06), 3-hydroxyfluorene (aOR = 1.76; 95% CI: 1.02-3.04), and a summed variable of all low molecular weight PAHs (aOR = 2.32; 95% CI: 1.39-3.85) showed a positive association with stroke. **Conclusions:** Exposure to high levels of PAHs are positively associated with stroke in the U.S. general population. These findings add to the growing body of evidence indicating the potential harms of PAH exposure.

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Theme: **Cardiovascular**

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**P-0159**

### **The Influence of Socioeconomic Status on the Relationship of Daily Cardiovascular Mortality with Daily Ambient PM<sub>2.5</sub> Concentrations in Phoenix, AZ**

**Presenter:** William E Wilson, Retired, Chapel Hill, United States

**Authors:** W. E. Wilson;  
Retired, Chapel Hill, NC.

Background/Aim. Test the suggestion that people with high socioeconomic status (SES) are less susceptible to air pollution than those with low SES. Methods. Standard regression analysis using R. Results. People in different SES populations die on different lag days. By breaking the county into three SES populations, much higher associations are found in the SES populations than in the county. For example, betas for the strongest single lag day association for the low, medium, and high SES populations are 0.063, 0.061, and 0.046 but only 0.030 for the whole county. Since strong associations occur only on 4 or 5 lag days out of 12, and there are not enough deaths on other days to give meaningful associations, an unconstrained distributed lag model is used to estimate the total effect of PM<sub>2.5</sub> on mortality. Total increase in % risk for an interquartile increase in PM<sub>2.5</sub> (95% confidence interval) (range) is: low, 13.0% (5.1, 21.5) (16.5); middle 7.3% (0.2, 14.8) (14.6); high 11.6% (4.4, 19.3) (7.3); entire county 7.6 % (4.0, 11.3) (7.3). Conclusions. When risks from all lag days with meaningful associations are combined, people with low and high SES have approximately the same % increase in risk for a unit increase in PM<sub>2.5</sub>. However, it takes longer for the high SES people to die. If on a given lag day, only people in one SES population die due to PM<sub>2.5</sub> exposure, the association will be high for that SES population lag day, but much lower for that lag day for the total population, since there will be the same number of deaths due to PM<sub>2.5</sub>, but within three times the total number of deaths. Thus, by breaking the county population into three SES populations, much higher associations are found in the low and high SES populations than in the county.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0160**

### **Cross-sectional study at the secondary health care level on Cardio-respiratory disease in three municipalities of Abidjan district hospitals with contrasted levels of air pollution**

**Presenter:** kouame kouadio, Pasteur Institute, 01 BP 490, Côte D'Ivoire

**Authors:** k. kouadio<sup>1</sup>, C. Konan<sup>1</sup>, I. Maesano<sup>2</sup>, v. Yoboue<sup>3</sup>;

<sup>1</sup>Pasteur Institute, 01 BP 490, CÔTE D'IVOIRE, <sup>2</sup>INSERM and Sorbone Univerité, Medical School St Antoine, 27 Rue Chaligny, FRANCE, <sup>3</sup>Laboratory of atmospheric physics, Felix Houphouet Boigny University, Abidjan, CÔTE D'IVOIRE.

**Background/Aim** The human health effects for both particulate matter and gaseous contaminants are global public health concern. The objective of this study was to assess any variations of air pollution in contributions from waste burning, heavy motor vehicle traffic and biomass burning and the impact on health in Abidjan, with special attention to cardiorespiratory diseases, **Methods** A survey was conducted during two years in 5 hospitals, 3 months during the rainy and the dry season. We estimated air pollution levels simultaneously with health care assessment with a particular attention for cardio-respiratory diseases. PM<sub>2.5</sub> concentration and cardiorespiratory diseases outcomes were recorded in a questionnaire sheet in the district hospitals. The relative Risks (RR) of the relationship between the observed cardiorespiratory outcomes and air pollution exposure were estimated using a Poisson regression model. **Results** The results showed that PM<sub>2.5</sub> Concentrations from the waste burning and traffic sites were comparable with annual averages of 28.51 µg/m<sup>3</sup> and 29.69 µg/m<sup>3</sup> respectively. In Yopougon, where domestic fires are common, the annual average is drastically higher at 155.1 µg/m<sup>3</sup>. PM<sub>2.5</sub> were elevated in both seasons with an average of 145µ/m<sup>3</sup>; more than the one recommended by WHO. Also, cardiorespiratory diseases occurred in 66% and the most affected were women (54%) and children under 18 years old. The highest PM<sub>2.5</sub> concentrations were due to biomass burning, seen in Yopougon. Outpatient visits for cardiorespiratory symptoms showed a significant association with PM<sub>2.5</sub> concentrations during the rainy season and respiratory outpatient visits were significant throughout the entire year. Overall, we estimate that 143 hospital visits could have been avoided during the rainy seasons of our study period. **Conclusion:** Accessing to air pollution data has been difficult in developing countries. This survey was one the first conducted so far in Côte d'Ivoire addressing pollutant concentrations and cardiorespiratory outcomes.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0161**

**Transportation noise exposure and cardiovascular mortality: a 15-year analysis in Switzerland**

**Presenter:** Danielle Vienneau, Swiss Tropical and Public Health Institute, Basel, Switzerland

**Authors:** D. Vienneau<sup>1</sup>, A. Saucy<sup>1</sup>, B. Schäffer<sup>2</sup>, L. Tangermann<sup>1</sup>, J. Wunderli<sup>2</sup>, M. Rösli<sup>1</sup>;

<sup>1</sup>Swiss Tropical and Public Health Institute, Basel, SWITZERLAND, <sup>2</sup>Empa, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, SWITZERLAND.

Background: Transportation noise from road, rail and air traffic can be detrimental to health and wellbeing. Previous studies, including our own, have shown death from specific cardiovascular diseases (CVD) to be associated with these exposures. Now, with double the follow-up, integrated address history and transportation noise exposure data for multiple years corresponding to census decades, we conducted an extended analysis of the Swiss National Cohort. Methods: Mean noise exposure in 5-year periods was calculated, and three virtual sub-cohorts were defined (2000-2005, etc.) in addition to the full cohort (2000-2015). Multi-pollutant (Lden<sub>road</sub>, Lden<sub>rail</sub>, Lden<sub>air</sub>), time dependent Cox proportional hazards models were applied to 3.8 mil adults (30-100 years old at 2000; age as timescale) and adjusted for sex, civil status, education, mother tongue, nationality, neighborhood socio-economic position and NO<sub>2</sub> exposure. Results: During the 15-year follow-up, there were 249,000 CVD and 30,500 myocardial infarction deaths. In the full cohort, the relative risk for myocardial infarction mortality significantly increased by 4.1% [95% confidence interval: 2.6–5.6], 2.0% [0.9–3.1] and 3.2% [1.5–5.0] per 10 dB road traffic, railway and aircraft noise, respectively. CVD mortality was also significantly associated with road traffic noise (2.7% [2.2–3.2]) and railway noise (1.6% [1.2–2.0]) per 10 dB increase. Relative risks were remarkably consistent with our previous analyses with follow-up until 2008, and rather similar across the three virtual sub-cohorts indicating an absence of time trends for these associations. Conclusions: Cardiovascular effects of transportation noise may be modified by many factors such as building characteristics, window opening habits during the night and other lifestyle factors. For this reason, representative local data can be highly valuable for informing national noise limits aimed at protecting public health.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

**P-0162**

### **Risk of persistent cardiovascular conditions in the Deepwater Horizon Oil Spill Coast Guard Cohort during five years of follow-up**

**Presenter:** Hristina Denic-Roberts, Department of Preventive Medicine and Biostatistics, Uniformed Services University (USU); Oak Ridge Institute for Science and Education (ORISE), Bethesda, United States

**Authors:** H. Denic-Roberts<sup>1</sup>, L. S. Engel<sup>2</sup>, M. C. Haigney<sup>3</sup>, K. Christenbury<sup>4</sup>, J. Barrett<sup>5</sup>, D. L. Thomas<sup>6</sup>, J. A. Rusiecki<sup>7</sup>;

<sup>1</sup>Department of Preventive Medicine and Biostatistics, Uniformed Services University (USU); Oak Ridge Institute for Science and Education (ORISE), Bethesda, MD, <sup>2</sup>Department of Epidemiology, Gillings School of Public Health, Chapel Hill, NC, <sup>3</sup>Department of Medicine, Uniformed Services University, Bethesda, MD, <sup>4</sup>Social & Scientific Systems, Durham, NC, <sup>5</sup>Department of Preventive Medicine and Biostatistics, Uniformed Services University, Bethesda, MD; War Related Illness & Injury Study Center, Veterans Affairs Medical Center, Washington, D.C., DC, <sup>6</sup>United States Coast Guard Headquarters, Directorate of Health, Safety, and Work Life, Washington, D.C., DC, <sup>7</sup>Department of Preventive Medicine and Biostatistics, Uniformed Services University, Bethesda, MD.

**Background/Aim:** In 2010, nearly 9,000 U.S. Coast Guard (USCG) members led the clean-up response to the Deepwater Horizon (DWH) oil spill. To date, human studies evaluating persistent cardiovascular conditions associated with oil spill-related exposures are sparse. Thus, our aim was to prospectively evaluate risk of incident cardiovascular conditions among active-duty USCG DWH responders. **Methods:** Crude oil and oil dispersant exposures were ascertained via self-report from responders who completed post-deployment surveys. Cardiovascular outcomes, classified via International Classification of Diseases, 9th Edition (ICD-9), were queried from military health encounter records for responders and non-responders up to 5.5 years post-DWH. We used Cox proportional hazards regression to calculate adjusted hazard ratios (aHR) and 95% confidence intervals (CIs) for cardiovascular conditions diagnosed during 2010-2012 and 2013-2015. **Results:** This cohort (N=42,721) was predominantly male (~86%), white (~77%), and younger than 35 (~71%). Compared to non-responders, responders had an elevated risk for mitral valve disorders (ICD-9: 424.0) during 2013-2015 (aHR=2.12, 95% CI=1.15-3.90). Compared to non-exposed responders, responders reporting crude oil exposure had a significantly higher risk for essential hypertension (ICD-9: 401) during 2010-2012 (aHR=1.68, 95% CI=1.15-2.44); for those reporting crude oil inhalation exposure, aHR was 1.46 (95% CI=1.02-2.11). Responders with crude oil inhalation exposure also had a significantly elevated risk for palpitations (ICD-9: 785.1) during 2013-2015 (aHR=2.54, 95% CI=1.36-4.74). Risk estimates for hypertension and palpitations were slightly stronger and remained significant for responders reporting exposure to both crude oil and oil dispersant versus those reporting neither (aHRs=1.91 and 2.87, respectively). **Conclusions:** This study of healthy military members with equal healthcare access indicates that oil spill exposures may be associated with incident cardiovascular conditions. **Disclaimer:** The contents, views or opinions expressed in this presentation are those of the authors and do not necessarily reflect official policy or position of USU, the Department of Defense, or the USCG.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0163**

**Association between air quality health index (AQHI) and cardiorespiratory diseases**

**Presenter:** Temitope Christina Adebayo Ojo, Swiss Tropical and Public Health, Basel, Switzerland

**Authors:** T. C. Adebayo Ojo<sup>1</sup>, J. Wichmann<sup>2</sup>, N. Probst-Hensch<sup>1</sup>, N. Kuenzli<sup>1</sup>;

<sup>1</sup>Swiss Tropical and Public Health, Basel, SWITZERLAND, <sup>2</sup>University of Pretoria, Pretoria, SOUTH AFRICA.

Air quality index (AQI) is an index based on calculating daily index values for pollutants and reporting the value that corresponds to the criteria pollutant with the highest index value. The index is used to communicate air quality levels to the public at any specific time and place. The AQI has been criticized for many reasons, which includes its inability to quantitatively account for the combined effects of exposure to multiple pollutants, it does not capture low-level effects and in some cases, health components are not included in the models. This has encouraged the development of multiple pollutant indices which are commonly called air quality health index (AQHI) that adequately captures the joint effects of multiple air pollutants on health outcomes. The AQHI is developed using multiple pollutants and obtaining estimates from each pollutants. It assumes an additive or overall effect to produce an index; this ensures the contribution to adverse health effects of each pollutant is considered. In this review, ten studies on the association between AQHIs and health outcomes were identified but only two compare health effects of AQHIs with those of AQIs. A Chinese study found that an IQR increase in AQHI vs AQI represented 3.61% (95%CI: 2.85% - 4.37%) vs 2.71% (95% CI: 1.98% - 3.43%), 3.73% (95% CI: 2.18% - 5.27%) vs 2.12% (95% CI: 0.63% - 3.61%) and 4.19% (95% CI: 2.87% - 5.52%) vs 1.88% (95% CI: 0.60% - 3.17%) increase in mortality, respiratory and cardiovascular disease respectively. An American study found that the AQHI was positively associated with respiratory emergency visits in low and high ozone-seasons compared to the AQI, which was only significant for low ozone-season. The AQHI demonstrated stronger effects per IQR. Whether AQHI also capture a larger burden attributable to daily exposure to air pollution will be further investigated.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0164**

### **Short-term health effects of traffic-related air pollution exposures in multi-modal commuting in Chengdu, China**

**Presenter:** Yisi Liu, Department of Environmental and Occupational Health Sciences, University of Washington, Seattle, United States

**Authors:** Y. Liu<sup>1</sup>, J. Chen<sup>2</sup>, L. Zhang<sup>2</sup>, C. Yang<sup>2</sup>, E. Austin<sup>1</sup>, J. Shirai<sup>1</sup>, B. Han<sup>3</sup>, Z. Bai<sup>3</sup>, W. Yang<sup>3</sup>, E. Seto<sup>1</sup>;  
<sup>1</sup>Department of Environmental and Occupational Health Sciences, University of Washington, Seattle, WA,  
<sup>2</sup>Sichuan Center for Diseases Control and Prevention, Chengdu, CHINA, <sup>3</sup>State Key Laboratory of Environmental Criteria and Risk Assessment, Chinese Research Academy of Environmental Sciences, Beijing, CHINA.

**Objectives:** To investigate cardiorespiratory health effects of traffic-related air pollution (TRAP) exposures in different transportation modes. **Methods:** This was a randomized double-blind crossover intervention trial. Each of the 21 healthy adults enrolled into the study completed 8 two-hour trips on a script route between November and December in 2019 in Chengdu, China. Subjects travelled twice using each of the four modes (walking, bus, subway and car), where they used effective masks in one trip, and used sham masks in another one. The order of the two trips was randomized and double-blind. Each trip was separated by at least one day. During the travelling, ultrafine particles (UFP), particulate matters (PM<sub>1</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>), black carbon (BC), noise and physical activity levels were monitored. Blood pressure, fractional exhaled nitric oxide (FeNO) and spirometry were measured right before and after each trip. Mixed effect models were used to explore the association between TRAP inhalation doses and cardiorespiratory health, and the efficacy of using masks to prevent adverse cardiorespiratory health in commuting. **Results:** Mean age of the 21 subjects was 27.4 years; 15 were female and 6 were male. Subjects in walking and car trips had the highest and lowest TRAP inhalation doses, respectively. During the two-hour trip, per 10µg increase in PM<sub>1</sub> inhalation dose, diastolic blood pressure (DBP) increased 0.94 mmHg (95%CI: 0.06, 1.82). BC was positively associated FeNO; per 1µg increase in BC inhalation dose, subjects had 1.10ppb higher FeNO levels (95%CI: 0.12, 2.09). Subject using effective masks in commuting had lowered FEV1/FVC ratio (0.76%, 95%CI: 0.13% - 1.4%) compared to those with sham masks. **Conclusion:** Results from this study suggest that increased TRAP exposures associate with elevated blood pressure and airway inflammation among healthy young adults. However, further studies are warranted to evaluate the efficacy of using masks in commute.

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Theme: **Cardiovascular**

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**P-0165**

### **Fine Particulate Matter (PM<sub>2.5</sub>) is Associated with Chronic Kidney Disease: Findings Using Electronic Health Record Data**

**Presenter:** Jesse Berman, University of Minnesota, Minneapolis, United States

**Authors:** L. Ghazi, P. Drawz, J. Berman;  
University of Minnesota, Minneapolis, MN.

**Background/Aim:** Fine particulate matter (PM<sub>2.5</sub>) is an environmental risk factor associated with worsening health outcomes, but limited work has explored its connection to nephrological disorders. Evidence suggests that geographical heterogeneities of chronic kidney disease (CKD) cannot be explained fully by patient level factors. We aimed to investigate the association between PM<sub>2.5</sub> and CKD in a 7-county metropolitan area in Minnesota.

**Methods:** We acquired data for 113,725 patients (2012-2014) from electronic health records who had measured glomerular function rate (eGFR). For each patient, we estimated the previous 1-year average PM<sub>2.5</sub> (ug/m<sup>3</sup>) from time of first eGFR at home locations. We evaluated the spatial relative risk and clustering of CKD prevalence using a K-function test statistic. We estimated the prevalence ratio (PR) of the association of PM<sub>2.5</sub> with CKD (eGFR <60 ml/min/1.73 m<sup>2</sup>) prevalence using a modified Poisson regression with robust error variance. We assessed the association of PM<sub>2.5</sub> with incident CKD in 20,289 patients who did not have CKD at baseline using a Cox proportional hazard models [Hazard rates (HR), 95% CI]. We adjusted for demographics, comorbidities, tract socioeconomic characteristics, and census tract.

**Results:** We identified neighborhoods for greater relative risk of CKD incidence and found that cases of CKD cluster significantly more than controls. We found no association between PM<sub>2.5</sub> and prevalent CKD, but did observe associations with more severe CKD (eGFR<45). With increasing PM<sub>2.5</sub> quartiles, incidence of CKD increased. Patients in the fourth quartile (PM<sub>2.5</sub>>10.4), third quartile (10.3 < PM<sub>2.5</sub><10.8) and 2<sup>nd</sup> quartile (9.9 < PM<sub>2.5</sub><10.3) vs. first quartile (PM<sub>2.5</sub><9.9) had a 2.52 [2.21, 2.87], 2.18 [1.95, 2.45], and 1.72 [1.52, 1.97] HR of developing CKD in the fully adjusted models, respectively.

**Conclusion:** Exposure to higher PM<sub>2.5</sub> is associated with greater risk for incident CKD. Improvements in air quality specifically at CKD hotspots may reduce kidney related disease.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

**P-0166**

**Natural and cause-specific mortality and long-term exposure to particle components in a pooled cohort of 323,782 participants in Europe: the ELAPSE project**

**Presenter:** Jie Chen, Institute for Risk Assessment Sciences, Utrecht, Netherlands

**Authors:** J. Chen<sup>1</sup>, G. Weinmayr<sup>2</sup>, M. Strak<sup>3</sup>, K. de Hoogh<sup>4</sup>, F. Forastiere<sup>5</sup>, Z. Andersen<sup>6</sup>, G. Pershagen<sup>7</sup>, B. Brunekreef<sup>1</sup>, G. Hoek<sup>1</sup>, K. Katsouyanni<sup>8</sup>;

<sup>1</sup>Institute for Risk Assessment Sciences, Utrecht, NETHERLANDS, <sup>2</sup>Ulm University, Ulm, GERMANY,

<sup>3</sup>National Institute for Public Health and the Environment, Bilthoven, NETHERLANDS, <sup>4</sup>Swiss Tropical and Public Health Institute, University of Basel, Basel, SWITZERLAND, <sup>5</sup>Dep. of Epidemiology, Lazio Regional Health Service, Rome, ITALY, <sup>6</sup>University of Copenhagen, Copenhagen, DENMARK, <sup>7</sup>Karolinska Institutet, UtrechtStockholm, SWEDEN, <sup>8</sup>Medical School, University of Athens, Athens, GREECE.

**Background/Aim** Inconsistent associations between long-term exposure to components of particulate matter (PM) air pollution and adverse health outcomes have been reported. The aim of this study was to investigate the associations between long-term exposure to elemental components of PM and mortality in a pooled European cohort.

**Methods** We pooled data from nine ongoing European cohorts with 323,782 participants. Residential exposure to annual 2010 mean concentrations of eight a priori-selected components of PM (copper, iron, potassium, nickel, sulfur, silicon, vanadium, and zinc) were assessed based on Europe-wide land use regression models at 100 m spatial scale. After harmonizing individual and area-level variables between cohorts, we applied Cox proportional hazard models with increasing adjustment for potential confounders to investigate the association between long-term air pollution exposure and natural and cause-specific mortality. Two-pollutant models were conducted for each element by adjusting for PM<sub>2.5</sub> and NO<sub>2</sub>.

**Results** The total study population contributed 6,317,234 person-year at risk (average follow-up 19.5 years). For natural-cause mortality, the hazard ratios were significantly positive for all components, and were strongly attenuated in two-pollutant models with adjustment for PM<sub>2.5</sub> or NO<sub>2</sub>. Hazard ratios (HRs) in two-pollutant models for PM<sub>2.5</sub> nickel, PM<sub>2.5</sub> sulfur, PM<sub>2.5</sub> vanadium and PM<sub>2.5</sub> zinc remained (borderline) significant [HRs adjusted for PM<sub>2.5</sub>: PM<sub>2.5</sub> nickel: 1.04 (95% CI: 1.02, 1.07) per 1 ng/m<sup>3</sup>; PM<sub>2.5</sub> sulfur: 1.05 (95% CI: 1.01, 1.09) per 200 ng/m<sup>3</sup>; PM<sub>2.5</sub> vanadium: 1.0 (95% CI: 1.00, 1.03) per 2 ng/m<sup>3</sup>; PM<sub>2.5</sub> zinc: 1.03 (95% CI: 1.02, 1.05) per 10 ng/m<sup>3</sup>; HRs adjusted for NO<sub>2</sub> were similar]. The effect estimates for the more traffic-related pollutants copper and iron were especially reduced after adjustment for NO<sub>2</sub>. For cardiovascular and respiratory mortality, no consistent associations were found in two-pollutant models.

**Conclusions** Long-term exposure to nickel, sulfur, vanadium and zinc in PM<sub>2.5</sub> were associated with natural-cause mortality.

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**P-0168**

### **Neighborhood-level stroke and its neighborhood-level determinants: a Bayesian machine learning approach**

**Presenter:** Bian Liu, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** L. Hu, B. Liu, J. Ji, Y. Li;  
Icahn School of Medicine at Mount Sinai, New York, NY.

The substantial health and economic burden of stroke has prompted numerous studies examining the risk factors of stroke using individual patient level data. Increasingly, place-based evidence is recognized as a critical part of stroke management, but descriptions of risk factors and their associations with stroke at the same neighborhood level smaller than counties are lacking. We applied a novel Bayesian machine learning approach to an integrated data set consisted of 24 potential variables to identify factors with high predictive power for stroke and quantify the associations between predictors and stroke prevalence. Both the stroke outcome and its predictors were measures at neighborhood level, defined as census tracts ( $n=26697$ ) from 500 large cities in the United States. Variable selection was conducted using Bayesian Additive Regression Trees (BART)-Machine, and compared with conventional models: step-wise regression and regression with all predictors. The exposure-outcome associations were further assessed using Bayesian linear regression. We identified six high importance tract-level predictors for tract-level stroke prevalence. They were prevalence of no leisure-time physical activity (%LPA), proportions of population who were aged 65 years and above (%OlderAdults) and who were non-Hispanic black (%NHB), median household income, and ozone level, as well as the interaction term between %LPA and %OlderAdults. Among these factors, %OlderAdults, %NHB, %LPA, and ozone were positively associated with stroke prevalence, while median household income was inversely associated with stroke prevalence. The interaction term showed an exacerbated adverse effect of aging population structure and low physical activity on tract-level stroke prevalence. High-performance machine learning identified the most important determinants of neighborhood-level cardiovascular health from a wide-ranging variables in an agnostic, data-driven and reproducible way. The identified neighborhood-level predictors were consistent with known patient-level risk factors. The results can be used to prioritize and allocate resources to develop targeted neighborhood-level interventions for stroke prevention and control.

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**P-0169**

**Personal exposure during cycling and health effects (PEDAL) - a semi-controlled crossover study**

**Presenter:** Vanessa Jana Soppa, Heinrich Heine University, Institute of Occupational, Social and Environmental Medicine, Düsseldorf, Germany

**Authors:** V. J. Soppa<sup>1</sup>, L. Glaubitz<sup>1</sup>, T. Pohl<sup>2</sup>, C. Fischer<sup>2</sup>, M. Lange<sup>2</sup>, T. Kramer<sup>2</sup>, K. Weber<sup>2</sup>, B. Hoffmann<sup>1</sup>;  
<sup>1</sup>Heinrich Heine University, Institute of Occupational, Social and Environmental Medicine, Düsseldorf, GERMANY, <sup>2</sup>University of Applied Sciences, Laboratory for Environmental Measurement Techniques, Düsseldorf, GERMANY.

Background: Cycling is a beneficial physical activity and an air pollution- and climate-neutral form of transportation. However, specifically in urban areas cyclists are often highly exposed to traffic-related air pollutants due to proximity to road traffic and increased minute ventilation. Portable instruments allow the precise assessment of personal exposure to ultrafine particles (UFP), an important traffic-related pollutant. We aim to estimate cyclists' UFP exposure on high and low traffic cycling routes and health-related, short-term effects in a real world setting. Methods: The PEDAL study is a semi-controlled crossover exposure study in which healthy volunteers cycled for two hours (20 km) on a high and a low traffic route in the city of Düsseldorf in Germany. During these rides, ambient air pollutants (PN<sub>10-700nm</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, PM<sub>1</sub>, BC, NO<sub>2</sub>, and O<sub>3</sub>), wind, temperature and position were measured continuously with instruments mounted on an accompanying cargo bike. Cardiovascular and respiratory examinations were conducted in the study center pre- and post-exposure. We used linear regression to analyze the association of air pollution and health effects. Results: In this pilot study, 13 participants (69.2% men) with a mean age of 32.3 (10.6) years were included. Personal air pollution exposure was generally lower on the low traffic route (mean difference in PN<sub>10-700nm</sub>, NO<sub>2</sub> and BC concentrations 18,000/cm<sup>3</sup>, 10 µg/m<sup>3</sup> and 1 µg/m<sup>3</sup>, respectively), but exposures overlapped considerably. In preliminary analyses, group comparisons showed decreases in mean values for blood pressure and pulse wave velocity after the low traffic route, compared to no changes or increases after the high traffic route. Conclusions: This pilot study showed differences in personal air pollution exposure, depending on the inner city cycling route, and gives a first indication on associated health effects.

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**P-0170**

### Assessing Multiple Pollutants' Impacts on Multiple Health Outcomes in New York City

**Presenter:** Ariel Spira-Cohen, NYC Department of Health and Mental Hygiene, New York, United States

**Authors:** A. Spira-Cohen<sup>1</sup>, S. Johnson<sup>2</sup>, C. Olson<sup>2</sup>, K. Ito<sup>2</sup>;

<sup>1</sup>NYC Department of Health and Mental Hygiene, New York, NY, <sup>2</sup>New York City Department of Health and Mental Hygiene, New York, NY.

Background: Although air pollution is a mixture that includes local and regional emissions sources, local governments currently rely on single-pollutant-based U.S. national ambient air quality standards (NAAQS) to protect health. We developed a framework to assess multi-pollutants' impacts on health outcomes in New York City (NYC) using time-series analyses. Methods: Single- and multi-pollutant Poisson models for ozone, nitrogen dioxide (NO<sub>2</sub>), and fine particles (PM<sub>2.5</sub>) were evaluated for multiple outcomes (morbidity models: 2005-2014; mortality models: 2004-2016): (1) asthma-related emergency department visits (ages 6-18); (2) cardiovascular-related hospitalizations (ages 40+); (3) hospitalizations for chronic lung diseases (ages 20+); and (4) cardiovascular (CVD) and all-natural-cause mortality (all ages). Seasonal models were adjusted for within-season trend, temperature, and day-of-week, and considered up to 3-day lagged effects. Attributable fractions (AFs) were estimated considering single and multiple pollutants when associations were found. Results: All outcomes were associated with one or more pollutants at levels below their current NAAQS. Individual pollutants' estimates were sometimes sensitive (e.g., attenuation of risk estimates by 50%) to the addition of another pollutant, and total AFs in multi-pollutant models were typically smaller than the sum of those from single pollutant models. For hospitalization outcomes, AFs from NO<sub>2</sub>-only models were generally closest to those from corresponding multi-pollutant models (e.g., cold-season NO<sub>2</sub>-only models for lung diseases and CVD AFs (95% CI): 2.2% (-0.6, 5.0) and 3.3% (1.0, 5.6); NO<sub>2</sub> + PM<sub>2.5</sub>: 2.2% (-1.9, 6.3) and 3.2% (-0.1, 6.5). Mortality outcomes were associated with all three pollutants in the warm season, with ozone-only models most indicative of multi-pollutant effects (e.g. all-cause mortality AFs: ozone only: 1.6% (0.1, 3.7); ozone + PM<sub>2.5</sub> + NO<sub>2</sub>: 1.8% (-1.1, 5.1)). Conclusions: Given the substantial regional source contributions to PM<sub>2.5</sub> and ozone, reducing local NO<sub>2</sub> emissions (i.e., traffic and buildings) may be most impactful in reducing pollution-associated illness exacerbations in NYC.

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**P-0171**

### **Neighborhood Socioeconomic Status, Long-Term Exposure to Particulate Matter, and Risk of Cardiovascular Disease and Mortality in the Nurses' Health Study**

**Presenter:** Nicole V DeVillie, Harvard T.H. Chan School of Public Health and Brigham and Women's Hospital, Boston, United States

**Authors:** N. V. DeVillie<sup>1</sup>, E. G. Elliot<sup>2</sup>, I. Holland<sup>3</sup>, H. Iyer<sup>4</sup>, I. Kawachi<sup>2</sup>, P. James<sup>5</sup>, F. Laden<sup>6</sup>, J. E. Hart<sup>6</sup>; <sup>1</sup>Harvard T.H. Chan School of Public Health and Brigham and Women's Hospital, Boston, MA, <sup>2</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>3</sup>Brigham and Women's Hospital, Boston, MA, <sup>4</sup>Harvard T.H. Chan School of Public Health and Dana-Farber Cancer Institute, Boston, MA, <sup>5</sup>Harvard Medical School, Harvard Pilgrim Health Care Institute, and Harvard T.H. Chan School of Public Health, Boston, MA, <sup>6</sup>Brigham and Women's Hospital, Harvard Medical School, and Harvard T.H. Chan School of Public Health, Boston, MA.

**Background:** Although associations between particulate matter <2.5 microns (PM<sub>2.5</sub>) and cardiovascular disease (CVD) and mortality are well-established, less is known regarding the joint impact of PM<sub>2.5</sub> and neighborhood socioeconomic status (nSES). Our objective was to investigate this interaction in a nationwide cohort of U.S. women. **Methods:** We used time-varying Cox proportional hazards models, conditioned on age and calendar time, to assess main and interaction effects of PM<sub>2.5</sub> and nSES on risk of CVD (stroke, myocardial infarction) and mortality among 100,257 women in the Nurses' Health Study between 1986 and 2008. Incident CVD (n=6,445) and mortality (n=10,186) cases were ascertained from medical or death record reviews. We created Census tract-level nSES scores by summing z-scores (where increasing scores were associated with affluence) of selected nSES metrics (e.g., race, education, income, home value, nativity, unemployment), and calculated time-varying 24-month average PM<sub>2.5</sub> exposure using residential address history. Models were adjusted for time-varying demographic, lifestyle (e.g., diet, physical activity, smoking), and individual-level SES factors. **Results:** In multivariable adjusted models, increases in nSES (Hazard Ratio [HR]<sub>CVD</sub>: 0.98, 95% Confidence Interval [CI]: 0.97, 0.99; HR<sub>mortality</sub>: 0.99, 95% CI: 0.99, 1.00, per 1 unit increase) and PM<sub>2.5</sub> (HR<sub>CVD</sub>: 1.03, 95% CI: 0.95, 1.12; HR<sub>mortality</sub>: 1.04, 95% CI: 0.97, 1.11, per 10 µg/m<sup>3</sup> increase) were associated with incident CVD and mortality rates, although the associations with PM<sub>2.5</sub> did not reach statistical significance. The interaction between PM<sub>2.5</sub> and nSES was statistically significant for CVD risk (p<0.001) and mortality (p<0.013); associations with mortality were strongest among the least affluent neighborhoods, while associations with CVD were weakest in areas of least and greatest affluence. **Conclusions:** Our results suggest that PM<sub>2.5</sub> and nSES exposures are associated with small changes in rates of mortality and CVD incidence. These exposures interact in a complex fashion, even within a relatively demographically homogeneous cohort of women.

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**P-0174**

**Long term exposure to ambient PM<sub>2.5</sub> and its effects on lipid levels in an adult cohort in India**

**Presenter:** Gagandeep Kaur Walia, Public Health Foundation of India, Gurgaon, India

**Authors:** G. K. Walia<sup>1</sup>, K. Anand<sup>2</sup>, S. Jagannathan<sup>3</sup>, S. Mandal<sup>3</sup>, J. Schwartz<sup>2</sup>, D. Prabhakaran<sup>1</sup>;

<sup>1</sup>Public Health Foundation of India, Gurgaon, INDIA, <sup>2</sup>Harvard TH Chan School of Public Health, Boston, MA,

<sup>3</sup>Centre for Chronic Disease Control, Delhi, INDIA.

**Background:** According to GBD estimates 30% of cardiovascular mortality has been attributed to ambient PM<sub>2.5</sub> exposure. Limited evidence on association between PM<sub>2.5</sub> exposure and lipids has emerged mainly from developed countries which are well established risk factors of various cardiometabolic disorders. This is not well understood in developing countries like India with alarming high levels of PM<sub>2.5</sub> and unique lipid profile.

**Methods:** Association between long-term average exposure to ambient PM 2.5 and longitudinally measured lipid levels was examined in 4083 cohort participants from urban Delhi using linear mixed regression models. Exposure to ambient PM<sub>2.5</sub> were assessed using the retrospective daily average PM<sub>2.5</sub> predictions at 1kmx1km grids from a hybrid spatiotemporal model, by assigning the cohort households in New Delhi to their respective grids. Lipid levels were measured in the cohort at baseline (2010-2012), 2<sup>nd</sup> follow up (2013-14) and fourth follow up (2016-17).

**Results:** Median annual and monthly exposure to PM<sub>2.5</sub> at baseline was 92.1 µg/m<sup>3</sup> (IQR=7.96) and 82.4 µg/m<sup>3</sup> (IQR: 39.02) respectively, Out of various lipid traits examined, HDL-C was observed to be associated with average annual and monthly PM<sub>2.5</sub> exposure. An IQR increase of 27.48 ug/m<sup>3</sup> annual and 46.09 ug/m<sup>3</sup> monthly PM<sub>2.5</sub> exposure was associated with increase of 0.08 mmol/l (95%CI=0.04-0.11) and 0.01 mmol/l (95%CI=0.002-0.001), respectively. **Conclusion:** Long-term exposure to ambient PM<sub>2.5</sub> was observed to be associated with HDL-C level in Indian population. Similar analyses in under way for a South Indian city for comparisons. Such evidence on association between PM<sub>2.5</sub> exposure and cardiovascular risk factors are crucial for public health interventions and policy advocacy.

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**P-0175**

### **Short-term effects of particulate matter concentrations on Pulmonary Embolism and Deep Vein Thrombosis at national level in Italy**

**Presenter:** Chiara Di Blasi, Department of Epidemiology, Lazio Region Health Service / ASL Roma1, Rome; Umberto Veronesi Foundation, Milan, Italy

**Authors:** C. Di Blasi<sup>1</sup>, M. Stafoggia<sup>2</sup>, M. Renzi<sup>2</sup>, P. Michelozzi<sup>2</sup>, M. Davoli<sup>2</sup>, F. Forastiere<sup>3</sup>, P. Mannucci<sup>4</sup>; <sup>1</sup>Department of Epidemiology, Lazio Region Health Service / ASL Roma1, Rome; Umberto Veronesi Foundation, Milan, ITALY, <sup>2</sup>Department of Epidemiology, Lazio Region Health Service / ASL Roma1, Rome, ITALY, <sup>3</sup>Environmental Research Group, King's College, London, UNITED KINGDOM, <sup>4</sup>IRCCS Ca' Granda Maggiore Policlinico Hospital Foundation, Milan, ITALY.

**Background:** Several studies reported a link between increases of particulate matter (PM) air pollution and cardiovascular diseases. However, only few reported consistent associations with Venous Thromboembolism (VTE), i.e., Pulmonary Embolism (PE) and Deep Vein Thrombosis (DVT), the third most frequent cardiovascular disease. Our aim was to estimate the association between hospital admissions for these clinical manifestation of VTE and PM concentrations at the national level in Italy. **Methods:** We collected all hospital discharges during 2006-2015 from the Italian Ministry of Health. Daily counts of VTE, PE and DVT admissions in all the 8,094 municipalities were merged with daily and concentrations estimated by a satellite-based spatiotemporal model. First, we applied multivariate Poisson regression models at province level; then, we aggregated results by random-effects meta-analysis and obtained the overall effect at national level. We analyzed each outcome at different temporal latencies (lags), in the warm period (defined as April to September) and in the main urban areas. **Results:** Analysis were conducted on 432,245 VTE hospitalizations (PE= 219,952; DVT= 275,506). National daily mean (standard deviation) concentrations of and were 23 (14) and 17 (12) , respectively. Meta-analytical results showed weak associations between PM concentrations and the study outcomes in the full year analysis. During the warm season and in the main urban areas, the daily relative increase of VTE admissions per 10 increment in same day was 3.4% (95% Confidence Intervals [CI]: -0.01; 6.93). Corresponding estimate for PE and DVT were 3.9% (95% CI: -0.51; 8.68) and 1.4% (95% CI: -2.61; 5.50). **Conclusions:** This is the first study conducted in Europe to investigate the association between air pollutants and PE-DVT at national level. We found an immediate effect of on VTE only during the warm months and in the main urban areas.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0176**

**Acute blood pressure-lowering effects of nitrogen dioxide exposure from domestic gas cooking via elevation of plasma nitrite concentration in healthy individuals**

**Presenter:** Heather Anne Walton, Environmental Research Group, and Health Protection Research Unit on Health Impacts of Environmental Hazards, King's College London, London, United Kingdom

**Authors:** C. N. Floyd<sup>1</sup>, F. Shahed<sup>1</sup>, F. Ukah<sup>1</sup>, K. McNeill<sup>1</sup>, K. O'Gallagher<sup>1</sup>, C. E. Mills<sup>2</sup>, D. Evangelopoulos<sup>3</sup>, S. Lim<sup>4</sup>, I. Mudway<sup>3</sup>, B. Barratt<sup>3</sup>, H. A. Walton<sup>3</sup>, A. J. Webb<sup>1</sup>;

<sup>1</sup>King's College London, British Heart Foundation Centre, School of Cardiovascular Medicine and Sciences, Department of Clinical Pharmacology; Biomedical Research Centre, Clinical Research Facility, Guy's and St Thomas' NHS Foundation Trust, London, UNITED KINGDOM, <sup>2</sup>Food and Nutritional Sciences, School of Chemistry, Food and Pharmacy, University of Reading, Reading, UNITED KINGDOM, <sup>3</sup>Environmental Research Group, and Health Protection Research Unit on Health Impacts of Environmental Hazards, King's College London, London, UNITED KINGDOM, <sup>4</sup>Environmental Research Group, King's College London, London, UNITED KINGDOM.

**Background/Aim:** Air pollution is a major cause of cardiovascular and all-cause morbidity and mortality. However, disentangling the relative contributions of individual pollutants is challenging, as epidemiological data measuring exposure to one (e.g. nitrogen dioxide; NO<sub>2</sub>) is inevitably confounded by exposure to others (e.g. particulate matter). Domestic gas appliances, e.g. cookers, represent a globally important, yet under-recognized, source of NO<sub>2</sub> and provide a relatively selective method to investigate the effects of NO<sub>2</sub>. We hypothesized that acute exposure to NO<sub>2</sub> from gas cooking would lower blood pressure (BP) by increasing plasma [nitrite]. **Methods:** We conducted an acute, randomized, controlled, crossover study to assess the impact of 90min exposure to NO<sub>2</sub> versus control (room air) on plasma [nitrite] and BP in healthy volunteers. **Results:** Plasma [nitrite] was significantly elevated compared to control over the 3-hour period comprising 90min NO<sub>2</sub> exposure and 90min washout (P<0.001), notably within 15min of exposure (P<0.05), and at all timepoints until 2h15min (45min after the end of exposure); P<0.05. There were corresponding decreases in systolic and diastolic BP over the 3-hour period (both P<0.001). Systolic BP was decreased relative to control at individual timepoints of 45min and 90min by 4.6mmHg (95% CI 0.2 to 8.9; P=0.032) and 5.5mmHg (95% CI 1.2 to 9.9; P=0.005), respectively. The maximal diastolic BP difference was 5.7mmHg (95% CI 1.0 to 10.5; P=0.009) at 45min.

**Conclusions:** NO<sub>2</sub> exposure from gas cooking acutely lowers BP, associated with a rapid increase (by 15min) in plasma [nitrite]. This finding favours chemical conversion via intermediates over induction of inflammatory pathways. Such a functional "ecophysiological NO<sub>x</sub> cycle" may directly feed into the "nitrate-nitrite-NO pathway", thus linking with wider evidence on both beneficial and adverse cardiovascular effects. Our proposed mechanism contributes to the understanding of how NO<sub>2</sub> exposure impacts human health.

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**P-0177**

### **Exposure to Volatile Organic Compounds - Acrolein, 1,3-Butadiene, and Crotonaldehyde - is Associated with Vascular Dysfunction**

**Presenter:** Katlyn E McGraw, University of Louisville Department of Environmental and Occupational Health Sciences, Louisville, United States

**Authors:** K. E. McGraw<sup>1</sup>, D. W. Riggs<sup>2</sup>, Z. Xie<sup>3</sup>, P. Lorkiewicz<sup>3</sup>, T. Krivokhizhina<sup>3</sup>, N. Zafar<sup>3</sup>, S. Krishnasamy<sup>3</sup>, S. N. Rai<sup>3</sup>, D. J. Conklin<sup>3</sup>, A. Defilippis<sup>3</sup>, S. Srivastava<sup>4</sup>, A. Bhatnagar<sup>3</sup>;

<sup>1</sup>University of Louisville Department of Environmental and Occupational Health Sciences, Louisville, KY,

<sup>2</sup>University of Louisville Department of Epidemiology, Louisville, KY, <sup>3</sup>Christina Lee Brown Envirome Institute at University of Louisville, Louisville, KY, <sup>4</sup>University of Louisville Superfund Basic Research Program, Louisville, KY.

**Background:** Cardiovascular disease (CVD) is the leading cause of mortality worldwide. Exposure to air pollution, specifically PM<sub>2.5</sub>, is a well-established risk factor for CVD. However, the contribution of gaseous pollutant exposure to CVD risk is less clear. **Methods:** To examine the cardiovascular effects of volatile organic compounds (VOCs) on vascular function, we measured urinary metabolites of acrolein (CEMA and 3-HPMA), 1,3-butadiene (DHBMA and MHBMA3), and crotonaldehyde (HPMMA) in 309 nonsmokers with varying levels of CVD risk, recruited from a preventive cardiology clinic. On the day of enrollment, we measured blood pressure (BP), reactive hyperemia index (RHI - a marker of endothelial dysfunction), and urinary levels of biogenic amines and their metabolites. **Results:** We found that the urinary levels of 3-HPMA, DHBMA, and HPMMA were higher in White than Black participants. Levels of DHBMA and HPMMA were higher in women than men. Using generalized linear models, we found that 3-HPMA was positively associated with systolic BP (0.98 per SD of 3HPMA; CI: 0.04, 1.91; P=0.04). The relationship found in the total cohort remained significant for Black participants, despite lower levels of urinary 3-HPMA in this population. Associations between VOC metabolites and BP were independent of PM<sub>2.5</sub> exposure and BP medications. For each IQR of 3-HPMA or DHBMA, there was a 3.3% (CI: -6.18, -0.37; p-value: 0.03) or a 4.0% (CI: -7.72, -0.12; P=0.04) decrease in RHI. Urinary levels of MHBMA3 were positively associated with a 2.92% increase in urinary epinephrine (CI: 0.48, 5.37; P=0.02). Although the association between VOC metabolites and BP were independent of urinary catecholamines, it was stronger in participants with higher urinary levels of epinephrine. **Conclusions:** Taken together, these findings suggest that exposure to VOCs (acrolein, 1,3-butadiene, and crotonaldehyde) may lead to endothelial dysfunction particularly in those with a higher sympathetic tone, and contribute to risk of hypertension.

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**P-0178**

**association between short-term exposure to ambient particulate air pollution and biomarkers of oxidative stress: a meta-analysis**

**Presenter:** Zichuan Li, Department of Occupational and Environmental Health Sciences, School of Public Health, Peking University, Beijing, China

**Authors:** Z. Li, Q. Liu, Z. Xu, S. Wu;  
Department of Occupational and Environmental Health Sciences, School of Public Health, Peking University, Beijing, CHINA.

**Background:** Exposure to ambient particulate air pollution contributes substantially to the mortality and morbidity due to cardiovascular diseases (CVD). Several hypothetical mechanisms have been proposed to explain these associations, particularly oxidative stress. Malondialdehyde (MDA), 8-hydroxy-2'-deoxyguanosine (8-OHdG), and Superoxide Dismutase (SOD) are typical biomarkers of oxidative stress and have been frequently investigated. However, the association between exposure to ambient particulate matter (PM) and these biomarkers has not been well established. **Objectives:** Evaluate the association between ambient particulate air pollution and biomarkers of oxidative stress based on existing epidemiological studies. **Methods:** A systematic literature search was conducted in databases of Science Direct, PubMed, Web of Science, and Scopus up to October 2019 to summarize epidemiological studies reporting the association between exposure to ambient PM (PM<sup>2.5</sup>, PM<sup>10</sup>, or both) and biomarkers of oxidative stress, and a meta-analysis was performed for the associations reported in individual studies using a random-effect model. **Results:** This meta-analysis included 18 epidemiological studies (12 identified for 8-OHdG, 6 identified for MDA and 4 identified for SOD). A pooled percent change in 8-OHdG, MDA and SOD associated with a 10 µg/m<sup>3</sup> increase in short-term exposure to ambient PM<sup>2.5</sup> was 1.54% (95% CI: -0.78%, 3.88%), 2.31% (95% CI: 0.49%, 4.15%) and -0.85% (95% CI: -2.59%, 0.93%), respectively. **Conclusion:** Short-term exposure to ambient PM<sup>2.5</sup> was associated with a significantly increased level of MDA, indicating that ambient particulate air pollution may contribute to increased oxidative stress.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0179**

### **Acute Differences in Inflammatory Biomarkers Following Controlled Exposures to Cookstove Air Pollution in the STOVES Study**

**Presenter:** Ethan S Walker, Colorado State University, Fort Collins, United States

**Authors:** E. S. Walker<sup>1</sup>, K. M. Fedak<sup>1</sup>, N. Good<sup>1</sup>, J. Balmes<sup>2</sup>, R. D. Brook<sup>3</sup>, M. L. Clark<sup>1</sup>, T. Cole-Hunter<sup>1</sup>, R. B. Devlin<sup>4</sup>, C. L'Orange<sup>1</sup>, G. Luckasen<sup>5</sup>, J. Mehaffy<sup>1</sup>, R. Shelton<sup>1</sup>, A. Wilson<sup>1</sup>, J. Volckens<sup>1</sup>, J. L. Peel<sup>1</sup>;  
<sup>1</sup>Colorado State University, Fort Collins, CO, <sup>2</sup>University of California San Francisco, San Francisco, CA,  
<sup>3</sup>University of Michigan Medical School, Ann Arbor, MI, <sup>4</sup>United States Environmental Protection Agency, Research Triangle Park, NC, <sup>5</sup>Heart Center of the Rockies, Fort Collins, CO.

**Background/Aim:** Household air pollution from cooking with solid fuels is an important risk factor for global morbidity and mortality. Improved cookstoves have been designed and distributed to reduce household air pollution exposures, but whether such stoves meaningfully improve health remains unclear. We used a crossover design in a laboratory setting to assess the effect of pollution emitted from multiple cookstoves on acute differences in inflammatory biomarkers in healthy, young adults.

**Methods:** Participants (n=48) were assigned to treatment sequences of 2-hour controlled exposures to air pollution emitted from five cookstoves and a filtered-air control. The treatments, administered at least 2 weeks apart, each had a fine particulate matter target concentration ( $\mu\text{g}/\text{m}^3$ ): control (0); liquefied petroleum gas (10); gasifier (35); fan rocket (100); rocket elbow (250); and three stone fire (500). Inflammatory biomarkers were measured before and 0, 3, and 24 hours after treatments: intercellular adhesion molecule-1 (ICAM-1), vascular cell adhesion molecule-1 (VCAM-1), C-reactive protein (CRP), serum amyloid-A, tumor necrosis factor-alpha, interleukin-6, and interleukin-8. We used linear mixed models to assess differences in inflammatory biomarkers for treatments versus control.

**Results:** ICAM-1 and VCAM-1 were higher 3 hours after all cookstove treatments (relative to control). For example, 3 hours after the three stone fire treatment, ICAM-1 was 13.1 ng/mL (95% confidence interval: 2.0, 24.3) higher than control and VCAM-1 was 6.9 ng/mL (-2.1, 16.0) higher than control. There was also evidence that CRP was higher 24 hours after cookstove treatments versus control, although confidence intervals were wide. Differences for outcomes at other time points were not consistent.

**Conclusions:** Short-term controlled exposures to air pollution from improved and traditional cookstoves acutely impact vascular adhesion molecules and CRP. These findings may provide insight into the initial, underlying health impacts following cookstove air pollution exposures. This abstract does not represent EPA policy.

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**P-0180**

### **Personal PM<sub>2.5</sub> Exposure and Resting Heart Rate in the Study of Pollution and COPD Exacerbation (SPACE) Cohort**

**Presenter:** Melissa Fiffer, Harvard T.H. Chan School of Public Health, Department of Environmental Health, Boston, United States

**Authors:** M. Fiffer<sup>1</sup>, L. Nurhussien<sup>2</sup>, A. Synn<sup>3</sup>, M. B. Rice<sup>2</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Department of Environmental Health, Boston, MA, <sup>2</sup>Beth Israel Deaconess Medical Center, Division of Pulmonary, Critical Care and Sleep Medicine, Boston, MA, <sup>3</sup>Beth Israel Deaconess Medical Center, Division of Pulmonary, Critical Care and Sleep Medicine & Division of Pulmonary and Critical Care Medicine, Massachusetts General Hospital, Boston, MA.

**Background**Daily changes in fine particulate matter (PM<sub>2.5</sub>) exposure have been linked to intermediate cardiovascular outcomes such as reduced heart rate (HR) variability and elevated HR. While less is known about PM<sub>2.5</sub> exposure and resting HR, higher resting HR can indicate cardiovascular pathophysiology that may predict poor cardiovascular outcomes.  
**Methods**We recruited 27 former smokers with a clinical diagnosis of COPD and GOLD Stage II or greater airflow obstruction on spirometry residing in the Boston area. Participants were followed for up to 4 months (1 month per season), during which they wore Fitbit Charge 2 activity monitors and a personal air quality monitor by Atmospheric Sensors Ltd (ASL). We applied linear mixed effects models to examine associations between same- and previous-day PM<sub>2.5</sub> and daily resting HR. We accounted for intra-individual correlations by using participant-specific random effects and nesting participants within observation month. Errors were assumed to follow a first-order autoregressive covariance structure. Models were adjusted for age, sex, race, BMI, COPD severity (FEV<sub>1</sub>), education, season, temperature, relative humidity, coronary artery disease, congestive heart failure, arrhythmia, and nodal blocker use.  
**Results**A total of 2,120 observation-days were collected from the study participants, who were 44% female with mean (SD) age of 72 (8) years. 75% of the daily PM<sub>2.5</sub> fell between 4-11 µg/m<sup>3</sup> (mean=10 µg/m<sup>3</sup>). Daily resting HR was normally distributed with mean 70 bpm (SD=8.7). Same-day PM<sub>2.5</sub> is not associated with resting HR when evaluated as a continuous variable, in quartiles, or as a binary variable relative to the EPA Air Quality Index 24-hour threshold of 12 µg/m<sup>3</sup> (for “good” air quality). Previous-day PM<sub>2.5</sub> was not associated with resting HR. Across all models, lower education level and arrhythmia were associated with higher resting HR.  
**Conclusion**Same and previous-day personal PM<sub>2.5</sub> exposure was not associated with daily resting HR in this population with moderate to severe COPD.

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**P-0181**

### **Associations between Greenness and Mortality by Ecoregion in the United States**

**Presenter:** Daniel W Riggs, Christina Lee Brown Envirome Institute, University of Louisville, Louisville, United States

**Authors:** D. W. Riggs<sup>1</sup>, R. Yeager<sup>1</sup>, N. C. DuPre<sup>2</sup>, S. N. Rai<sup>3</sup>, P. James<sup>4</sup>, F. Laden<sup>5</sup>, A. Bhatnagar<sup>1</sup>;  
<sup>1</sup>Christina Lee Brown Envirome Institute, University of Louisville, Louisville, KY, <sup>2</sup>Department of Epidemiology and Population Health, University of Louisville, Louisville, KY, <sup>3</sup>Department of Bioinformatics and Biostatistics, University of Louisville, Louisville, KY, <sup>4</sup>Department of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute; Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA, <sup>5</sup>Department of Environmental Health and Department of Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA.

**Background:** Several epidemiological studies report that residential proximity to greenness is associated with positive health benefits. However, it is unclear whether such associations vary with ecology and the type of vegetation. Therefore, we investigated whether the associations between greenness and mortality vary by ecology, as categorized by EPA ecoregions. **Methods:** County level data from 2010 in the contiguous United States (n=2,733) were analyzed using linear regression to determine whether greenness was associated with log-transformed age-adjusted all-cause and cardiovascular mortality rates (CDC WONDER). In specific EPA level I ecoregions, greenness was estimated using the normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI), which corrects for dense vegetation and distortions caused by airborne particles. Rural-urban continuum codes (RUCC) were used to categorize urbanicity. All models were adjusted for % male, % white, % smoking, median household income, population density, and fine particulate matter. **Results:** All-cause and cardiovascular mortality were inversely associated with EVI, and to a lesser extent, NDVI. Upon stratification by ecoregion, we observed that EVI was negatively associated with all-cause mortality (-4.5% per 0.1 EVI; 95% CI: -5.4, -3.5) and cardiovascular mortality (-4.6% per 0.1 EVI; 95% CI: -6.1, -3.0) in the Great Plains Region. In Eastern Temperate Forests, all-cause mortality was negatively associated with EVI (-1.8% per 0.1 EVI; 95% CI: -2.7, -1.0), but not NDVI (-0.1% per 0.1 NDVI; 95% CI: -1.1, 0.9). Stratifying by RUCC, we observed the strongest associations between greenness and mortality in rural counties with low populations. In cardiovascular mortality models, we observed stronger negative interactions with particulate matter and EVI than NDVI. **Conclusions:** The association between greenness and mortality varies by the surrounding ecology, such as the Great Plains region, an ecologically diverse region dominated by grasslands.

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**P-0182**

**Epigenetic mechanisms affecting blood pressure in the elderly population**

**Presenter:** Da Hae Kim, Sejong University, Seoul, Korea, Republic of

**Authors:** D. Kim<sup>1</sup>, Y. Hong<sup>2</sup>, J. Kim<sup>1</sup>;

<sup>1</sup>Sejong University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF.

Background: Hypertension, a risk factor for various diseases such as cardiovascular and kidney diseases, was known to be incurable. Therefore, it is important to prevent the increase of blood pressure by understanding the cause and mechanism. So our research aim was to investigate factors affecting blood pressure in the elderly population and their epigenetic mechanisms. Methods: We recruited 45 females, who were aged 60 years. Participants visited our center 3 times with 1 week interval. On every visit, their blood samples were collected for miRNA level measurements, and diastolic and systolic blood pressures were measured. We isolated total RNA from the collected blood samples and measured epigenome-wide miRNA levels to evaluate relationships between miRNA levels and blood pressures. Five public database (DIANA-mt, miRDB, miRWalk 2.0, TargetsCan 7.2, and miRTarBase) were used to predict the target genes of each miRNA, and the target genes were used to explore functional networking related with blood pressure. We explored KEGG pathways related with miRNA-related target genes using DAVID bioinformatics resources 6.8. Results: Twenty-three miRNAs (miR-1225-5p, miR-1229, miR-1236, miR-125a-5p, miR-1299, miR-1468, miR-1913, miR-197-3p, miR-30c-5p, miR-323a-5p, miR-4448, miR-4516, miR-490-3p, miR-514b-5p, miR-599, miR-609, miR-623, miR-643, miR-671-3p, miR-744-5p, miR-877-5p, miR-939, and miR-99a-5p) were positively associated with both diastolic and systolic blood pressures. The predicted target genes of 23 miRNAs were found to be related with various disease classes including metabolic, cardiovascular, and chemdependency. Furthermore, KEGG pathways on metabolic pathways (hsa01100), pathways in cancer (hsa05200) and PI3K-Akt signaling pathway (hsa04151) in order of precedence were related with hypertension. Conclusions: Our study results suggest that epigenetic mechanisms could be related with development of hypertension.

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Theme: **Cardiovascular**

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**P-0183**

**Epigenetic mechanisms affecting heart rate variability**

**Presenter:** Da Hae Kim, Sejong university, Seoul, Korea, Republic of

**Authors:** D. Kim<sup>1</sup>, Y. Hong<sup>2</sup>, J. Kim<sup>1</sup>;

<sup>1</sup>Sejong university, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF.

Background: Heart rate variability (HRV) is a reliable indicator of the many physiological factors affecting the heart. So our research aim was to investigate factors affecting HRV and their epigenetic mechanisms. Methods: We recruited 23 non-smoking female elders. Their HRVs were repeatedly measured using an automated HRV analyzer. Total RNA was isolated from blood samples collected every visits and used for epigenome-wide miRNA measurements. We evaluated relationships between miRNA levels and two HRV indicators, standard deviation of normal-to-normal intervals (SDNN) and the root mean square of successive differences (RMSSD). Results: Three miRNAs (miR-1255b-5p, miR-155-5p, and miR-411-5p) were positively associated with both SDNN and RMSSD. ( $p < 0.05$  for relations with all 3 miRNAs). The predicted target genes of 3 miRNAs were found to be related with various disease classes including metabolic, cardiovascular and chemdependency. Furthermore, KEGG pathways on pathways in cancer (hsa05200), PI3K-Akt signaling pathway (hsa04151) and HTLV-I infection (hsa05166) in order of precedence were related with HRV. Conclusions: Our study results suggest a potential that HRV modifies epigenetic mechanisms, resulting in a variety of diseases.

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**P-0184**

**Community characteristics affecting lag-structure of short-term exposure effect of ambient particulate matter on mortality: contextual variation of cumulative exposure effect and mortality displacement in 72 municipalities of seven major cities of South K**

**Presenter:** Honghyok Kim, Yale University, New Haven, United States

**Authors:** H. Kim<sup>1</sup>, M. L. Bell<sup>1</sup>, J. Lee<sup>2</sup>;

<sup>1</sup>Yale University, New Haven, CT, <sup>2</sup>Korea University, Seoul, KOREA, REPUBLIC OF.

**Background:** The association between ambient particulate matter (PM) and mortality may vary by community characteristics. Variation in lag-structure is related to how this association varies. This variation has not been well studied. **Objectives:** We assessed variation in lag-structure of short-term exposure to PM<sub>10</sub> on mortality in 72 municipalities in seven major South Korean cities (2006-2013), regarding the modification by other pollutants, socioeconomic deprivation, medical resources, greenness, and health behaviors. **Methods:** We used municipality-specific Poisson regression models considering overdispersion. We applied constrained distributed lag models to estimate lag-structures for associations between cumulative PM<sub>10</sub> exposure and mortality, up to 45 lag days of PM<sub>10</sub>. Lag-structures were adjusted for O<sub>3</sub>, weather, seasonality, and time. We performed random-effect meta-regressions with variable selection methods. Variable selections and changes in coefficients were interpreted based on a priori hypothesized pathways between community characteristics and mortality risk due to PM<sub>10</sub>. **Results:** A 10 µg/m<sup>3</sup> increase in PM<sub>10</sub> on average across 46 days was associated with a 1.05% (95% CI: 0.24, 1.88) increase in all-cause mortality (ALL), 1.32% (95% CI: -0.29, 2.95) increase in cardiovascular mortality (CVD), and 6.47% (95% CI: 3.06, 10.00) increase in respiratory mortality (RES). Mortality risk associated with PM<sub>10</sub> was higher in communities with higher ratio of SO<sub>2</sub> to PM<sub>10</sub> (ALL and RES), higher socioeconomic deprivation (ALL, CVD, and RES), lower medical resources (CVD), higher prevalence of drinking (ALL and CVD), and lower prevalence of smoking (CVD and RES). Lag-structures differed by these community characteristics, suggesting that effects of cumulative PM<sub>10</sub> exposure and mortality displacement may differ across communities. **Conclusion:** The association between PM<sub>10</sub> and mortality may be higher in communities with higher SO<sub>2</sub>, higher socioeconomic deprivation, lower medical resources, higher prevalence of drinking, and lower prevalence of smoking. This contextual variation may result from variation in not only cumulative exposure effect of PM but also mortality displacement.

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**P-0185**

### **The Long-term Effect of Exposure to Air Pollutants on Mortality among Medicare Participants: A National Study Using an Additive Hazards Model**

**Presenter:** Mahdiah Danesh Yazdi, Harvard TH Chan School of Public Health, Boston, United States

**Authors:** M. Danesh Yazdi, Y. Wang, Q. Di, L. Shi, B. Sabbath, B. Coull, P. Koutrakis, J. Evans, F. Dominici, J. Schwartz;  
Harvard TH Chan School of Public Health, Boston, MA.

**Background/Aims:** Our goal is to look at the relationship between long-term exposure to multiple air pollutants and mortality among Medicare participants in the United States on an additive hazard scale using a doubly robust model. **Methods:** We used a doubly robust additive hazard model (DRAHM) to assess the effect of long-term exposure to PM<sub>2.5</sub>, NO<sub>2</sub>, and ozone on mortality among Medicare participants across the contiguous United States from 2000 to 2016. This effect estimates from this model are unbiased if either the inverse probability weight (IPW) model for exposure or the outcome regression model are correctly specified. Furthermore, unlike the Cox proportional hazards model, it does not require a proportional hazards assumption. PM<sub>2.5</sub>, NO<sub>2</sub>, and ozone levels were obtained from a previously validated high-resolution prediction models which utilized machine learning algorithms. These predictions were averaged spatio-temporally to obtain annual exposure on a zip code level. Mortality information was derived from the Medicare denominator file. Covariates included demographic and socioeconomic variables. Effect measure modification was assessed for sex, age, race, and Medicaid eligibility. We then repeated the analyses among observations that were less than the international annual standard of 10 mcg/m<sup>3</sup> for PM<sub>2.5</sub> and 20 ppb for NO<sub>2</sub>. For the ozone subgroup analysis, we looked at individuals in whom all years of observation had levels below 50 ppb. **Results:** Our preliminary results indicate that exposure to PM<sub>2.5</sub> led to a 0.00248% (95% CI: -0.000252% to 0.00521%) per 1 µg/m<sup>3</sup> increase in the hazard of death among the study population after adjustment for individual demographic factors and zip code-level socioeconomic and air pollution factors. Further results are pending. **Conclusions:** Long-term exposure to fine particulate matter does not significantly increase the hazard of mortality in the elderly Medicare population on an additive scale.

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**P-0188**

### **Effects of residential PM<sub>2.5</sub> exposures from indoor and outdoor sources on blood pressure and respiratory inflammation in rural and urban Beijing**

**Presenter:** Hanbin ZHANG, Department of Analytical, Environmental & Forensic Sciences, NIHR HPRU in Health Impact of Environmental Hazards, King's College London, London, United Kingdom

**Authors:** H. ZHANG<sup>1</sup>, Y. FAN<sup>2</sup>, Y. HAN<sup>3</sup>, L. YAN<sup>3</sup>, W. CHEN<sup>2</sup>, Y. CAI<sup>3</sup>, Q. CHAN<sup>3</sup>, T. ZHU<sup>2</sup>, F. J. KELLY<sup>1</sup>, B. BARRATT<sup>1</sup>;

<sup>1</sup>Department of Analytical, Environmental & Forensic Sciences, NIHR HPRU in Health Impact of Environmental Hazards, King's College London, London, UNITED KINGDOM, <sup>2</sup>College of Environmental Sciences and Engineering, Center for Environment and Health, Peking University, Beijing, CHINA, <sup>3</sup>MRC Centre for Environment and Health, King's College London, London, UNITED KINGDOM.

Introduction Arising from different activities, indoor-generated (PM<sub>2.5\_ig</sub>) and outdoor-generated residential PM<sub>2.5</sub> (PM<sub>2.5\_og</sub>) may have different toxicities and health effects. We aimed to evaluate the effects of PM<sub>2.5\_ig</sub> and PM<sub>2.5\_og</sub> on systolic blood pressure (SBP), diastolic blood pressure (DBP) and respiratory inflammation (represented by exhaled Nitric Oxide (eNO)). Methods 72 subjects participated in the residential monitoring of PM<sub>2.5</sub> in urban and rural Beijing during winter 2016 and summer 2017. In total, valid data were captured for 450 measurement days (approx. 3 days per participant per season). Within the same week of exposure monitoring, BP and eNO from participants were measured two times. A classifying algorithm was developed to isolate PM<sub>2.5\_ig</sub> and PM<sub>2.5\_og</sub> from residential and ambient measurements. Linear mixed-effects model was used to examine the associations between residential exposure and health outcomes. Results For all measurements except PM<sub>2.5\_og</sub> (PM<sub>2.5\_ig</sub>, eNO, SBP and DBP), significant differences were observed between rural and urban participants during the two seasons. For all measurements (PM<sub>2.5\_ig</sub>, PM<sub>2.5\_og</sub>, eNO, SBP and DBP), significant differences were observed between seasons in both sites. Overall, an interquartile range (IQR) increase (22.0 ug/m<sup>3</sup>) in lag 1-day exposure to PM<sub>2.5\_og</sub> was associated with an elevation in SBP by 1.70% (confidence interval [CI]: 0.47%, 2.95%) and eNO by 15.44% (CI: 6.60%, 25.02%); an IQR increase (5.8 ug/m<sup>3</sup>) in lag 2-day exposure to PM<sub>2.5\_ig</sub> was associated with an elevation in SBP by 1.12% (CI: 0.26%, 2.00%) and an increased DBP by 1.26% (CI: 0.39%, 2.14%). However, PM<sub>2.5\_ig</sub> were negligible (<0.5 ug/m<sup>3</sup>) in 44% and 54% of measurement days during winter 2016 and summer 2017, which affected the output from the linear mixed-effects model. Conclusion PM<sub>2.5\_og</sub> and PM<sub>2.5\_ig</sub> demonstrated different lag effects and effect sizes in the assessed health metrics. Full investigation with alternative modelling techniques is ongoing to evaluate the relationship in more detail.

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**P-0189**

### **Community Social Stressors and Susceptibility to Urban Air Pollution in Cardiovascular Disease**

**Presenter:** Jane E. Clougherty, Drexel University Dornsife School of Public Health, Philadelphia, United States

**Authors:** J. E. Clougherty<sup>1</sup>, J. Humphrey<sup>1</sup>, E. J. Kinnee<sup>2</sup>, L. D. Kubzansky<sup>3</sup>, C. E. Reid<sup>4</sup>, L. A. McClure<sup>1</sup>, L. Robinson<sup>1</sup>;

<sup>1</sup>Drexel University Dornsife School of Public Health, Philadelphia, PA, <sup>2</sup>University of Pittsburgh, Pittsburgh, PA, <sup>3</sup>T.H. Chan School of Public Health at Harvard University, Boston, MA, <sup>4</sup>University of Colorado, Boulder, CO.

Cardiovascular disease (CVD), the leading cause of death in the U.S., has been linked to chronic and acute air pollution exposures. Research has identified stronger effects of air pollution in lower-socioeconomic position (SEP) communities, where pollution exposures are also often higher. While specific factors underlying this susceptibility are unknown, chronic psychosocial stress related to social adversity is hypothesized as a key component. In this study, we use data on 1.3 million New York City (NYC) CVD emergency department (ED) visits, multiple air pollutants [fine particles (PM<sub>2.5</sub>), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>)], and community-level SEP, violence, and race-based residential segregation to: (1) examine associations between spatiotemporal pollution exposures and CVD events in NYC for 2005-2011, and (2) assess effect modification in pollution-CVD associations by community social stressors. In case-crossover models examining associations between spatio-temporal air pollution and CVD, we found significant same-day associations between NO<sub>2</sub> and risk of any CVD event, ischemic heart disease, and heart failure; this association remained significant with any form of co-pollutant adjustment. Significant associations for PM<sub>2.5</sub> and SO<sub>2</sub> on all CVD, heart failure (for PM<sub>2.5</sub>), and ischemic heart disease (for SO<sub>2</sub>) were somewhat less robust to co-pollutant adjustment. Finally, to test effect modification in the relationship between spatio-temporal pollution measures and CVD, we tested whether associations with individual-level CVD risk differed by community SEP and/or chronic stressors. We found, as hypothesized, stronger associations between pollutants and CVD risk among individuals in communities with higher social stressor exposures. Further analyses are needed to compare relative modification by multiple community stressors.

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**P-0190**

### **The relationship of socio-environmental factors with hospital admissions and readmissions for Sickle Cell Disease**

**Presenter:** Nicole Sieck, University of Maryland, College Park, United States

**Authors:** N. Sieck<sup>1</sup>, E. Rigterink<sup>1</sup>, J. D. Yanosky<sup>2</sup>, T. Wen<sup>2</sup>, R. Ezeugoh<sup>1</sup>, N. Crnosija<sup>1</sup>, D. Payne-Sturges<sup>1</sup>, R. Puett<sup>1</sup>;

<sup>1</sup>University of Maryland, College Park, MD, <sup>2</sup>Pennsylvania State University, Hershey, PA.

**Background** Though approximately 100,000 Americans have sickle cell disease (SCD), studies over long time periods and large geographic areas in the US are limited. Patients routinely have multiple hospital admissions per year. Identification of potential contributing socio-environmental factors is important to advance prevention efforts.

**Methods** We conducted a descriptive study of SCD hospital encounters and readmissions by individual and area-level socio-environmental factors using representative encounter data from all hospitals in South Carolina. We obtained emergency department visit and hospital admission data from 2002 through 2013 for patients with a primary diagnosis related to SCD. We examined initial visits, total encounters, admission and readmission rates by individual and area-level socio-environmental factors. **Results** We identified 127,598 hospital encounters with complete data that were attributed to 6,631 individual patients. Average overall encounter rate was 19.2 (95% CI: 17.9, 20.6) and rate of readmissions within 30 days was 11.5 (95% CI: 10.2, 12.8). Encounter rates and readmission rates were lower among participants living in more affluent areas. Further, those who had Medicaid as their primary insurance had the highest rates of readmission.

**Conclusions** We observed some suggestion of increased SCD-related hospital admission rates and readmissions among participants living in less affluent areas, thus prevention efforts may be warranted for these underserved communities.

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**P-0191**

### **Electronic cigarette use and blood pressure endpoints: a systematic review**

**Presenter:** Irene Martinez-Morata, Columbia University Mailman School of Public Health, New York, United States

**Authors:** I. Martinez-Morata, A. Navas-Acien;  
Columbia University Mailman School of Public Health, New York, NY.

**Background:** Hypertension is a major risk factor for cardiovascular disease. E-cigarettes release toxic chemicals, including lead, known to increase blood pressure (BP) levels. While the association of combustion cigarettes with hypertension is established, the effects of e-cigarettes on BP endpoints remain unknown. Studying BP endpoints may help understand potential cardiovascular risks of short and long-term e-cigarette use.

**Objectives:** Summarize published studies on the association of e-cigarette use with blood pressure endpoints.

**Methods:** We systematically reviewed studies evaluating short-term and long-term changes of e-cig use on BP endpoints. A total of 16 e-cigarette trials (including 12 cross-over trials) and 3 observational studies published between 2012 and 2020 were included. Systolic and diastolic blood pressure levels were measured in all studies. The type of e-cigs included cigarlike, tanks/mods, and pods (USB-like).

**Results:** The studies were conducted in adults between 21 and 65 years, 54% participants were men and 18% were non-smokers. N ranged from 15 to 263. All trials included at least one e-cigarette arm. 9 trials compared to a combustion cigarette arm, 9 to a non-nicotine e-cigarette arm, and 5 to no intervention. All trials measured BP at baseline and at least once during the follow-up (from 10 minutes up to 54 weeks). Eight trials found a significant increase in systolic BP and 8 trials found a significant increase in diastolic BP after exposure to e-cigarettes containing nicotine compared to baseline. Two trials found significant increases in SBP comparing nicotine e-cigarettes to no intervention. The observational studies were limited by small sample sizes and the findings on BP endpoints were inconsistent.

**Conclusions:** This systematic review confirms that nicotine containing e-cigarettes result in short-term increases in both SBP and DBP. Few observational studies are available. Additional research is needed to evaluate the possible long-term effects of e-cigarettes on blood pressure endpoints.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0192**

### **Herbal remedies and hyperuricemia in a Central American population with elevated chronic kidney disease of unknown origin**

**Presenter:** Katie M. Applebaum, George Washington University, Milken Institute School of Public Health, Department of Environmental and Occupational Health, Washington, United States

**Authors:** T. L. Stallings<sup>1</sup>, N. McCray<sup>1</sup>, J. Lau<sup>2</sup>, A. Salinas<sup>2</sup>, O. Ramírez-Rubio<sup>3</sup>, D. López-Pilarte<sup>3</sup>, J. Amador Velazquez<sup>3</sup>, A. Riefkohl Lisci<sup>3</sup>, D. E. Weiner<sup>4</sup>, D. J. Friedman<sup>5</sup>, D. R. Brooks<sup>3</sup>, K. M. Applebaum<sup>1</sup>;

<sup>1</sup>George Washington University, Milken Institute School of Public Health, Department of Environmental and Occupational Health, Washington, DC, <sup>2</sup>Especialistas en Medicina Interna, Chichigalpa, NICARAGUA,

<sup>3</sup>Boston University School of Public Health, Department of Epidemiology, Boston, MA, <sup>4</sup>Tufts Medical Center, Nephrology, Boston, MA, <sup>5</sup>Beth Israel Deaconess Medical Center, Harvard Medical School, Division of Nephrology, Boston, MA.

**Background.** Herbal remedies may expose consumers to environmentally harmful agents, yet some may use them to self-treat illnesses. We examined herbal consumption in a population of renal patients in Central America, an area with elevated chronic kidney disease of unknown origin (CKDu). We investigated whether herbals were related to hyperuricemia, a common ailment in patients. **Methods.** We enrolled 311 patients attending a renal clinic in northwestern Nicaragua who were male, non-diabetic former sugarcane workers with early to late stage kidney dysfunction. A questionnaire asked about use of 15 specific herbals (some nephrotoxic, others beneficial) in the past year and frequency used. Serum uric acid and serum creatinine were measured. Medical records provided information on the uric acid lowering prescription allopurinol. Unconditional logistic regression models estimated odds ratios (ORs) and 95% confidence intervals (CIs) for the association of prevalent hyperuricemia (uric acid  $\geq 7$  mg/dL) and herbals, controlling for age, hypertension, disease stage, alcohol consumption, and allopurinol prescription. **Results.** Among patients, 40% were late stage disease and 85% were hyperuricemic. Sixty-one percent ( $n=191$ ) reported using at least one herbal and 47 patients used 3 or more. No herbals purported to be nephrotoxic were related to hyperuricemia. Chamomile (manzanilla) was taken by 27% of patients and consumed a mean 61 ( $\pm 102.6$  SD) times per year, with some consuming daily. Chamomile was associated with a reduced prevalence of hyperuricemia (OR = 0.45 (0.20, 1.00)) in the adjusted model. The inverse association with hyperuricemia was more pronounced in those with late stage disease who consumed chamomile compared with early stage non-consumers (OR=0.25 95% CI (0.09, 0.70)). **Conclusion.** Research is needed to determine if chamomile may be beneficial in preventing hyperuricemia in this patient population. Although potentially harmful herbals were not associated with hyperuricemia, they should be examined in relation to other kidney measures.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0193**

**The implementation of a low emission zone in a medium-sized Swedish city: estimated effects on mortality and morbidity**

**Presenter:** Anna Oudin, Lund University, Lund, Sweden

**Authors:** A. Oudin, E. Flanagan, E. Malmqvist;  
Lund University, Lund, SWEDEN.

Title: The introduction of a low emission zone in a medium-sized Swedish city: estimated effects on morbidity and mortality  
Authors: Anna Oudin<sup>1,2</sup>, Erin Flanagan<sup>1</sup>, Ebba Malmqvist<sup>1</sup>. Occupational and Environmental Medicine, Lund University, Sweden<sup>2</sup>. Occupational and Environmental Medicine, Umeå University, Sweden  
Air pollution is one of the leading causes of morbidity and mortality worldwide. The introduction of low emission zones has been implemented in some cities as a measure to reduce morbidity and mortality caused by air pollution. In other cities, such measures are being considered to be implemented. We undertook a health impact assessment to estimate effects on mortality and morbidity in Malmö by introducing a low emission zone. This was done in dialogue with the Malmö city's environmental department, assuming adjusted emission factors according to the Handbook Emission Factors for Road Transport version 3.3 with all vehicles on municipal roads being euro6 or better and a mix of vehicles on state roads. The intervention would lead to decreased nitrogen dioxide-levels by in average 2.1 mikrogr/m<sup>3</sup> per person (minimum: 0.2, maximum: 5.1 mikrogr/m<sup>3</sup>). We estimated that the cleaner air would prevent 1-2% of all deaths, depending on what dose-response function was assumed. This corresponds to 26-37 lives per year in Malmö. In comparison in average 7 people die in Malmö each year from traffic accidents. We will also present results regarding how morbidity would be affected.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0194**

### **Short-term Effects of Fine Particulate Matter on Heart Rate in Heart Failure Patients**

**Presenter:** Miyuki Breen, ORISE/US Environmental Protection Agency, Chapel Hill, United States

**Authors:** M. Breen<sup>1</sup>, W. Cascio<sup>2</sup>, J. Moyer<sup>2</sup>, J. Schwartz<sup>3</sup>, Q. Di<sup>4</sup>, E. Pfaff<sup>5</sup>, R. Devlin<sup>2</sup>, D. Diaz-Sanchez<sup>2</sup>, C. Ward-Caviness<sup>2</sup>;

<sup>1</sup>ORISE/US Environmental Protection Agency, Chapel Hill, NC, <sup>2</sup>US Environmental Protection Agency, Chapel Hill, NC, <sup>3</sup>Harvard TH Chan School of Public Health, Boston, MA, <sup>4</sup>Tsinghua University, Beijing, CHINA, <sup>5</sup>University of North Carolina, Chapel Hill, NC.

**Background:** Air pollution, particularly particulate matter less than 2.5 micrometers in diameter (PM<sub>2.5</sub>), is a significant risk factor for cardiovascular morbidity. Current studies have been primarily based on the general, typically healthy, population and there is limited information for individuals with pre-existing disease. We used the EPA CARES resource to examine the association between short-term PM<sub>2.5</sub> exposure and heart rate (HR) in heart failure (HF) patients. Additionally, we examine potential effect modification by beta-blockers, a common medication class that modifies HR. **Methods:** We analyzed 3,048,856 heart rate (HR) measurements on 26,634 HF patients between January 2014 and December 2016, compiled using electronic health records from University of North Carolina affiliated hospitals. Satellite data, land use, and ground based monitoring were used to estimate daily average concentrations of PM<sub>2.5</sub> at 1km resolution, and immediate (lag 0), delayed (lag 1 to 4), and 5 day moving average (5dMA) exposures at each primary address were computed. We used generalized additive mixed models to associate PM<sub>2.5</sub> with HR while adjusting for age, sex, race, season, time-trend, daily temperature, and relative humidity, with a random intercept for individual. **Results:** PM<sub>2.5</sub> exposure was associated with HR for lag 2 and 3 (beta = 0.006, CI = 0.002, 0.009; beta = 0.005, CI = 0.002, 0.010). Associations were stronger in individuals not taking beta-blocker medications at any time prior to HR measurement, with associations seen at all lags and strongest for 5dMA (beta = 0.086, CI = 0.073, 0.099). **Conclusions:** Elevated PM<sub>2.5</sub> is associated with increased HR in HF patients. Associations are at best weak for the entire population, but strong and consistent across lags for measurements prior to beginning beta-blockers, suggesting that beta-blocker medication regimes may substantially attenuate effects of PM<sub>2.5</sub> on HR. This abstract does not necessarily reflect the policies of the U.S. EPA.

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## ABSTRACT E-BOOK

Theme: **Cardiovascular**

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**P-0195**

**Effects of ambient ozone on daily mortality in a suburban district, Beijing**

**Presenter:** Jinliang Zhang, Center of Environmental Health,  
Chinese Research Academy of Environmental Sciences (CRAES),  
Ministry of Environment Protection, Beijing, China

**Authors:** Y. Gu<sup>1</sup>, G. Zhen<sup>2</sup>, D. Tan<sup>2</sup>, H. Zhang<sup>1</sup>, Z. Lv<sup>1</sup>, J. Zhang<sup>1</sup>;  
<sup>1</sup>Chinese Research Academy of Environmental Sciences, Beijing, CHINA, <sup>2</sup>Shunyi Center for Disease  
Prevention and Control, Beijing, CHINA.

**Background/Aim** To understand the effects of ambient ozone on daily mortality in suburban area in China. **Methods** Data on air pollution, mortality and meteorology in Shunyi District were collected from Jan. 2012 to Dec. 2016. Generalized additive model (GAM) was applied to evaluate the association between ambient ozone and daily mortality. **Results** The average level was 111.8 $\mu\text{g}/\text{m}^3$  for  $\text{O}_{3.1\text{h-max}}$ , 94.6 $\mu\text{g}/\text{m}^3$  for  $\text{O}_{3.8\text{h-max}}$  and 54.8 $\mu\text{g}/\text{m}^3$  for  $\text{O}_{3.24\text{h}}$ . Daily non-accidental mortality increased by 0.59% (95%CI:0.28%-0.91%), 0.64%(95%CI:0.22%-1.06%) and 0.95%(95% CI:0.28%-1.62%) with 10  $\mu\text{g}/\text{m}^3$  increases of  $\text{O}_{3.1\text{h-max}}$ ,  $\text{O}_{3.8\text{h-max}}$  and  $\text{O}_{3.24\text{h}}$  concentrations(lag1) , respectively. Which were higher than those of in large and medium-sized cities in China. The increase of 10  $\mu\text{g}/\text{m}^3$  in  $\text{O}_{3.1\text{h-max}}$  were significantly associated with 0.56%(95%CI:0.14%-0.97%) increasing for daily mortality caused by circulatory system diseases, 0.87%(95%CI:0.25%-1.48%) for cardiovascular diseases and 0.84%(95%CI:0.22%-1.47%) for ischemic heart disease, respectively. Effects of  $\text{O}_{3.8\text{h-max}}$  and  $\text{O}_{3.24\text{h}}$  on daily mortality caused by above diseases were similar with  $\text{O}_{3.1\text{h-max}}$  without significance. The increases of 10  $\mu\text{g}/\text{m}^3$  in the level of  $\text{O}_{3.1\text{h-max}}$ ,  $\text{O}_{3.8\text{h-max}}$  and  $\text{O}_{3.24\text{h}}$  were responsible for 0.33%, 0.29% and 0.16% increases in daily mortality caused by cerebrovascular diseases, respectively, with no significance. Daily mortality caused by cerebrovascular diseases showed lower risk to ambient ozone compared with that caused by cardiovascular diseases. **Conclusions** The risks of ambient O<sub>3</sub> in Shunyi District were very similar with those in large or medium-sized cities. Mortality caused by cardiovascular diseases suffered higher risk to ozone than that by cerebrovascular diseases. For the studies of effects on daily mortality,  $\text{O}_{3.1\text{h-max}}$  as an indicator was more sensitive compared with  $\text{O}_{3.8\text{h-max}}$  and  $\text{O}_{3.24\text{h}}$ .

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Theme: **Children's health**

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**P-0196**

**Association of prenatal exposure to phthalates with measures of cognition in 4.5-month-old infants**

**Presenter:** Francheska Marie Merced-Nieves, Neuroscience Program and Beckman Institute, University of Illinois Urbana-Champaign, Urbana, United States

**Authors:** F. M. Merced-Nieves<sup>1</sup>, K. L. Dzwirewski<sup>1</sup>, A. A. Aguiar<sup>2</sup>, A. M. Calafat<sup>3</sup>, S. A. Korrick<sup>4</sup>, S. L. Schantz<sup>2</sup>;

<sup>1</sup>Neuroscience Program and Beckman Institute, University of Illinois Urbana-Champaign, Urbana, IL,

<sup>2</sup>Department of Comparative Biosciences and Beckman Institute, University of Illinois Urbana-Champaign, Urbana, IL, <sup>3</sup>Division of Laboratory Sciences, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA, <sup>4</sup>Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA.

**Background:** Phthalates are endocrine disrupting chemicals found in consumer products. Previous studies reported associations of prenatal phthalate exposure with adverse child neurodevelopment, but few assessed the impact on cognitive development in early infancy. **Methods:** As part of a prospective cohort study, physical reasoning was assessed in 159 (78 female; 81 male) 4.5-month-old infants. Phthalate metabolites were quantified in urine collected at 16-18 weeks of pregnancy and a pool of five urines collected across pregnancy. Infants' looking times to a physically impossible and a possible event were recorded via infrared eye-tracking. At 4.5 months, females recognize this impossible event, as indicated by longer looking at the impossible versus possible event. Males demonstrate this knowledge 4-6 weeks later. Associations of phthalate biomarkers with looking time differences (impossible - possible) were adjusted for infant age, household income, maternal age, education, and order of event presentation and assessed with multivariable general linear models stratified by sex. **Results:** Mothers were mostly white and college educated with household incomes >\$60,000. Each interquartile range (IQR) increase of the sum of di(2-ethylhexyl) phthalate metabolites at 16-18 weeks (0.054  $\mu\text{mol/L}$ ) was associated with females' 1.7 seconds (95%CI=0.2, 3.1) increased looking to the impossible event. For males, an IQR increase in the sum of di(isononyl) phthalate metabolites at 16-18 weeks and the pooled sample ( $\beta=-1.1$ ; 95%CI=-1.9,-0.4 and  $\beta=-1.2$ ; 95%CI=-2.3,-0.05 seconds per 0.035-0.036  $\mu\text{mol/L}$ , respectively), the sum of Anti-Androgenic phthalate metabolites in the pooled sample ( $\beta=-3.8$ ; 95%CI=-6.4, -1.2 seconds per 0.17  $\mu\text{mol/L}$ ), and the sum of metabolites at 16-18 weeks ( $\beta=-3.1$ ; 95%CI=-5.3, -0.9 seconds per 0.37  $\mu\text{mol/L}$ ) were associated with increased looking to the possible event— typical behavior of early learning stages about a physical event. **Conclusion:** Results need corroboration in a larger sample, but suggest that higher prenatal phthalate exposure may be associated with delays in males' physical reasoning. ES007326;ES022848;RD83543401;OD023272.

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Theme: **Children's health**

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**P-0197**

### **Reducing Mercury and Increasing Gold in Artisanal Gold Mines**

**Presenter:** David F Goldsmith, George Washington University, Silver Spring, United States

**Authors:** P. W. Appel<sup>1</sup>, D. F. Goldsmith<sup>2</sup>;

<sup>1</sup>Appelglobal, Copenhagen, DENMARK, <sup>2</sup>George Washington University, Silver Spring, MD.

**Background:** Thirty seven percent of global mercury (Hg) pollution stems from small-scale or artisanal gold mining (AGM) usually in impoverished rural communities in developing countries. Small-scale AGM is a main source of income for millions of people. Hg is used to form an amalgam with gold ore and when fired, gold metal remains. We know Hg is toxic to miners, children, waterways and wildlife. There are ways to reduce this pollution

**Methods:** Forty years ago a small-scale gold miner in Philippines developed a mercury-free gold extraction method, borax, which apart from being nontoxic has two important benefits: it has higher gold-recovery and miners do not need to purchase expensive and toxic Hg. Furthermore, waste tailings from AGM contain high amounts of Hg which slowly evaporates and contributes to global pollution. Appelglobal and partners have developed methods—Peter Plates-- to recover much of the Hg bound gold in the tailings. A byproduct of recovery produces greater amounts of gold – a win-win procedure. **Results:** The borax Hg-free gold extraction method has positive environmental and health benefits, and has also been shown to recover between 50 to 74% more gold than the traditional method. Projects demonstrating Hg-free gold extraction have been carried out in Philippines, Uganda, Mozambique, Mongolia and Peru. In January 2019, a project was carried out in Uganda demonstrating that Hg-free gold extraction required 10 percent longer processing time, but recovered 40% more gold than traditional Hg methods. **Conclusion:** In contrast with Hg, borax gold mining methods offer clear environmental and worker benefits, and Appelglobal Hg recovery reduces water pollution and increases gold metal recovery. Adopting these methods will benefit informal gold miners and their communities.

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Theme: **Children's health**

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**P-0198**

**Early-Life Exposure to Polycyclic Aromatic Hydrocarbons and ADHD Behavior Problems**

**Presenter:** I-Jen Wang, Taipei Hospital Ministry of Health and Welfare, New Taipei City, Taiwan

**Authors:** I. Wang;

Taipei Hospital Ministry of Health and Welfare, New Taipei City, TAIWAN.

Background: Polyfluoroalkyl chemicals (PFCs) have been widely used in consumer products. Exposures in the United States and in world populations are widespread. PFC exposures have been linked to various health impacts, and data in animals suggest that PFCs may be potential developmental neurotoxicants. Little is known about the effect of PFCs on Attention Deficit/Hyperactivity Disorder (ADHD). This study investigated the associations (i) between postnatal PFCs exposure and ADHD in children; and (ii) between PFCs and IgE levels for the possible disease pathogenesis. Methods: A total of 453 children from Childhood Environment and Allergic Diseases Study cohort with urine samples were recruited in Taiwan. Urinary (PFCs) levels were measured by UPLC-MS/MS. The associations between BPAG levels and IgE levels and the risk of ADHD were evaluated by multivariate linear regression and logistic regression. Results: The geometric mean (SD) of PFCS concentrations was 8.84(2.57) ng/ml at age 6. Urinary PFCS levels were positively associated with the risk of ADHD at age 6 ( $\beta=3.21$  KU/l per ln-unit increase PFCS level; 95% CI, 0.99-10.51 KU/l), after adjusting for potential confounders. There was no significant gender difference. The FPCS levels were positively associated with IgE levels at age 6 ( $\beta=64.85$  KU/l per ln-unit increase BPAG level; 95% CI, 14.59-115.11 KU/l). Conclusions: PFCS exposures were positively associated with the risk of ADHD in children.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0199**

### **Bisphenol A Exposure May Increase the Risk of Developmental Delay**

**Presenter:** I-Jen Wang, Taipei Hospital Ministry of Health and Welfare; Taichung Hospital Ministry of Health and Welfare; National Taiwan University; National Yang-Ming University; China Medical University, New Taipei City, Taiwan

**Authors:** I. Wang;

Taipei Hospital Ministry of Health and Welfare; Taichung Hospital Ministry of Health and Welfare; National Taiwan University; National Yang-Ming University; China Medical University, New Taipei City, TAIWAN.

**Abstract:** Background: Little is known about the effect of Bisphenol A (BPA) on developmental delay. This study investigated the associations (i) between postnatal BPA exposure and developmental delay in children; (ii) between BPA and IgE levels for the possible disease pathogenesis; and (iii) gender-based differences. Methods: A total of 453 children from Childhood Environment and Allergic Diseases Study cohort with urine samples were recruited in Taiwan. Urinary BPA glucuronide (BPAG) levels were measured by UPLC- MS/MS. The associations between BPAG levels at different ages and IgE levels and the development of developmental delay were evaluated by multivariate linear regression and logistic regression. Results: The BPAG levels were positively associated with IgE levels ( $\beta=64.85$  KU/I per ln-unit increase BPAG level; 95% CI, 14.59-115.11 KU/I ). When dividing into tertiles, urinary BPAG levels at age 3 were significantly associated with developmental delay ages 6, with OR (95%CI) of 6.68 (2.15-20.82) compared to reference group. Interestingly, analyses stratified by gender revealed that BPA levels were significantly associated with developmental delay, particularly in boys with OR (95%CI) of 6.22(1.77-21.86). Conclusions: BPA exposures may increase the risk of development of developmental delay in children, particularly in boys.

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Theme: **Children's health**

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**P-0200**

**Short-term exposure to ambient particulate matter and hospital outpatient visits for respiratory diseases among children: A five-city time-series study in China**

**Presenter:** Meng Li, Huazhong University of Science and Technology, Wuhan, China

**Authors:** M. Li<sup>1</sup>, L. Zhao<sup>1</sup>, H. Yang<sup>1</sup>, J. Zhang<sup>1</sup>, J. Tang<sup>2</sup>, X. Zhang<sup>1</sup>;  
<sup>1</sup>Huazhong University of Science and Technology, Wuhan, CHINA, <sup>2</sup>Guangzhou Medical University, Guangzhou, CHINA.

Background: Evidence concerning the association between ambient particulate matter (PM) and outpatient visits for respiratory diseases is quite limited, especially in children at a multicity level. Methods: A time-series study was performed in five Chinese cities from 2013 to 2018 among children aged 0-14 years. The city-specific effects of PM were estimated for time lags of zero up to seven days using the overdispersed generalized additive models after adjusting for time trends, meteorological variables, day of the week and holidays. Meta-analyses using random effects models were applied to pool the effect estimates in the five cities. The exposure-response relationship curves were also evaluated. Results: Exposure to PM was dose-responsive related to an increased respiratory outpatient visits among children. The cumulative lag effects of PM showed higher estimates than that of single-day exposure, and the lag07 (moving averages for the present day and the previous 7 days) concentrations of fine particles (PM<sub>2.5</sub>) and inhalable particles (PM<sub>10</sub>) produced the largest estimates. Each 10 µg/m<sup>3</sup> increment in PM<sub>2.5</sub> and PM<sub>10</sub> at the lag07 was associated with a 1.39% (95% CI: 0.36%, 2.43%) and 1.11% (95% CI: 0.38%, 1.84%) increase in outpatient visits for all respiratory diseases among children, respectively, and the associations remained statistically significant at levels below the current Chinese Ambient Air Quality Standards (CAAQS). The effect estimates for acute lower respiratory infections (ALRIs) tended to be higher. Children 7-14 years old and 4-6 years old are the most susceptible groups for acute upper respiratory infections (AURIs) and ALRIs, respectively, but no sex differences were observed. Moreover, the effects of PM were stronger in the transition season of Beijing and Xining, whereas stronger in the cold season of the other 3 cities. Conclusions: Ambient PM concentrations, even at levels below the CAAQS, was dose-responsive associated with increased respiratory outpatient visits among children.

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Theme: **Children's health**

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**P-0201**

### **Prenatal exposure to particulate matter and ADHD in children: a prospective cohort study**

**Presenter:** Jiyoung Shin, Department of Occupational and Environmental Medicine, College of Medicine, Ewha Womans University, Seoul, Korea, Republic of

**Authors:** J. Shin<sup>1</sup>, H. Park<sup>2</sup>, Y. Kim<sup>3</sup>, Y. Hong<sup>4</sup>, M. Ha<sup>5</sup>, E. Ha<sup>1</sup>;

<sup>1</sup>Department of Occupational and Environmental Medicine, College of Medicine, Ewha Womans University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Department of Preventive Medicine, Ewha Medical Research Center, College of Medicine, Ewha Womans University, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Department of Occupational and Environmental Medicine, Ulsan University Hospital, University of Ulsan College of Medicine, Ulsan, KOREA, REPUBLIC OF, <sup>4</sup>Institute of Environmental Medicine, Medical Research Center, Seoul National University, Seoul, KOREA, REPUBLIC OF, <sup>5</sup>Department of Preventive Medicine, College of Medicine, Dankook University, Cheonan, KOREA, REPUBLIC OF.

**Background/Aim** Environmental factors may play a role in the development of attention-deficit/hyperactivity disorder (ADHD) and some studies have shown that ambient air pollution is associated with the ADHD. This study was designed to investigate the impact of prenatal particulate matter (PM<sub>10</sub>) exposure on ADHD among children over 60 months of age in Korea by using MOCEH birth cohort study's data.

**Methods** This study is a part of the Mothers and Children's Environmental Health (MOCEH) study, a Korean multi-center prospective birth cohort study initiated in 2006. After the delivery, children were followed up at 60, 72, 84 and 96 months of age. The average exposure level of particulate matter (PM<sub>10</sub>) were estimated using the inverse distance weighting (IDW) method from the prenatal period. ADHD behaviour were assessed using the K-ARS, K-CBCL/1.5-5 and 6-18 at each follow-up period. Generalized Linear Models (GLM) were used to explore the association between PM<sub>10</sub> and ADHD.

**Results** The mean PM<sub>10</sub> concentrations during total pregnancy was 54.1µg/m<sup>3</sup> with a range from 24.2 to 85.7µg/m<sup>3</sup>. In the GLM model, exposure to PM<sub>10</sub> at first trimester and during pregnancy showed significant positive association with 72 months K-ARS score ( $\beta=0.06$ , 95% CI: 0.01,0.11 for first trimester,  $\beta=0.10$ , 95% CI: 0.01,0.19 for total pregnancy exposure). Furthermore, exposure to PM<sub>10</sub> at first trimester and during total pregnancy showed significant association with 60, 72, and 84 months K-CBCL score, especially with total problems, attention problems and aggressive behaviour ( $\beta=0.26$ , 95% CI: 0.07,0.44 between first trimester and total problem score at 60 months,  $\beta=0.10$ , 95% CI: 0.05,0.15 between first trimester and attention problems at 72 months).

**Conclusions** In conclusions, our results have demonstrated that the prenatal PM<sub>10</sub> concentration was significantly associated with ADHD behaviour in Korean children. Further studies regarding other air pollutants' effects to the neurodevelopment in children are recommended.

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Theme: **Children's health**

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**P-0202**

**Environmental Health and Child's Nutrition Outcomes: Evidence from Nigeria**

**Presenter:** Toluwalope Toyin Ogunro, Centre for Petroleum Energy Economics and Law University of Ibadan Nigeria, Ibadan, Nigeria

**Authors:** T. T. Ogunro;  
Centre for Petroleum Energy Economics and Law University of Ibadan Nigeria, Ibadan, NIGERIA.

Environmental health has been projected by the United Nations as a key to reduce morbidity and mortality in developing countries (WHO, 2008; Fayehun, 2010). The developing world is faced with multi-faceted problems often within the auspices of environmental factors inhibiting child growth and development. Such environmental factors like unhygienic environment, inaccessibility to portable water and sanitation are loopholes for infections to thrive; ultimately causing malnutrition, morbidity and mortality among children. Statistics show that about 100 million Nigerians lack access to basic sanitation facilities; 63 million do not have access to improved source of drinking water (WHO, 2015) and 75% of households burn biomass for cooking (IEA, 2013). 7 million avoidable deaths is attributed to poor sanitation and contaminated drinking water annually (UNICEF, 2018) while Nigeria ranks high among countries experiencing acute malnutrition among children (UNICEF, 2018). Achieving sustainable development goals 3, 6 and 8 which target healthy lives and well being; sustainable water and sanitation and affordable and sustainable energy for all may be a mirage. This study quantified the association between environmental health and nutrition; a cross-sectional analysis was undertaken using the Nigeria Demographic and Health Survey 2013 to analyze nutrition (weight for age and height for age) of about 31,482 children while environmental health is an index composed from household source of drinking water, type of toilet facility and choice of cooking fuel. Analysis was done using regression. Result from regression analysis shows that there is a positive and significant association between environmental health and child's height for age (24% and significant at 1%) and child's weight for age (23%). The study recommends the need for policy makers to address environmental health as important condition for child's nutrition.

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## ABSTRACT E-BOOK

Theme: **Children's health**

**P-0205**

**Association of maternal exposure to ambient PM<sub>2.5</sub> with birthweight and effect modification by maternal socioeconomic factors**

**Presenter:** Sabah M. Quraishi, University of Washington, Seattle, United States

**Authors:** S. M. Quraishi<sup>1</sup>, M. Hazlehurst<sup>1</sup>, C. Loftus<sup>1</sup>, C. Karr<sup>1</sup>, N. Bush<sup>2</sup>, K. LeWinn<sup>2</sup>, F. Tylavsky<sup>3</sup>, S. Sathyanarayana<sup>4</sup>, M. Young<sup>1</sup>, J. D. Kaufman<sup>1</sup>, A. Szpiro<sup>1</sup>, D. Enquobahrie<sup>1</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>University of California San Francisco, San Francisco, CA,

<sup>3</sup>University of Tennessee Health Science Center, Memphis, TN, <sup>4</sup>Seattle Children's Research Institute, Seattle, WA.

**Background:** Few prior studies of prenatal air pollutant exposures on birth outcomes have examined effect modification by socioeconomic factors or infant sex, nor examined critical exposure windows smaller than trimesters. We investigated associations of prenatal concentrations of fine particulate matter (PM<sub>2.5</sub>) with birthweight and small for gestational age (SGA). **Methods:** The analytic population (n=1,879) comprised of term (≥37 weeks) births in two pregnancy cohorts in the ECHO-PATHWAYS consortium (CANDLE and TIDES). PM<sub>2.5</sub> exposure was estimated using a fine-scale spatiotemporal model and averaged over windows that may be critical to prenatal growth and development (0-2, 10-12 weeks of gestation, and last month of pregnancy as well as each trimester). SGA was calculated as <10th percentile based on U.S. referent percentiles. We fit adjusted linear and modified Poisson regression models to estimate linear associations with birthweight and relative risk (RR) of SGA, respectively, per 2-µg/m<sup>3</sup> PM<sub>2.5</sub>. Interactions by maternal education, household income, neighborhood socioeconomic environment, and infant sex were explored. **Results:** Overall, 2.5% of births were low birthweight (<2,500g) and 10.3% were SGA. Mean PM<sub>2.5</sub> pregnancy exposure was 9.8 µg/m<sup>3</sup> (interquartile range = 2.2). Birthweight was inversely associated with PM<sub>2.5</sub> during 0-2 weeks (β: -25.0g; 95%CI: -46.3,-3.8), month before delivery (β: -35.5g; 95%CI: -62.1,-8.9), and in trimester 1, 2, and 3 (βs: -43.3g, -70.2g, -51.3g; 95%CIs: -85.0,-1.7; -111.4,-29.0; -90.7,-11.9; respectively), but not 10-12 weeks (β: -9.7g; 95%CI: -34.3,14.8). For SGA, we only observed associations with 0-2 weeks (RR: 1.2; 95%CI: 1.0,1.4). There was suggestive evidence associations with SGA is modified by household income, with stronger associations in lower incomes. No modification by other socioeconomic factors or sex were observed. **Conclusions:** Findings indicate that prenatal PM<sub>2.5</sub> exposure, particularly during early and late pregnancy, is associated with fetal growth. There is suggestive evidence that the association is stronger with lower household incomes.

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Theme: **Children's health**

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**P-0206**

**A semi-automated approach to data harmonization across environmental health studies**

**Presenter:** Deborah L McGuinness, Rensselaer Polytechnic Institute, Troy, United States

**Authors:** M. Johnson<sup>1</sup>, M. Ravi<sup>1</sup>, P. Pinheiro<sup>1</sup>, J. A. Stingone<sup>2</sup>, D. L. McGuinness<sup>1</sup>;  
<sup>1</sup>Rensselaer Polytechnic Institute, Troy, NY, <sup>2</sup>Columbia University, New York, NY.

The NIEHS-supported Human Health and Exposure Analysis Resource (HHEAR) Data Center maintains a public-use data repository to promote reuse of environmental health data generated by the HHEAR program. The creation and maintenance of this repository requires the integration of information from a wide variety of epidemiologic studies. We have developed the Human Aware Data Acquisition Framework to enable this complex integration, supporting harmonization across multiple studies, and enabling meaningful search and access of the data deposited in the HHEAR Data Repository. To integrate data from a new study, investigators engage in an initial, time-consuming effort to link study data to the HHEAR ontology, a controlled vocabulary of environmental and public health terms. This is accomplished by generating a semantic data dictionary (SDD) from the data dictionaries and codebooks provided by HHEAR study investigators. Originally, this had been done manually by an expert in both epidemiological terminology and ontological modeling. To increase the accessibility of these tools for environmental health scientists who lack formal ontologic training, we have developed an SDD-Editor that simplifies the ontology modeling process. The SDD-Editor reuses elements common to epidemiologic data dictionaries and spreadsheet software, while integrating features needed to form semantic links between public health concepts and existing ontologies. The SDD-Editor suggests potential concept matches for study variables within the SDD using natural language processing to capture the semantic similarity between data dictionary and ontology class descriptions. If no suitable suggestion exists, investigators can search for ontology terms using a search engine powered by Bioportal. Once finished, a validator is run to check that the SDD has the correct format and all classes are valid. By automating parts of the ontology modeling process, the SDD-Editor greatly facilitates the dynamic integration of HHEAR environmental health studies into a single repository, benefiting the scientific community.

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**P-0207**

**Cat and Dog Ownership in Early Life and Infant Development: A Prospective Birth Cohort Study of Japan Environment and Children's Study.**

**Presenter:** Machiko Minatoya, Hokkaido University, Sapporo, Japan

**Authors:** M. Minatoya<sup>1</sup>, A. Araki<sup>1</sup>, C. Miyashita<sup>1</sup>, S. Itoh<sup>1</sup>, S. Kobayashi<sup>1</sup>, Y. Ait Bamai<sup>1</sup>, Y. Saijyo<sup>2</sup>, Y. Ito<sup>3</sup>, R. Kishi<sup>1</sup>;

<sup>1</sup>Hokkaido University, Sapporo, JAPAN, <sup>2</sup>Asahikawa Medical University, Asahikawa, JAPAN, <sup>3</sup>Japanese Red Cross Hokkaido College of Nursing, Kitami, JAPAN.

Contact with companion animals has been suggested to have important roles in enhancing child development. However, studies focused on child development and pet ownership at a very early age are limited. The purpose of the current study was to investigate child development in relation to pet ownership at an early age in a nationwide prospective birth cohort study: the Japan Environment and Children's Study. Associations between cat and dog ownership at six months and infant development at 12 months of age were examined in this study. Infant development was assessed using the Ages & Stages Questionnaires™ (ASQ-3) at 12 months. Among participants of (Japan Environment and Children's Study) JECS, those with available data of cat and dog ownership at six months and data for the ASQ-3 at 12 months were included (n = 78,868). Having dogs showed higher percentages of pass in all five domains measured by ASQ-3 (communication, gross motor, fine motor, problem-solving, and personal-social) compared to those who did not have dogs. Significantly decreased odds ratios (ORs) of developmental delays were observed in association with having dogs in all five domains (communication: OR = 0.73, gross motor: OR = 0.86, fine motor: OR = 0.84, problem-solving: OR = 0.90, personal-social: OR = 0.83). This study suggested that early life dog ownership may reduce the risks of child developmental delays.

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Theme: **Children's health**

**P-0208**

### **Prepubertal Urinary Phthalate Metabolite Concentrations and Pubertal Onset in a Prospective Cohort of Russian Boys**

**Presenter:** Jane S Burns, Harvard T. H. Chan School of Public Health, Boston, United States

**Authors:** J. S. Burns<sup>1</sup>, O. Sergeev<sup>2</sup>, P. L. Williams<sup>1</sup>, M. M. Lee<sup>3</sup>, S. A. Korrick<sup>1</sup>, H. M. Koch<sup>4</sup>, S. Kovalev<sup>5</sup>, A. T. Lebedev<sup>5</sup>, S. A. Sokolov<sup>6</sup>, R. Hauser<sup>1</sup>;

<sup>1</sup>Harvard T. H. Chan School of Public Health, Boston, MA, <sup>2</sup>A.N. Belozersky Research Institute Of Physico-Chemical Biology, Moscow State University, Moscow, RUSSIAN FEDERATION, <sup>3</sup>Nemours Al duPont Hospital for Children/Sidney Kimmel Medical School, Jefferson University, Wilmington, DE, <sup>4</sup>Institute for Prevention and Occupational Medicine of the German Social Accident Insurance - Institute of the Ruhr-University Bochum (IPA), Bochum, GERMANY, <sup>5</sup>Lomonosov Moscow State University, Moscow, RUSSIAN FEDERATION, <sup>6</sup>Russian Mass-Spectrometric Society, Moscow, RUSSIAN FEDERATION.

**Aim:** We examined the association of prepubertal urinary phthalate metabolites with age at pubertal onset in a prospective cohort of Russian boys. **Methods:** 516 boys were enrolled at ages 8-9 years (2003-2005). A single physician performed annual physical exams including Tanner Staging (genitalia (G), pubarche (P)) and testicular volume (TV) by orchidometer, and parents/guardians completed medical history and demographic questionnaires. Annual spot urines were collected, and each boy's prepubertal urines were pooled. 15 phthalate metabolite concentrations including anti-androgenic monobenzyl (MBzP), mono-n-butyl (MnBP), mono-isobutyl (MiBP), and metabolites of di(2-ethylhexyl) (DEHP) and di-isononyl (DiNP) were measured with HPLC-MS/MS and isotope dilution quantification at Moscow State University. We calculated the molar sum of DEHP and DiNP metabolites. Interval-censored models were used to assess associations of quartiles of individual and summed metabolites with pubertal onset indicators -- G2, P2 and TV >3mL -- adjusted for covariates and specific gravity. **Results:** 320 boys (62%) had  $\geq 1$  prepubertal urine samples (range:1-6; median=3). Median concentrations of MBzP, MnBP, and MiBP were 6.0, 194, and 57 ng/mL, respectively. In adjusted models, the highest versus lowest quartile of MBzP was associated with later pubertal onset, by 6.5 months (95%CI) for TV (1.2-11.8, p-trend <0.001), 8.2 for G2 (1.7-14.7, p-trend=0.008), and 15 months for P2 (8.2-22.1, p-trend <0.001). The highest versus lowest quartile of  $\Sigma$ DiNP was also associated with later pubertal onset, by 6.9 months for TV (1.5-12.4, p-trend=0.02), 7.8 for G2 (1.2-14.5, p-trend=0.03), and 8.9 months for P2 (1.7-16.1, p-trend=0.006). The highest versus lowest quartile of  $\Sigma$ DEHP was associated only with later P2, by 9.5 months (2.0-16.9, p-trend=0.008). **Conclusion:** On average, boys with higher prepubertal anti-androgenic MBzP,  $\Sigma$ DiNP, and  $\Sigma$ DEHP concentrations had later pubertal onset, ranging from six months to over a year. These phthalates may affect androgen signaling, in turn, impacting pubertal timing. **Funding:** NIEHS ES014370 & ES000002.

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**P-0209**

### **Traffic-related Air Pollution and Incident Obesity during Ages 10-18 years in the Southern California Children's Health Study**

**Presenter:** Erika Garcia, University of Southern California, Los Angeles, United States

**Authors:** E. Garcia<sup>1</sup>, H. Hao<sup>1</sup>, Z. Chen<sup>1</sup>, F. W. Lurmann<sup>2</sup>, K. Berhane<sup>3</sup>, R. McConnell<sup>1</sup>, F. Gilliland<sup>1</sup>, R. Habre<sup>1</sup>;

<sup>1</sup>University of Southern California, Los Angeles, CA, <sup>2</sup>Sonoma Technology, Inc., Petaluma, CA, <sup>3</sup>Columbia University, New York, NY.

Childhood obesity is a global public health crisis, often continuing into adulthood and contributing to increased morbidity and mortality. A growing literature suggests traffic pollution may contribute to increased BMI in childhood, but few studies have examined whether this translates to an increased risk of obesity. In this study we evaluated how traffic-related air pollution relates to incident obesity in a prospective study of schoolchildren from ages 10 to 18 years. The study population comprised 3430 children from eight Southern California communities who were not obese at study entry, recruited over three waves in 1992-93, 1995-96, and 2002-03. Children were followed until age 18 or high school graduation, and height and weight measurements were collected longitudinally. Residential traffic pollution exposure at baseline was estimated as nitrogen oxides (NO<sub>x</sub>) using the California line-source dispersion model. Multilevel Poisson regression models were fitted to estimate incidence rate ratios (IRR) for obesity associated with traffic-related NO<sub>x</sub> exposure, adjusting for a set of confounding variables selected a priori using a directed acyclic graph. Participants were primarily non-Hispanic White (44%) or Hispanic (40%). At study entry the median age was 9.7 (IQR: 9.3-10.1) and most children were of normal weight (78%). Traffic-related NO<sub>x</sub> was associated with increased risk of childhood obesity: IRR=1.10 (1.01-1.19) per average standard deviation within community. Further adjustment for baseline body mass index category increased the risk: IRR=1.14 (1.05-1.24). Exposure to traffic was associated with higher obesity risk in childhood. These findings strengthen the scientific evidence linking childhood obesity and air pollution from near-roadway sources, a modifiable risk factor which could be targeted through vehicular emissions reductions and exposure policies.

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**P-0210**

### **Prenatal Exposure to Air Pollution and Traffic and the Risk of Child Liver Injury in European Children-The HELIX Project**

**Presenter:** Erika Garcia, University of Southern California, Los Angeles, United States

**Authors:** E. Garcia<sup>1</sup>, N. Stratakis<sup>1</sup>, D. Valvi<sup>2</sup>, L. Maitre<sup>3</sup>, N. Varo<sup>4</sup>, X. Basagana<sup>3</sup>, M. de Castro<sup>3</sup>, S. Fossati<sup>3</sup>, R. Grazuleviciene<sup>5</sup>, L. S. Haug<sup>6</sup>, B. Heude<sup>7</sup>, R. McEachan<sup>8</sup>, M. Nieuwenhuijsen<sup>3</sup>, E. Papadopoulou<sup>6</sup>, T. Roumeliotaki<sup>9</sup>, R. Slama<sup>10</sup>, J. Urquiza<sup>3</sup>, M. Vafeiadi<sup>9</sup>, M. B. Vos<sup>11</sup>, J. Wright<sup>8</sup>, D. V. Conti<sup>1</sup>, K. Berhane<sup>12</sup>, M. Vrijheid<sup>3</sup>, R. McConnell<sup>1</sup>, L. Chatzi<sup>1</sup>;

<sup>1</sup>University of Southern California, Los Angeles, CA, <sup>2</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>3</sup>ISGlobal, Universitat Pompeu Fabra (UPF), CIBER Epidemiología y Salud Pública (CIBERESP), Barcelona, SPAIN, <sup>4</sup>Clínica Universidad de Navarra, Pamplona, SPAIN, <sup>5</sup>Vytautas Magnus University, Kaunas, LITHUANIA, <sup>6</sup>Norwegian Institute of Public Health, Oslo, NORWAY, <sup>7</sup>Université de Paris, CRESS, INSERM, INRA, Paris, FRANCE, <sup>8</sup>Bradford Teaching Hospitals NHS Foundation Trust, Bradford, UNITED KINGDOM, <sup>9</sup>University of Crete, Heraklion, Crete, GREECE, <sup>10</sup>Institute for Advanced Biosciences (IAB), INSERM U1209, CNRS UMR 5309, Université Grenoble Alpes, Grenoble, FRANCE, <sup>11</sup>Emory University, Atlanta, GA, <sup>12</sup>Columbia University, New York, NY.

Nonalcoholic fatty liver disease (NAFLD) is now the most prevalent pediatric chronic liver disease, affecting an estimated 8% of the general pediatric population and 34% of children with obesity. It is expected to become the leading cause of liver pathology, liver failure and indication for liver transplantation in children in the next decade. Toxicological studies and limited epidemiologic evidence support a link between early life air pollution exposure and liver injury. Non-invasive clinical biomarkers can help assess liver injury and suspected NAFLD. This study evaluated the associations of prenatal and childhood air pollution and traffic exposure with biomarkers of child liver injury. The study population included 1103 children from the "Human Early Life Exposome (HELIX)" project. Liver injury biomarkers, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), and cytokeratin 18 (CK-18), were measured in serum between ages 6-10 years. Air pollutant exposures were based on land-use regression or dispersion models and included nitrogen dioxide, particulate matter  $\leq 10\mu\text{m}$ , and particulate matter  $\leq 2.5\mu\text{m}$ . Markers of traffic included traffic density on nearest road and load in 100 meters buffer, and inverse distance to nearest road. Exposure assignments were made to residential address during whole pregnancy period (prenatal) or to residential and school addresses for year preceding outcome assessment (childhood). Generalized additive models were fitted, adjusting for potential confounders selected using directed acyclic graphs. Prenatal and childhood air pollution exposures were not associated with liver injury biomarkers in childhood. Results for traffic markers were null, except for a positive association between closer proximity to road prenatally and higher AST. There was no consistent evidence of an interaction with child sex or child overweight/obese status for any exposure. This study did not find prenatal or childhood air pollution or traffic exposure to be associated with biomarkers of liver injury in children.

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**P-0211**

**Exposure to ambient air pollution & executive function among Chinese primary schoolchildren**

**Presenter:** Zhaohuan Gui, Sun Yat-sen University, Guangzhou, Guangdong, China

**Authors:** Z. Gui, L. Cai, J. Zhang, C. Huang, Y. Chen;  
Sun Yat-sen University, Guangzhou, Guangdong, CHINA.

Background: Evidence on the association between particulate matter (PM) and nitrogen dioxide (NO<sub>2</sub>) exposure with executive function in children is scarce in developing countries. Moreover, few studies investigated ozone (O<sub>3</sub>) and sulfur dioxide (SO<sub>2</sub>). This study was aimed to investigate the associations between long-term exposure to air pollution and executive function in Chinese children. Methods: In 2017, we randomly recruited 5,028 children aged 6-12 years from 5 schools in Guangzhou city, southern China. Each of 5,028 children's executive function were assessed using parent filled questionnaire. We further randomly selected 522 children to take computerized tests to assess working memory, inhibitory control, and cognitive flexibility. Residential PM with diameters  $\leq 2.5$  (PM<sub>2.5</sub>) or 10  $\mu$ m (PM<sub>10</sub>), NO<sub>2</sub>, O<sub>3</sub>, and SO<sub>2</sub> exposures were estimated by using an inverse-distance weighting approach. Associations were evaluated by mixed linear regression models. Results: Each interquartile range increment in PM<sub>2.5</sub> was associated with 54.02 milliseconds [95% confidence interval (CI): 5.52 to 102.52] increase in inhibitory control and 0.72 (95% CI: -1.17 to -0.27) points decrease in forward recall. PM<sub>10</sub> exposure was associated with 0.58 (95% CI: -1.09 to -0.77) and 0.62 points (95% CI: -1.00 to -0.23) reduction in forward and backward recall, respectively. SO<sub>2</sub> exposure was associated with 0.49 (95%CI: 0.18 to 0.80) and 0.73 (95%CI: 0.41 to 1.05) high scores of behavioral regulation index and metacognition index, respectively. Significant association was found between O<sub>3</sub> exposure and metacognition index (estimate, 95%CI: 0.88, 0.47 to 1.30). Conclusions: Long-term exposures to PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, and O<sub>3</sub> were associated with poorer performance in working memory, inhibitory control, behavioral regulation, and metacognition in children. Key words: Air pollution; Executive Function; Child; Cognitive Neuroscience; Cross-sectional study

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**P-0212**

### **School-based Greenness and its Association with Overweight and Obesity in Children and Adolescents: a National Cross-Sectional Study in China**

**Presenter:** Wen-wen Bao, Department of Maternal and Child Health, School of Public Health, Sun Yat-sen University, Guangzhou, China

**Authors:** W. Bao<sup>1</sup>, B. Yang<sup>2</sup>, Z. Gui<sup>1</sup>, J. Zhang<sup>1</sup>, J. Ma<sup>3</sup>, G. Dong<sup>2</sup>, Y. Chen<sup>1</sup>;

<sup>1</sup>Department of Maternal and Child Health, School of Public Health, Sun Yat-sen University, Guangzhou, CHINA, <sup>2</sup>Guangzhou Key Laboratory of Environmental Pollution and Health Risk Assessment, Department of Preventive Medicine, School of Public Health, Sun Yat-sen University, Guangzhou, CHINA, <sup>3</sup>Institute of Child and Adolescent Health, School of Public Health, Peking University, Beijing, CHINA.

**Background:** Prior investigations on the associations of greenness exposure, which is generally assessed at participants' home addresses, with obesity are still controversial. Furthermore, few documented evidences have focused on the association between childhood obesity and school-based greenness exposure. **Objective:** This study aimed to assess the associations between school-based greenness and markers of adiposity in children and adolescents in China. **Method:** We performed a national cross-sectional analysis of a representative sample including 56,620 children and adolescents aged 6-18 years in seven municipalities/provinces across China. We utilized the Normalized Difference Vegetation Index (NDVI) and Soil Adjusted Vegetation Index (SAVI) within 100-, 500-, and 1,000m circular buffers around each school's address to evaluate greenness exposures. We estimated the associations of greenness with changes in BMI z-scores and waist circumference as well as odds ratio of overweight and/or obesity using two-level logistic and generalized linear mixed regression models. We also took consideration of the modifying effects of ambient air pollution and physical activity into the greenness-adiposity associations. **Result:** We found that BMI z-scores (-0.13, 95%CI:-0.13, -0.07) and waist circumference (-0.63, 95%CI:-1.2, -0.06) were decreased when NDVI-1000m per interquartile (IQR, 0.13 unit) increase in adjusted model. And an IQR increase in NDVI of three different buffers was associated with 10-21% lower odds ratio (OR) of overweight and/or obesity. We also found that the associations were more pronounced in boys, urban dwellers and children with lower parental education levels. Air pollution mediated 9.8-56.9% of the greenness-obesity associations, but no mediating effects were observed for physical activity. **Conclusion:** Higher school-based greenness exposure was associated with decreased BMI z-scores and lower relative prevalence of overweight and/or obesity in children and adolescents. Ambient air pollutants may partially mediate the greenness-adiposity associations.

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**P-0213**

**Traffic-related NO<sub>x</sub> exposure and proximity to freeways are related to adverse changes in subclinical atherosclerosis measures from childhood to adulthood**

**Presenter:** Shohreh F Farzan, University of Southern California, Los Angeles, United States

**Authors:** S. F. Farzan<sup>1</sup>, P. Danza<sup>1</sup>, R. Habre<sup>1</sup>, H. N. Hodis<sup>1</sup>, F. Lurmann<sup>2</sup>, E. Avol<sup>1</sup>, T. Bastain<sup>1</sup>, C. Breton<sup>1</sup>;  
<sup>1</sup>University of Southern California, Los Angeles, CA, <sup>2</sup>Sonoma Technologies Inc, Petaluma, CA.

**Background:** Chronic exposure to air pollutants is associated with increased risk of cardiovascular disease (CVD) among adults. However, little is known about how air pollution may affect the development of subclinical atherosclerosis in younger populations. Subclinical measures of atherosclerosis, including carotid artery intima-media thickness (CIMT) and arterial stiffness (CAS), may provide insight into early CVD pathogenesis. **Methods:** In a pilot study of 70 participants from the Southern California Children's Health Study, we investigated subclinical atherosclerosis progression from childhood to adulthood. Using carotid artery ultrasound images obtained at age 10 and follow-up images from age 21-22, we examined associations between traffic-related pollutants and changes in CIMT and CAS. Lifetime average traffic-related NO<sub>x</sub> exposures were assigned using the CALINE4 (California Line Source) dispersion model. Distance to nearest roadways by class was assigned based on ESRI Streetmap Premium roadway data. **Results:** For each interquartile range increase in average lifetime NO<sub>x</sub> exposure, we observed a 12.12 $\mu$ m (95% CI: 1.11-23.13; p=0.03) increase in early adulthood attained CIMT and greater longitudinal changes in CIMT from childhood to adulthood (11.5 $\mu$ m, 95% CI: 1.29-21.73, p=0.03) over the follow-up period. Similar adverse changes in CIMT were observed with distance to nearest freeway. Changes in CAS were related to distance to freeway, such that living in closer proximity to freeways was related to greater adverse change in CAS over the follow-up period (stiffness index beta: 0.85; 95% CI: 1.50, 0.21, p=0.01; distensibility: -5.61; 95% CI: -0.93, -10.27, p=0.02). **Conclusions:** We observed greater adverse changes measures of carotid artery wall thickness and stiffness over time in relation to lifetime traffic-related NO<sub>x</sub> exposure and residential proximity to freeways. To our knowledge, this is the first study to evaluate the longitudinal impact of lifetime traffic-related air pollution exposure on changes in subclinical markers of atherosclerosis during the critical transition from childhood to adulthood.

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**P-0214**

### **Joint effects of maternal smoking and ambient air pollution on neonatal adiposity and BMI trajectories in the Healthy Start study**

**Presenter:** Brianna F Moore, University of Texas School of Public Health, Austin, United States

**Authors:** B. F. Moore<sup>1</sup>, A. P. Starling<sup>2</sup>, S. Martenies<sup>3</sup>, S. Magzamen<sup>3</sup>, D. Dabelea<sup>2</sup>;

<sup>1</sup>University of Texas School of Public Health, Austin, TX, <sup>2</sup>Colorado School of Public Health, Aurora, CO,

<sup>3</sup>Colorado State University, Fort Collins, CO.

**Background:** Exposure to environmental toxicants during pregnancy, including maternal smoking and ambient air pollution, may influence early-life growth. These exposures may work synergistically, but few studies have explored this potential interaction. We sought to explore the potential interaction between fetal exposure to tobacco and O<sub>3</sub> and PM<sub>2.5</sub> with birth weight and neonatal adiposity, as well as BMI growth trajectories through age 3 years.

**Methods:** We followed 526 mother-child pairs enrolled in the Healthy Start cohort, who were born full-term (≥37 weeks gestation). Maternal urinary cotinine was measured at ~27 weeks gestation. Maternal residential address at study enrollment was used to estimate average concentrations of fine particulate matter (PM<sub>2.5</sub>) and ozone (O<sub>3</sub>) by trimester and throughout pregnancy. Neonatal adiposity (fat mass percentage) was measured using air displacement plethysmography. Child weight and length/height were abstracted from medical records. Interaction was assessed by including cotinine categories (<31.5 versus ≥31.5 ng/mL [indicating active smoking]), PM<sub>2.5</sub> or O<sub>3</sub> categories (first and second tertiles versus third tertile), and their product with childhood BMI. Mixed-effects regression models estimated the association between cotinine categories, PM<sub>2.5</sub>/O<sub>3</sub> categories, and their product with childhood BMI.

**Results:** Our interaction results suggest that the rate of BMI growth among offspring exposed to both maternal smoking and higher PM<sub>2.5</sub> exposure in the third trimester (PM<sub>2.5</sub>≥8.1 µg/m<sup>3</sup>) was higher than would be expected due to the individual exposures alone (0.6 kg/m<sup>2</sup> per year; 95% CI: 0.1, 2.3; p for interaction=0.03). We did not detect interactions between maternal smoking and O<sub>3</sub> or PM<sub>2.5</sub> at any other time point on birth weight, neonatal adiposity, or BMI growth trajectories.

**Conclusions:** Although PM<sub>2.5</sub> was well below EPA standards, exposure during the third trimester may influence early-life growth when combined with maternal smoking.

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Theme: **Children's health**

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**P-0215**

### **The Effect of Nature Based Environmental Education on the Health Related Quality of Life of Low Income Black and Hispanic Youth**

**Presenter:** Nadav Sprague, Brown School at Washington University in St. Louis, St. Louis, United States

**Authors:** N. Sprague, C. C. Ekenga;  
Brown School at Washington University in St. Louis, St. Louis, MO.

The Effect of Nature-Based Environmental Education on the Health-Related Quality of Life of Low-Income Black and Hispanic Youth  
Nadav Sprague<sup>1</sup>, Christine C. Ekenga<sup>1</sup>  
<sup>1</sup> Brown School, Washington University in St. Louis, St. Louis, MO 63130, USA  
Background: Urban, low-income, Black and Hispanic youth experience multiple health and educational disparities. These youth also experience disparities in nature contact, an environmental exposure that has been associated with enhanced physical and emotional well-being. Nature-based education (NBE) uses nature contact to promote healthy behaviors and academic success in youth. However, few studies have evaluated the health outcomes of NBE. In this prospective study, we evaluated the impact of NBE on the health-related quality of life (HRQoL) of low-income, urban Black and Hispanic youth.  
Methods: Participants were recruited from four schools in St. Louis, Missouri, USA. The sample consisted of 378 children, ages 9-15 years old, assigned to an intervention group or a school-matched control group. The 15-week intervention included weekly environmental in-class lessons and monthly nature-based trips. Study participants completed pre- and post-intervention questionnaires that included demographic questions and six validated HRQoL domains (Physical Health Functioning, Emotional Health Functioning, School Functioning, Social Functioning, Family Functioning, and overall HRQoL). Logistic regression models were used to evaluate the intervention's influence on HRQoL.  
Results: Approximately 61% of the intervention group and 17% of the control group experienced a clinically significant improvement in overall HRQoL. After adjusting for age and past environmental education and nature-contact experiences before entering the intervention, the NBE intervention was associated with a clinically significant improvement in overall HRQoL (OR = 1.70, 95% CI = 1.01, 2.43).  
Conclusion: Nature-based education is a low-cost method for improving HRQoL and for low-income, urban, Black and Hispanic youth.

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**P-0216**

**Prenatal exposure to trichlorinated biphenyls (PCB 18 and 28) is associated with child hyperactivity 8 years later**

**Presenter:** Diane L Putnick, NICHD, Bethesda, United States

**Authors:** D. L. Putnick<sup>1</sup>, N. J. Perkins<sup>1</sup>, K. Kannan<sup>2</sup>, C. Gao<sup>2</sup>, S. L. Robinson<sup>1</sup>, A. Ghassabian<sup>3</sup>, P. Mendola<sup>1</sup>, E. M. Bell<sup>4</sup>, E. Yeung<sup>1</sup>;

<sup>1</sup>NICHD, Bethesda, MD, <sup>2</sup>New York University School of Medicine, New York, NY, <sup>3</sup>New York University Grossman School of Medicine, New York, NY, <sup>4</sup>University at Albany School of Public Health, Albany, NY.

Background: Polychlorinated biphenyl (PCB) exposure may be associated with neurodevelopmental problems, particularly hyperactivity and attention deficit/hyperactivity disorder (ADHD). In animal studies, exposure to PCBs increased hyperactivity, decreased dopamine in key brain regions, and PCB 28, 47, and 52 were found in those regions. Dopamine has also been implicated in the etiology of ADHD in humans. Most epidemiologic studies have relied on maternal blood rather than newborn blood to quantify prenatal PCB exposure, and neonatal levels might better reflect fetal exposure. Methods: Whole-blood concentrations of PCB congeners #8, 15, 18, 28, 52, 70, 95, 101, 138, and 153 were measured in the Upstate KIDS study, a population-based longitudinal study of children born in New York State between 2008-2010, using newborn dried blood spots (n=2610). PCBs were quantified (ng/mL) using gas chromatography-DFS high resolution mass spectrometry. Individual blood spots provided insufficient volume for assays, so pools of 5 were used, and individual values were derived from pools. Child hyperactivity symptoms (Mean=4.82, SD=5.13) were assessed by maternal report on the Vanderbilt ADHD Parent Rating Scale when children were 8 years of age. Models were adjusted for child age, sex, and plurality, and maternal age, education, race/ethnicity, insurance status, marital status, pre-pregnancy body mass index, gestational weight gain, parity, and pregnancy smoking. Results: Each 1 ng/mL increase in PCB 18 and PCB 28 was associated with 3.63 (95%CI=0.42-6.84) and 4.08 (95%CI=0.61-7.55) more points in hyperactive behavioral ratings, respectively. Except for PCB 15, other PCBs also had positive but imprecise relations with hyperactivity. Conclusions: Levels of PCBs in newborn blood spots were associated with less than 1 standard deviation higher hyperactivity 8 years later. Even low-level prenatal exposure may have long-term behavioral consequences.

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**P-0217**

### **Relationship between Gestational 25-hydroxyvitamin D Status and Neurocognitive Development at Age 4**

**Presenter:** Melissa M. Melough, Seattle Children's Research Institute, Seattle, United States

**Authors:** M. M. Melough<sup>1</sup>, L. E. Murphy<sup>2</sup>, J. Graff<sup>2</sup>, K. J. Derefinko<sup>2</sup>, N. R. Bush<sup>3</sup>, K. Z. LeWinn<sup>3</sup>, C. T. Loftus<sup>4</sup>, S. Sathyanarayana<sup>1</sup>, F. A. Tylavsky<sup>2</sup>;

<sup>1</sup>Seattle Children's Research Institute, Seattle, WA, <sup>2</sup>University of Tennessee Health Science Center, Memphis, TN, <sup>3</sup>University of California San Francisco, San Francisco, CA, <sup>4</sup>University of Washington, Seattle, WA.

**Background:** The gestational environment can influence brain development and have lasting impacts on future neurocognitive function. Vitamin D is critical to embryonic neuronal differentiation, and animal studies show that vitamin D deficiency can impair brain development. However, observational human studies have found inconsistent associations between gestational vitamin D and children's neurocognitive outcomes. We assessed whether gestational 25-hydroxyvitamin D [25(OH)D] status was associated with children's cognitive development at 4 years of age.

**Methods:** This study used prospective data from the Conditions Affecting Neurocognitive Development and Learning in Early Childhood (CANDLE) study, a large pregnancy cohort in Memphis, Tennessee (65% black, 32% white). We examined the relationship between second trimester maternal 25(OH)D plasma concentrations and age 4 child IQ through linear regression in 965 dyads. The primary outcome was Stanford-Binet full-scale IQ; additional modeling examined verbal and non-verbal IQ. Models were adjusted for children's sex and age, as well as mothers' age, race, parity, marital status, health insurance, pre-pregnancy BMI, IQ, education, diet quality, and alcohol and tobacco use. Interaction models explored effect modification by maternal race.

**Results:** The mean gestational 25(OH)D was 21.8 ng/mL (SD: 8.4). In 44.7% of mothers, 25(OH)D was below 20 ng/mL. Gestational 25(OH)D differed by race with a mean of 19.8 ng/mL (SD: 7.2) in blacks compared to 25.9 ng/mL (SD: 9.3) in whites ( $p < 0.0001$ ). In adjusted models full-scale IQ averaged 1.7 points (95% CI: 0.3, 3.1) higher per 10 ng/mL increase in 25(OH)D. Verbal and non-verbal IQ were also positively associated with 25(OH)D [0.9 (95% CI: 0.1, 1.7) and 0.7 (95% CI: 0, 1.5) points per 10 ng/mL 25(OH)D, respectively]. There was little evidence that associations varied by race.

**Conclusions:** Gestational 25(OH)D was positively associated with age 4 IQ, suggesting that vitamin D status in pregnancy is an important determinant of children's neurocognitive development.

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**P-0218**

### **The Impact of Reducing Air Pollution during Pregnancy on Cognitive Abilities at Four Years of Age: The UGAAR Randomized Controlled Trial of HEPA Air Cleaners**

**Presenter:** Battsetseg Ulziikhuu, Simon Fraser University, Burnaby, Canada

**Authors:** B. Ulziikhuu<sup>1</sup>, E. Gombojav<sup>2</sup>, C. Banzrai<sup>2</sup>, E. Enkhtuya<sup>2</sup>, S. Batsukh<sup>2</sup>, B. Boldbaatar<sup>2</sup>, B. Lanphear<sup>1</sup>, L. McCandless<sup>1</sup>, D. Bellinger<sup>3</sup>, R. Allen<sup>1</sup>;

<sup>1</sup>Simon Fraser University, Burnaby, BC, CANADA, <sup>2</sup>Mongolian National University of Medical Sciences, Ulaanbaatar, MONGOLIA, <sup>3</sup>Harvard University, Cambridge, MA.

**Background** Air pollution is a leading contributor to the global burden of disease. Observational evidence indicates that exposure can affect cognitive abilities, but the influence of gestational exposure on cognitive development in childhood is poorly understood. The Ulaanbaatar Gestation and Air Pollution Research (UGAAR) study is a randomized controlled trial of portable (High-Efficiency Particulate Air) HEPA air cleaners use during pregnancy and childhood development. Ulaanbaatar, Mongolia's capital, is among the most polluted cities due primarily from coal combustion for home heating. We investigated the effect of air cleaners use during pregnancy on cognitive development in 4-year old children. **Methods** We enrolled 540 non-smoking, apartment-dwelling pregnant women in 2014 and 2015 and randomly assigned them to an intervention (use of 1-2 HEPA air cleaners from enrollment to childbirth) or control (no air cleaners) group. There were 464 live births. We administered the Wechsler Preschool and Primary Scale of Intelligence, 4<sup>th</sup> edition (WPPSI) to 390 children (187 control and 203 intervention) at a mean age of 48.2 months. Our primary outcome was full-scale IQ. **Results** The mean maternal age at birth was 29 (26 - 33) years. We previously reported 29% reduction in particulate matter (PM) concentration. The intervention was associated with a 3.3 point (95% CI: 0.39, 6.25) increase in full-scale IQ. The mean verbal comprehension score was also higher (3.8 points, 95% CI: 0.5 - 7.1 points) among children in the intervention group. Intervention participants had higher mean scores across all 10 of the WPPSI indices, although confidence intervals spanned the null. **Conclusion** Our findings indicate that reducing PM exposure during pregnancy led to an improvement in children's neurocognitive performance at four years of age. The use of portable air cleaners during pregnancy may mitigate some of the adverse neurodevelopmental impacts of air pollution.

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**P-0220**

**Gestational phthalate exposures and bone mineral density in early adolescence: the HOME Study**

**Presenter:** Jordan Richard Kuiper, Johns Hopkins University Bloomberg School of Public Health, Baltimore, United States

**Authors:** J. R. Kuiper<sup>1</sup>, J. M. Braun<sup>2</sup>, B. P. Lanphear<sup>3</sup>, K. M. Cecil<sup>4</sup>, A. Chen<sup>5</sup>, K. Yolton<sup>4</sup>, H. J. Kalkwarf<sup>4</sup>, J. P. Buckley<sup>1</sup>;

<sup>1</sup>Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, <sup>2</sup>Brown University, Providence, RI, <sup>3</sup>Simon Fraser University, Vancouver, BC, CANADA, <sup>4</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>5</sup>University of Cincinnati, Cincinnati, OH.

**Background/Aim:** Phthalate exposures have been associated with lower areal bone mineral density (aBMD) and osteoporosis in adults. Although early life may be a period of heightened susceptibility to environmental osteotoxicants, we are unaware of any studies of phthalate exposures in utero and aBMD in children. Thus, we examined gestational phthalate exposures and early adolescent aBMD in a prospective birth cohort study. **Methods:** We used data from 225 pregnant mothers and their children enrolled in a Cincinnati, OH area cohort from 2003-2006. We measured monobutyl phthalate (MnBP), monobenzyl phthalate (MBzP), mono-(3-carboxypropyl) phthalate (MCPP), monoethyl phthalate (MEP), monoisobutyl phthalate (MiBP), and four metabolites of di-2-ethylhexyl phthalate (DEHP) in maternal urine collected at 16- and 26-weeks gestation and calculated the average of creatinine-adjusted concentrations. We measured children's femoral neck, distal forearm (1/3 radius), spine, total hip, and total body (excluding head) aBMD with dual x-ray absorptiometry at 12 years of age and calculated height-, age-, sex-, and race-specific aBMD z-scores. We estimated covariate-adjusted associations per 2-fold increase in maternal urinary phthalate concentrations and assessed effect measure modification (EMM) by child's sex using sex-stratified models. **Results:** In adjusted analyses, higher MCPP and MEP concentrations were associated with greater aBMD at all sites with estimates generally stronger for MCPP. For example, associations of MCPP and MEP concentrations with total hip aBMD z-score were 0.16 (95% CI: 0.01, 0.32) and 0.09 (95% CI: 0.01, 0.17), respectively. Sex modified urinary MEP and MiBP concentration's associations with spine aBMD. Higher MEP concentrations were associated with greater spine aBMD z-score in males ( $\beta = 0.19$ , 95% CI: 0.09, 0.30; EMM p-value 0.06) while higher MiBP concentrations were associated with greater spine aBMD z-score in females ( $\beta = 0.24$ , 95% CI: 0.07, 0.41; EMM p-value 0.07). **Conclusions:** Gestational phthalate exposures may increase bone mineral density in early adolescence.

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**P-0221**

### **Association between Personal PM<sub>2.5</sub> Exposure and Blood Pressure in Children: A Panel Study**

**Presenter:** Sanghyuk Bae, College of Medicine, The Catholic University of Korea, Seoul, Korea, Republic of

**Authors:** S. Bae<sup>1</sup>, K. Choi<sup>2</sup>, S. Kim<sup>3</sup>, H. Kwon<sup>2</sup>;

<sup>1</sup>College of Medicine, The Catholic University of Korea, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>College of Medicine, Dankook University, Cheonan, KOREA, REPUBLIC OF, <sup>3</sup>Soon Chun Hyang University, Asan, KOREA, REPUBLIC OF.

**Background:** Exposure to particulate matter has been associated with increased blood pressure in adults. However, the results among children are inconsistent and few studies evaluated indoor exposure. We examined the association between 7-day exposure to PM<sub>2.5</sub> and blood pressure in children's panel. **Methods:** We conducted a panel study among 50 children who participated in up to three physical examinations in different seasons of 2018 (Spring, Summer and Fall). The indoor PM<sub>2.5</sub> concentration was continuously measured at each child's home and classroom using indoor air quality monitor equipped with light-scattering particle sensor. The outdoor PM<sub>2.5</sub> concentration measured from nearest air quality monitoring station operated by Ministry of Environment was extracted from Air Korea database. Each child was asked to keep time-activity journal for each wave (approx. 1 week), and we calculated daily mean concentration for each child according to the time spent at each place. The 7-day average concentration was used for analysis. Blood pressure was measured at the end of each phase using automatic sphygmomanometer. We constructed mixed effect model to examine the association adjusting for potential confounders (age, height, weight, exposure to environmental tobacco smoke, breast feeding history, annual household income and house type). **Result:** The 7-day mean PM<sub>2.5</sub> were 36.3±20.7 µg/m<sup>3</sup>, 32.7±20.1 µg/m<sup>3</sup> and 33.5±19.7 µg/m<sup>3</sup> at home, classroom and outdoor, respectively. A 10-µg/m<sup>3</sup> increment of PM<sub>2.5</sub> was associated with 3.68 mmHg (P-value=0.0005) and 3.66 mmHg (P-value=0.0001) increase of systolic and diastolic blood pressure, respectively. **Conclusion:** We observed statistically significant association between children's blood pressure and PM<sub>2.5</sub> exposure in a panel study evaluating both indoor and outdoor exposures.

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**P-0222**

### **Toluene exposure is associated with intelligence function in childhood-A systematic review and meta-analysis**

**Presenter:** Ka Young Kim, Gachon University, Incheon, Korea, Republic of

**Authors:** K. Kim<sup>1</sup>, E. Lee<sup>2</sup>;

<sup>1</sup>Gachon University, Incheon, KOREA, REPUBLIC OF, <sup>2</sup>Korea University, Seoul, KOREA, REPUBLIC OF.

Toluene exposure is associated with intelligence function in childhood – A systematic review and meta-analysis  
Ka Young Kim<sup>1</sup> and Eunil Lee<sup>2,\*</sup>

<sup>1</sup>Department of Nursing, College of Nursing, Gachon University, 191 Hambakmoeiro, Yeonsu-gu, Incheon 21936, Republic of Korea<sup>2</sup>Department of Preventive Medicine, College of Medicine, Korea University, 73 Incheon-ro, Seongbuk-gu, Seoul 02841, Republic of Korea\*Correspondence: eunil@korea.ac.kr  
ABSTRACT Toluene is an aromatic hydrocarbon and colorless, water-insoluble solvent that widely used in paints, paint thinners, rubber, printing ink, and many chemical reactants. Toluene is associated with neurotoxicity and neurodevelopment. However, it is still controversial whether toluene affects neurotoxicity according to exposure level. Furthermore, despite the importance of environmental hazards in health effects, the impact of environmental hazards has been underestimated due to the difficulties and limitations to demonstrate the exposure risk. In this study, we aimed to elucidated the association between toluene exposure and cognitive function in children using systematic review with meta-analysis. We searched PubMed, Embase, Web of Science, and Cochrane Library for all articles published up to Oct 2019. We evaluated observational studies that assessed the association between toluene exposure and cognitive function. Of 735 articles, final 7 articles were used in this study. In this study, we found that toluene abuse impeded the cognitive function using meta-analysis (standardized mean difference = -1.784, 95% CI: -3.510 to -0.059, p = 0.043). In non-abuse level, toluene exposure has no shown to association to cognitive decline in children with autism. However, 2 studies showed about 50% decrease of cognitive function with toluene exposure, which suggested large-scale study is needed to evaluate the association between low level of toluene exposure and cognitive function. This study elucidates the association between non-abuse and abuse level to toluene and cognitive function in children.

Keywords: Toluene, Cognitive function, Childhood, Meta-analysis, Systematic review

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**P-0223**

**Changing trends in urinary phthalate metabolites in elementary school children; 2012-2017**

**Presenter:** RAHEL MESFIN KETEMA, Hokkaido University, Sapporo, Japan

**Authors:** R. M. KETEMA, Y. Ait Bamai, A. Atsuko, T. Saito, R. Kishi;  
Hokkaido University, Sapporo, JAPAN.

**Background/Aim** Phthalates; chemicals used in consumer products have a potential endocrine disrupting effects. Thus, certain phthalates have been regulated in products such as children's toys in Japan since 2010. However, humans particularly vulnerable children are still exposed to phthalates. Thus, in this study the first time in Japan, we investigated consequent phthalate exposure trends in children. **Methods** From participants of an on-going Hokkaido birth cohort study, 300 (50 per year) were randomly selected from 2012-2017 for this study. Urine samples of 7 years old children were collected and measured 10 phthalate metabolites concentration using UPLC-MS/MS. For the trend analysis, we combined 2 consecutive year metabolite concentrations as one year. Thus samples were considered as "year 1" for 2012 and 2013, "year 2" for 2014 and 2015 and "year 3" for 2016 and 2017. **Results and discussion** Metabolites MnBP, MEOHP, MEHHP, and MECPP were detected in all children. A decreased creatinine adjusted median level of MnBP was observed (45.1, 38.7 and 33.0  $\mu\text{g/g cr}$ ) from year 1-3, respectively. In contrast, MiBP showed a slight increased median from 13.7  $\mu\text{g/g cr}$  in year 1 to 14.7  $\mu\text{g/g cr}$  in year 3. While MBzP declined from 2.4 to 1.6  $\mu\text{g/g cr}$  in the study period. Median concentrations of DEHP metabolites; MEHP (4.8 vs 3.8), MEOHP (24.0 vs 21.1), MEHHP (30.7 vs 27.4), and MECPP (41.7 vs 37.8) showed a decreased level compared year 1 vs year 3. DiNP metabolites; MiNP (0.6 vs 0.5), OH-MiNP (3.1 vs 2.4), and cx-MiNP (10.2 vs 5.5) showed a decline median concentration as the DEHP metabolites. **Conclusions** Our findings revealed that except MiBP all measured phthalate metabolites show a decreased level in Japanese children urine from 2012-2017. Future studies are necessary to assess the potential health risks of phthalates and new alternative plasticizers.

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**P-0224**

**Sex-specific associations between early-life exposure to manganese and white matter microstructure in adolescents and young adults**

**Presenter:** Elza Rechtman, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** E. Rechtman<sup>1</sup>, P. Curtin<sup>1</sup>, D. Papazaharias<sup>1</sup>, E. de Water<sup>1</sup>, E. Navarro<sup>1</sup>, C. Ambrosi<sup>2</sup>, L. Mascaro<sup>2</sup>, R. Gasparotti<sup>3</sup>, C. Austin<sup>1</sup>, M. Arora<sup>1</sup>, D. R. Smith<sup>4</sup>, R. O. Wright<sup>1</sup>, C. Y. Tang<sup>1</sup>, R. G. Lucchini<sup>1</sup>, M. K. Horton<sup>1</sup>;  
<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>ASST Spedali Civili Hospital, Brescia, ITALY, <sup>3</sup>University of Brescia, Brescia, ITALY, <sup>4</sup>University of California Santa Cruz, Santa Cruz, CA.

**Background:** The brain white matter (WM) connects gray matter regions into functional networks and is critical for human cognition and behavior. Early-life metal exposure can disrupt WM maturation and lead to long-lasting changes in neuronal circuitry. Despite a growing literature suggesting associations between environmental levels of metal exposures and persistent neurodevelopmental effects, the underlying brain mechanisms of these associations are poorly understood. Furthermore, the influence of sex on these associations is understudied. The goal of the present study was to examine sex-specific associations between early-life exposure to manganese (Mn) and WM microstructure in young adults. **Methods:** Participants are adolescents and young adults enrolled in the ongoing Public Health Impact of Manganese Exposure (PHIME) study. Fractional anisotropy (FA) measures from diffusion tensor imaging (DTI) were acquired from 73 participants (16-23 years; 39 females) in a 3T Siemens scanner. Prenatal, early postnatal and childhood Mn concentrations were measured in deciduous teeth using laser ablation-inductively coupled plasma-mass spectrometry. We generated an FA index (representing a combination of FA in 48 brain regions of the ICBM-DTI-81 atlas) using weighted quantile sum (WQS) regression and investigated associations between the FA index and Mn at each timepoint, controlling for socioeconomic status, sex, and age. To test our hypothesis that sex has a moderating effect on the association between early life Mn exposure and WM integrity, we included an interaction term between sex and Mn. **Results:** The FA index was positively associated with dentine Mn at all three timepoints. This association was driven by FA in the fornix, cerebral peduncle, tapetum and superior longitudinal fasciculus. Associations were stronger in males. **Conclusion:** These results suggest that a) early-life Mn exposure is associated with WM microstructure within regions involved in widespread motor and cognitive functions, and b) the effect of Mn exposure on the brain differs by sex.

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**P-0225**

### **Fitness Performance Among Fifth Grade Students and Ambient Fine Particulate Matter, Chemical Constituents, and Sources in California**

**Presenter:** Keita Ebisu, Office of Environmental Health Hazard Assessment, Oakland, United States

**Authors:** K. Ebisu<sup>1</sup>, A. Tjemsland<sup>1</sup>, M. Kleeman<sup>2</sup>;

<sup>1</sup>Office of Environmental Health Hazard Assessment, Oakland, CA, <sup>2</sup>University of California, Davis, Davis, CA.

#### Background

Children are vulnerable to associations between fine particulate matter (PM<sub>2.5</sub>) and respiratory-related health, such as asthma. A potential explanation is that PM<sub>2.5</sub> is associated with a reduced growth of lung function. Because exposure to PM<sub>2.5</sub> is tied to lung performance, it may also be linked to reduced physical performance. However, few studies have explored the relationship between PM<sub>2.5</sub> and physical performance. We examined the association between PM<sub>2.5</sub> and its chemical constituents/sources and physical fitness performance of students in California for 2000-2007.

#### Methods

Fifth grade students at California public schools (n=4,041) are required to take a physical fitness test. The aerobic capacity assessment was used as an outcome to represent their cardiorespiratory endurance. The assessment has sex-specific standards, and each school reported the percentage of students who met the standards. Exposure data, including PM<sub>2.5</sub>, constituents, and sources, were obtained from the chemical transportation model with 4x4 km resolution. Annual averaged pollutant levels were assigned based on the grid of school's location. A generalized estimating equation was conducted for each pollutant adjusted by year, urbanicity level, obesity rate, and poverty rate of the schools.

#### Results

Odds of failing the aerobic capacity assessment increased 3.4% (95% confidence interval: 0.3, 6.6) per interquartile range (IQR) increase in PM<sub>2.5</sub> (10.8 µg/m<sup>3</sup>). Similarly, odds increased by 7.8% (4.4, 11.2) and 7.1% (3.3, 10.9) per IQR increase in PM<sub>2.5</sub> organic carbon and on-road gasoline vehicles, respectively. We did not observe any notable difference between sexes in stratified analysis.

#### Conclusions

Our study suggests that PM<sub>2.5</sub>, particularly traffic-related PM<sub>2.5</sub>, is associated with lowering an achievement of aerobic capacity. This supports previous findings that some PM<sub>2.5</sub> constituents and sources are more toxic than other pollutants. Given that few studies have explored the associations between ambient pollution and physical performance among children, further study is warranted to solidify this relationship.

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**P-0226**

**The associations between housing quality and acute lower respiratory infection among under-5 children: a multi-country analysis across sub-Saharan Africa**

**Presenter:** Yutong Cai, University of Oxford, Oxford, United Kingdom

**Authors:** Y. Cai<sup>1</sup>, S. Barzin<sup>1</sup>, N. O'Clery<sup>2</sup>, K. Rahimi<sup>1</sup>;

<sup>1</sup>University of Oxford, Oxford, UNITED KINGDOM, <sup>2</sup>University College London, London, UNITED KINGDOM.

**Background/objectives:** Acute lower respiratory infection (ALRI) among children under five years old (under-5) is a leading risk factor for disease burden in sub-Saharan Africa (SSA), but its association with housing quality is not fully explored. We aim to investigate their spatial and temporal associations within and across 34 SSA countries. **Methods:** Data were extracted from the Demographic and Health Surveys (DHS) conducted 1990-2018 that collected data on both housing and ALRI. Housing quality were derived as a binary variable: 1) finished and unfinished built based on materials used for wall, roof and floor; 2) improved and unimproved house based on data on built materials as well as access to safe water and sanitation. ALRI was defined as having cough in combination with short/rapid breathing, or difficult breathing at any time in the two weeks preceding the surveys. Conditional logistic regression was ran to model the associations in each country and then the odds ratios (OR) were pooled via meta-analysis, controlling for cluster-level effects and adjusting for child's age, sex, breastfeeding, size at birth, maternal education and type of cooking fuel. **Results:** Preliminary analysis currently included the most recent DHS surveys from 12 SSA countries, consisting of 56,519 under-5 children. The percentage of urban residence ranged from 16% to 61%; majority of mothers were educated up to primary-school level and most households did not have access to clean cooking fuel. Prevalence of unfinished built ranged from 43% to 95% across countries whilst using the stricter definition, over 90% of houses in each country were classified as unimproved. Pooling all country-specific ORs, we observed a higher ALRI risk in association with housing with unfinished built (OR: 1.07, 95%CI: 0.99-1.16). **Conclusion:** Poor housing quality is associated with higher ALRI prevalence in SSA and necessary interventions should be considered to reduce the ALRI burden.

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**P-0227**

### **Asthma-Related Emergency Department Visits in Texas: Associations with Allergenic Pollen and Other Seasonal Triggers**

**Presenter:** Daniel Katz, University of Texas - Austin, Austin, United States

**Authors:** D. Katz, E. Matsui;  
University of Texas - Austin, Austin, TX.

Background/Aim: Asthma is one of the most prevalent diseases in the United States and is a substantial contributor to emergency department (ED) visits. Seasonal triggers of asthma attacks include pollen and influenza, but little is known about their epidemiological importance in Texas. Here we describe associations between asthma-related ED visits in Texas and seasonally important asthma triggers including several pollen types and influenza. Methods: We obtained all asthma-related ED visits in Texas from September 2015 to December 2017. Population-based incidence rates (PBIR) were estimated using population estimates from census data as the denominators and influenza data was gathered from the CDC. Analyses were restricted to pediatric populations (age 5-17y) in the six counties where pollen concentration measurements were available from National Allergy Bureau monitoring stations. Generalized linear models were used to model associations between PBIR and daily pollen concentrations of Cupressaceae (primarily Juniperus), Quercus (oak), and Ambrosia (ragweed), and influenza. Results: The rate of asthma-related ED visits were highest in Dallas (0.122 cases per 10,000 people) and San Antonio (0.118 cases per 10,000 people) and lowest in Houston (0.061 cases per 10,000 people). Airborne pollen concentrations also varied regionally; for example, across the study period, average Cupressaceae pollen concentrations in San Antonio were 283 pollen grains/m<sup>3</sup>, whereas in Dallas they were significantly lower at 29 pollen grains/m<sup>3</sup> ( $p < 0.001$ ). There were significant associations between PBIR and each pollen type including: Cupressaceae ( $p < 0.05$ ), Quercus ( $p < 0.05$ ), and Ambrosia ( $p < 0.001$ ) and flu ( $p < 0.001$ ). Conclusions: PBIR varied substantially across Texas as did airborne concentrations of several pollen types. These results suggest that the epidemiological importance of pollen varies across the state.

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**P-0228**

### **Parental Preconception Phenol and Phthalate Mixtures in Relation to Birth Weight**

**Presenter:** Yu Zhang, Harvard T.H. Chan School of Public Health, Boston, United States

**Authors:** Y. Zhang<sup>1</sup>, V. Mustieles<sup>2</sup>, P. L. Williams<sup>1</sup>, J. M. Braun<sup>3</sup>, B. J. Wylie<sup>4</sup>, I. Souter<sup>5</sup>, A. M. Calafat<sup>6</sup>, R. Hauser<sup>1</sup>, C. Messerlian<sup>1</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>2</sup>University of Granada, Granada, SPAIN, <sup>3</sup>Brown University School of Public Health, Providence, RI, <sup>4</sup>Beth Israel Deaconess Medical Center, Boston, MA, <sup>5</sup>Massachusetts General Hospital Fertility Center, Boston, MA, <sup>6</sup>National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA.

**Background:** Although maternal and paternal preconception exposures to some phenols and phthalates have been associated with reduced birthweight in single-chemical analyses, their effect in the context of complex mixtures is unknown. **Methods:** We used principal component analysis (PCA) with multivariable linear regression and Bayesian Kernel Machine Regression (BKMR) to examine maternal and paternal preconception mixtures of urinary concentrations of phenol and phthalate biomarkers in relation to birthweight among 384 singletons (384 mothers, 211 fathers, 203 couples) from the Environment and Reproductive Health (EARTH) Study, a prospective cohort of couples seeking fertility evaluation. We also fit couple-based BKMR with hierarchical variable selection to assess couples' joint mixtures in relation to birthweight. Natural log-concentrations of bisphenol A (BPA), parabens, and eleven phthalate metabolites including those of di(2-ethylhexyl) phthalate (DEHP) were examined. Birthweight was abstracted from medical records. **Results:** The PCA identified the same four main factors for maternal and paternal preconception mixtures. Each 1-unit increase in PCA scores of maternal (-51g; 95%: -105, 2) and paternal (-73g; 95%CI: -141, -4) preconception low molecular weight phthalates factors, and paternal preconception DEHP-BPA factor (-63g; 95%CI: -134, 7) were associated with reduced birthweight. In BKMR models of individual biomarkers, we found that maternal preconception monoethyl phthalate and BPA, and paternal preconception mono-n-butyl phthalate were inversely associated with birthweight when the remaining mixture components were held at their median concentration. In couple-based BKMR models, we observed a negative joint effect on birthweight across increasing quantiles of couples' total phenol and phthalate mixture concentration. Paternal preconception biomarkers contributed more to couples' joint effect on birthweight (Posterior Inclusion Probability (PIP)=70%) compared with maternal preconception biomarkers (PIP=18%). **Conclusions:** Our analysis suggests a complex interplay between paternal and maternal preconception exposure to mixtures of non-persistent chemicals, with both parental windows of exposure independently and jointly contributing to reduced birthweight.

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**P-0229**

### **Residential Greenness, Asthma, and Lung Function in Young Children**

**Presenter:** Kimberly Hartley, University of Cincinnati, Cincinnati, United States

**Authors:** K. Hartley<sup>1</sup>, P. Ryan<sup>2</sup>, G. Gillespie<sup>1</sup>, J. Perazzo<sup>1</sup>, R. Gernes<sup>3</sup>, G. Khurana Hershey<sup>2</sup>, G. Lemasters<sup>1</sup>, C. Brokamp<sup>2</sup>;

<sup>1</sup>University of Cincinnati, Cincinnati, OH, <sup>2</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH,

<sup>3</sup>Association of Schools and Programs of Public Health, Washington, DC.

**Background.** While benefits of greenness to health have been reported, studies specific to child respiratory health are scarce and findings are inconsistent. **Objective.** Exposure to greenness and respiratory outcomes were examined among the Cincinnati Childhood Allergy and Air Pollution Study (CCAAPS) cohort from birth to age 7 years. **Methods.** Residential surrounding greenness was averaged using the Normalized Difference Vegetation Index (NDVI) within 200, 400, and 800 meter distances from the home address at birth, age 7 years, and cumulative exposure across childhood (averaged for each year from birth to age 7 years). Respiratory outcomes were assessed at age 7 years, including lung function [percent predicted FEV<sub>1</sub> (%FEV<sub>1</sub>), percent predicted FVC (%FVC), and percent predicted FEV<sub>1</sub>/FVC (%FEV<sub>1</sub>/FVC)] and asthma. The associations of a 0.1 unit increase in NDVI with respiratory outcomes were assessed using linear and logistic regression models adjusted for community deprivation, household income, and traffic-related air pollution. **Results.** Mean NDVI was significantly higher among children without asthma compared to those with asthma at birth in 200 meter and 800 meter distances from the home, and across childhood 200 meters from the home. No relationship was observed between NDVI at any age or buffer distance and asthma after adjustment. NDVI was significantly positively correlated with %FEV<sub>1</sub> and %FVC for all distances at age 7 years and across childhood, and at 800 meters at birth. After adjustment, NDVI at age 7 years was significantly associated with %FEV<sub>1</sub> (200 meters:  $\beta=2.05$ , 95% CI: [0.08, 3.3]; 400 meters:  $\beta=1.64$ , 95% CI: [0.3, 2.9]) and %FVC (200 meters:  $\beta=1.84$ , 95% CI: [0.7, 3.0]; 400 meters:  $\beta=1.55$ , 95% CI: [0.3, 2.8]; 800 meters:  $\beta=1.45$ , 95% CI: [0.1, 2.8]). No relationship was found between greenness and %FEV<sub>1</sub>/FVC. **Conclusions.** Greenness may not increase risk for child asthma, but may be beneficial to concurrent lung function.

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**P-0230**

**Air pollution associated blood pressure may be modified by diet among children in Guangzhou, China**

**Presenter:** Jingshu Zhang, Sun Yat-Sen University, Guangzhou, China

**Authors:** J. Zhang, L. Cai, Z. Gui, X. Zeng, C. Huang, Y. Chen;  
Sun Yat-Sen University, Guangzhou, CHINA.

**Background:** Air pollution has been associated with elevated blood pressure (BP) in adults. However, epidemiological evidence from children is limited and no studies report whether diet modifies this association in children. **Methods:** We evaluated 7,225 primary school children aged 6-12 years from Guangzhou, China, in 2017. The BP was measured objectively. The individual one-year average concentration of particles with an aerodynamic diameter of  $\leq 2.5\mu\text{m}$  or  $\leq 10\mu\text{m}$  ( $\text{PM}_{2.5}$ ,  $\text{PM}_{10}$ ), sulfur dioxide ( $\text{SO}_2$ ), and ozone ( $\text{O}_3$ ) before each BP measurement were calculated by inverse distance weighting (IDW) interpolation according to each home address. Generalized linear mixed-effects models were used to examine the health effects and potential effect modifications by diet factors after adjusting for covariates. **Results:** The results showed that the estimated increase in mean systolic BP (SBP) was 0.92 mmHg (95% CI, 0.05-1.79) per interquartile range increase in  $\text{O}_3$ . An IQR increase in the 1-year mean of  $\text{SO}_2$  and  $\text{O}_3$  was associated with odds ratios of 1.26 (95% CI, 1.04-1.52) and 1.20 (95% CI, 1.06-1.35) for prehypertension, respectively. In addition, an IQR increase in  $\text{PM}_{2.5}$ ,  $\text{SO}_2$ , and  $\text{O}_3$  exposure was positively associated with hypertension, with odds ratios of 1.33 (95% CI, 1.11-1.61), 1.70 (95% CI, 1.33-2.16), and 1.48 (95% CI, 1.20-1.83), respectively. Stronger effect estimates between  $\text{PM}_{2.5}$ ,  $\text{SO}_2$ , and  $\text{O}_3$  concentration on prehypertension were exhibited among subgroups of children with a higher intake of sugar-sweetened beverages (SSBs). **Conclusions:** Long-term exposure to  $\text{PM}_{2.5}$ ,  $\text{SO}_2$ , and  $\text{O}_3$  were associated with higher BP levels in children, and higher SSBs intake might modify these associations.

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**P-0231**

**Gender difference associated with the pre- and postnatal maternal mobile phone usage and behavioral problems in preschool children**

**Presenter:** hyunjoo Joo, Department of Preventive Medicine, College of Medicine, Dankook University, Cheonan, Korea, Republic of

**Authors:** h. Joo<sup>1</sup>, K. Choi<sup>1</sup>, S. Bae<sup>2</sup>, H. Choi<sup>3</sup>, A. Lee<sup>3</sup>, M. Ha<sup>1</sup>, H. Kwon<sup>1</sup>;

<sup>1</sup>Department of Preventive Medicine, College of Medicine, Dankook University, Cheonan, KOREA, REPUBLIC OF, <sup>2</sup>Department of Preventive Medicine, College of Medicine, Catholic University of Korea, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Broadcasting and Media Research Laboratory, Electronics and Telecommunications Research Institute, Daejeon, KOREA, REPUBLIC OF.

Background Concern has been raised regarding the possible effects of mobile phone use on children's health. The World Health Organization has emphasized the need for research into the possible effects of radiofrequency electromagnetic field (RF-EMF) in children. We examined the association between pre- and postnatal exposure to maternal mobile phones and neurobehavioral development in children. Method Study subjects were 763 mother-child pairs from a prospective birth cohort, Mothers and Children's Health (MOCEH) study. Mother's mobile phone calling frequency and duration were assessed at early pregnancy ( $\leq 20$  weeks), 3, 4 and 5 years of children's age via questionnaire. High and low exposed group were classified using trajectory analysis. Children's neurodevelopment was assessed using the Korea-Child Behavior Checklist (K-CBCL) of Infant Development-Revised at 4, 5 and 6 years of age. The K-CBCL is consisted of total behavior problems, internalizing and externalizing problem. Generalized estimating equation model was applied to analyze neurodevelopmental patterns by exposed group over time adjusted for residential area, gender, maternal age at child birth, maternal education and secondhand smoke. Results The mean and standard deviation of total behavior problems were  $47.8 \pm 10.3$ ,  $47.5 \pm 10.2$ ,  $49.4 \pm 9.7$  respectively at 4, 5 and 6 years of age. When stratified with gender, for analysis calling frequency, total behavior problems and Internalizing problem score were significantly 27.7 points ( $p=0.02$ ) and 29.3 ( $p=0.02$ ) points higher in high exposed group than those in low exposed group among only males from 3 to 5 years of age. No significant results showed among females. Conclusion The research results showed that the effects of mother's mobile phone call on children's behavior showed different susceptible exposure of neurobehavioral development by gender. Acknowledgement This work was supported by the ICT R&D program of MSIT/IITP. [2019-0-00102, A Study on Public Health and Safety in a Complex EMF Environment]

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**P-0232**

### **Associations between exposure to Air Pollution and Congenital Hypothyroidism**

**Presenter:** Ruthie Harari Kremer, Braun School of Public Health and Community Medicine, Hebrew University - Hadassah, Jerusalem, Israel

**Authors:** R. Harari Kremer<sup>1</sup>, D. Broday<sup>2</sup>, I. Kloog<sup>3</sup>, R. Calderon-Margalit<sup>1</sup>, I. Grotto<sup>4</sup>, I. Karakis<sup>4</sup>, A. Shtein<sup>3</sup>, D. Nevo<sup>5</sup>, T. Korevaar<sup>6</sup>;

<sup>1</sup>Braun School of Public Health and Community Medicine, Hebrew University - Hadassah, Jerusalem, ISRAEL, <sup>2</sup>The Technion Center of Excellence in Exposure Science and Environmental Health, Haifa, ISRAEL, <sup>3</sup>Department of Geography and Environmental Development, Ben-Gurion University, Beer Sheva, ISRAEL, <sup>4</sup>Israeli Ministry of Health, Jerusalem, ISRAEL, <sup>5</sup>Department of Statistics and Operations Research, Tel Aviv University, Tel Aviv, ISRAEL, <sup>6</sup>Department of Epidemiology, University Medical Center Rotterdam, Rotterdam, NETHERLANDS.

**Background:** Adequate thyroid hormone (TH) availability is required for optimal development of the fetal brain. Untreated permanent congenital hypothyroidism (CHT) typically results in intellectual disability in humans. Newborns with transient-CHT have temporary TH deficiency and will improve to normal TH levels usually in few months.

**Aims:** To estimate the associations of prenatal exposure to particulate matter (PM) with CHT and transient-CHT in newborns.

**Methods:** A historical birth cohort study, based on the Israeli national program for neonatal screening, including term infants born in Israel in 2009-2015 (N=696,461). Separate logistic regression models were used to estimate the associations of PM as a continuous variable with CHT and transient-CHT, adjusted for ethnicity, calendar month and year of conception, socioeconomic status, and sub-district. To assess residual confounding, postnatal exposures to the same pollutants were used as negative control exposures. These pollutants are impacted by the same potential unmeasured confounders, but should have null relationship with the outcome in mutually adjusted models, if there are no substantial unmeasured confounders.

**Results:** First and second trimester exposure to PM<sub>2.5</sub>, and third trimester exposure to PM<sub>2.5-10</sub>, were associated with CHT (adjusted-OR: first and second trimester PM<sub>2.5</sub>: 1.12, 95% CI: 1.00-1.27; and 1.10, 0.99-1.22, respectively; third trimester PM<sub>2.5-10</sub>: 1.18, 95% CI: 1.07-1.29). No evidence of residual confounding was noted. Exposure to PM<sub>2.5-10</sub> during the first and second trimester were associated with transient-CHT (adjusted-OR = 1.42, 95% CI: 1.10-1.83; and 1.27, 0.95-1.69, respectively), with no evidence of residual confounding.

**Conclusions:** Exposure to PM<sub>2.5</sub> and PM<sub>2.5-10</sub> in specific trimesters of pregnancy are associated with increased risk of CHT and transient-CHT. Negative control analyses applied to this study support a causal interpretation of these findings. Additional studies are needed to refine the exact timing of these effects, quantify associations with additional pollutants, and explore possible biological mechanisms.

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**P-0233**

### **Maternal Urinary Benzophenone-3 Concentrations During Pregnancy and Duration of Breastfeeding**

**Presenter:** Noelle B Henderson, Brown University, Providence, United States

**Authors:** N. B. Henderson<sup>1</sup>, C. G. Sears<sup>1</sup>, B. P. Lanphear<sup>2</sup>, M. E. Romano<sup>3</sup>, K. Yolton<sup>4</sup>, J. M. Braun<sup>1</sup>;

<sup>1</sup>Brown University, Providence, RI, <sup>2</sup>Simon Fraser University, Vancouver, BC, <sup>3</sup>Geisel School of Medicine at Dartmouth, Hanover, NH, <sup>4</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH.

**Background:** Benzophenone-3, an ultraviolet-protectant used in some sunscreens and personal care products, is detectable in the urine of virtually all Americans. In animal models, gestational benzophenone-3 exposure leads to alterations in mammary gland morphology and function. However, it is unknown if benzophenone-3 exposure affects mammary gland function in humans. We estimated the association between maternal urinary benzophenone-3 concentrations during gestation and subsequent breastfeeding duration.

**Methods:** We used data from 302 mother-child pairs in the HOME Study (Cincinnati, Ohio, enrolled: 2003-2006). We calculated average benzophenone-3 concentrations in two urine samples collected from women at 16- and 26-weeks gestation. After delivery, participants completed standardized interviewer-administered surveys on their breastfeeding practices every 3 months until discontinuation of breastfeeding or when children were age 3 years. We used a multivariable Poisson regression model with robust standard errors adjusted for relevant demographic and perinatal potential confounders to estimate the relative risk (RR) of discontinuing breastfeeding by age 3 months or 6 months with increasing benzophenone-3 concentrations.

**Results:** Median urinary benzophenone-3 concentrations were 35 ng/mL (25<sup>th</sup>-75<sup>th</sup> percentile: 11-107). Approximately 57% and 44% of women fed their infants some breastmilk until 3 and 6 months, respectively. Increasing urinary benzophenone-3 concentrations were not associated with a higher risk of breastfeeding cessation at 3 months (RR for 3<sup>rd</sup> vs. 1<sup>st</sup> tercile=1.09; 95% CI: 0.75-1.58) or at 6 months (RR for 3<sup>rd</sup> vs. 1<sup>st</sup> tercile=1.13; 95% CI: 0.86-1.21).

**Conclusion:** In this cohort, gestational urinary benzophenone-3 concentrations were not associated with duration of breastfeeding.

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**P-0234**

### **Psychosocial Stressors in Relation to Maternal Plasma Levels of Corticotrophin Releasing Hormone (CRH) During Pregnancy**

**Presenter:** Stephanie M Eick, University of California, San Francisco, San Francisco, United States

**Authors:** S. M. Eick<sup>1</sup>, D. Goin<sup>1</sup>, M. Izano<sup>1</sup>, L. Cushing<sup>2</sup>, E. DeMicco<sup>1</sup>, A. Padula<sup>1</sup>, T. Woodruff<sup>1</sup>, R. Morello-Frosch<sup>3</sup>;

<sup>1</sup>University of California, San Francisco, San Francisco, CA, <sup>2</sup>San Francisco State University, San Francisco, CA, <sup>3</sup>University of California, Berkeley, Berkeley, CA.

Background: Psychosocial stress during pregnancy has been associated with a number of adverse birth outcomes, including preterm birth. However, we have a limited understanding of the biologic pathways that might link stress to adverse outcomes. Corticotrophin Releasing Hormone (CRH) may represent one possible mechanism, as elevated levels of CRH have been associated with preterm birth. The purpose of this study was to examine the relationships between maternal self-reported psychosocial stress and CRH during pregnancy. We hypothesized that women who experienced psychosocial stress would have elevated levels of CRH. Methods: Women were enrolled in the Chemicals in Our Bodies-2 cohort (N=496), a demographically diverse cohort of pregnant women in San Francisco. CRH (pg/mL) was measured in plasma obtained at the 2<sup>nd</sup> trimester visit. Psychosocial stress was assessed via self-reported questionnaire at the 2<sup>nd</sup> trimester and included dichotomous measures of neighborhood quality, stressful life events, caregiving, discrimination, financial strain, job strain, food insecurity, unplanned pregnancy, perceived stress, depression, and perceived community status. Linear regression was used to examine associations between psychosocial stressors and CRH. Results: Experiencing >2 stressful life events was associated with elevated levels of CRH after adjusting for gestational age at visit, maternal race/ethnicity, maternal education, and marital status ( $\beta=0.16$ , 95% confidence interval [CI]=0.02, 0.31). Women who experienced financial strain ( $\beta=0.13$ , 95% CI=-0.10, 0.36), caregiving for an ill family member ( $\beta=0.13$ , 95% CI=-0.06, 0.32), or who had elevated levels of perceived stress ( $\beta=0.20$ , 95% CI=-0.20, 0.41) also had moderately increased CRH levels. No associations were observed between other psychosocial stressor and CRH levels. Conclusions: We observed a positive association between stressful life events and elevated CRH levels in our study population. Future research should explore the combined effects of psychosocial stress and chemicals on birth outcomes and examine CRH as a mediator of the psychosocial stress and birth outcomes relationships.

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**P-0235**

### **Association of Environmental Tobacco Smoke Exposure and Infant Neurodevelopmental Achievements and Effect Modification by Maternal Overweight and Obesity: Results from the Taiwan Birth Cohort Study**

**Presenter:** Mei-Huei Chen, Institute of Population Health Sciences, National Health Research Institutes, Miaoli County, Taiwan

**Authors:** M. Chen<sup>1</sup>, C. Wei<sup>2</sup>, C. Lin<sup>2</sup>, M. Tsai<sup>2</sup>, Y. Guo<sup>2</sup>, S. Lin<sup>3</sup>, H. Liao<sup>4</sup>, W. Hsieh<sup>5</sup>, P. Chen<sup>2</sup>;  
<sup>1</sup>Institute of Population Health Sciences, National Health Research Institutes, Miaoli County, TAIWAN, <sup>2</sup>Institute of Environmental and Occupational Health Sciences, National Taiwan University, Taipei City, TAIWAN, <sup>3</sup>Department of Pediatrics, Chi Mei Medical Center, Tainan City, TAIWAN, <sup>4</sup>School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei City, TAIWAN, <sup>5</sup>Department of Pediatrics, Cathay General Hospital, Taipei City, TAIWAN.

**Background:** Environmental tobacco smoke (ETS) is a common indoor air pollutant associated with multiple adverse health effects, but it remains unclear regarding effect modifiers and susceptible groups for detrimental neurodevelopmental effect of ETS. We examine the associations between ETS exposure and infant neurodevelopmental parameters in a national-wide representative population. **Methods:** We extracted the information via structured questionnaires upon home interview from Taiwan Birth Cohort Study (TBCS). The associations between ETS exposure and infant neurodevelopmental milestones were evaluated with multivariate conditional logistic regression and the Cox model and with propensity score (PS) weighting and matching based upon preselected covariates. **Results:** In this study, 15 987 term singletons were included, and 3598 mother-infant pairs were further selected to PS-matched subpopulation. Higher ETS exposure was associated with increased likelihood of delay in caregiver-reported fine motor (adjusted odds ratio (aOR)=1.29, 95% CI=1.07-1.55; adjusted hazard ratio (aHR)=1.06, 95% CI=1.01-1.11 for clapping hands; aOR=1.21, 95% CI=1.03-1.43; aHR=1.05, 95% CI=1.00-1.10 for scribbling), language-related (aOR=1.25, 95% CI=1.03-1.50; aHR=1.08, 95% CI=1.03-1.13 for waving goodbye; aOR=1.22, 95% CI=1.01-1.47; aHR=1.08, 95% CI=1.04-1.14 for calling a parent meaningfully), and it was consistent in PS-weighted, PS-matched, and among non-smoking families. We also detected positive interaction for both maternal overweight and obesity before pregnancy and after delivery upon the association between high ETS exposure and delayed milestone achievement in scribbling. **Conclusions:** Maternal peripartum ETS exposure was associated with delayed neurodevelopmental milestone achievement at eighteen months among non-smoking families, and effect modification by maternal overweight and obesity status indicated possible intervention targets for pregnant women.

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**P-0236**

### **Early life exposure to fine particulate matter and childhood asthma in Beijing, China: A case-control study**

**Presenter:** Meimei Xu, Institute of Medical Information, Chinese Academy of Medical Sciences, Beijing, China

**Authors:** M. Xu<sup>1</sup>, M. Shao<sup>2</sup>, X. An<sup>1</sup>, C. Liu<sup>2</sup>, Y. Chen<sup>2</sup>;

<sup>1</sup>Institute of Medical Information, Chinese Academy of Medical Sciences, Beijing, CHINA, <sup>2</sup>Capital Institute of Pediatrics, Beijing, CHINA.

**Background:** Previous studies indicated that the effect of early life exposure to ambient air pollution on childhood asthma is still unclear. **Methods:** A case-control study for children in 2010 was performed in Beijing. A spatio-temporal model was developed using PM<sub>2.5</sub> (particles with an aerodynamic diameter of less than 2.5 µm) data from 35 monitoring stations and the geographic information data from 2013, which was time-adjusted and then be applied to estimate the personal exposure level in 2004-2010. Logistic regression model was used to examine the effects of PM<sub>2.5</sub> exposure during different pre-natal (the first trimester, second trimester, third trimester and whole pregnancy) and post-natal periods (the first year after birth) on childhood asthma. **Results:** In total, 118 cases (mean:4.5 ys) and 133 healthy controls (mean:4.3 ys) were included in this study. The PM<sub>2.5</sub> exposure level of asthma cases ranged from 74.4 to 233.0 µg /m<sup>3</sup> in different time windows of early life. The level of PM<sub>2.5</sub> in the case group was higher than that in the control group (P<0.05). The exposure to PM<sub>2.5</sub> during the whole pregnancy had an effect on asthma in the preschool children, with OR of 1.77 (95% CI: 1.33-2.36) for per 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub>. The sensitive exposure window during pregnancy was the second trimester, with OR of 1.25 (95% CI: 1.10-1.41) for per 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub>. PM<sub>2.5</sub> exposure in the first year after birth also had an effect on asthma in the preschool children, with OR of 1.34 (95% CI: 1.07-1.68), and the risk was higher than that in the sensitive window of pregnancy. **Conclusions:** Exposures to PM<sub>2.5</sub> during pregnancy and the first year of life were associated with the increased risk of asthma and there appeared to be stronger effects on asthma in the second trimester and the first year after birth.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0238**

### **Evaluating Associations between Mixtures of Hazardous Air Pollutants and Birth Weight**

**Presenter:** Alison K Krajewski, ORISE/US Environmental Protection Agency, Research Triangle Park, United States

**Authors:** A. K. Krajewski<sup>1</sup>, M. P. Jimenez<sup>2</sup>, L. C. Messer<sup>3</sup>, D. T. Lobdell<sup>4</sup>, T. J. Luben<sup>4</sup>, K. M. Rappazzo<sup>4</sup>;  
<sup>1</sup>ORISE/US Environmental Protection Agency, Research Triangle Park, NC, <sup>2</sup>ORAU/US Environmental Protection Agency, Research Triangle Park, NC, <sup>3</sup>OHSU-PSU School of Public Health, Portland, OR, <sup>4</sup>US Environmental Protection Agency, Research Triangle Park, NC.

**Background:** Prenatal exposure to ambient air pollutants has been associated with both reduced and increased birth weight (BW) in epidemiological studies. Many studies focus on the association of a single pollutant with BW rather than a mixture of pollutants.

**Methods:** We compared two approaches for identifying prenatal exposure to hazardous air pollutants (HAPs), (1) each HAP and (2) mixture of 15 HAPs together, as predictors to changes in BW. We evaluated 15 HAPs at the census tract level from the 2011 National Air Toxics Assessment and linked with 735,507 infant-mother pairs in North Carolina with birth years between 2006-2011. We used random intercept mixed effects regression models to estimate the change in BW in grams (g), presented as  $\beta$  estimates and 95% confidence intervals (CI), adjusted for maternal race/ethnicity, age, marital status, and medicaid status.

**Results:** Cyanide (CN), mercury, and cadmium were identified as the strongest individual predictors, with a consistent reduction in BW across all HAPs (range  $\beta$ : -3995.31g for CN to -1.34g for methyl-tert-butyl-ether). In the HAPs mixture, CN and xylene were the strongest predictors of increased BW ( $\beta$ : 1908.65g CN and 213.91g for xylene) whereas toluene and benzene ( $\beta$ : -174.13g and -150.87g, respectively) were the strongest predictors for reduced BW. In the individual adjusted models, CN showed the strongest change in BW with a reduction of -1242.37g (-1939.27, -545.47). When analyzing HAPs as a mixture, in the adjusted models, toluene had the greatest change in BW with a reduction of -87.62g (-120.65, -54.59).

**Conclusions:** Comparing the two approaches, CN was the only consistent HAP identified as a predictor for change in BW. Evaluating exposure to individual pollutants in relation to BW may be neglecting the synergistic and/or antagonistic effects and underlying confounding when there are concurrent exposures to multiple pollutants. This abstract does not reflect EPA policy.

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**P-0239**

### **Evidence for differential thyroid sensitivity from prenatal exposure to polychlorinated biphenyl chemicals in children with autism**

**Presenter:** Jennifer Ames, Kaiser Permanente Northern California, Oakland, United States

**Authors:** J. Ames<sup>1</sup>, G. Windham<sup>2</sup>, K. Lyall<sup>3</sup>, M. Pearl<sup>2</sup>, M. Kharrazi<sup>2</sup>, C. K. Yoshida<sup>1</sup>, J. Van de Water<sup>4</sup>, P. Ashwood<sup>4</sup>, L. A. Croen<sup>1</sup>;

<sup>1</sup>Kaiser Permanente Northern California, Oakland, CA, <sup>2</sup>Environmental Health Investigations Branch, California Department of Public Health, Richmond, CA, <sup>3</sup>A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA, <sup>4</sup>University of California, Davis, Davis, CA.

**Background/Aim:** Prenatal exposure to polychlorinated biphenyls (PCBs), persistent organic pollutants, is linked to altered thyroid function and adverse neurodevelopmental outcomes, including autism spectrum disorder (ASD). We examined whether neonatal thyroid-stimulating hormone (TSH) mediates the relationship between prenatal PCB exposure and risk of ASD. **Methods:** We analyzed data from the Early Markers for Autism (EMA) Study, a case-control study of children born during 2000-2003 in Southern California. Children diagnosed with ASD (n=523), Intellectual disability (ID; n=147), and general population controls (n=405) were identified from birth and Department of Developmental Services records. Eleven PCB congeners were measured above the limit of detection in maternal serum collected during the second trimester and modeled as quartiles. Neonatal TSH levels were obtained from state newborn screening records and ln-transformed. We assessed relationships between PCBs and neonatal TSH in models stratified by neurodevelopmental outcome and TSH mediation of the significant relationships we previously observed in EMA between several PCBs and ASD. **Results:** In the full sample, correlations between PCB concentrations and neonatal TSH were weak and not significant (ranging from 0 to 0.06). However, among children with ASD, we observed significant increases in neonatal TSH associated with an interquartile increase in prenatal levels of four PCBs, including PCB153 (adj-β: 0.21, 95%CI: 0.02-0.39) and PCB138/158 (adj-β: 0.19, 95%CI: 0.01-0.37). We did not observe associations between neonatal TSH and PCBs among children with ID only or controls. Mediation analyses did not suggest that relationships between these PCBs and ASD were mediated by neonatal TSH. **Conclusions:** Prenatal exposure to PCBs, particularly congeners previously found to be associated with ASD in EMA, were positively associated with neonatal TSH, but only among children subsequently diagnosed with ASD. These findings, needing replication in larger cohorts, may indicate differential fetal sensitivity to thyroid-disrupting chemicals among individuals born, and later-diagnosed, with ASD.

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**P-0240**

### **Associations between Environmental Quality across Multiple Environmental Domains and Birth Weight**

**Presenter:** Alison K Krajewski, ORISE/US Environmental Protection Agency, Research Triangle Park, United States

**Authors:** A. K. Krajewski<sup>1</sup>, L. C. Messer<sup>2</sup>, K. M. Rappazzo<sup>3</sup>, M. P. Jimenez<sup>4</sup>, J. S. Jagai<sup>5</sup>, C. L. Gray<sup>6</sup>, T. J. Luben<sup>3</sup>, D. T. Lobbell<sup>3</sup>;

<sup>1</sup>ORISE/US Environmental Protection Agency, Research Triangle Park, NC, <sup>2</sup>OHSU-PSU School of Public Health, Portland, OR, <sup>3</sup>US Environmental Protection Agency, Research Triangle Park, NC, <sup>4</sup>ORAU/US Environmental Protection Agency, Research Triangle Park, NC, <sup>5</sup>University of Illinois at Chicago School of Public Health, Chicago, IL, <sup>6</sup>Duke Global Health Institute, Durham, NC.

**Background:** Exposure to environmental pollutants has been associated with both reduced birth weight (BW) through air pollutants and increased BW through endocrine disrupting chemicals. The impact of multiple environmental exposures across several domains in relation to changes in BW are not well understood. **Methods:** We constructed an environmental quality index at the census tract level (trEQI) to represent environmental quality across five domains (air, water, land, sociodemographic, and built) and overall for 2006-2010 using principal components analysis. The trEQI domains were categorized into quartiles (<25<sup>th</sup>, or best environmental quality and referent; 25<sup>th</sup>-50<sup>th</sup>; 50<sup>th</sup>-75<sup>th</sup>; >75<sup>th</sup>, or worst environmental quality) and linked to 735,507 mother-infant pairs in North Carolina (NC) with births between 2006-2011. Random intercept mixed effects linear regression models estimated the change in BW, in grams (g), presented as  $\beta$  estimate and 95% confidence intervals (CI), adjusted for maternal race/ethnicity, age, marital status, and Medicaid status. **Results:** The worst environmental quality, or highest quartile, was associated with reduction in BW in the air [ $\beta$ : -10.41 g (95% CI: -17.06, -3.75)], water [ $\beta$ : -11.84 g (-18.82, -4.86)], and land [ $\beta$ : -9.17 g (-15.71, -2.65)] domains, compared to the best environmental quality. However, we observed increased BW in association with the sociodemographic [ $\beta$ : 34.82 g (28.44, 41.20)] domain and overall [ $\beta$ : 21.64 g (15.55, 27.73)] trEQI. **Conclusions:** With increasing interest in how environmental mixtures can influence health, this analysis uses a more spatially resolved exposure index than previously employed (i.e., census tract vs. county) and provides a broad view of how simultaneous environmental exposures across multiple domains can result in reduced or increased BW. This abstract does not reflect EPA policy.

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**P-0241**

**Genetic risk, early life phthalate exposure and childhood wheeze: is there a link?**

**Presenter:** Garthika Navaranjan, University of Toronto, Toronto, Canada

**Authors:** G. Navaranjan<sup>1</sup>, M. L. Diamond<sup>1</sup>, Q. Duan<sup>2</sup>, J. Choi<sup>2</sup>, S. A. Harris<sup>1</sup>, L. Jantunen<sup>3</sup>, S. Bernstein<sup>3</sup>, J. A. Scott<sup>1</sup>, T. K. Takaro<sup>4</sup>, R. Dai<sup>5</sup>, D. L. Lefebvre<sup>6</sup>, M. B. Azad<sup>7</sup>, A. B. Becker<sup>7</sup>, P. J. Mandhane<sup>8</sup>, T. J. Moraes<sup>5</sup>, S. E. Turvey<sup>9</sup>, M. R. Sears<sup>6</sup>, P. Subbarao<sup>5</sup>, J. R. Brook<sup>1</sup>;

<sup>1</sup>University of Toronto, Toronto, ON, CANADA, <sup>2</sup>Queen's University, Kingston, ON, CANADA, <sup>3</sup>Environment and Climate Change Canada, Toronto, ON, CANADA, <sup>4</sup>Simon Fraser University, Burnaby, BC, CANADA, <sup>5</sup>Hospital for Sick Children, Toronto, ON, CANADA, <sup>6</sup>McMaster University, Hamilton, ON, CANADA, <sup>7</sup>University of Manitoba, Winnipeg, MB, CANADA, <sup>8</sup>University of Alberta, Edmonton, AB, CANADA, <sup>9</sup>University of British Columbia, Vancouver, BC, CANADA.

### Background/Aim

Both genetics and environment play a role in the development of asthma and wheeze. However, epidemiological studies have not assessed the extent to which genetics modifies risks associated with indoor environmental exposures such as from phthalate exposure. We examined how children's polygenic risk score (GRS) for asthma modifies the association between early life phthalate exposure and recurrent wheeze.

### Methods

We designed a case-cohort study within the CHILD cohort study, a population-based birth cohort, using a random sample of 450 children and adding all children with any recurrent wheeze between 2 to 5 years. House dust samples collected at 3 months of age were analyzed for 6 phthalates. Children were assigned a GRS for asthma computed using multiple genetic variants for childhood asthma identified by Pividori et al (2019). Logistic regression was used to assess the association between phthalate exposure and recurrent wheeze between 2 to 5 years within GRS tertiles. Interaction was examined between phthalate exposure and GRS.

### Results

A stronger effect was observed between DEHP and DiBP exposure and recurrent wheeze risk among children in the lowest GRS tertile compared to the highest tertile. A six-fold increased risk (OR=6.07, 95% CI:2.35-15) and two-fold increased risk (OR=2.55, 95% CI:1.13-5.74) of recurrent wheeze was observed in the second quartile of DEHP and DIBP exposure, respectively, among children in the lowest GRS tertile compared to a two-fold increased risk (OR=2.24, 95% CI:1.19-4.22) and 1.48 times increased risk (95% CI:0.79-2.74) for DEHP and DIBP, respectively, among children in the highest GRS. A significant interaction ( $p < 0.05$ ) was observed between DEHP, DIBP, and DEP exposure and GRS.

### Conclusions

Preliminary results suggest that early life phthalate exposure poses a greater risk of developing recurrent wheeze among children with lower genetic risk compared to those with higher genetic risk.

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**P-0242**

### **Upregulation of placental genes in the Aryl Hydrocarbon Receptor Pathway with Prenatal Tobacco Smoke Exposure**

**Presenter:** Todd M Everson, Emory University, Atlanta, United States

**Authors:** T. M. Everson<sup>1</sup>, E. M. Kennedy<sup>1</sup>, A. Burt<sup>1</sup>, M. McCallum<sup>2</sup>, C. J. Marsit<sup>1</sup>, L. Stroud<sup>2</sup>;  
<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Brown University, Providence, RI.

**Background:** Smoking during pregnancy increases the risk for growth restriction and children's health outcomes. Epigenomic studies have identified multiple genes within the aryl hydrocarbon receptor (Ahr) pathway as being differentially methylated in response to prenatal tobacco exposure, but it is unclear whether this exposure affects the functional activity of the Ahr pathway. This pathway has also been associated with multiple health outcomes, making it a strong candidate pathway for targeted studies of prenatal tobacco smoke exposure. We aimed to study whether placental expression of genes in the Ahr pathway are responsive to maternal cigarette use during pregnancy and whether this response correlates with dose. **Methods:** This study included 68 mothers (34 that smoked throughout pregnancy), from which placental gene expression was quantified via RNA-seq. Of the 46 genes that comprise the Ahr Pathway, 34 were detectable and passed QC metrics. We regressed normalized gene-expression on smoking status while adjusting for covariates and surrogate variables. We performed secondary analyses to test whether expression was associated with total cigarettes throughout pregnancy and cotinine concentrations. **Results:** Four genes within the Ahr pathway, TGFB1, CYP1A1, CYP1A2, and CYP1B1, exhibited increased expression in association with smoking during pregnancy (FDR < 0.05). Among smokers, cumulative dose of cigarettes throughout pregnancy, and average cotinine across three timepoints, was associated with increased expression, particularly for TGFB1 and CYP1A2 (p-value < 0.05). **Conclusions:** Placental Ahr-pathway genes, particularly TGFB1 and CYP1A1, are up-regulated in response to maternal smoking during pregnancy. TGFB1 is a multifunctional cytokine with critical roles in developmental processes, while CYP1A1 is the primary xenobiotic metabolizing enzyme in the placenta, and others have shown that elevated placental CYP1A1 is associated with adverse pregnancy outcomes. These may represent some of the functional responses of the placenta to prenatal tobacco exposure and potential intermediates on the path to pregnancy outcomes.

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**P-0244**

**Early-life air pollution exposure and biomarkers of systemic inflammation in young children**

**Presenter:** Gabriel Baldanzi, Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden

**Authors:** G. Baldanzi<sup>1</sup>, E. Melén<sup>2</sup>, T. Lind<sup>3</sup>, G. Pershagen<sup>1</sup>, O. Gruzieva<sup>1</sup>;

<sup>1</sup>Institute of Environmental Medicine, Karolinska Institutet, Stockholm, SWEDEN, <sup>2</sup>Department of Clinical Science and Education, Karolinska Institutet, Stockholm, SWEDEN, <sup>3</sup>Centre for Occupational and Environmental Medicine, Karolinska Institutet, Stockholm, SWEDEN.

**Background/Aims.** Air pollution exposure has been associated with adverse health effects in children. Although the exact underlying mechanisms are not clarified, systemic inflammation may play a role in pollution-induced health effects. This study aimed to investigate inflammatory markers in children in relation to early-life air pollution exposure. **Methods.** We measured 92 inflammatory markers in plasma samples collected at ages 6 months, 1 and 2 years from healthy children residing in Stockholm, Sweden (n=108), using Olink Proteomics (Uppsala, Sweden). Residential time-weighted average (TWA) outdoor exposure to particulate matter with an aerodynamic diameter of <10 µm (PM<sub>10</sub>) and <2.5 µm (PM<sub>2.5</sub>), black carbon (BC), nitrogen oxides (NO<sub>x</sub>) and nitrogen dioxide (NO<sub>2</sub>) from birth up to age 6 months was estimated by dispersion modeling. Age-specific associations between TWA air pollution exposures and inflammatory markers were investigated using linear regression with inclusion of potential confounding variables. Further, we applied linear mixed-effect models to analyze the temporal patterns of biomarkers during the first 2 years of life in relation to early-life air pollution exposure. Multiple comparisons were accounted for using False Discovery Rate (FDR 5%) adjustment. **Results.** At age 1 year, tumor necrosis factor (TNF) and chemokine ligand 9 (CXCL9) were inversely associated with TWA exposure to NO<sub>2</sub>, NO<sub>x</sub>, and BC (FDR p-value<0.05). However, no clear association was found at ages 6 months or 2 years. In the mixed models, only TNF was associated with NO<sub>2</sub>, NO<sub>x</sub>, and BC, but the associations were not significant after adjustment for multiple testing. **Conclusions:** Our findings suggest that air pollution exposure during the first 6 months of life is related to certain markers of systemic inflammation in children at age 1 year. These markers may be involved in biological processes through which air pollution exposure may modulate systemic inflammation in infants.

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**P-0245**

**Prenatal phthalate exposures and anthropometry during adolescence: The HOME Study**

**Presenter:** Taylor M Etzel, Johns Hopkins University Bloomberg School of Public Health, Baltimore, United States

**Authors:** T. M. Etzel<sup>1</sup>, J. M. Braun<sup>2</sup>, J. R. Kuiper<sup>1</sup>, K. Yolton<sup>3</sup>, K. M. Cecil<sup>3</sup>, A. Chen<sup>4</sup>, B. P. Lanphear<sup>5</sup>, H. J. Kalkwarf<sup>3</sup>, J. P. Buckley<sup>1</sup>;

<sup>1</sup>Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, <sup>2</sup>Brown University School of Public Health, Providence, RI, <sup>3</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>4</sup>University of Pennsylvania, Philadelphia, PA, <sup>5</sup>Simon Fraser University, Vancouver, BC, CANADA.

**Background/Aim:** Phthalate exposures are ubiquitous in pregnant women and may be obesogenic. Although excess adolescent adiposity predicts obesity and cardiometabolic diseases during adulthood, few studies have examined associations between prenatal phthalate exposures and anthropometric outcomes during adolescence. We investigated the relationships between prenatal phthalate exposures and anthropometry at age 12 years.

**Methods:** We used data from 219 mother-child pairs enrolled in the Health Outcomes and Measures of the Environment (HOME) Study, a prospective pregnancy and birth cohort enrolled in Cincinnati, OH from 2003-2006. We measured monobutyl phthalate (MnBP), monobenzyl phthalate (MBzP), mono-(3-carboxypropyl) phthalate (MCPP), monoethyl phthalate (MEP), monoisobutyl phthalate (MiBP), and four metabolites of di-2-ethylhexyl phthalate (DEHP) in maternal urine samples collected at 16 and 26 weeks of pregnancy. At age 12 years, we measured child weight and height. We used multivariable linear regression to estimate covariate-adjusted associations of a 10-fold increase in average maternal urinary phthalate metabolite concentrations with age- and sex- standardized height, weight, and BMI z-scores. We assessed effect measure modification (EMM) by child sex using stratified models.

**Results:** In adjusted analyses, maternal urinary phthalate metabolite concentrations were not associated with height, weight, or BMI z-scores in the overall sample. However, associations of MBzP concentrations with all anthropometry z-scores were modified by child sex, with lower z-scores among girls, but not boys. For example, a 10-fold increase in MBzP concentrations was associated with lower BMI z-scores in girls ( $\beta=-0.4$ ; 95% CI: -0.9, 0.0) but not boys ( $\beta=0.2$ ; 95% CI: -0.3, 0.7; EMM p-value=0.09). Additionally, a 10-fold increase in MiBP was associated with increased height z-scores among boys ( $\beta=0.7$ ; 95% CI: 0.1, 1.3), but not girls ( $\beta=0.0$ ; 95% CI: -0.6, 0.5; EMM p-value=0.09).

**Conclusions:** In this prospective cohort study, higher prenatal phthalate exposures were not associated with adolescent anthropometry, but there may be sex-specific effects.

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**P-0246**

**Long-term trends in NO<sub>2</sub> exposure and associated pediatric asthma impacts in urban areas worldwide**

**Presenter:** Susan C Anenberg, George Washington University, Washington, United States

**Authors:** S. C. Anenberg<sup>1</sup>, M. Brauer<sup>2</sup>, P. Hystad<sup>3</sup>, K. Burkart<sup>2</sup>, D. Goldberg<sup>1</sup>, A. Mohegh<sup>1</sup>, A. Larkin<sup>3</sup>, S. Wozniak<sup>2</sup>, B. Duncan<sup>4</sup>, L. Lamsal<sup>4</sup>;

<sup>1</sup>George Washington University, Washington, DC, <sup>2</sup>Institute for Health Metrics and Evaluation, Seattle, WA,

<sup>3</sup>Oregon State University, Corvallis, OR, <sup>4</sup>NASA, College Park, MD.

Recent meta-analyses of epidemiological studies conducted in North America, Latin America, Europe, and East Asia show that traffic-related nitrogen dioxide (NO<sub>2</sub>) pollution is associated with pediatric asthma incidence. Using concentration-response relationships from these meta-analyses, traffic-related NO<sub>2</sub> has been estimated to be responsible for 13% (~4 million) of new pediatric asthma cases globally. The objective of this study is to estimate surface ambient annual average NO<sub>2</sub> concentrations and associated pediatric asthma burdens from 2005 to 2019 in urban areas worldwide. We estimate 15-year trends in population exposure to NO<sub>2</sub> with global coverage at 1km resolution using 2010-2012 NO<sub>2</sub> concentrations from a previously published land use regression model, along with satellite remote sensing observations of NO<sub>2</sub> columns from the Ozone Monitoring Instrument. We use epidemiologically-derived concentration-response factors to estimate temporal trends in NO<sub>2</sub>-attributable pediatric asthma incidence in hundreds of cities worldwide. Results include 2005-2019 trends in NO<sub>2</sub> concentrations and the associated burden on pediatric asthma incidence in major cities around the world, including major reductions in places with strong emission regulations and increases in areas experiencing rapid economic growth without effective emission controls. Results may be informative for data-driven decision-making about mitigating the public health impacts of air pollution in urban areas, where two-thirds of the global population is expected to live by 2050.

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**P-0247**

**Associations of prenatal exposure to phthalates with measures of cognition in 7.5-month-old infants**

**Presenter:** Andrea Aguiar, University of Illinois at Urbana-Champaign, Urbana, United States

**Authors:** K. Dzwilewski<sup>1</sup>, A. Aguiar<sup>2</sup>, F. Merced-Nieves<sup>3</sup>, A. Calafat<sup>4</sup>, S. Korrick<sup>5</sup>, S. Schantz<sup>2</sup>;  
<sup>1</sup>Carle Cancer Center, Carle Foundation Hospital, Urbana, IL, <sup>2</sup>University of Illinois at Urbana-Champaign, Urbana, IL, <sup>3</sup>Icahn School of Medicine at Mt Sinai, New York, NY, <sup>4</sup>Centers for Disease Control and Prevention, Atlanta, GA, <sup>5</sup>Brigham and Women's Hospital and Harvard Medical School, Boston, MA.

Background: Phthalates are endocrine disrupting chemicals found in consumer products. Prenatal exposure has been associated with adverse neurobehavior, but little is known about the influence on infant cognition. Methods: A visual recognition memory task was used to assess cognition in 239 7.5-month-old infants (122 females; 117 males) from a prospective cohort study. Phthalate metabolites were quantified in maternal urine from 16-18 gestational weeks and a pool of five urines collected across pregnancy. The cognitive task included familiarization trials (infant shown 2 identical images/stimuli) and test trials (infant shown a familiar image/stimulus paired with a novel one). During familiarization trials, average time looking at stimuli before looking away (measure of processing speed), and time to reach looking time criterion (measure of attention) were assessed. During test trials, proportion of time looking at the novel stimulus (measure of recognition memory) was assessed. Associations of monoethyl phthalate (MEP), sum of di(2-ethylhexyl) phthalate metabolites ( $\Sigma$ DEHP), and sum of di(isononyl) phthalate metabolites ( $\Sigma$ DINP) with each outcome were assessed using generalized linear models adjusted for multiple potential confounders. Infant sex was considered a potential effect modifier. Results: Mothers were mostly white and college educated. Phthalate biomarker concentrations were consistent with the U.S. general population. Each interquartile range (IQR) increase of  $\Sigma$ DEHP at 16-18 weeks was associated with a 5.2-second (95%CI=1.8,8.6) increase in time to reach looking time criterion in males but not females. An IQR increase in  $\Sigma$ DINP in the pooled sample was associated with a 1.0% (95%CI=-1.8,-0.3) decrease in novelty preference across both sexes and similarly associated with 16-18 week  $\Sigma$ DINP. MEP was not associated with cognition. None of the phthalate biomarkers were associated with information processing speed. Conclusion: Prenatal exposure to DEHP may be associated with poorer visual attention in males and DINP with poorer recognition memory in both sexes. ES007326;ES022848;ES028607;RD83543401;OD023272.

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**P-0248**

**Machine learning approach for genome-wide polymorphisms to predict childhood allergic rhinitis in a longitudinal follow-up birth cohort study**

**Presenter:** Hui-Ju Wen, National Health Research Institutes, Miaoli County, Taiwan

**Authors:** H. Wen, S. Tsai, F. Tsai, S. Jiang, Y. L. Guo, S. Wang;  
National Health Research Institutes, Miaoli County, TAIWAN.

Background: Allergic rhinitis (AR) is a common chronic inflammatory disorder in children. Genetic characteristics and environmental exposures contribute to the development of allergic diseases. This study aimed to develop a predictive model using genetic single nucleotide polymorphisms (SNPs) for the development of childhood AR from a longitudinal follow-up birth cohort study. Methods: Mother-infant pairs in the birth-cohort study were recruited from night Taiwanese hospitals from 2001 to 2005. Information on children's health status including AR occurrence was obtained via questionnaire interviews at the age of 2, 5, 10, and 14 years old. SNP Array (Axiom Genome-Wide TWB 2.0) was used for genotype measurements. We applied machine learning method to establish predictive model for childhood AR. Multiple variable regression was used to assess the association of childhood AR with genotypes and conventional risk factors. Results: Overall, 247 mother-infant pairs completed all measurements. The prevalence of ever having physician-diagnosed AR by 14 years of age was 40.1%. By decision tree analysis, 19 SNPs were found to efficiently distinguish children with or without AR. The area under the receiver operating characteristic curve (AUROC) of the predictive model was 0.825. We then used backward stepwise regression to select significant SNPs in the predictive model and 8 SNPs were selected (AURIC = 0.806). After adjusted for potential confounders of child sex and maternal education, 6 SNPs of them (i.e. CD28 rs12693993, EGFR rs117179604, FTO rs71390222, IL1RAPL1 rs1016210, SEMA3A rs1520102, and SOCS3 rs4969169) were still significantly associated with childhood AR. The AUROC was slightly improved to 0.827. Conclusion: This study provides a model for predicting the risk of childhood AR according to hereditary factors. Future functional investigations of the SNPs and verifications with additional larger cohorts are warranted.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0250**

**Near real-time modeling of daily asthma emergency department visits syndrome as a function of air pollution, weather, and other environmental risk factors in New York City, 2010-2019**

**Presenter:** Kazuhiko Ito, New York City Department of Health, New York, United States

**Authors:** K. Ito, R. Lall;  
New York City Department of Health, New York, NY.

**Background:** Research has shown that asthma morbidity is associated with multiple temporally-varying environmental risk factors including air pollution, weather, pollen, and viral infections. Predicting its temporal variation near real-time is useful for situational awareness as the relative importance of these risk factors changes across seasons.

**Methods:** We developed a regression model to predict daily asthma emergency department (ED) visits based on chief complaint text and diagnosis code (i.e., syndrome) available from previous day since 2010 at the New York City Health Department. The 2010-2018 data were used to develop a quasi-Poisson model for a 121-day moving time window for each day of 2019 for ages 5-17, with predictors including: day-of-year; day-of-week; temperature; citywide average fine particles (PM<sub>2.5</sub>) and ozone (warm season only); ED visits syndromes for allergy (proxy for spring pollen impact) and flu; school-opening date (proxy for fall rhinovirus infections); and holidays, considering non-linear distributed lags when multi-day impacts were observed. Point estimates and prediction intervals are produced along with the observed values in a dashboard to facilitate daily assessment.

**Results:** The model goodness of fit varied across seasons, with the best fit occurring in the fall season (e.g., % deviance explained up to 85%) and the worst in the spring (e.g., ~ 40%). Daily absolute percent errors, with a median of 15% for the 2019 prediction period, were also higher in the spring, because the peak tree pollen impacts were not fully captured. PM<sub>2.5</sub> associations were mostly limited to cold months, with diminished predictive power during the warm period when ozone was a better predictor.

**Conclusion:** The dynamic near real-time prediction model for asthma ED syndrome for young age group developed in this study provides a useful tool for evaluating the impacts of current events. Further model improvement will consider spatially-resolved predictors (e.g., satellite-derived air pollution data).

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## ABSTRACT E-BOOK

Theme: **Children's health**

**P-0251**

**Associations between urinary biomarkers of oxidative stress in the third trimester of pregnancy and behavioral outcomes in the offspring at 4 years of age**

**Presenter:** Anna S Rommel, Mount Sinai, New York, United States

**Authors:** A. S. Rommel<sup>1</sup>, G. L. Milne<sup>2</sup>, E. S. Barrett<sup>3</sup>, N. Bush<sup>4</sup>, R. Nguyen<sup>5</sup>, S. Sathyanarayana<sup>6</sup>, S. H. Swan<sup>1</sup>, K. K. Ferguson<sup>7</sup>;

<sup>1</sup>Mount Sinai, New York, NY, <sup>2</sup>Vanderbilt University Medical Center, Nashville, TN, <sup>3</sup>Rutgers University, Piscataway, NJ, <sup>4</sup>UCSF, San Francisco, CA, <sup>5</sup>University of Minnesota, Minneapolis, MN, <sup>6</sup>Seattle's Children Hospital, Seattle, WA, <sup>7</sup>NIEHS, Durham, NC.

**Background/Aim:** Prenatal oxidative stress has been linked to adverse pregnancy outcomes, including intrauterine growth restriction and preterm birth. However, little is known about neurodevelopmental outcomes following intrauterine oxidative stress exposure. We examined the association of prenatal oxidative stress with behavioral problems and social impairment in children at 4 years of age.

**Methods:** Urinary concentrations of 8-iso-prostaglandin F<sub>2α</sub> (8-iso-PGF<sub>2α</sub>), its primary metabolite 2,3-dinor-5,6-dihydro-15-F<sub>2T</sub>-isoprostane, and prostaglandin F<sub>2α</sub> (PGF<sub>2α</sub>) were measured in the third trimester in 512 pregnant women from The Infant Development and Environment Study (TIDES), a multi-center pregnancy cohort study. Behavioral problems and social impairment in the child were assessed using parent-rated Behavioral Symptoms Index (BSI) scores on the Behavior Assessment System for Children (BASC), and total Social Responsiveness Scale (SRS) scores, respectively. For the analysis, we used linear models, stratified by maternal education level, and adjusted for urinary-specific gravity, gestational age at urine collection, BMI, race, and maternal age.

**Results:** Mean BSI and total SRS t-scores were 53.17 (SD=12.85) and 51.7 (SD=8.39), respectively, in less educated mothers (≤high school, n=60), and 48.47 (SD=7.91) and 44.17 (SD=6.24), respectively, in more educated mothers (>high school, n=452). Among less educated mothers, none of the oxidative stress biomarkers were related to BSI or total SRS scores. Among more educated mothers, 8-iso-PGF<sub>2α</sub> was positively related to BSI ( $\beta=0.03$ ; 95% CI=0.01-0.06) and total SRS ( $\beta=0.02$ ; 95% CI=0.002-0.04) scores. Moreover, 2,3-dinor-5,6-dihydro-15-F<sub>2T</sub>-isoprostane showed a significant association with higher total SRS scores ( $\beta=0.03$ , 95% CI=0.001-0.06), while PGF<sub>2α</sub> showed a significant positive association with BSI scores ( $\beta=0.03$ ; 95% CI=0.01-0.05).

**Conclusions:** In TIDES, associations between biomarkers of oxidative stress and behavioral outcomes were modified by maternal education. In more educated mothers increased levels of oxidative stress during the third trimester of pregnancy were associated with increased behavioral problems and social impairment in the child at 4 years of age.

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## ABSTRACT E-BOOK

Theme: **Children's health**

**P-0252**

**Prenatal coexposure to phthalates and bisphenol A and neurodevelopment in preschool children**

**Presenter:** Surabhi Shah, Department of Occupational and Environmental Medicine, College of Medicine, Ewha Womans University, Seoul, Korea, Republic of

**Authors:** S. Shah<sup>1</sup>, J. Shin<sup>1</sup>, H. Kim<sup>2</sup>, H. Park<sup>3</sup>, Y. Hong<sup>4</sup>, M. Ha<sup>5</sup>, Y. Kim<sup>6</sup>, E. Ha<sup>1</sup>;

<sup>1</sup>Department of Occupational and Environmental Medicine, College of Medicine, Ewha Womans University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Department of Pediatrics, College of Medicine, Ewha Womans University, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Department of Preventive Medicine, College of Medicine, Ewha Womans University, Seoul, KOREA, REPUBLIC OF, <sup>4</sup>Department of Preventive Medicine, College of Medicine Seoul National University, Seoul, KOREA, REPUBLIC OF, <sup>5</sup>Department of Preventive Medicine, Dankook University College of Medicine, Cheonan, KOREA, REPUBLIC OF, <sup>6</sup>Department of Occupational and Environmental Medicine, University of Ulsan College of Medicine, Ulsan University Hospital, Ulsan, KOREA, REPUBLIC OF.

**Introduction:** Endocrine-disrupting chemicals (EDCs) are a group of chemical that can alter the homeostasis or signaling components of the endocrine system. Exposure to mixture of early life exposure to EDCs affect mental and psychomotor development in children. EDCs are of particular concern, as there is a need to evaluate the synergistic or antagonistic effects of EDCs on each other. Thus, we evaluate the combined effect of EDCs: phthalates and bis-phenol A (BPA) on cognitive development of children.

**Methods:** We selected 398 mother-children pair from Mothers and Children's Environmental Health study in South Korea. We evaluated the effect of prenatal: first (early) and third (late) trimester of pregnancy, urinary phthalates: mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), mono(2-ethyl-5-oxohexyl) phthalate (MEOHP), mono-n-butyl phthalate (MBP) and bis-phenol A (BPA) on Bayley: mental development index (MDI) and psychomotor development index (PDI) of children at 6,12 ,24 and 36 months using linear regression, mixed model and Bayesian kernel machine regression (BKMR).

**Results:** Linear regression analysis showed that late pregnancy MBP ( $\beta= -1.39$ ,  $p<0.05$ ) and BPA ( $\beta= -1.23$ ,  $p<0.05$ ) affected MDI and MBP ( $\beta= -2.20$ ,  $p<0.05$ ) was negatively associated with PDI in boys at 6 months. While early pregnancy MEOHP ( $\beta= -3.00$ ,  $p<0.05$ ) and MBP ( $\beta= -4.42$ ,  $p<0.05$ ) PDI in boys at 12 months. Late pregnancy MBP ( $\beta= -2.36$ ,  $p<0.05$ ) PDI in boys at 24 months. Mixed model analysis showed that early pregnancy phthalates significantly affected MDI and PDI up to 24 months in boys. Further, BKMR analysis showed that exposure to mixture of early pregnancy: phthalates and BPA (estimate= -2.68, 95% C.I. = -5.01, -0.35) affect PDI in boys at 12 months.

**Conclusion:** Our results identified that prenatal co-exposure to phthalates and BPA affected psychomotor development in boys at 12 months. Further studies are needed to explore how the mixture of BPA and phthalates interact with each other.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0253**

### **Prenatal Phthalate Exposure and Social Responsiveness Scores in Early Childhood Using Quantile Regression: The HOME and EARLI Studies**

**Presenter:** Marisa A Patti, Brown University School of Public Health, Providence, United States

**Authors:** M. A. Patti<sup>1</sup>, M. Eliot<sup>1</sup>, C. Newschaffer<sup>2</sup>, K. Yolton<sup>3</sup>, J. Khoury<sup>3</sup>, A. Chen<sup>4</sup>, B. P. Lanphear<sup>5</sup>, K. Lyall<sup>6</sup>, I. Hertz-Picciotto<sup>7</sup>, M. D. Fallin<sup>8</sup>, L. A. Croen<sup>9</sup>, J. M. Braun<sup>1</sup>;

<sup>1</sup>Brown University School of Public Health, Providence, RI, <sup>2</sup>Pennsylvania State University, State College, PA, <sup>3</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>4</sup>University of Pennsylvania, Philadelphia, PA, <sup>5</sup>Simon Fraser University, Vancouver, BC, CANADA, <sup>6</sup>Drexel University, Philadelphia, PA, <sup>7</sup>University of California, Davis, CA, <sup>8</sup>Johns Hopkins University, Baltimore, MD, <sup>9</sup>Kaiser Permanente Northern California, Oakland, CA.

**Background/Aim:** Prenatal exposure to phthalates, non-persistent chemicals used in some consumer products, may adversely affect neurodevelopment. However, linear regression estimates effects at the mean of a neurodevelopmental trait and the effect of phthalates may be underestimated if sub-populations at the 'tails' of distributions are more susceptible. To address this gap, we assessed the relation between prenatal phthalate exposure and children's Autism Spectrum Disorder (ASD)-related behaviors using quantile regression. **Methods:** We used harmonized data from the Health Outcomes and Measures of the Environment (HOME) Study, a general population cohort (n= 276) and Early Autism Risk Longitudinal Investigation (EARLI) (n=145) Study, an enriched risk cohort of moms who had a child with ASD. We measured maternal concentrations of 9 phthalate metabolites in urine samples collected twice during pregnancy. Caregivers reported children's behaviors associated with ASD on the Social Responsiveness Scale (SRS) at age 3-8 years; higher scores indicate more ASD-related behaviors. We estimated covariate-adjusted differences in continuous SRS T-scores with increasing log<sub>10</sub>-transformed phthalate metabolite concentrations using quantile regression. **Results:** In HOME, monobenzyl phthalate, monoethyl phthalate, and di-2-ethylhexyl phthalate (ΣDEHP) metabolite concentrations were modestly associated with increased SRS T-scores at the 50<sup>th</sup> or 75<sup>th</sup> percentile compared to the 25<sup>th</sup>. For example, each 10-fold increase in ΣDEHP concentrations was associated with higher SRS T-scores at the 50<sup>th</sup> (β:3; 95% CI:2, 7) and 75<sup>th</sup> (β:3; 95% CI:-1, 7) percentiles, but not the 25<sup>th</sup> (β:1; 95% CI: 0, 5). In EARLI, there were predominately inverse and less precise associations between phthalate metabolite concentrations and SRS T-scores across percentiles. **Conclusion:** In the HOME Study, concentrations of some phthalate were associated with more autistic behaviors among children with higher SRS T-scores; inconsistencies with the EARLI Study may be due to differences in cohort specific participant characteristics.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0254**

### **Gestational Triclosan Exposure and Infant Birth Weight: A Systematic Review and Meta-analysis**

**Presenter:** Marisa A Patti, Brown University School of Public Health, Providence, United States

**Authors:** M. A. Patti, N. B. Henderson, M. Eliot, J. M. Braun;  
Brown University School of Public Health, Providence, RI.

Background/Aim: Exposure to triclosan, an antimicrobial chemical used in personal care and cleaning products, has been associated with reduced birth weight in some, but not all studies. Thus, we conducted a systematic review and meta-analysis to characterize the relation of gestational triclosan exposure with infant birth weight, and identify potential sources of heterogeneity between studies. Methods: We identified original studies that measured maternal urinary triclosan concentrations during pregnancy and reported their association with infant birth weight. We considered birth weight, which we further characterized based on adjustment for gestational age or gestational age standardized birth weight z-scores. Using a random effects model, we estimated differences in these outcomes per 10-fold increase in triclosan concentrations. Results: Among thirteen identified studies, the range of median triclosan concentrations varied by approximately 2 orders of magnitude (0.6 to 29 ng/mL), with higher concentrations in North American and most European studies compared to Asian ones. Associations between triclosan and birth weight ( $\beta$ : -41g; 95% CI: -110, -28; n=4) were stronger than those when birth weight was adjusted for gestational age ( $\beta$ : -16g; 95% CI: -24, -8; n=8). Similarly, increasing triclosan was associated with modest decreases in birth weight z-scores ( $\beta$ : -0.08; 95% CI: -0.22, 0.07; n=4). The association between triclosan and gestational age adjusted birth weight was stronger in studies with higher median triclosan values >10ng/mL compared to studies with median values <10 ng/mL ( $\beta$ : -27g; 95% CI: -61, 7; n=3 vs.  $\beta$ : 6g; 95% CI: -20, 31; n=5). Conclusion: We observed that the association of urinary triclosan concentrations with birth weight varied by adjustment for gestational age and study-specific urinary triclosan concentrations. Our results suggest that urinary triclosan concentrations are associated with lower infant birth weight in populations with higher degrees of exposure prevalence.

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## ABSTRACT E-BOOK

### Theme: Children's health

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P-0255

#### Association of placental concentrations of phenolic endocrine disrupting chemicals with cognitive functioning in preschool children from the Environment and Childhood (INMA) Project

**Presenter:** Carmen Freire, Instituto de Investigación Biosanitaria de Granada (ibs.granada); CIBER de Epidemiología y Salud Pública (CIBERESP), Granada, Spain

**Authors:** C. Freire<sup>1</sup>, F. Vela-Soria<sup>2</sup>, A. Beneito<sup>3</sup>, M. Lopez-Espinosa<sup>4</sup>, J. Ibarluzea<sup>5</sup>, F. Barreto<sup>6</sup>, M. Casas<sup>7</sup>, M. Vrijheid<sup>7</sup>, G. Fernández-Tardón<sup>8</sup>, I. Riaño-Galan<sup>8</sup>, M. Fernandez<sup>9</sup>;

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**Aim:** To examine the association of placental concentrations of several phenolic endocrine disrupting chemicals (EDCs), including bisphenol A (BPA), parabens (PBs), and benzophenones (BzPs), with cognitive development in preschool children from the Environment and Childhood (INMA) Project in Spain. **Methods:** Concentrations of BPA, four PBs (methylparaben [MePB], ethylparaben [EtPB], propylparaben [PrPB], and butylparaben [BuPB]), and six BzPs (BzP-1, BzP-2, BzP-3, BzP-6, BzP-8, and 4-hydroxybenzophenone [4-OH-BzP]) were measured in placenta samples randomly selected from five INMA cohorts collected between 2000 and 2008. Neuropsychological assessment of cognitive and motor function was performed with the McCarthy Scales of Children's Abilities (MSCA) at the age of 4-5 years. Associations were assessed in a sub-sample of 191 mother-child pairs using linear and logistic regression models adjusted for confounding factors. **Results:** PB compounds were detected in >71% of placentas, BPA in 62%, 4-OH-BzP in 50%, and the remaining BzPs in <9%. After adjustment for confounders, BPA was associated with greater odds of scoring lower (<20<sup>th</sup> percentile) in the verbal area (odds ratio [OR]= 2.78, 95% confidence interval [CI]=1.00; 5.81 for upper vs. first tertile, p-trend=0.05), whereas PrPB was inversely associated with scores in memory ( $\beta$ =-4.96, 95%CI=-9.54; -0.31 for detected vs. undetected), span memory (OR=2.50, 95%CI=0.95; 6.92 and 2.71, 95%CI=0.97; 6.64, respectively for middle and upper tertiles, p-trend=0.03), and motor function ( $\beta$ =-5.15, 95%CI=-9.26; -0.01 for upper vs. first tertile, p-trend=0.04). EtPB and total PB concentrations ( $\Sigma$ PBs) in the middle tertile were also inversely associated with visual function of posterior cortex and quantitative scores, respectively, but linear trends were not statistically significant. **Conclusions:** These associations of BPA and PrPB with poorer verbal, memory, and motor skills are novel observations that warrant further attention. Larger prospective studies are required to confirm whether prenatal exposure to BPA and other phenols is associated with impaired cognitive development.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0256**

**Kawasaki disease and prenatal exposure to air pollution: A population-based cohort study**

**Presenter:** Stephane Buteau, Institut national de sante publique du Quebec, Montreal, Canada

**Authors:** S. Buteau<sup>1</sup>, S. Belkaibech<sup>1</sup>, M. Bilodeau-Bertrand<sup>1</sup>, M. Hatzopoulou<sup>2</sup>, A. Smargiassi<sup>3</sup>, N. Auger<sup>1</sup>;  
<sup>1</sup>Institut national de sante publique du Quebec, Montreal, QC, CANADA, <sup>2</sup>University of Toronto, Toronto, ON, CANADA, <sup>3</sup>School of Public Health, University of Montreal, Montreal, QC, CANADA.

Background/Aim: Kawasaki disease (KD) is the leading cause of acquired heart disease in children in North America. Causes of KD remain to be elucidated. Environmental factors may play an etiologic role but prenatal environmental exposures are understudied. We investigated whether prenatal exposure to outdoor air pollution is associated with the incidence of KD in childhood. Methods: We used an open birth cohort derived from health administrative databases. Children born in the province of Quebec (Canada) between 2006-2012 were followed up until March 31, 2018. Incident diagnoses of KD were ascertained from health administrative data. We assigned prenatal exposures using annual average concentrations at the residential postal code at birth. Pollutants investigated were ambient fine particulate matter (PM<sub>2.5</sub>), nitrogen dioxide (NO<sub>2</sub>) and sulfur dioxide (SO<sub>2</sub>) from industrial emissions estimated from dispersion modeling, as well as regional PM<sub>2.5</sub> and traffic-related NO<sub>2</sub> estimated from satellite-based and land-use regression models. We assessed associations between prenatal air pollutant exposure and incident KD using Cox proportional hazards models, adjusting for individual and contextual factors. Sensitivity analyses included modifying effects of maternal comorbidities (i.e., obesity, diabetes and preeclampsia). Results: The cohort comprised 505,336 children, including 539 incident cases of KD. Adjusted hazard ratios (HRs) per interquartile range increase in industrial air pollution were 1.07 (95% CI: 1.01, 1.13) for SO<sub>2</sub>, 1.09 (95% CI: 0.99, 1.20) for NO<sub>2</sub>, and 1.01 (95% CI: 0.97, 1.05) for PM<sub>2.5</sub>. Association for industrial SO<sub>2</sub> strengthened (HR = 1.23; 95% CI: 1.06, 1.42) upon adjustment for industrial NO<sub>2</sub> and PM<sub>2.5</sub>. For regional PM<sub>2.5</sub> and traffic-related NO<sub>2</sub>, HRs were 1.16 (95% CI: 0.96, 1.39) and 1.12 (95% CI: 0.96, 1.31). Associations for NO<sub>2</sub> appeared enhanced by maternal diabetes. Conclusions: This population-based cohort study supports a possible link between KD and prenatal exposure to air pollution. Further studies are needed to consolidate these findings.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0257**

**Dietary patterns among pregnant women in the SELMA study**

**Presenter:** Katherine Svensson, Department of Health Sciences, Karlstad University, Karlstad, Sweden

**Authors:** K. Svensson<sup>1</sup>, C. Gennings<sup>2</sup>, A. Wolk<sup>3</sup>, S. Wikström<sup>4</sup>, C. Bornehag<sup>1</sup>;

<sup>1</sup>Department of Health Sciences, Karlstad University, Karlstad, SWEDEN, <sup>2</sup>Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>3</sup>Institute of Environmental Medicine, Karolinska Institutet, Stockholm, SWEDEN, <sup>4</sup>School of Medical Sciences, Örebro University, Örebro, SWEDEN.

Background: Nutrition is important during pregnancy both for the health of the mother and fetal development. There are nutritional guidelines for pregnant women in order to get the nutrients that are needed for healthy pregnancy outcomes. Our objective was to identify dietary patterns among pregnant women. Methods: We used data from 1,770 pregnant women participating in the Swedish Environmental Longitudinal Mother and child Asthma and allergy (SELMA) study. Food intake was collected through a 30-day recall food-frequency questionnaire during 2<sup>nd</sup> trimester of pregnancy. Dietary intake was calculated to grams per day. We performed principal component (PC) analysis to identify different food patterns. Results: Overall, women were 31 years of age, of normal weight (BMI=25), a college degree or higher (65%), and were mainly non-smokers (95%). We found 11 principal components (PC) with eigenvalues above 1 explaining 61% of the dietary variation. PC1, representing 13% of the variance, showed a varied diet with higher positive loadings for meat, fish, vegetables, fruits, cakes, and sweets. PC2 (8% variance) had higher loadings on cakes and sweets and lower on vegetables, whereas PC3 (7% variance) had negative loadings on fish. The group in PC4 (6% variance) had a less varied diet with positive loadings on sweets and vegetables but negative loadings on dairy, cereals, meat and fish. Women in PC8 (4% variance) ate more dairy, meat and fish but no sweets, bread or cereals. These dietary patterns are currently being analyzed with a nutrition index based on nutritional guidelines and with prenatal exposure to endocrine disruptors (EDCs) in a mixture analysis. Conclusion: Results provide a depiction of women's dietary patterns during mid-pregnancy. They will be further analyzed with prenatal nutrient intake and exposure to EDCs in order to get a better understanding of the relationship between food patterns, nutrition, and exposure to EDCs

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Theme: **Children's health**

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**P-0259**

**NeuroSmog: Determining the impact of air pollution on the developing brain - outline of the project protocol**

**Presenter:** Yarema Mysak, Jagiellonian University, Kraków, Poland

**Authors:** Y. Mysak<sup>1</sup>, S. Adamus<sup>1</sup>, M. Lipowska<sup>2</sup>, K. Sitnik-Warchulska<sup>3</sup>, B. Izydorczyk<sup>4</sup>, K. Skotak<sup>5</sup>, J. Grellier<sup>6</sup>, I. Markevych<sup>1</sup>, M. Szwed<sup>1</sup>;

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**Background:** Recent studies have linked exposure to airborne particulate matter (PM) to neurodevelopmental outcomes but the findings are mixed and mechanisms are unclear. We aim to determine the impact of PM on the developing brain of schoolchildren in Poland, a European country characterized by very high levels of air pollution. **Methods:** During 2020-2021, 800 children aged 10 to 13 years will be recruited in a case-control study. Attention Deficit Hyperactivity Disorder (ADHD) cases will be sampled from psychological centres and clinics. Population-based controls will be sampled from schools. The study area will include 20 towns in southern Poland characterized by different PM levels. Behavioural testing will be done using a battery of tests, including the inhibition measuring Go-NoGo task and the Attention Network Task. Magnetic Resonance Imaging (MRI) acquisition will be conducted in line with the Human Connectome Project Adolescent Brain Cognitive Development protocols (resting-state functional MRI, Diffusion Tensor Imaging (DTI), T1/T2 structural MRI, one functional MRI task - Conditioned Approach Response Inhibition Task (CARIT)). Estimates of PM and other air pollutants will be modelled using a combination of land use regression, transport models, satellite observations and monitoring data. These will be assigned to prenatal and early postnatal residential addresses of children. Associations of PM with ADHD-related symptoms, intelligence quotient (IQ), attention, emotional and social function and the role of changes in specific brain regions will be assessed by mediation models, adjusted for confounders. **Results and Discussion:** This comprehensive four-year study will provide novel, in-depth understanding of the neurodevelopmental effects of PM.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0260**

**Gene-environment interactions between air pollution and biotransformation enzymes and risk of birth defects**

**Presenter:** Amy Padula, University of California San Francisco, San Francisco, United States

**Authors:** A. Padula<sup>1</sup>, W. Yang<sup>2</sup>, K. Schultz<sup>3</sup>, C. Lee<sup>3</sup>, F. Lurmann<sup>4</sup>, S. Hammond<sup>5</sup>, G. M. Shaw<sup>2</sup>;  
<sup>1</sup>University of California San Francisco, San Francisco, CA, <sup>2</sup>Stanford University, Palo Alto, CA, <sup>3</sup>UCSF Benioff Children's Hospital, Oakland, CA, <sup>4</sup>Sonoma Technology Inc, Petaluma, CA, <sup>5</sup>University of California, Berkeley, Berkeley, CA.

Background: Genetic factors and environmental factors have been observed to influence risks for birth defects. Few studies have investigated gene-environment interactions that could contribute to birth defects. Our aim was to examine the interaction between gene variants in biotransformation enzyme pathways and ambient air pollution exposures and risk of several structural birth defects. Methods: We evaluated the role of ambient air pollutant exposure [nitrogen dioxide (NO<sub>2</sub>), nitrogen oxide, carbon monoxide, particulate matter <10 (PM<sub>10</sub>) and <2.5 (PM<sub>2.5</sub>) microns] during pregnancy and 104 gene variants of biotransformation enzymes from infant bloodspots or buccal cells in a California population-based case-control (409 cases and 208 nonmalformed controls) study. Cases included cleft lip with or without cleft palate (N=206), gastroschisis (N=94), tetralogy of Fallot (N=69) and dextro-transposition of the great arteries (d-TGA; N=40). We considered race/ethnicity and folic acid vitamin use as potential effect modifiers and adjusted for smoking. Results: We observed increased risk of d-TGA associated with interactions between CYP2A6 and NO<sub>2</sub> (OR=7.1), SLCO1B1 and NO<sub>2</sub> (OR=4.0), NAT2 and PM<sub>10</sub> (OR=3.5), SLCO1B1 and PM<sub>10</sub> (OR=3.0), SLCO2B1 and PM<sub>10</sub> (OR=4.4). We also observed gene-environment interactions for cleft lip with or without cleft palate (CYP2D6 and PM<sub>10</sub>; OR=2.8), gastroschisis (CYP2C9 and PM<sub>10</sub>; OR=4.2) and tetralogy of Fallot (NAT2 and PM<sub>2.5</sub>; OR=5.0). Conclusions: These analyses show interactions between air pollution exposure during early pregnancy and gene variants associated with metabolizing enzymes with regard to risk of d-TGA, though results were less consistent for other birth defects. These exploratory results suggest that some individuals based on their genetic background may be more susceptible to the adverse effects of air pollution.

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**P-0263**

### **Length of chronic exposure to particulate matter and adverse birth outcomes: A population-based cohort study**

**Presenter:** Wiessam Abu Ahmad, Hebrew University–Hadassah, Jerusalem, Israel

**Authors:** W. Abu Ahmad<sup>1</sup>, R. Nirel<sup>2</sup>, I. Kloog<sup>3</sup>, R. Golan<sup>3</sup>, M. Negev<sup>4</sup>, G. Koren<sup>5</sup>, H. Levine<sup>6</sup>;  
<sup>1</sup>Hebrew University–Hadassah, Jerusalem, ISRAEL, <sup>2</sup>Hebrew University, Jerusalem, ISRAEL, <sup>3</sup>Ben-Gurion University of the Negev, Beer Sheva, ISRAEL, <sup>4</sup>University of Haifa, Haifa, ISRAEL, <sup>5</sup>Institute of Research and Innovation, Maccabitech, and Sackler Faculty of Medicine, Tel Aviv University, Tel-Aviv, ISRAEL, <sup>6</sup>Hadassah-Hebrew University and The Hebrew University Center of Excellence in Agriculture and Environmental Health, Jerusalem, ISRAEL.

**Background/Aim:** Previous studies have shown associations between particulate matter (PM) air pollution and adverse birth outcomes. However, most studies focused on relatively short periods of prenatal exposure to PM and in a low to moderate polluted areas. We examined the possible impact of exposure to particulate matter with diameter  $\leq 10 \mu\text{m}$  (PM<sub>10</sub>) and  $\leq 2.5 \mu\text{m}$  (PM<sub>2.5</sub>) for a number of years before delivery on the occurrence of adverse birth outcomes: term low birth weight (TLBW), preterm delivery (PTB), and small for gestational age (SGA) in a region exposed to long-range dust transport. **Methods:** This study was based on a cohort of births (N=90,505) that occurred in Israel during 2013-2015. We calculated prenatal PM averages during 1, 5, and 10 years prior to delivery. Logistic regression models with mother-level as a random intercept were used to determine the association between exposure and adverse birth outcomes, adjusting for a priori known covariates. **Results:** In fully adjusted models, a 10- $\mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub> during 1-, 5- and 10-years prior to delivery was associated with a monotonically increasing risk of TLBW [odds ratio (OR)=1.51 95% confidence interval (CI): (1.14-1.99), 1.54 (1.12-2.14) and 1.70 (1.21-2.41), respectively] and SGA [1.25 (1.03-1.49), 1.43 (1.16-1.77) and 1.45 (1.16-1.80), respectively]. ORs increased with the length of exposure period also for PM<sub>10</sub>. For example, ORs for TLBW in association with a 20- $\mu\text{g}/\text{m}^3$  increase in PM<sub>10</sub> over 1-, 5-, and 10-years prior to delivery were 1.25 (1.00-1.58), 1.32 (1.01-1.72) and 1.46 (1.11-1.90), respectively. PTB was not associated with neither PM<sub>2.5</sub> nor PM<sub>10</sub>. For example, the OR for PTB in association with a 10- $\mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub> over 10-years prior to delivery was 1.19 (0.91-1.52). **Conclusions** The magnitude of the estimated associations between maternal exposure to both PM<sub>2.5</sub> and PM<sub>10</sub> exposure and birth outcomes increased with the length of the exposure period.

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**P-0264**

### **Sex-specific associations between early life exposure to manganese and intrinsic functional connectivity of the brain in adolescents and young adults**

**Presenter:** Elza Rechtman, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** E. Rechtman<sup>1</sup>, E. Navarro<sup>1</sup>, E. de Water<sup>1</sup>, D. M. Papazaharias<sup>1</sup>, P. Curtin<sup>1</sup>, C. Ambrosi<sup>2</sup>, L. Mascaro<sup>2</sup>, R. Gasparotti<sup>3</sup>, C. Austin<sup>1</sup>, M. Arora<sup>1</sup>, D. R. Smith<sup>4</sup>, R. O. Wright<sup>1</sup>, C. Y. Tang<sup>1</sup>, R. G. Lucchini<sup>1</sup>, M. K. Horton<sup>1</sup>;

<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>ASST Spedali Civili Hospital, Brescia, ITALY,

<sup>3</sup>University of Brescia, Brescia, ITALY, <sup>4</sup>University of California Santa Cruz, Santa Cruz, CA.

**Background:** Manganese (Mn) is an essential nutrient. Homeostatic levels are critical to healthy human development, yet high levels of exposure can be neurotoxic and result in adverse effects. Given that optimal brain development requires complex maturational processes to occur in the right order and time, both timing and intensity of Mn exposure matter. Previous research has found critical windows of susceptibility and sex-specific associations between Mn exposure and unfavorable behavioral outcomes; however, few studies have explored the neural mechanisms behind these results. To address this research gap, we used magnetic resonance imaging (MRI) to investigate sex-specific associations between early life Mn exposure and intrinsic functional connectivity (iFC) of the brain.

**Methods:** Seventy-one participants (15-23 years; 46% male) from the ongoing Public Health Impact of Manganese Exposure (PHIME) completed a resting-state functional MRI scan and donated a naturally shed deciduous tooth. Prenatal, postnatal, and early childhood dentine Mn were measured using laser ablation-inductively coupled plasma-mass spectrometry. We performed seed-based correlation analyses, focusing on the left and right caudate, putamen, pallidum and bilateral middle frontal gyrus and examined correlations between dentine Mn at each time points in iFC in these regions. Subsequent analysis included an interaction term between sex and Mn. All models controlled for age, socioeconomic status, and IQ.

**Results:** Dentine Mn was correlated with iFC in areas involved in executive and motor functions, including the caudate, the middle frontal gyrus, the left putamen, and the left pallidum. The strength of the associations varied by sex and timepoint.

**Conclusion:** These findings suggest that early-life Mn exposure is associated with brain functional connectivity within cognitive and motor brain regions, and further suggests that females and males are not evenly vulnerable to these effects. Future studies should investigate cognitive and motor outcomes related to these associations.

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**P-0265**

### **Prenatal Exposure to Ambient Air Pollutants and Infant Growth Among Hispanics from Southern California**

**Presenter:** William B. Patterson, University of Colorado Boulder, Boulder, United States

**Authors:** W. B. Patterson<sup>1</sup>, N. Naik<sup>1</sup>, J. Glasson<sup>1</sup>, R. B. Jones<sup>2</sup>, J. F. Plows<sup>2</sup>, P. K. Berger<sup>2</sup>, H. A. Minor<sup>3</sup>, F. Lurmann<sup>3</sup>, M. I. Goran<sup>2</sup>, T. L. Alderete<sup>1</sup>;

<sup>1</sup>University of Colorado Boulder, Boulder, CO, <sup>2</sup>Children's Hospital of Los Angeles, Los Angeles, CA,

<sup>3</sup>Sonoma Technologies Inc., Petaluma, CA.

**Background:** Prior epidemiological and animal work has linked in utero exposure to ambient air pollutants (AAP) with accelerated postnatal weight gain. The objective of this study was to examine relationships between prenatal residential AAP exposure with infant growth.

**Methods:** Residential exposure to AAP (particulate matter <2.5 and 10 microns in aerodynamic diameter [PM<sub>2.5</sub>, PM<sub>10</sub>]; nitrogen dioxide [NO<sub>2</sub>]; ozone [O<sub>3</sub>]; oxidative capacity [Ox: redox-weighted oxidative potential of O<sub>3</sub> and NO<sub>2</sub>]) was modeled for 123 participants from the longitudinal Mother's Milk Study, an ongoing cohort of Hispanic mother-infant dyads from Southern California. Multivariate linear regression was performed to examine the relationships between prenatal AAP exposure and changes in infant growth, skinfold measures, and predicted body fat and lean mass (calculated using infant demographics, anthropometrics, and EchoMRI from a subset) from 1-to-6 months of life. Models adjusted for maternal age, pre-pregnancy body mass index, socioeconomic status, infant age, sex, and breastfeeding frequency. Sex interactions were tested, and effects are reported for each standard deviation increase in exposure.

**Results:** Higher NO<sub>2</sub> was associated with a greater increase in infant weight ( $\beta=0.14$ ,  $p=0.03$ ), predicted lean mass ( $\beta=0.05$ ,  $p=0.01$ ), and midhigh skinfold thickness ( $\beta=0.84$ ,  $p=0.03$ ). PM<sub>10</sub> and PM<sub>2.5</sub> were positively associated with change in umbilical circumference ( $\beta=0.84$ ,  $p=0.001$  and  $\beta=0.56$ ,  $p=0.04$ , respectively) and suprailiac skinfold thickness ( $\beta=0.38$ ,  $p=0.02$  and  $\beta=0.34$ ,  $p=0.04$ , respectively). Lastly, Ox ( $p_{\text{interactions}}<0.02$ ) was positively associated with change in umbilical circumference among females ( $\beta=1.23$ ,  $p=0.001$ ), but not males ( $\beta=-0.08$ ,  $p=0.84$ ) and was inversely associated with infant length change ( $\beta=-0.57$ ,  $p=0.02$ ) among males, but not females ( $\beta=0.17$ ,  $p=0.48$ ).

**Conclusion:** Prenatal AAP exposure was associated with increased weight gain and anthropometric measures from 1-to-6 months of life. Sex-specific associations suggest differential consequences of in utero oxidative stress. These results indicate that prenatal AAP exposure may alter infant growth, which has potential to increase childhood obesity risk.

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**P-0266**

**The association of prenatal exposure to intensive traffic with early preterm infant neurobehavioral development as reflected by the NICU Network Neurobehavioral Scale (NNNS)**

**Presenter:** Xueying Zhang, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** X. Zhang, E. Spear, C. Gennings, P. Curtin, A. Just, J. Bragg, A. Stroustrup;  
Icahn School of Medicine at Mount Sinai, New York, NY.

**Introduction:** Traffic-related air pollution has been shown to be neurotoxic to the developing fetus and in term-born infants during early childhood. It is unknown whether there is an increased risk of adverse neurobehavioral outcome in preterm infants exposed to higher levels of air pollution during the fetal period. **Objective:** To assess the association between prenatal exposure to traffic-related air pollution on early preterm infant neurobehavior. **Methods:** Air pollution exposure was estimated by two methods: density of major roads and density of vehicle-miles traveled (VMT), each at multiple buffering areas around residential addresses. We examined the association between prenatal exposure to traffic-related air pollution and performance on the Neonate Intensive Care Unit (NICU) Network Behavioral Scale (NNNS), a measure of neurobehavioral outcome in infancy for 240 preterm neonates enrolled in the NICU-Hospital Exposures and Long-Term Health cohort. Linear regression analysis was conducted for exposure and individual NNNS subscales. Latent profile analysis (LPA) was applied to classify infants into distinct NNNS phenotypes. Multinomial logistic regression analysis was conducted between exposure and LPA groups. Covariates included gestational age, birth weight z-score, post-menstrual age at NNNS assessment, socioeconomic status, race, delivery type, maternal smoking status, and medical morbidities during the NICU stay. **Results:** Among all 13 NNNS subscales, hypotonia was significantly associated with VMT ( $10^4$  vehicle-mile/km<sup>2</sup>) in 150m ( $\beta=0.01$ , P-value<0.001), 300m ( $\beta=0.01$ , P-value=0.003), and 500m ( $\beta=0.01$ , P-value=0.002) buffering areas, as well as with road density in a 500m buffering area ( $\beta=0.03$ , P-value=0.03). We identified three NNNS phenotypes by LPA. Among them, high density of major roads within 150m, 300m, and 500m buffers of the residential address was significantly associated with the same phenotype (P<0.05). **Conclusion:** Prenatal exposure to intensive air pollution emitted from major roads may impact early neurodevelopment of preterm infants. Motor development may be particularly sensitive to air pollution-related toxicity.

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**P-0267**

### **Health Disparities in Exposures to Chemicals and Pollutants Affecting Neurodevelopment: A Hybrid Systematic-Scoping Review**

**Presenter:** Kathryn Hirabayashi, University of Maryland School of Public Health, College Park, United States

**Authors:** K. Hirabayashi<sup>1</sup>, K. M. Ellickson<sup>2</sup>, D. C. Payne-Sturges<sup>1</sup>;

<sup>1</sup>University of Maryland School of Public Health, College Park, MD, <sup>2</sup>Minnesota Pollution Control Agency, Saint Paul, MN.

**Background:** One in six children in the United States have a developmental disability, and widespread exposures to toxic chemicals can increase the risks for cognitive, behavioral, and social impairment in children. Project TENDR (Targeting Environmental Neuro-Development Risks) is an alliance of more than 50 leading scientists, health professionals and advocates focused on preventing exposures to toxins that harm brain development, and to eliminating disproportionate exposures to children of color and low-income children. We initiated this systematic-scoping review to map the epidemiologic literature regarding increased exposure and biological susceptibility to neurotoxic chemicals among pregnant women and children living in the U.S. who face health disparities related to social, economic or environmental disadvantage.

**Methods:** Eligible literature included observational studies published in English, measuring neurotoxic exposures (combustion-related air pollution, lead, mercury, organophosphate pesticides, polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs) or phthalates) in children aged 0-18 or pregnant women living in the U.S., and examining a social, economic or environmental health disparity. PubMed, Web of Science and CINAHL were searched in July 2019 and gray literature was evaluated. Articles were categorized by population, exposure, health disparity comparator and neurodevelopmental outcome.

**Results:** 199 studies met the review eligibility criteria and assessed neurodevelopmental measures. The most common exposures examined were lead (37%) and combustion-related air pollution (35%), while PBDEs were the least common (1%). Neurodevelopmental outcomes included neural tube defects, Autism Spectrum Disorder, Attention-Deficit/Hyperactivity Disorder, and academic, behavioral, cognitive, intellectual and learning outcomes. Common health disparities examined included race, ethnicity, socioeconomic status, and urban or rural populations.

**Conclusions:** The review revealed a notable gap in literature on Native American populations. Additional research on exposures to mercury, phthalates, PCBs and PBDEs may benefit our knowledge of the neurodevelopmental effects of combined exposures to neurotoxic chemicals and social, economic and environmental factors that stratify health outcomes.

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**P-0269**

### **Methylparaben in Meconium and Risk of Maternal Thyroid Dysfunction, Adverse Birth Outcomes, and Attention-Deficit Hyperactivity Disorder**

**Presenter:** Brennan H Baker, Columbia University, New York, United States

**Authors:** B. H. Baker<sup>1</sup>, H. Wu<sup>1</sup>, H. E. Laue<sup>2</sup>, A. Boivin<sup>3</sup>, V. Gillet<sup>3</sup>, M. Langlois<sup>3</sup>, J. Bellenger<sup>3</sup>, A. A. Baccarelli<sup>1</sup>, L. Takser<sup>3</sup>;

<sup>1</sup>Columbia University, New York, NY, <sup>2</sup>Dartmouth College, Hanover, NH, <sup>3</sup>University of Sherbrooke, Sherbrooke, QC, CANADA.

Background Parabens are detected ubiquitously in human urine samples, but the effects of prenatal exposure are unclear, partially due to inadequate exposure assessment in maternal urine, which may fail to capture fetal exposure. We examined the association of meconium methylparaben detection with preterm birth, gestational age, birthweight, maternal thyroid hormones, and child attention-deficit hyperactivity disorder (ADHD) at 6-7 years. Methods Methylparaben was measured in meconium with ultraperformance liquid chromatography mass spectrometry and dichotomized (detect/non-detect) for 345 children in the Gestation and the Environment cohort in Sherbrooke, Quebec, Canada. Birth outcomes and maternal thyroid hormones (T3, T4, and thyroid stimulating hormone [TSH]) at <20 weeks gestation were measured at the Centre Hospitalier Universitaire de Sherbrooke. ADHD diagnosis at age 6-7 was determined at follow-up or from medical records. Associations were estimated with logistic and linear regressions, and the potential for mediation by birthweight and preterm birth of the effect of methylparaben on ADHD was modeled with causal mediation analysis. Results Meconium methylparaben detection was associated with increased odds of preterm birth (odds ratio [OR]=4.81; 95% CI [2.29, 10.10]), decreased gestational age (beta [ $\beta$ ]=-0.61 weeks; 95% CI [-0.93, -0.29]) and decreased birthweight ( $\beta$ =-0.12 kilograms; 95% CI [-0.21, -0.03]). Associations were also found with decreased maternal TSH (relative concentration [RC]=0.76; 95% CI [0.58, 0.99]) and total T3 (RC=0.84; 95% CI [0.75, 0.96]), but increased total T4 (RC=1.10; 95% CI [1.01, 1.19]). Mothers of infants with detectable meconium methylparaben had increased odds of hypothyroxinemia (OR=2.50, 95% CI [1.01, 6.22]), and children were more likely to be diagnosed with ADHD at age 6-7 (OR=2.33, 95% CI [1.45, 3.76]). Preterm birth and birthweight mediated 20% and 13% of the effect of methylparaben on ADHD respectively. Conclusions This adverse association between methylparaben and ADHD, partially mediated by birth outcomes, warrants further research into fetal methylparaben exposure.

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**P-0270**

### **The Association between Sex Hormones, Pubertal Milestones and Benzophenone-3 (BP-3) Exposure Assessed by Urinary Biomarker or Questionnaire**

**Presenter:** Courtney M Giannini, University of Cincinnati, Cincinnati, United States

**Authors:** C. M. Giannini<sup>1</sup>, B. Huang<sup>2</sup>, C. S. Fassler<sup>1</sup>, R. C. Schwartz<sup>3</sup>, F. M. Biro<sup>2</sup>, S. M. Pinney<sup>1</sup>;

<sup>1</sup>University of Cincinnati, Cincinnati, OH, <sup>2</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH,

<sup>3</sup>Michigan State University, East Lansing, MI.

**Introduction:** Experimental studies have suggested endocrine disruption by BP-3, an active ingredient in sunscreen, with widespread exposure around the world. **Methods:** We recruited girls ages 6 - 8 years who returned semi-annually for pubertal maturation staging (thelarche, pubarche), to provide blood for serum hormone assay [estradiol, estrone, testosterone, dehydroepiandrosterone-sulfate (DHEA-S)], and urine for BP-3 assay. Parents completed yearly questionnaires on participant's past-year sunscreen use and attainment of menarche. Quantile regression determined the relationship between each log-transformed sex hormone with BP-3 exposure, measured by either biomarker (with half-life of 16 hours) or sunscreen questionnaire (use over the last year). Cox-proportional hazards models examined whether higher quartile of BP-3 exposure was associated with age-of-pubertal milestone. **Results:** The median value of baseline BP-3 measurements was 25.0 µg/g-creatinine (N=353), with detection in 98.9% of samples. The median number of days sunscreen was used in the past year was 48 days (N=302). There was no evidence of associations between any of the four hormones and the BP-3 biomarker. Testosterone, measured at the time of thelarche, was inversely associated with sunscreen use by questionnaire data (N=157, adjusted  $\beta = -0.0163$ , 97.5%CI: -0.0300, -0.0026). There was no evidence of association between sunscreen use by questionnaire and testosterone during other time windows (-6 months and +6 months) or other hormones at any time points. Age-of-Thelarche was later among participants in the 2nd quartile of BP-3 biomarker compared to the 1st quartile (N=282, adjusted HR=1.5900, 97.5%CI:1.0430-2.4230). Age-of-menarche and age-of-pubarche were not different among participants in different biomarker or questionnaire quartiles. **Conclusions:** Results suggest that higher report of sunscreen use was associated with lower testosterone levels during thelarche and a non-linear relationship between age-of-thelarche and BP-3 biomarker. Results using questionnaire and biomarker to represent exposure are not completely consistent with each other, thus conclusions should be interpreted with caution.

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**P-0271**

**Maternal air pollution exposure & adverse neonatal outcomes. Protocol of a scope review**

**Presenter:** Luisa Fernanda Londoño, School of Medicine and Health Science. Universidad del Rosario, Bogotá, Colombia

**Authors:** D. Buitrago-Medina, A. M. Barragan, L. F. Londoño-Tobon, M. Ospina-Espinosa, S. Noriega-Ramirez, I. Hernandez-Duarte, C. A. Moya-Ortiz, S. De Brigard-Cabal, C. Rojas-Reyes, S. J. Guerrero-Leon, A. D. Orjuela-Canon, O. J. Perdomo-Charry; Universidad del Rosario, Bogotá, COLOMBIA.

Introduction Infant mortality, low birth weight, impaired lung development, later respiratory morbidity & alterations in immune development were associated with maternal air pollution exposure. Consequence of these pregnancy outcomes are increased risk of death in the first month of life, growth retardation, lower IQ & metabolic diseases in adulthood in evidence from China & Australia. Frequency of reported outcomes & the nature, type or extent of evidence in the rest of the world on adverse neonatal outcomes is unclear. Objective To assess the nature, type & extent of evidence related to maternal air pollution exposure & adverse neonatal outcomes

Methodology Scoping Literature Review will be conducted. Complete protocol was developed & is available upon request. We search in MEDLINE, EMBASE, Scopus, Virtual Health Library PAHO & Google Scholar. We search for all research designs describing maternal air pollution exposure & adverse neonatal outcomes. At least two independent reviewers screen titles & abstracts according to inclusion criteria. Data extraction phase will be carried on a form. No risk of bias assessment will be performed. Search strategies will be reported, including number of references examined, duplicates removed, & full text papers reviewed according to PRISMA-P extension for Scoping. Results will be presented as a "map" of the data in the form of diagrams & tables, including Investigator, year, Country, Date, Objective, Epidemiological design, Analysis, Population characteristics, Outcomes. We will use Rayyan & Colab interactive environment to support self-learning projects, data analysis.

Results We get almost 9800 articles, full text reviewed 9200 & extracted information according forms. Most frequent outcomes include LBW then were grouped by pollutant agent & outcome. Social Impact This Scoping Literature Review will help identifying existing evidence related to maternal air pollution exposure & adverse neonatal outcomes suggesting potential modifiable factors to reduce adverse events after prove effectiveness through research hypotheses.

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## ABSTRACT E-BOOK

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**P-0272**

**Respiratory health effect of exposure to Indoor Microbiome on children under-five: a meta-analysis**

**Presenter:** Adekunle Gregory Fakunle, University of Ibadan, Ibadan, Nigeria

**Authors:** A. G. Fakunle<sup>1</sup>, N. Jafta<sup>2</sup>, R. Naidoo<sup>2</sup>;

<sup>1</sup>University of Ibadan, Ibadan, NIGERIA, <sup>2</sup>University of KwaZulu-Natal, Durban, SOUTH AFRICA.

**Background/Aim**The association between specific microbial agents such as mold within the indoor environment and adverse respiratory outcome among children under-five years of age has been widely reported but none have investigated the risk of exposure to the microbiome within the indoor environment. The aim of this review is to summarize published association between exposure to the microbiome within the indoor environment and respiratory endpoints among under-five children (U5-C).  
**Methods**Electronic scientific repositories; PUBMED, WEB OF SCIENCE, GREENFILE, EMBASE and Cochrane library were searched and screened through January 2020 for published reports for inclusion in the meta-analysis. Studies were eligible for inclusion if it reported an adjusted measure of risk for any of the respiratory outcomes associated with exposure to indoor microbiome, including the relative risk (RR) or odds ratio (OR) and CI. The pooled effective estimates was computed using inverse of variance method for weighting. Sensitivity analysis was used to evaluate the potential effect of individual studies on the overall estimates, while heterogeneity was evaluated by I<sup>2</sup> statistics using RevMan 5.3.  
**Results**Fifteen studies were eligible for inclusion in our meta-analysis. Exposure to a higher concentration of indoor microbiome was associated with an increased risk of wheeze [1.20 (1.03, 1.41), P < 0.02, I<sup>2</sup> = 76%], allergic rhinitis [1.25 (1.02, 1.54), P = 0.03, I<sup>2</sup> = 65%] and acute respiratory infections [1.35 (1.12, 1.62), P = 0.002, I<sup>2</sup> = 59%] among under-five children. The risk was stronger with exposure to fungi/molds [1.42 (1.27, 1.59), P < 0.00001; I<sup>2</sup> = 31%] than endotoxins [1.09 (0.93, 1.29), P = 0.29; I<sup>2</sup> = 72%].  
**Conclusions**The pooled effect estimate indicates an increased risk of adverse respiratory outcomes among U-5C. Therefore, interventions addressing exposure to microbiome within the indoor environment should be considered in the management of respiratory outcomes among under-five children.

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## ABSTRACT E-BOOK

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**P-0273**

**Assessment of methicillin resistance and toxin associated genes in staphylococcus species isolated from two selected pig farms in ogun state**

**Presenter:** Balogun Blessing Olalekan, Joseph Ayo Babalola University, Akure, Nigeria

**Authors:** O. Olakunle<sup>1</sup>, B. B. Olalekan<sup>2</sup>, E. L<sup>3</sup>;

<sup>1</sup>Federal Univerity Technology Akure, Akure, NIGERIA, <sup>2</sup>Joseph Ayo Babalola University, Akure, NIGERIA,

<sup>3</sup>Babcock University, Ilishan Remo, NIGERIA.

Swine especially pigs have been reported to harbor methicillin-resistant Staphylococcus species and have become a source of a novel and rapidly emerging infection in humans. This study was therefore, designed to investigate methicillin resistance status, susceptibility and exfoliative toxin-encoded genes in Staphylococcus species isolated from pigs. Hundred and fifty (150) samples consisting of 50 anal, nostril and environmental swabs were collected at Ode Remo and Sapade in Ogun state after obtaining ethical clearance. These were transferred into transport medium and transported to Microbiology laboratory of Babcock University. The isolates were identified to species level by Matrix Assisted Laser Desorption Ionization Time of Flight Mass Spectrometry. The phenotypic detection of methicillin resistance and susceptibility of the isolates to selected antibiotic classes were evaluated by agar diffusion and interpreted according to CLSI, 2011. Exfoliative toxin-encoding genes (eta and etb) in the isolates were screened by Polymerase Chain Reaction (PCR). The data were analyzed by descriptive statistics (frequency). Fifty (50) staphylococcal strains were isolated from anus (28), nostril (17) and environment (5) of which Staphylococcus sciuri(23), Staphylococcus cohnii(11), Staphylococcus piscifermentas(7), Staphylococcus carnosus(1), Staphylococcus condiment (3), Staphylococcus xylosus(2), Staphylococcus Kloosii(1), Staphylococcus pasteurii(1) and Staphylococcus succinus(1). Methicillin resistance was detected in 12 strains S. xylosus (1), S. kloosii (1), S. piscifermentas (2) and S. sciuri (8) with phenotypic method while none of the strains were positive by molecular counterpart. Susceptibility to other antibiotics indicated that all the strains were resistant to ceftazidime S. sciuri(23), S. cohnii(11), S. piscifermentas(7), S. carnosus(1), S. condimenti(3), S. xylosus(2), S. kloosii(1), S. pasteurii(1), and S. succinus(1). All the strains were negative for exfoliative toxin encoding genes after several trails in PCR. Methicillin resistance is absent among the strains studied and the resistance patterns observed indicated that the pattern of resistance predominantly found in clinical isolates are also emerging in the animal husbandry.

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**P-0274**

**Maternal residential proximity to Central Appalachian surface mining and adverse birth outcomes**

**Presenter:** Lauren Grace Buttlng, Virginia Tech, Blacksburg, United States

**Authors:** L. G. Buttlng, M. McKnight, M. Marston, K. Kolivras, S. Ranganathan, J. M. Gohlke;  
Virginia Tech, Blacksburg, VA.

Background: Over the past 25 years in Central Appalachia, there have been major shifts in land use due to surface mining. Previous studies have reported increased adverse birth outcomes in Central Appalachian coalfields compared to other regions at a county-level scale. This study addresses gaps in knowledge of exposure by developing a fine-scale spatiotemporal characterization of adverse birth outcomes in Central Appalachia through use of satellite imagery and address-level birth records. Methods: Surface mining boundaries in Central Appalachia between 1989-2015 were delineated using Landsat satellite imagery. These boundaries were used to characterize land as pre, active, and post mining areas. Geocoded maternal addresses from VA, WV, KY, and TN birth records were assigned exposures based on the amount of surface mining within a 5km radius. Births were also assigned exposures based on the amount of surface mining within their residential zip code and county. Mining exposures were further categorized into quantiles of high, moderate, and low amounts or no exposure. Regression models determined the association between surface mining during gestation and birth weight, preterm birth (PTB), low birth weight (LBW), and term low birth weight (TLBW), adjusting for available demographic factors. Results: Preliminary models indicate that prenatal exposure to high amounts of post mining operations (1 to 33 sq. km of land within 5km) of residence is associated with a decrease in birth weight (26 g 95% CI:15 g, 38g). Zip code and county level analysis results were consistent with street level results. Pregnant women who resided in zip codes during high amounts of active surface mining (between 1.3 and 41% of land area) had significantly lower birth weights (31 g, 95% CI:24 g, 39 g) when compared to infants born prior to mining. Conclusions: These preliminary findings suggest Central Appalachian surface mining may be associated with increases in adverse birth outcomes.

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**P-0275**

### **Exploring Effects of Sociodemographic Inequities in Greenness Accessibility on the Development of Allergic-related Respiratory Diseases in Children, Ontario**

**Presenter:** Erjia Ge, Dalla Lana School of Public Health, University of Toronto, Toronto, Canada

**Authors:** E. Ge<sup>1</sup>, Z. Huang<sup>2</sup>, R. Jaffe<sup>3</sup>, J. Brook<sup>1</sup>, W. Lou<sup>1</sup>, E. Lavigne<sup>4</sup>, P. J. Villeneuve<sup>5</sup>, L. Li<sup>6</sup>, Z. Lu<sup>1</sup>, T. To<sup>7</sup>;

<sup>1</sup>Dalla Lana School of Public Health, University of Toronto, Toronto, ON, CANADA, <sup>2</sup>Department of Mathematics, University of Toronto, Toronto, ON, CANADA, <sup>3</sup>School of Life Sciences, University of Toronto, Toronto, ON, CANADA, <sup>4</sup>Health Canada, Ottawa, ON, CANADA, <sup>5</sup>School of Mathematics and Statistics, Carleton University, Ottawa, ON, CANADA, <sup>6</sup>Public Health Ontario, Toronto, ON, CANADA, <sup>7</sup>Child Health Evaluation Sciences, The Hospital for Sick Children, Toronto, ON, CANADA.

Greenness, linked with fresh air and active living environment, is thought to associate with various health benefits. The normalized difference vegetation index (NDVI), which has been the most widely used proxy for measuring green space in traditional epidemiological studies, does not effectively reflect access to greenness nor the attributes of the space. Therefore, it may not capture the relevant complex exposure pathways that impact human health, e.g. the development of childhood asthma. Given these issues, we have initiated a research project, funded by the Canadian Institute of Health Research (CIHR), to 1) create a matrix that measures greenness accessibility by the travel time of each residential location to its nearest greenness, including park and forest/natural space; and 2) to determine the associations between greenness accessibility and the risks of developing asthma, allergic rhinitis, bronchitis, and bronchiolitis in children. Accessibility of greenness will be measured by travel time regarding road types and condition, land use, and other geographic variables (e.g. altitude, slopes, rivers/lakes), as well as season, weather, air quality, travel modes, holidays, and the day of the week as proxies for people's potential activities, which may provide a more precise daily-varying exposure measure of access. Additionally, we will compare our proposed matrix of greenness accessibility to the traditional NDVI in characterizing the inequity of greenness exposure at both individual and community levels. Finally, we will assess if better greenness accessibility is associated with reduced risk of childhood asthma and other respiratory conditions. The study will include about one million healthy Ontario infants who were born between April 1<sup>st</sup>, 2006 and March 31<sup>st</sup>, 2014. Analysis will be stratified by and/or adjusted for individual and contextual covariates. Our study offers a novel matrix on greenness accessibility and also a comprehensive measure of the impact of exposure to greenness on young children's health.

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**P-0276**

**Association between environmental pollution by PM 2.5 exposure and childhood overweight/obesity in children from 6 to 59 months in Lima and Callao, Perú**

**Presenter:** Valeria Paz, Universidad Peruana Cayetano Heredia, Lima, Peru

**Authors:** V. Paz, G. F. Gonzales;  
Universidad Peruana Cayetano Heredia, Lima, PERU.

Background: Air pollution by PM<sub>2.5</sub> is an important public health problem of considerable impact worldwide due to its deleterious effects in human beings. A recent report ranked Lima (Peru) as the second most polluted South American city by PM<sub>2.5</sub>. Recent evidences suggest that PM<sub>2.5</sub> may be a obesogenic factor. Overweight and obesity in childhood is related with PM<sub>2.5</sub> exposure by inflammation, methylation of adipogenic receptors and also associated to a fat consumption behavior. There is no time-series studies in Peru that associated PM<sub>2.5</sub> with overweight/obesity in pre-school children (PSC). Methods: Average daily PM<sub>2.5</sub> concentrations were calculated for 43 districts of Lima and Callao using an advanced machine learning model to estimate daily PM<sub>2.5</sub> concentrations at a 1 km<sup>2</sup> spatial resolution in Lima, Peru. Daily PM<sub>2.5</sub> concentrations were attributed to overweight/obese PSC by day of medical control. Overweight/obesity cases were diagnosed when Z score of weight per stature were >2DS. The time-series study used Distributed Lag model and Poisson regression to estimate RR for daily overweight/obesity diagnoses with daily PM<sub>2.5</sub>, controlling by relative humidity, temperature, year and Lima area. Results: An increase of 10 ug/m<sup>3</sup> of PM<sub>2.5</sub> 90 days before medical control was significantly associated with the development of overweight/obesity (RR 1.92, 95% CI: 1.90-1.94) in children aged 6 to 59 months when controlled by temperature, relative humidity, year and Lima area. The highest concentrations of PM<sub>2.5</sub> were found in East Lima districts. Overweight/obesity risk was highest also in East Lima (RR 2.53, 95% CI: 2.49-2.57). Conclusions: Data in PSC children in Lima and Callao, Peru demonstrate that PM<sub>2.5</sub> is obesogenic.

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**P-0277**

### **The Relationship between Pollen, Air Pollution, and Asthma Exacerbations in Children in Allegheny County, Pennsylvania: A Case-Crossover Analysis**

**Presenter:** Sarah DePerrior, University of Pittsburgh, Pittsburgh, United States

**Authors:** S. DePerrior<sup>1</sup>, J. Rager<sup>1</sup>, Y. Han<sup>1</sup>, D. Gentile<sup>2</sup>, L. Brink<sup>1</sup>, E. Talbott<sup>1</sup>;  
<sup>1</sup>University of Pittsburgh, Pittsburgh, PA, <sup>2</sup>Allegheny Health Network, Pittsburgh, PA.

**Background:** Asthma is a common chronic disease among children in the US. Outdoor air pollutants have been linked to asthma exacerbations but fewer studies have been conducted to examine the association between outdoor levels of pollens and asthma outcomes in children. **Methods:** Time-stratified case-crossover design with conditional logistic regression was used to study the short-term effects of three major pollens (grass, tree, and weed) and four criteria pollutants (PM 2.5, Ozone, SO<sub>2</sub>, and NO<sub>2</sub>) on asthma Emergency Department (ED) visits in children age 5-17 reported in Allegheny County, Pennsylvania from April to October 2003-2011. Multivariable models controlling for all pollens, all pollutants, and apparent maximum temperature were conducted to investigate the effects of pollen and pollutant levels on the day of the ED visit, lags of day 1, 2, 3, 4, and 5, and averages of day 0-2 and day 0-5. **Results:** A total of 8,711 asthma ED visits were reported during the study period. In multivariable models, tree and weed pollen were significant positive predictors of asthma ED visits across multiple lags when controlling for temperature and air pollutants. Strongest effects were reported on the average of lag days 0-2 for tree pollen (Odds Ratio = 1.016, 95% CI 1.007-1.024) and the average of lag days 0-5 for weed pollen (Odds Ratio = 1.044, 95% CI 1.026-1.062). PM 2.5 and NO<sub>2</sub> were also significantly positively associated with ED visits across multiple lags, whereas SO<sub>2</sub> was negatively associated with ED visits at several lags. **Conclusions:** This study reported that higher tree and weed pollen levels were associated with increased odds of asthma ED visits in children, independent of air pollution levels. Implementing methods to control allergen exposure during particular seasons may prevent adverse asthma outcomes.

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**P-0279**

**Assessment of asthma risk in the population living near incineration facilities in Seoul, Korea**

**Presenter:** HYUN-JOO BAE, Korea Environment Institute, Sejong-si, Korea, Republic of

**Authors:** H. BAE<sup>1</sup>, D. JUNG<sup>1</sup>, J. KANG<sup>2</sup>;

<sup>1</sup>Korea Environment Institute, Sejong-si, KOREA, REPUBLIC OF, <sup>2</sup>Pusan National University, BUSAN, KOREA, REPUBLIC OF.

While incineration is among the most commonly used technologies for waste disposal, there is ongoing public concern regarding the adverse health impacts associated with the pollutants released from incinerators. The aim of this study is thus to use health statistics to assess the relative risk of asthma-related hospitalization for people living in close proximity to incineration facilities. We also examine whether there are differences in asthma risk related to age demographics. We analyzed the spatial relationship between incineration facilities and asthma-related admissions in Seoul. The Rapid Inquiry Facility (RIF) is used to map the indirect standardized relative risks of asthma hospitalization by administrative geography, as well as to analyze geographical differences regarding asthma risk in relation to the proximity of incinerators. SaTScan software is used to identify sub-divisions of Seoul in which the relative risk of asthma is increased compared to that of the disease map, while the disease mapping results show an increased relative risk for asthma in specific areas within Seoul. The relative risk of asthma-related hospitalization decreased with increasing distance from incinerators, but increased among those living within a 2-km radius. After adjusting for socioeconomic factors, the relative risks of asthma-related hospitalization were 1.13 (95% confidence interval : 1.10-1.17), 1.12 (95% CI: 1.08-1.17), and 1.18 (95% CI: 1.10-1.27) for all ages, those aged below 15 years, and those aged 65 years and older, respectively. This study is the first to observe an increased risk of asthma-related hospitalization in relation to a person's distance from an incinerator. Although there are still uncertainties surrounding the estimated relative risk, mainly due to the less-sophisticated exposure assessment approach used in the analysis, it is clear that asthma should be considered an adverse health outcome during health impact assessments of incineration plants.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0282**

**Prenatal phthalate exposure quantified in meconium and cognition at 12-months: findings from the Early Autism Risk Longitudinal Investigation (EARLI) and the Prenatal Alcohol in SIDS and Stillbirth (PASS) network study**

**Presenter:** Leny Mathew, Drexel University, Philadelphia, United States

**Authors:** L. Mathew<sup>1</sup>, N. Snyder<sup>2</sup>, K. Lyall<sup>3</sup>, B. K. Lee<sup>1</sup>, H. Volk<sup>4</sup>, M. Fallin<sup>4</sup>, L. Croen<sup>5</sup>, I. Hertz-Picciotto<sup>6</sup>, C. J. Newschaffer<sup>7</sup>, A. J. Elliott<sup>8</sup>;

<sup>1</sup>Drexel University, Philadelphia, PA, <sup>2</sup>Temple University, Philadelphia, PA, <sup>3</sup>A.J Drexel Autism Institute, Philadelphia, PA, <sup>4</sup>Johns Hopkins University, Baltimore, MD, <sup>5</sup>Kaiser Permanente, Oakland, CA, <sup>6</sup>University of California, Davis, Sacramento, CA, <sup>7</sup>Penn State University, University Park, PA, <sup>8</sup>Avera Health, Sioux Falls, SD.

### Background/

Prenatal phthalate exposure may affect children's cognitive development. Although commonly measured in urine, phthalate metabolites are also detectable in meconium, the first stool of a child, potentially reflecting more cumulative prenatal exposure. We quantified phthalate metabolites in meconium from two cohorts and evaluated associations with cognition at 12-months.

### Methods

Phthalate metabolites were quantified using high performance liquid chromatography- high resolution mass spectrometry in meconium from children in EARLI, a high familial autism risk pregnancy cohort (N=160, enrolled from 2009-12), and PASS, a pregnancy cohort recruited from a region at high risk for prenatal alcohol use (N=606, enrolled from 2007-15). Molar sum of di-2-ethylhexyl phthalate ( $\Sigma$ DEHP) metabolites and an anti-androgenic (AA) score using mono-isobutyl, mono-n-butyl, mono benzyl phthalate (MBzP), and 4 DEHP metabolites were calculated. Cognition at 12-months was assessed using the Mullen Scales of Early Learning-Composite (ELC). Linear regression adjusted for a priori specified covariates and assessed associations between log-transformed metabolites and ELC. Sex-metabolite interaction terms explored effect modification in the models.

### Results

Phthalate metabolites (8 of 13 in EARLI and 9 of 12 in PASS) were detected in over 90% of meconium samples. Few metabolites retained statistically significant associations with ELC in covariate adjusted models, but effect-modification by sex in the same direction was suggested ( $P < 0.2$ ) for  $\Sigma$ DEHP, AA score, MBzP, and mono-2-ethylhexyl (MEHP) in both study samples. In sex-stratified analysis,  $\Sigma$ DEHP, AA score, MBzP, and MEHP were associated with increasing ELC among males and with decreasing ELC among females in both samples.

### Conclusions

Prenatal phthalate exposure was associated with early cognitive development. A subset of metabolites displayed similar sex-specific associations in both cohorts, with decrease in cognition indicating neurodevelopmental harm among females, but increase in cognition among male children.



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**P-0285**

### **Quantile regression analysis of socioeconomic disparities in household air pollution and child undernutrition in Nepal**

**Presenter:** Dirga Kumar Lamichhane, Inha University, Incheon, Korea, Republic of

**Authors:** D. K. Lamichhane, H. Kim, J. Leem;  
Inha University, Incheon, KOREA, REPUBLIC OF.

**Background/Aim** Several studies have demonstrated associations between household air pollution (HAP) and child undernutrition, but the extent to which this relationship varies across the outcome distribution and according to socioeconomic status (SES) is unknown. We aimed to address this using data from Nepal Demographic and Health Survey (NDHS).

**Methods** We used child anthropometry data for 9,914 children aged 0-59 months from the 2006, 2011, and 2016 NDHS. Sex-stratified quantile regression (QR) analysis was performed to identify the relationship between the markers of HAP and child nutritional status, which is indicated by z scores for height-for-age (HAZ), weight-for-age (WAZ), and weight-for-height (WHZ). The SES was based on the composite of education, household wealth, and occupation. We used QR plots to visually examine the effect of HAP across the entire outcome distribution for each SES group.

**Results** In the adjusted model, the negative association between HAP and HAZ was stronger at the lower end of HAZ distribution in both sexes. For example, the estimate for female children at the 10<sup>th</sup> quantile was  $-0.39$  (95% confidence interval (CI) =  $-0.65, -0.13$ ), decreasing to  $-0.26$  (95% CI =  $-0.52, 0.01$ ) at the 90<sup>th</sup> quantile. The QR plots showed a pattern of stronger association in low SES group and at the lower end of HAZ distribution, particularly among female children. For example, female children from low SES group, HAP was associated with a 0.81 unit decrease (95% CI = 1.51, 0.11) in HAZ at the 10<sup>th</sup> quantile, whereas it was associated with a 0.49 unit decrease (95% CI = 0.69, 0.28) for high SES group in the same quantile. The strength of evidence for socioeconomic inequalities for WAZ and WHZ was weak.

**Conclusions** We observed evidence for a pattern of stronger effect of HAP in lower SES group, particularly among female children and at the lower end of the HAZ.

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**P-0286**

### **ESTIMATING THE CHILDREN'S HEALTH BENEFITS BY REDUCING FINE PARTICULATE MATTER IN SEOUL, KOREA**

**Presenter:** HYUN-JOO BAE, Korea Environment Institute, Sejong-si, Korea, Republic of

**Authors:** H. BAE, D. JUNG, K. CHOI;  
Korea Environment Institute, Sejong-si, KOREA, REPUBLIC OF.

One component of air pollution, in particular, particulate matter (PM<sub>2.5</sub>) has aroused wide public concern because of its high concentration. We investigated the short-term association between PM<sub>2.5</sub> and asthma admission and assessed the impact of improved air quality on asthma admission from January 2015 to December 2017 in Seoul, Korea. Generalized additive modeling with a Poisson distribution was used to examine short-term effects of PM<sub>2.5</sub> on asthma admission. The time trends, seasonal variations, day of week effects, and weather effects were controlled in the models. To estimate the health benefits of attaining the Seasonal PM<sub>2.5</sub> management system, we used the US Environmental Protection Agency's BenMAP. For people 0-14 years of age groups, an increase of 10 $\mu\text{g}/\text{m}^3$  in PM<sub>2.5</sub> was associated with increases in daily asthma admission of 2.67% (95% CI, 1.90~3.44). For 0-14 years of age group, it was estimate that the health benefits of attaining the Seasonal PM<sub>2.5</sub> management system would suggest an annual reduction of 195 (95% CI, 140~251) asthma admission. This study showed that children are at higher risk for the acute asthma effects of PM<sub>2.5</sub>. According to the findings of this study, the Seasonal PM<sub>2.5</sub> management system results of environmental policy can be used as an useful decision making basis in setting policy priority.

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**P-0287**

### **Associations of Prenatal Metal Mixtures with Mitochondria DNA and Telomere Length in Mothers and Children**

**Presenter:** Anna R Smith, UC Berkeley School of Public Health, Berkeley, United States

**Authors:** A. R. Smith<sup>1</sup>, P. D. Lin<sup>2</sup>, M. L. Rahman<sup>2</sup>, S. L. Rifas-Shiman<sup>2</sup>, D. R. Gold<sup>3</sup>, A. A. Baccarelli<sup>4</sup>, C. Amarasiriwardena<sup>5</sup>, R. O. Wright<sup>5</sup>, B. Coull<sup>3</sup>, M. Hivert<sup>2</sup>, E. Oken<sup>2</sup>, A. Cardenas<sup>1</sup>;

<sup>1</sup>UC Berkeley School of Public Health, Berkeley, CA, <sup>2</sup>Harvard Medical School and Harvard Pilgrim Health Care Institute, Boston, MA, <sup>3</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>4</sup>Columbia University Mailman School of Public Health, NYC, NY, <sup>5</sup>Icahn School of Medicine at Mount Sinai, NYC, NY.

Background: Essential and non-essential metal exposure during pregnancy is ubiquitous, influencing maternal and child health. We evaluated associations of prenatal metals with mitochondria DNA abundance (mtDNA) and telomere length (TL) in mothers during pregnancy and their children at birth, as biomarkers of oxidative stress and inflammation. Methods: We measured six nonessential metals (As, Ba, Cd, Cs, Hg, Pb) and four essential metals (Mg, Mn, Se, Zn) in first trimester red blood cells from women in Project Viva, a prospective pre-birth cohort in Massachusetts. We measured mtDNA and TL in second trimester maternal blood (N=893-898) and cord blood (N=408-419). We used multivariable linear regression models and Bayesian Kernel Machine Regression (BKMR) to evaluate their associations, adjusted for confounders. Results: Mean (SD) mtDNA was 1.05 (0.32) in maternal blood and 1.01 (0.25) in cord blood. Mean (SD) TL was 0.68 (0.24) in maternal and 1.24 (0.70) in cord blood. In adjusted models, a two-fold increase in maternal magnesium was associated with decreased maternal mtDNA ( $\beta$  -0.09, 95% CI: -0.15, -0.03) and cord blood mtDNA ( $\beta$  -0.08, 95% CI: -0.14, -0.01). A two-fold increase in maternal lead was associated with increased maternal mtDNA ( $\beta$  0.04, 95% CI: 0.01, 0.06). Selenium was associated with increased cord blood TL ( $\beta$  0.26, 95% CI: 0.0, 0.52). When characterizing the overall effect of the mixtures, our BKMR analyses suggested a dose-response association between the metal mixture and cord blood mtDNA relative to the 50<sup>th</sup> percentile (25<sup>th</sup> percentile of mixture  $\beta$  0.08, 95% CI: -0.05, 0.20; 75<sup>th</sup> percentile of mixture  $\beta$  -0.11, 95% CI: -0.25, 0.03). Conclusion: Our findings suggest that certain prenatal metals are associated with molecular biomarkers of oxidative stress and inflammation in both maternal second trimester and cord blood, and future work will evaluate the extent to which these markers are associated with health outcomes.

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**P-0288**

### **Prenatal Ambient Air Pollutants Influence Fetal Blood Flow and Shunting to the Brain in the Third Trimester**

**Presenter:** Carrie V. Breton, University of Southern California, Los Angeles, United States

**Authors:** C. V. Breton<sup>1</sup>, A. Peterson<sup>1</sup>, R. Habre<sup>1</sup>, F. Lurmann<sup>2</sup>, M. Amin<sup>1</sup>, S. P. Eckel<sup>1</sup>, B. Grubbs<sup>1</sup>, D. Walker<sup>1</sup>, E. Grant<sup>1</sup>, D. Lerner<sup>3</sup>, L. Al-Marayati<sup>1</sup>, A. Quimby<sup>4</sup>, S. Twogood<sup>4</sup>, F. Gilliland<sup>1</sup>, T. Bastain<sup>1</sup>;  
<sup>1</sup>University of Southern California, Los Angeles, CA, <sup>2</sup>Sonoma Technology Inc, Petaluma, CA, <sup>3</sup>Eisner Health, Los Angeles, CA, <sup>4</sup>Cedars Sinai Medical Group, Los Angeles, CA.

**Background:** Prenatal exposure to air pollutants has been associated with numerous adverse fetal outcomes. **Objectives:** We tested whether air pollutants affect umbilical venous perfusion of the fetal liver and shunting of blood from liver to brain in the Maternal and Developmental Risks from Environmental and Social Stressors (MADRES) pregnancy cohort. We hypothesized prenatal air pollution exposure contributes to an adverse intrauterine environment and alters fetal blood flow by shunting less blood to the liver and more to the brain. **Methods:** Daily estimates of ambient air pollutants NO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and O<sub>3</sub> were spatially interpolated at each participant's residence. Prenatal average exposures were calculated from the date of conception to the date of ultrasound. Doppler ultrasound measurements were performed between 30-34 weeks' gestation for 102 participants by a certified obstetrics sonographer to determine the proportion of umbilical vein (UV<sub>f</sub>) blood flowing to the ductus venosus (DV<sub>f</sub>) or the fetal liver (FL<sub>f</sub>) in ml/min. Shunting was calculated as the proportion of blood flow, DV<sub>f</sub>/UV<sub>f</sub>. Linear regression models were used to evaluate the associations between single pollutants and UV<sub>f</sub>, DV<sub>f</sub>, FL<sub>f</sub>, and DV<sub>f</sub>/UV<sub>f</sub> adjusting for covariates. **Results:** Mean maternal age was 28 (6) years and gestational age at study visit was 31.7 (1.1) weeks. PM<sub>10</sub> and PM<sub>2.5</sub> were significantly associated with DV<sub>f</sub> ( $\beta = 9.4$  and  $5.1$ ,  $p < 0.0001$ ,  $p=0.04$  for a 1 SD change in pollutant) and with shunting ( $\beta = 3.3$  and  $0.20$ ,  $p < 0.0001$ ,  $p=0.02$ ). Daily 8hr maximum O<sub>3</sub> and 24hr average O<sub>3</sub> were associated with DV<sub>f</sub> ( $\beta = 7.1$ ,  $5.8$ ,  $p = 0.003$ ,  $0.02$ ) and 8hr maximum O<sub>3</sub> with shunting ( $\beta = 1.7$ ,  $p= 0.04$ ). **Conclusions:** Prenatal air pollutant exposure was associated with blood flow in the ductus venosus and shunting of blood from liver to brain, the long-term consequences of which remain unknown.

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## ABSTRACT E-BOOK

Theme: **Children's health**

**P-0289**

### **Prenatal polycyclic aromatic hydrocarbon (PAH) exposure and early childhood asthma in a diverse US pregnancy cohort**

**Presenter:** Christine Loftus, University of Washington, Seattle, Seattle, United States

**Authors:** C. Loftus<sup>1</sup>, M. Hazlehurst<sup>1</sup>, E. Wallace<sup>1</sup>, E. Masterson<sup>1</sup>, A. Szpiro<sup>1</sup>, F. Tylavsky<sup>2</sup>, S. Sathyanarayana<sup>1</sup>, N. Bush<sup>3</sup>, K. LeWinn<sup>3</sup>, K. Carroll<sup>4</sup>, M. Adgent<sup>4</sup>, K. Kannan<sup>5</sup>, E. Barrett<sup>6</sup>, C. Karr<sup>1</sup>;  
<sup>1</sup>University of Washington, Seattle, Seattle, WA, <sup>2</sup>University of Tennessee Health Science Center, Memphis, TN, <sup>3</sup>University of California, San Francisco, San Francisco, CA, <sup>4</sup>Vanderbilt University Medical College, Nashville, TN, <sup>5</sup>New York State Department of Health, New York, NY, <sup>6</sup>Rutgers University, New Brunswick, NJ.

#### Background/Aim

Exposure to polycyclic aromatic hydrocarbons (PAH) may increase risk of pediatric asthma. Effects of prenatal PAH exposure, specifically, are hypothesized but understudied. The ECHO PATHWAYS Consortium investigated these relationships in a large, diverse prospective cohort study.

#### Methods

We included 919 mother-child dyads from the CANDLE Study, a longitudinal pregnancy cohort set in Shelby County, TN. PAH metabolites were measured in second trimester urine and adjusted for specific gravity. Seven metabolites detected in >80% of women were included in analysis. When children were 4-6 years old, mothers completed the International Study on Allergies and Asthma in Childhood survey. Poisson regression with robust standard errors was used to estimate relative risk of current wheeze, current asthma, and ever asthma associated with each metabolite in separate models, adjusted for maternal age, race, education and other asthma risk factors. Effect modification by child sex and maternal asthma was assessed using interaction models. We did not adjust for multiple comparisons.

#### Results

Participants were 66% Black, 44% White; 58% with high school education or less. On average, urinary PAH metabolite concentrations were higher than in other US cohorts. Mean (SD) child age at assessment was 4.3 (0.4) years. Prevalence of reported current wheeze and asthma and ever asthma was 19.4%, 16.1%, and 14.6%, respectively. In multivariable models, we observed no evidence that any metabolite was associated with any outcome. No differences by child sex were observed. Maternal asthma modified associations between 1/9-hydroxyphenanthrene and current asthma ( $RR_{\text{maternal asthma}} = 0.88$ ; 95%CI: 0.78, 0.99 versus  $RR_{\text{without maternal asthma}} = 1.09$ ; 95%CI: 0.97, 1.23 per two-fold increase in exposure;  $p_{\text{interaction}}=0.012$ ).

#### Conclusions

Results of our analysis, the largest cohort study of prenatal PAH and childhood airway outcomes conducted to date, did not support the hypothesis that prenatal PAHs increases risk of early childhood asthma.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0291**

**Preterm birth and PM<sub>2.5</sub> in Puerto Rico**

**Presenter:** Kipruto Kirwa, University of Washington, Seattle, United States

**Authors:** K. Kirwa<sup>1</sup>, Z. Feric<sup>2</sup>, J. Manjourides<sup>2</sup>, A. Alshawabek<sup>2</sup>, C. Milagros Velez Vega<sup>3</sup>, J. F. Cordero<sup>4</sup>, J. Meeker<sup>5</sup>, H. Suh<sup>6</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>Northeastern University, Boston, MA, <sup>3</sup>University of Puerto Rico, San Juan, PR, <sup>4</sup>University of Georgia, Athens, GA, <sup>5</sup>University of Michigan, Ann Arbor, MI, <sup>6</sup>Tufts University, Medford, MA.

**Background**Preterm birth (PTB, birth before 37 weeks of gestation) has been associated with adverse health outcomes across the lifespan. Evidence on the association between PTB and prenatal exposure to air pollutants is inconsistent, but is especially lacking for ethnic/racial minority populations.**Methods**We examined the association between PTB and prenatal exposure to PM<sub>2.5</sub> among Hispanic women enrolled in the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) cohort in municipalities located along the North Coast of Puerto Rico. Exposures were assigned based on nearest Environmental Protection Agency monitor. We used modified Poisson regression to estimate the association, adjusting for potential individual and area-level socioeconomic and behavioral confounders.**Results**Among 1,116 singleton births, 8.2% of infants were born preterm, and 93% of mothers had at least a high school education. Mothers had a mean (standard deviation) age of 26.9 (5.5) years and a median (range) of 2 (1-8) total pregnancies. Median (range) prenatal PM<sub>2.5</sub> concentrations were 6.0 (1.2-19.8) g/m<sup>3</sup>. An interquartile range increase in PM<sub>2.5</sub> was associated with a 1.1% (95% CI 0.4%, 1.6%) higher risk of PTB. In stratified analysis, there was little difference in PTB risk in strata of infant sex, mother's age (<25 vs ≥ 25 years), family income (<30K vs ≥ 30K USD), history of adverse birth outcome, parity, pre-pregnancy body mass index, and degree of prematurity (24-34 weeks vs 34-36 weeks).**Conclusion**Among Hispanic women in Puerto Rico, prenatal PM<sub>2.5</sub> exposure is associated with a small but significant increase in risk of PTB.

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**P-0292**

**Cumulative lifetime maternal stress and stress in pregnancy are differentially associated with extracellular vesicle encapsulated microRNA profiles in breast milk: Findings from the PRogramming of Intergenerational Stress Mechanisms (PRISM) pregnancy cohort**

**Presenter:** Anne Bozack, Department of Environmental Medicine and Public Health & Division of Pulmonary Medicine, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** A. Bozack<sup>1</sup>, E. Colicino<sup>2</sup>, R. Rodosthenous<sup>3</sup>, A. Baccarelli<sup>4</sup>, T. Bloomquist<sup>4</sup>, R. J. Wright<sup>5</sup>, A. Lee<sup>6</sup>;  
<sup>1</sup>Department of Environmental Medicine and Public Health & Division of Pulmonary Medicine, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>3</sup>Cardiovascular Research Center, Massachusetts General Hospital, Boston, MA, <sup>4</sup>Environmental Health Sciences, Columbia University, New York, NY, <sup>5</sup>Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>6</sup>Division of Pulmonary, Critical Care and Sleep Medicine, Icahn School of Medicine at Mount Sinai, New York, NY.

**Background/Aims:** While maternal stress has been linked to adverse child health outcomes, mechanistic links have not been fully elucidated. Maternal microRNAs encapsulated in Extracellular Vesicles (EVs) reach the infant through breastmilk and are a novel biochemical communication pathway for early-life programming. We leverage the PRogramming of Intergenerational Stress Mechanisms (PRISM) pregnancy cohort to investigate associations between maternal stress and breast milk EV-microRNAs. **Methods:** We assessed maternal lifetime stress using the Life Stressor Checklist-Revised (LSCR) survey and negative life events (NLEs) experienced in the past 6 months during pregnancy using the Crisis in Family Systems-Revised (CRISYS-R) survey. Extracellular vesicles were isolated from N=80 breastmilk samples collected at 6.1±5.9 weeks postnatally. Total RNA was extracted and microRNAs were profiled using the TaqMan OpenArray Human miRNA panel. Logistic regression assessed associations between continuous LSCR and NLE scores and EV-microRNA detection (outcome yes/no); associations with EV-microRNA expression levels were assessed using robust linear regression (N=74 with EV-microRNA and maternal stress data). Models were adjusted for infant sex, maternal race/ethnicity, education, and week of breast milk collection. **Results:** Among 345 EV-microRNAs detected in >10% of samples, detection of 127 (47%) was associated with LSCR score and detection of 97 (28%) was associated with NLE score ( $p < 0.05$ ). Among 205 EV-microRNAs detected in >50% of samples, expression of 8 was associated with LSCR scores and expression of 17 was associated with NLE score at our a priori criteria of  $p < 0.05$  and  $|B_{\text{regression}}| > 0.2$ . MicroRNAs associated with LSCR and NLE scores were involved in KEGG pathways related to fatty acid metabolism and steroid biosynthesis. **Conclusions:** Maternal lifetime cumulative stress and stress during pregnancy were associated with EV-microRNAs in breast milk although microRNA profiles differed. Further research is needed to identify biological pathways impacted by differentially expressed microRNAs and investigate relationships with child health outcomes.

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Theme: **Children's health**

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**P-0293**

### **Non-Nutritive Suck and Airborne Metal Exposures Among Puerto Rican Infants**

**Presenter:** Sarah Morton, Dept. of Civil and Environmental Engineering, Tufts University, Medford, United States

**Authors:** S. Morton<sup>1</sup>, K. Kirwa<sup>2</sup>, E. Zimmerman<sup>3</sup>, G. Huerta-Montanez<sup>4</sup>, A. Martens<sup>3</sup>, M. Hines<sup>3</sup>, K. Eum<sup>1</sup>, J. Cordero<sup>5</sup>, A. Alshawabekeh<sup>4</sup>, H. Suh<sup>1</sup>;

<sup>1</sup>Dept. of Civil and Environmental Engineering, Tufts University, Medford, MA, <sup>2</sup>Dept. of Environmental and Occupational Health Sciences, University of Washington, Seattle, WA, <sup>3</sup>Dept. of Communication Sciences and Disorders, Northeastern University, Boston, MA, <sup>4</sup>Dept. of Civil and Environmental Engineering, Northeastern University, Boston, MA, <sup>5</sup>Dept. of Epidemiology, University of Georgia, Athens, GA.

**Background** - Air pollution has been shown to impair fetal development. However, its effect on fetal development among ethnic minorities is less studied, in part due to lack of non-intrusive assessment methods. One possible such method is non-nutritive suck (NNS), a measure of infant's non-nutritive sucking ability and an early index of central nervous system development. **Methods** - Among infants aged 0-3 months enrolled in the Center for Research on Early Childhood Exposure and Development (CRECE) cohort from 2017-2019, we examined the association between exposure to fine particulate matter (PM<sub>2.5</sub>) and its components on NNS in Puerto Rican infants. We measured NNS using a pacifier attached to a pressure transducer, allowing for real-time visualization of NNS amplitude, frequency, duration, cycles/burst, cycles/min and bursts/min. We obtained data on maternal smoking, age, residential location, and infant gender and gestational age. We linked these data to prenatal concentrations of PM<sub>2.5</sub> and components, measured at three community monitoring sites. We used linear regression to examine the PM<sub>2.5</sub>-NNS association in single pollutant models, with change in NNS expressed per 1 µg/m<sup>3</sup> increase for sulfur, black carbon, and PM<sub>2.5</sub> and per 1 ng/m<sup>3</sup> for other pollutants. **Results** - Among 191 infants, the average NNS amplitude and burst duration was 17.0 cmH<sub>2</sub>O and 6.19 sec, respectively. Decreased NNS amplitude was consistently and significantly associated with 9-month average exposure to sulfur (-52.3 cmH<sub>2</sub>O), zinc (-0.610 cmH<sub>2</sub>O), copper (-1.63 cmH<sub>2</sub>O), vanadium (-12.7 cmH<sub>2</sub>O), nickel (-9.18 cmH<sub>2</sub>O), and to a lesser extent lead and bromine. We found no association between NNS amplitude and PM<sub>2.5</sub>, black carbon, and other components related to soil and salt. No other NNS measure was significantly associated with any examined pollutant. **Conclusions** - In Puerto Rican infants, prenatal maternal exposure to zinc, copper, sulfur, vanadium, and nickel is associated with lower NNS amplitudes soon after birth.

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Theme: **Children's health**

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**P-0294**

### **Residential greenspace and attention problems in early childhood**

**Presenter:** Marnie Hazlehurst, University of Washington, Seattle, United States

**Authors:** M. Hazlehurst<sup>1</sup>, A. Hajat<sup>1</sup>, P. Tandon<sup>2</sup>, J. Kaufman<sup>1</sup>, A. Szpiro<sup>1</sup>, C. Loftus<sup>1</sup>, F. Tylavsky<sup>3</sup>, K. LeWinn<sup>4</sup>, S. Sathyanarayana<sup>2</sup>, N. Bush<sup>4</sup>, C. Karr<sup>1</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>Seattle Children's Research Institute, Seattle, WA, <sup>3</sup>University of Tennessee Health Science Center, Memphis, TN, <sup>4</sup>University of California San Francisco, San Francisco, CA.

Background: Observational and experimental studies suggest that access to greenspace and spending time in parks both reduce symptoms of inattention and improve behavioral outcomes among children. Parks may provide an opportunity for intervention, yet few studies in the US have examined the potential benefits of access to public urban greenspace in early childhood. Methods: Within the ECHO-PATHWAYS Consortium, we investigated associations between residential proximity to publicly accessible parks and attention problems in the Conditions Affecting Neurocognitive Development and Learning in Early Childhood (CANDLE) study in Shelby County, TN. At child age 4-6, mothers completed the Child Behavior Checklist that assessed attention problems on a five-item scale. Park proximity was calculated as the Euclidean distance between the residential location at the time of this assessment and the edge of the nearest park. In Poisson regression models, we adjusted for child, maternal, and neighborhood characteristics. Results: In CANDLE, 65% of mothers identified as black, 29% white; 53% had at least a college or technical school degree. Children (N=886) were 4.3 (SD 0.4) years at the time of assessment; 51% were males; and 28% lived within 300m of a park. Preliminary results found no association between park proximity and child attention problems as a continuous measure (1% decrease in attention problems per two-fold increase in park proximity, 95%CI: -4%,4%) or dichotomized at a clinical threshold (risk ratio=1.02, 95%CI: 0.88,1.19). Effect modification by child sex was not statistically significant ( $p_{\text{interaction}}=0.12$ ). Conclusions: While no significant associations were observed in the full sample or by child sex in this preliminary analysis, residential proximity is an imperfect proxy for access or exposure to greenspace. Future analyses will utilize greenspace exposures that additionally include private land and street trees, as well as investigating neighborhood factors, such as crime rate, that may affect children's use of public greenspace.

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Theme: **Children's health**

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**P-0295**

### **Maternal Thyroid Anomalies and Risk of Attention Deficit Hyperactivity Disorder in Progeny**

**Presenter:** Ran S Rotem, Harvard TH Chan School of Public Health, Boston, United States

**Authors:** R. S. Rotem<sup>1</sup>, G. Chodick<sup>2</sup>, M. Weisskopf<sup>1</sup>;

<sup>1</sup>Harvard TH Chan School of Public Health, Boston, MA, <sup>2</sup>Maccabi-KSM Institute for Research and Innovation, Israel, ISRAEL.

**Background.** The fetus is dependent on adequate maternal supply of thyroid hormones, which have important neurodevelopmental roles. Impaired thyroid function was linked with exposure to several environmental toxicants, and these thyroid-related effects may be a mechanism through which environmental toxicants affect neurodevelopment. Extreme maternal thyroid dyshomeostasis causes adverse neurodevelopmental effects, but impacts of subtler thyroid disruption remain unclear. We evaluated the risk of Attention Deficit Hyperactivity Disorder (ADHD) in children of mothers with thyroid anomalies, and the relation between gestational maternal thyroid hormone levels and child ADHD risk. **Methods.** The study included 445,477 singletons born in 1999-2012 in a large Israeli health fund, with data on ADHD diagnoses retrieved through 2019. Maternal thyroid conditions were ascertained through ICD-9 codes with subsequent validation through review of drug dispensing and laboratory data. ADHD cases were identified through ICD-9 codes, with additional information on dispensing of stimulants and nonstimulants medications. Analyses were performed using Cox proportional hazard and additive Poisson regression models employing a robust variance estimator. **Results.** Children of mothers who experienced hypothyroidism had a higher ADHD risk compared to children of mothers without thyroid conditions (HR=1.11, 95% C.I.:1.07-1.15), with more robust results in the subgroup of ADHD children who also received pharmaceutical ADHD treatments. Hyperthyroidism results were less consistent. Results were materially unchanged when restricting to mothers gestationally treated with levothyroxine. Analysis of maternal gestational thyrotropin and free-thyroxine levels did not show consistent associations with ADHD risk. **Conclusions.** Maternal hypothyroidism was associated with increased child ADHD risk, but seemingly not due to direct effects of thyroid hormones. Instead, factors that influence maternal thyroid function may have etiologic roles in ADHD through pathways independent of maternal gestational thyroid hormones, and thus be unaffected by medication treatment. Environmental factors known to disrupt thyroid function should be examined for possible involvement in ADHD etiology.

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Theme: **Children's health**

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**P-0297**

**Monitoring personal exposure to semi-volatile organic chemicals in Uruguayan school children using silicone wristbands**

**Presenter:** Katarzyna Kordas, University at Buffalo, Buffalo, United States

**Authors:** S. C. Travis<sup>1</sup>, D. S. Aga<sup>1</sup>, E. I. Queirolo<sup>2</sup>, J. Olson<sup>1</sup>, M. Daleiro<sup>2</sup>, K. Kordas<sup>1</sup>;  
<sup>1</sup>University at Buffalo, Buffalo, NY, <sup>2</sup>Catholic University of Uruguay, Montevideo, URUGUAY.

Children are vulnerable to the harmful effects of chemicals and are exposed to many potentially toxic compounds in their daily lives. Due to their ease of implementation and non-invasive, silicone wristbands have emerged as passive samplers to study personal environmental exposures. The Scola-Exposome study in Montevideo, Uruguay investigated the extent of exposure to several classes of chemicals among school children (n=23) aged 6-7 years old, who wore a silicone wristband for 7 days. All wristbands were quantitatively analyzed using gas chromatography tandem mass spectrometry (GC-MS/MS) at the University at Buffalo for 46 chemicals, including polychlorinated biphenyls (PCBs), pesticides, polybrominated diphenyl ethers (PBDEs), organophosphorus flame retardants (OFPRs), and novel halogenated flame retardants (NHFRs). An average of 13 analytes were detected in each wristband. OPFR concentrations ranged from <LOD to 8920 ng/g band. The sum of PBDE ( $\Sigma$ PBDE) concentrations ranged from <LOD to 433 ng/g band, DDT and its derivatives (DDx) range from 0.2 to 23.5 ng/g band, and  $\Sigma$ PCBs range from <LOD to 8.4 ng/g band. Urban children in Uruguay are exposed to a wide range of chemicals, with nearly half of them to a recent application of DDT. Silicone wristbands show promise for passive, non-invasive exposure assessment to environmental chemicals in children, detecting both legacy and emerging pollutants.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0298**

**Placental Gene Transcription and Child Cognitive and Behavioral Outcomes**

**Presenter:** Drew B Day, Seattle Children's Research Institute, Seattle, United States

**Authors:** D. B. Day<sup>1</sup>, A. R. Paquette<sup>2</sup>, J. W. MacDonald<sup>3</sup>, T. K. Bammler<sup>3</sup>, K. Z. LeWinn<sup>4</sup>, D. A. Enquobahrie<sup>3</sup>, C. J. Marsit<sup>5</sup>, R. L. Davis<sup>6</sup>, N. R. Bush<sup>4</sup>, F. A. Tylavsky<sup>6</sup>, S. Sathyanarayana<sup>7</sup>;

<sup>1</sup>Seattle Children's Research Institute, Seattle, WA, <sup>2</sup>Institute for Systems Biology, Seattle, WA, <sup>3</sup>University of Washington, Seattle, WA, <sup>4</sup>University of California, San Francisco, San Francisco, CA, <sup>5</sup>Emory University, Atlanta, GA, <sup>6</sup>University of Tennessee Health Sciences Center, Memphis, TN, <sup>7</sup>Seattle Children's Research Institute & University of Washington, Seattle, WA.

**Background/Aim:** The placenta plays an important role in neurodevelopment by synthesizing key hormones and providing nutrients involved in brain development. To date, no study has examined child cognitive outcomes in the context of the placental transcriptome.

**Methods:** Placental transcriptomic data for 637 mother-child dyads (327 girls; 310 boys) from the CANDLE study (ECHO/PATHWAYS consortium) were obtained using paired-end RNA sequencing. Genes (N=13321) were clustered using Weighted Gene Co-expression Network Analysis (WGCNA). Cluster eigenvectors (eigengenes) were used as explanatory variables for three different outcome measures from the 4-6-year visit: Stanford Binet-5 full scale intelligence quotient (FSIQ) and externalizing or internalizing score from the Child Behavior Checklist (CBCL). Associations between outcomes and eigengenes were modeled in separate regressions controlling for covariates, adjusting p-values using Benjamini-Hochberg FDR correction (significance cutoff = 0.05). Separate analyses in sex-stratified datasets examined effect modification by sex. Functions of gene clusters were inferred using Fisher's exact test based on Gene Ontology terms (unadjusted p-value cutoff = 0.0001).

**Results:** Overall, two clusters (macromolecule metabolism and cell membrane structure) were negatively associated with FSIQ. Four clusters (nuclear protein transport, mitochondrial cristae, angiogenesis, and ribosome structure) were positively associated with and one cluster (biomolecule location maintenance) was negatively associated with CBCL externalizing score. In girls, FSIQ was positively associated with one cluster (myeloid leukocyte activation). In boys, FSIQ was negatively associated with one cluster (protein modification) and positively associated with another cluster (macromolecule metabolism). CBCL externalizing score in boys was positively associated with one cluster (mitochondrial cristae). All associations became nonsignificant after p-value adjustment.

**Conclusion:** In this first study to assess placental transcriptome relationships with childhood neurodevelopmental outcomes, we identified functional gene clusters involved in diverse biological pathways that may provide evidence for a mechanistic link between the placenta and child cognitive and behavioral outcomes that may differ by sex.

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Theme: **Children's health**

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**P-0299**

### **Trimester Specific Association of Prenatal Fluoride Exposure and Cognitive Outcomes in Children in Mexico**

**Presenter:** Morteza Bashash, University of Toronto, Toronto, Canada

**Authors:** M. Bashash<sup>1</sup>, H. Hu<sup>2</sup>, E. Martinez Mier<sup>3</sup>, B. Sanchez<sup>4</sup>, N. Basu<sup>5</sup>, K. Peterson<sup>6</sup>, L. Schnaas<sup>7</sup>, A. Mercado-García<sup>8</sup>, M. Mauricio Hernández-Avila<sup>8</sup>, M. Téllez-Rojo<sup>8</sup>;

<sup>1</sup>University of Toronto, Toronto, ON, CANADA, <sup>2</sup>University of Washington, Seattle, WA, <sup>3</sup>Indiana University, Indianapolis, IN, <sup>4</sup>Drexel University, Philadelphia, PA, <sup>5</sup>McGill University, Montreal, QC, CANADA, <sup>6</sup>University of Michigan, Ann Arbor, MI, <sup>7</sup>Instituto Nacional de Perinatología, Mexico City, MEXICO, <sup>8</sup>Instituto Nacional de Salud Pública, Cuernavaca, MEXICO.

**Background:** There is increasing evidence suggesting that prenatal exposure to fluoride is associated with lower neurocognitive performance in offspring. The objective of this study is defining periods in early life associated with greater sensitivity to fluoride exposures. **METHODS:** This study focused on participants from the Early Life Exposures in Mexico to Environmental Toxicants (ELEMENT) project. Fluoride in archived urine samples taken from mothers across the trimesters of pregnancy were measured and adjusted for urinary creatinine (MUF<sub>cr</sub>). The main outcome of this analysis was the General Cognitive Index (GCI) of the McCarthy Scales of Children's Abilities at age 4. Regression models were used to assess the associations between prenatal fluoride at each trimester of pregnancy and GCI adjusted for gestational age, weight at birth, sex, parity, age at outcome measurement, and maternal characteristics including smoking history, marital status, age at delivery, IQ, education, and sub-cohort. **RESULTS:** Complete data were available for 256 mother-child pairs for trimester 1, 241 for trimester 2 and 115 for trimester 3. Mean and Standard Deviation (SD) of MUF<sub>cr</sub> were 0.93 (0.42) mg/L for trimester 1, 0.99 (0.53) for trimester 2 and 0.84 (0.41) for trimester 3. In multivariate models an increase of 1 mg/L MUF<sub>cr</sub> was associated with declines in GCI scores of -4.9 (95% CI; -8.80, -1.10) in trimester 1 and -3.35 (95%CI; -6.24, -0.47) in trimester 2, respectively. There were no significant associations between MUF<sub>cr</sub> and GCI score in trimester 3. **CONCLUSION:** In this study, trimester-specific analyses suggest that fluoride exposure during the early trimesters of pregnancy may have the strongest negative effect on offspring neurocognitive outcomes.

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**P-0300**

**Prenatal exposure pyrethroids and children's weight - PIPA Project**

**Presenter:** Ana Natividade, Federal University of Rio de Janeiro, RIO DE JANEIRO, Brazil

**Authors:** A. Natividade, N. Figueiredo, C. Beltri, M. Araujo, R. Lino, C. Froes;  
Federal University of Rio de Janeiro, RIO DE JANEIRO, BRAZIL.

**Background/Aims:** Experimental studies suggest that fetal exposure to pyrethroids may have growth effects. However, epidemiologic investigations are scarce and inconsistent. Our data are from pilot study conducted in 2018, that is a precursor of a birth cohort that will be started at the School Maternity of the Federal University of Rio de Janeiro. We aimed to assess prenatal pyrethroids exposure and weight gain until six month at age. **Methods:** 142 interviews were conducted about maternal exposure and maternal and children urine samples were collected. Babies' weight was assessed at birth and in outpatient visits at the first, third and sixth months of age, small and large children for gestational age were excluded. The metabolites of 3-phenoxybenzoic acid (3-PBA) and 4-fluorobenzylphosphonic acid (4FBPA) were analyzed in the urine of babies. For this study, we considered only the 3-PBA that had a higher detection rate among mothers and children. Our study population consisted of 49 children appropriate for gestational age (AGA). **Results:** The 3PBA-ng mL<sup>-1</sup> had a detection rate of 23% among babies and 47% among pregnant women. The group of babies that had detection of the pyrethroid metabolite in the urine, had a lower risk of weight gain below the expected for the age group, but without statistical significance (RR = 0.72 p = 0.74). For weight gain above the expected in the age group of the follow-up, there was a greater effect in the studied sample, but without statistical significance (RR = 0.32 p = 0.4332) **Conclusions:** This is the first study in Brazil that analyze women pregnant and babies with environmental pollutants and, therefore there isn't previous parameter of compare with laboratorial data. The findings of this study suggest attention for the exposure to pyrethroids as well as new studies in this thematic.

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**P-0301**

**Denver Developmental Screening Test II (DDST-R) adaptation for a birth cohort research - PIPA Project**

**Presenter:** Renata Rodrigues Garcia Lino, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

**Authors:** R. R. Lino, A. Natividade, N. Figueiredo, M. Araujo, C. Froes;  
Federal University of Rio de Janeiro, Rio de Janeiro, BRAZIL.

**Background/Aims:** The Denver Developmental Screening Test II (DDST-R) was used to evaluate the neuropsychomotor development of babies during the birth cohort pilot of the PIPA Project. In the pilot, data and samples of prenatal exposure to metals, plasticizers and pesticides were collected from pregnant women and babies who were evaluated in their first, third and sixth months of age. It was noticed that the standard form of the DDST-R contains many open fields that represents a hindering factor for research. We aim to present a new proposal for the application of the test. **Methods:** The DDST-R form was adapted to a table with closed fields to be marked with different options, according to ages and questions about the development milestone in different fields. The options were: pass (P), fail (F), refuse (R), no opportunity (NO). The table had hatched areas that highlighted the responses that the baby should present at each age and milestone, highlighting the 75% and 90% percentiles. There was also a field for caution and delay quantification, to be applied in the interpretation of normal, suspect and non-testable situations. **Results:** We obtained a total of 18.5% of fail in the first evaluation, 24.1% in the second and 31.7% in the third. In the first one, we did not find any children with an interpretation of the suspected DDST-R, and 6.2% of the children were untestable. In the second one, 6.35% of the children presented a suspected result, none of which was not testable; and in the third, 5.15% of the children had a suspected interpretation and 1.32% was not testable. **Conclusions:** The ease of marking in closed fields enabled a better evaluation and consequent interpretation of the results of the DDST-R, proving to be a good instrument for research in the field of health and birth cohorts.

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**P-0302**

**Fetal and early life exposure to multiple classes of environmental organics measured using teeth**

**Presenter:** Priyanthi Shyamalee Dassanayake, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** P. S. Dassanayake, L. Petrick, S. Andra, C. Austin, R. Wright, M. Arora; Icahn School of Medicine at Mount Sinai, New York, NY.

Background: Pediatric tooth biomatrix provides retrospective measurement of early life exposure to environmental contaminants. However, it is still underutilized due to limitations in sample preparation methods. In our previous work, isolated dentin region of the tooth has been used to analyze metal exposure with daily temporal resolution from pre-birth through the first year of postnatal life. We have now extended this technology to quantify pre- and post-natal exposure to organic pollutants. Aim: To develop a robust and sensitive protocol that allows the analysis of temporally-resolved measurements of multiple classes of known environmental organics in teeth. Methods: The analytical method involves the following steps: 1) identifying the temporal zones in dentin to separate pre and post-natal areas; 2) mechanically drilling the areas of interest in dentin; 3) de-calcifying the dried dentin; 4) solvent extraction of the digested dentin; and 5) instrumental analysis using gas chromatography-tandem mass spectrometry (GC-MS/MS). Dentin collected from 60 pediatric teeth were analyzed for persistent and other organic contaminants. Results: More than 100 analytes including polychlorinated biphenyls (PCBs), Polybrominated diphenyls (PBDEs), Organochlorine pesticides (OCPs) and Polyaromatic hydrocarbons (PAHs) were detected in both pre- and post-natal Fractions. Detection rates were > 80% for the majority of the analytes with concentrations up to 200 ng/g of tooth powder. Within each class of chemicals, analytes were highly correlated as observed in other commonly used matrices such as plasma or serum in both pre- and post-natal fractions. Pre- and post-natal analyte concentrations were positively correlated for all classes with higher correlations observed for PCBs and OCPs compared to PBDEs, suggesting differences in sources of exposure. Conclusions: Results of this study indicate that pre- and post-natal dentin fractions from tooth samples can be concurrently analyzed for environmental exposure to multiple classes of organic contaminants thus facilitating broad spectrum retrospective biomonitoring in epidemiological studies.

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**P-0303**

### **The Agency for Toxic Substances and Disease Registry's Choose Safe Places for Early Care and Education Disaster Recovery Supplement**

**Presenter:** Dana Williams, ATSDR, Washington, United States

**Authors:** D. Williams;  
ATSDR, Washington, DC.

During disaster recovery, affected communities might be at risk for exposure to harmful chemicals. Children are especially vulnerable. A child's environment has direct consequences on their health and well-being. The Agency for Toxic Substances and Disease Registry's (ATSDR) Choose Safe Places for Early Care and Education (CSPECE) Disaster Recovery Supplement can help environmental and public health professionals protect children from environmental exposures after a disaster. The supplement builds on concepts from ATSDR's CSPECE Guidance Manual. The supplement •defines places, in addition to early care, where children spend time, •describes how to apply CSPECE elements to places where children spend time, •identifies likely environmental hazards after a disaster and potential effects on children, and •compiles resources for more information on each environmental hazard or topic. The CSPECE Disaster Recovery Supplement helps public health professionals begin to consider potential environmental hazards unique to disasters and provides resources for addressing those hazards. The target audience for the CSPECE Disaster Recovery Supplement is environmental public health professionals. Many environmental public health professionals at the state level have limited interaction with early care and education (ECE) facilities or systems. This Disaster Recovery Supplement is a tool that public health professionals can use to consider the intersection of environmental hazards and places children spend time. Local decision makers, recovery specialists, ECE professionals, and even ECE providers may find the information in the CSPECE Disaster Recovery Supplement helpful as they plan for, or work towards, disaster recovery.

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**P-0304**

### **Understanding the Relationship Between Maternal Thyroid Hormones and Neurodevelopmental Outcomes**

**Presenter:** Lauren Brown, Abt Associates, Ann Arbor, United States

**Authors:** L. Brown<sup>1</sup>, R. Klein<sup>2</sup>;

<sup>1</sup>Abt Associates, Ann Arbor, MI, <sup>2</sup>Abt Associates, Rockville, MD.

**Background:** In utero exposures to endocrine disrupting chemicals can impact a range of health outcomes for the offspring. Specifically, when considering potential disruptions to proper maternal thyroid functioning due to chemical exposures there is increasing concern that adverse neurodevelopmental outcomes may occur in the offspring. A preclinical outcome, hypothyroxinemia (low free thyroxine and thyroid stimulating hormone within the reference range) is being recognized as a potential outcome of interest in understanding alterations in maternal thyroid functioning. **Methods:** A literature review on the associations between maternal thyroid hormone levels, including maternal hypothyroxinemia and offspring neurodevelopmental outcomes was conducted. Studies were categorized if the main analysis presented evaluated the risk of adverse neurological outcomes as a result of incremental changes in maternal fT4 or the categorical outcome of yes/no hypothyroxinemia. **Results:** We found that altered free thyroxine (fT4) in early pregnancy has the most evidence regarding the relationship between altered maternal thyroid hormone homeostasis and adverse neurodevelopmental outcomes in offspring. We will present multiple approaches to utilize data from the literature to evaluate the magnitude of impact from altered maternal fT4 levels on offspring neurodevelopment. These approaches consist of both evaluating dose-response relationships between maternal fT4 and offspring neurodevelopment and examining how shifts in distributions of thyroid hormone levels may place additional proportions of a population at risk. **Conclusions:** The presented methods can be used to assess the potential neurodevelopmental impacts on the fetus of a pregnant mother exposed to a chemical that may potentially alter homeostatic thyroid functioning (e.g., PCBs, perchlorate, PBDEs, PFAs, BPA)

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**P-0305**

**Reversal of association between prenatal phthalate levels and birth size when measuring phthalates in placental tissue versus maternal urine**

**Presenter:** Hai-Wei Liang, University of Pittsburgh Graduate School of Public Health, Pittsburgh, United States

**Authors:** H. Liang<sup>1</sup>, N. Snyder<sup>2</sup>, R. Birru<sup>1</sup>, K. Carroll<sup>3</sup>, X. Xun<sup>1</sup>, K. LeWinn<sup>4</sup>, N. Bush<sup>4</sup>, F. Tylavsky<sup>5</sup>, J. J. Adibi<sup>1</sup>;

<sup>1</sup>University of Pittsburgh Graduate School of Public Health, Pittsburgh, PA, <sup>2</sup>A.J. Drexel Autism, Drexel University, Philadelphia, PA, <sup>3</sup>Vanderbilt University, Nashville, TN, <sup>4</sup>University of California, San Francisco, San Francisco, CA, <sup>5</sup>The Urban Child Institute, Memphis, TN.

Di (2-Ethylhexyl) phthalate (DEHP) is a widely used plasticizer worldwide and is a potent endocrine disruptor. It is unclear which biospecimen from pregnancy best represents fetal exposure when estimating the relationship between maternal DEHP exposure and child health. Therefore, we compared the association between DEHP metabolites and birth size when biomarkers of exposure were measured in placental tissue versus maternal urine. This study included fifty mother-infant dyads from the CANDLE study. Samples were analyzed for DEHP metabolites (MEHP, MEOHP, MEHHP, MECPP), summarized as a molar sum (DEHP-oxo). Associations of placental and urinary DEHP metabolites were calculated, considering fetal sex, maternal race, and BMI as confounders and effect modifiers of maternal-placental transfer and metabolism. Fetal sex differences in DEHP pharmacokinetics are conceptualized as genetic/epigenetic in origin; whereas race and BMI could represent cultural, dietary, or other sources of variation in exposures and/or pharmacokinetics. In the second aim, multiple regression models were used to assess associations of DEHP oxidized metabolites and birth length and weight z scores, and head circumference (HC). DEHP metabolites in the two tissues were uncorrelated in univariate models. A negative effect was found between MEHP in placenta and MECPP in urine, interacted on race ( $\beta = -0.36$  log units MEHP [95% CI -0.67, -0.05] in Black vs. White women per log MECPP). The association was positive for the effect of urinary DEHP-oxo on birth size; and negative for the effect of placental tissue DEHP-oxo. The highest precision was observed in the association between placental DEHP-oxo and HC ( $\beta = -0.94$  cm per log DEHP-oxo; 95% CI = -2.03, 0.15). Maternal urine might provide different information than the placenta on prenatal exposure to phthalates. Future work will compare MEHP in these two tissue types, to better understand the pharmacokinetics and to clarify if these results indicate a measurement error or a biologic inference problem.

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**P-0307**

**Association between tree cover and academic performance in New York City schools**

**Presenter:** Chris Lim, Yale University, New Haven, United States

**Authors:** C. Lim, C. Chen, A. Chan, M. Bell;  
Yale University, New Haven, CT.

Background: Exposure to nature is linked with increased attentional capacity and reduced stress levels. Emerging evidence links greenspace exposure with improved academic performance in children and reduced crime. We conducted an ecological cross-sectional study to examine the association between school-level tree cover and metrics of academic performance in New York City public schools. We also evaluated high school graduation rates and crime as secondary outcomes of interest. Methods: School-level tree cover estimates based on Light Detection and Ranging (LiDAR) data with 8-in resolution were developed at multiple radiuses (100m, 250m, and 500m) around NYC (N=1,822) schools. School-level estimates for multiple air pollutants and noise were derived from published spatial models. We evaluated math and ELA test scores among students in grades 3-8; graduation rates for students in grades 9-12; and frequency of major and non-major crimes. Generalized linear mixed models were applied to study the association between school-level tree cover and the outcomes, adjusting for school-level demographics, air pollution, and noise; census-tract level median income; and borough and geographical area as random effects. Results: School-level tree cover at 500m radius was significantly associated with higher math scores among students in grades 3-5. Tree cover was also positively associated ( $p$ -value<0.10) with higher ELA scores among students in grades 3-5. Road noise was significantly associated with lower graduation rates among high school students. Higher school-level tree cover was also significantly associated with lower major crime rates. Conclusions: The findings from this study suggest that higher school-level tree cover is associated with improved test scores in elementary school students, while noise from traffic is negatively associated with academic performance amongst high school students. Additional studies are needed to examine the potentially causal relationship between greenspace exposures and academic performance.

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**P-0308**

### **Evaluating environmental risk factors for adolescent anxiety and depression in Pennsylvania using electronic health records**

**Presenter:** Irena Gorski Steiner, Johns Hopkins Bloomberg School of Public Health, Baltimore, United States

**Authors:** I. G. Steiner<sup>1</sup>, B. Schwatz<sup>2</sup>;

<sup>1</sup>Environmental Health and Engineering, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD,

<sup>2</sup>Johns Hopkins, Baltimore, MD.

Over the past decade, the use of electronic health records (EHRs) for epidemiologic studies has expanded due to their potential for longitudinally studying large sample sizes with lower budgets and less data collection time compared to primary data collection. The main purpose of EHRs is clinical, so researchers have to make many difficult decisions with the methods they use to define study populations, variables, and outcomes from information originally entered for a doctor's visit. There are even further challenges to overcome when using EHRs for studies in a particularly difficult area of epidemiology: the study of adolescent mental health outcomes. This poster will review some of the considerations for methods used in epidemiologic studies of psychiatric outcomes for children using EHRs, including options for how to define psychiatric outcomes in children and options for selecting controls given the common nonspecific use of mental health codes and their co-occurrence in children. Considerations and results specific to evaluating the association of new-onset adolescent depressive and anxiety disorders in Pennsylvania (with Geisinger subjects, who represent the general population of the region) with community and environmental risk factors will be shared. Risk factors evaluated include greenness, percent forest, distance to major road, community type, and urbanicity. While many studies have started to show an elevated odds of depressive and anxiety disorders amongst adults in urban versus rural areas, the signal is not clear across studies, none have been conducted with EHRs, and very few have evaluated the association amongst adolescents specifically, a critical developmental period for these disorders.

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**P-0309**

**Arsenic health risk studies in Uruguay with a Medical Geology approach: advantages and difficulties**

**Presenter:** Nelly Mañay, Universidad de la República, Montevideo, Uruguay

**Authors:** N. Mañay, V. Buhl, M. Caceres;  
Universidad de la República, Montevideo, URUGUAY.

In Uruguay safe drinking water is supplied to 94% of the population by a state company (OSE) and 28% is provided from groundwater sources. Geogenic Arsenic. Health risks through groundwater is a very recent issue of concern, regarding all international scientific evidence of several adverse effects associated with low levels ( $As > 20 \mu g/L$ ). We discuss the advantages of our research studies with a Medical Geology approach, to evaluate the influence of geological factors in the geographical distribution of health problems associated with arsenic exposure, and to highlight the main difficulties found in the process. This approach provides the tools for overlaying local geochemical data and arsenic water levels with disease registry data retrospectively, to potentially identify the possibility that the water consuming population, will develop a particular type of disease over time. We assess available geochemical data and As levels, provided by OSE and epidemiological data available from the National Atlas of Cancer prevalence that were geo-referred in the areas where arsenic data in water were available. We carried out a cross-over treatment data, to evaluate possible failures or deficiencies for their further analysis and correlation, finding several lacking records regarding environmental factors and/or drinking water sources. However, we could get distribution maps with refined data of arsenic levels, contrasted with the incidence data of cancer types associated with arsenic (lung cancer, bladder, melanoma, nonmelanoma skin, liver and kidney), for men and women respectively, finding some interesting correlations. Overlapping the Uruguayan cancer atlas data with As levels in wells can be a potential tool to estimate the contribution of As, to the incidence of cancer, though the retrospective data provided presented several difficulties and inconsistencies. We highlight the relevance of developing an interinstitutional and multidisciplinary common framework.

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**P-0310**

### **Impact of Ambient Air Pollution Exposure during Pregnancy on Adverse Birth Outcomes**

**Presenter:** Aweke A Mitku, University of KwaZulu-Natal, Durban, South Africa

**Authors:** A. A. Mitku, T. Zewotir, D. North, P. Jeena, R. N. Naidoo;  
University of KwaZulu-Natal, Durban, SOUTH AFRICA.

**Background** Air pollution exposure adversely affects birth outcomes. The study aimed to investigate the impact of ambient air pollution exposure during pregnancy adjusting prenatal risk factors on adverse birth outcomes among pregnant women in MACE birth cohort. **Methods** Data for the study was obtained from the Mother and Child in the Environment birth cohort (MACE) study in Durban, South Africa from 2013 to 2017. Land use regression models were used to determine household level prenatal exposure to PM<sub>2.5</sub>, SO<sub>2</sub> and NO<sub>x</sub>. Six hundred and fifty-six births of pregnant females selected from public sector antenatal clinics. We employed a Generalized Structural Equation Models with a complementary log-log-link specification which allowed multiple simultaneous equations and decomposition of the direct and indirect effects. **Results** After adjustment for prenatal factors, the results indicated that exposure to PM<sub>2.5</sub> was found to have both significant direct and indirect effects on the risk of adverse birth outcomes. Similarly, an increased level of maternal exposure to SO<sub>2</sub> during pregnancy was associated with an increased probability of being small for gestational age. Moreover, preterm birth showed a strong effect on low birthweight and SGA and act a mediating role on the relationship of exposure to PM<sub>2.5</sub>, and SO<sub>2</sub> with low birth weight and SGA. The findings also demonstrated that smoking, positive HIV status, and following junk foods dietary pattern of mothers were associated with increased risk of preterm birth. However, NO<sub>x</sub> showed inconsistent, protective direct and weak indirect adverse, effect on adverse birth outcomes. **Conclusions** Prenatal exposure to PM<sub>2.5</sub> and SO<sub>2</sub> pollution effects on adverse birth outcomes even after controlling for other risk factors, which were also associated with these outcomes. This suggests that health care providers should be informed about the risks of air pollution in order to aware pregnant women about limiting exposure to poor air quality.

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**P-0311**

### **Proximity and density to hydraulic fracturing wells, birth outcomes and maternal depression in Northeastern British Columbia, Canada**

**Presenter:** Elyse Caron-Beaudoin, Universite de Montreal - School of Public Health, Montreal, Canada

**Authors:** E. Caron-Beaudoin<sup>1</sup>, A. Aker<sup>2</sup>, K. Whitworth<sup>3</sup>, D. Bosson-Rieutord<sup>1</sup>, G. Wendling<sup>4</sup>, S. Liu<sup>5</sup>, M. Verner<sup>1</sup>;

<sup>1</sup>Universite de Montreal - School of Public Health, Montreal, QC, CANADA, <sup>2</sup>Interdisciplinary Centre for Health & Society, University of Toronto Scarborough, Toronto, ON, CANADA, <sup>3</sup>Center for Precision Environmental Health, Department of Medicine, Section of Epidemiology and Population Sciences, Baylor College of Medicine, Houston, TX, <sup>4</sup>GW Solutions, Nanaimo, BC, CANADA, <sup>5</sup>Department of Global Health, School of Health Sciences, Wuhan University, Wuhan, CHINA.

Northeast British Columbia (Canada) is an area of intensive hydraulic fracturing for natural gas exploitation. Some epidemiological studies have found associations between proximity/density of wells and negative health outcomes. Our objective was to assess associations between proximity/density of wells and 1) maternal depression, and 2) birth outcomes (birthweight, small for gestational age (SGA), preterm birth and head circumference). We used birth records from the Fort St John hospital from 2007 to 2016 (n = 6333 births). We constructed three exposure metrics by calculating the inverse distance-weighted (IDW) sum of wells within three buffers around maternal postal code centroid: 2.5, 5 and 10 km. We used linear or logistic regression to evaluate associations between IDW quartiles and outcomes. Maternal depression during pregnancy was obtained from the prenatal registration questionnaire. Birthweight and head circumference were obtained from the Perinatal Data Registry. Models were adjusted for relevant covariables determined a priori. We found increased adjusted odds of maternal depression associated with proximity/density of wells in the 2<sup>nd</sup> (1.31 [1.03, 1.66]) and 3<sup>rd</sup> quartiles (1.35 [1.07, 1.71]) of the 10-km buffer. We found increased adjusted odds of preterm birth associated with proximity/density of wells in the 2<sup>nd</sup> (odds ratio [95% confidence interval] = 1.60 [1.30, 2.43]) and 3<sup>rd</sup> quartiles (1.34 [0.90, 2.08]) of the 2.5-km buffer. We found negative associations between proximity/density of wells and birthweight in the 2<sup>nd</sup> (adjusted beta [95% confidence interval]: -40.9 g [-78.0, -3.7]) and 3<sup>rd</sup> (-42.0 g [-79.2, -4.9]) quartiles of the 5-km buffer, and in the 3<sup>rd</sup> quartile of the 10-km buffer (-47.3 g [-84.3, -10.3]). We found no association with SGA or head circumference. Our results provide some evidence of a potential association between proximity/density of hydraulic fracturing wells and more preterm births, reduced birthweight and maternal depression, but effect estimates did not match expected dose-response relationships.

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**P-0312**

**Features of the content of immunoglobulins in blood serum in children with repeated respiratory infections**

**Presenter:** Aksana Viktorovna Povarava, MSU, Mogilev, Belarus

**Authors:** A. V. Povarava<sup>1</sup>, N. D. Titova<sup>2</sup>, N. M. Novikava<sup>3</sup>, L. N. Liutsko<sup>4</sup>;

<sup>1</sup>MSU, Mogilev, BELARUS, <sup>2</sup>BMAPE, Minsk, BELARUS, <sup>3</sup>ISEI BSU, Minsk, BELARUS, <sup>4</sup>ISGlobal, Barcelona, SPAIN.

**Background/Aim:** Other studies showed that a large number of children with recurrent respiratory tract infections have disorders in the humoral immune system. Changes were detected from some antibody deficiency to conditions with persistent clinically significant manifestations of humoral protection insufficiency. The aim of the study was to identify diagnostically significant parameters of changes in the humoral link of immunity. **Methods:** The peripheral blood serum was taken from 512 children, aged 1-16 years old (y.o.) from Mogilev region (Belarus), who often suffered from respiratory diseases and the last episode of acute respiratory infection of more than 6 weeks ago. The total content of serum immunoglobulins IgG, IgA, IgM was determined by solid-phase enzyme immunoassay with sets of reagents based on monoclonal antibodies. **Results:** In 60.2% of children the indicators of total serum immunoglobulins IgG, IgA, IgM were within the age norms. Correlations between immunoglobulins in children with higher immunoglobulin values had statistically significant differences with the group of children with normal indicators. 39.8% of children had shown changes in humoral immunity indicators; and its frequency increased with the age of children: 1-2 y.o. - 26.4%, 3-5 y.o. - 27.6%, 6-9 y.o. - 31.5%, 10-13 y.o. - 50.5%, and 14-16 y.o. - 75.8%. The most common changes in IgG, IgA, IgM indicators in these children were: IgM hyperproduction in 8.2%, IgA decrease in 9.6%, IgG hyperproduction in 3.9%, IgG decrease in 7.4%, and a combination of IgG and IgA deficits in 2.9%. **Conclusions:** Changes in humoral immunity with age-specific features were detected in 39.8% of children with respiratory infections. Repeated studies are needed for detecting hyperproduction of certain classes of immunoglobulins since remains unclear to date. At the same time, early detection of deficits of the humoral immune system can contribute to the timely correct diagnosis of diseases associated with immunodeficiency states.

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**P-0313**

### **Identifying an appropriate biomarker for the tris (2-chloropropyl) phosphate (TCPP) flame retardant in children**

**Presenter:** Stephanie C Hammel, Duke University, Durham, United States

**Authors:** S. C. Hammel, H. M. Stapleton, K. Hoffman;  
Duke University, Durham, NC.

Background: Tris(2-chloropropyl) phosphate (TCPP) is an organophosphate flame retardant frequently applied to polyurethane foam. Bis(2-chloropropyl) phosphate (BCPP) is typically measured as the primary urinary biomarker for TCPP, but it is infrequently detected in adult urine and thus often considered unreliable. However, BCPP is frequently detected in urine samples from younger children, suggesting that it could still be effective for monitoring children's exposure to TCPP. More recently, bis(2-chloro-isopropyl) hydroxy-isopropyl phosphate (BCIPHIPP) was identified as another TCPP metabolite and is considered to be an improved biomarker compared to BCPP due to its high detection in urine from all age groups. Methods: We compiled individual urinary biomarker data from children ages 1-73 months recruited from two U.S. cohorts in our laboratory from September 2014 to January 2018 (n=314). Individual concentrations of BCPP and BCIPHIPP as well as their ratio were examined for changes based on child's age and demographic characteristics. Results: Children's ages were significantly associated with the BCIPHIPP:BCPP ratio, with each month increase in age being associated with a 0.11 increase in the ratio (95% CI: 0.08, 0.13; p<0.001). Patterns appeared to be driven by a decrease in urinary BCPP concentrations with age. Increased exposure to TCIPP via breastfeeding may contribute to the higher BCPP observed among the youngest children. Alternatively, metabolism differences during the first few years of life, particularly as they relate to child's race/ethnicity, may explain observed patterns. Also, children with a parent who graduated from college had a lower ratio ( $\beta = -7.3$ , 95% CI: -11.4, -3.3; p=0.0004). Conclusion: These results suggest that current analyses utilizing only BCPP as a biomarker could severely underestimate individual exposures to TCPP. Further, this study could have broader implications for biomonitoring as these results demonstrate that the selection of an appropriate exposure biomarker could change based on demographics of the study population.

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**P-0314**

**Young Infants' Exposure to Organophosphate Esters and Associations with Vaccination Responses**

**Presenter:** Stephanie C Hammel, Duke University, Durham, United States

**Authors:** S. C. Hammel, S. Zhang, A. M. Lorenzo, H. M. Stapleton, K. Hoffman;  
Duke University, Durham, NC.

**Background:** Organophosphate esters (OPEs) are applied as flame retardants and plasticizers to many consumer items such as home furnishings and children's products. Little is known about OPE exposure among infants, who are a vulnerable population due to their rapid development. **Methods:** We collected spot urine samples from 6-week-old (n=100) and 12-month-old infants (n=63), with about half of the infants evaluated at both ages (n=52), to characterize OPE exposure and assess factors contributing to higher exposures. In addition, we evaluated serum for tetanus and diphtheria antibody titers at 12 months (n=93; among children receiving the DTaP vaccine). **Results:** Five of six OPE urinary metabolites analyzed were detected frequently (>70%). Diphenyl phosphate was detected in every urine sample, while bis(2-chloro-isopropyl) phosphate (BCIPP) was the most abundant metabolite measured overall. Concentrations of BCIPP and a second tris(2-chloroisopropyl) phosphate (TCIPP) metabolite, BCIPHIPP, were significantly greater among 6-week-olds compared to 12-month-olds ( $p < 0.0001$ ). Levels of other OPE metabolites were not statistically different in the first year of life. Infants who were currently breastfed had higher levels of TCIPP metabolites in their urine, with BCIPP levels 6.2 times higher at 6 weeks and BCIPHIPP 2.2 times higher at 12 months ( $10^{\beta} = 7.2$ ; 95% CI: 1.6-32.1 and  $10^{\beta} = 3.2$ ; 95% CI: 1.2-8.1, respectively). After adjusting for demographics and breastfeeding status, each log<sub>10</sub>-increase in BCIPP concentrations was associated with a 0.5 IU/mL decrease in tetanus antibodies ( $p = 0.05$ ); a similar association was observed for urinary BDCIPP with diphtheria titers. Urinary BCIPP at 6-weeks was also associated with increased reports of respiratory infections within the first year of life (OR: 4.1, CI: 0.9-18,  $p = 0.06$ ); increased exposures to other OPEs were associated with decreased allergy reports. **Conclusions:** Cumulatively, results suggest levels of OPE exposure are higher for infants than older children, and these increased exposures could be associated with indicators of adverse immune function.

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## ABSTRACT E-BOOK

Theme: **Children's health**

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**P-0315**

**Urbanization and greenness in hbsc survey: association with life satisfaction and health complaints**

**Presenter:** Irene Gintoli, University of Turin, Torino, Italy

**Authors:** I. Gintoli, V. Bellisario, G. Squillacioti, M. Caputo, A. Borraccino, P. Dalmaso, R. Bono, P. Lemma; University of Turin, Torino, ITALY.

**BACKGROUND** Several studies have shown that neighborhood greenness is associated with lower problematic behaviors and better perceived well being in youth. While urbanization showed opposite results. The aim of the study was to assess the relationship between urbanization levels and greenness with perceived health, life satisfaction and health complaints on adolescents. **METHODS** The study is based on data from 2018 Health Behaviors in School-aged Children in Piedmont (Italy), which involved 3022 11-, 13-, 15-year old youth, sampled in 122 schools. Greenness exposure was quantified by Normalised Difference Vegetation Index (NDVI) within buffers around geocoded schools, using satellite imagery. Vehicular traffic was determined within same buffers, using thematic maps. Exposures to air pollution concentration (obtained from different local sampling stations) were provided by the Regional Agency for the Protection of the Environment. Health complaints were evaluated with a set of 8 psychosomatic symptoms (reported more than once a week). Life Satisfaction (LS) was measured by using the Cantril scale (low LS < 5, high LS ≥ 6). Self-Rated Health was measured by means of a four points scale (fair or poor, good or excellent). **RESULTS** More than 66% of adolescents reported frequent health complaints; 11% declared low life-satisfaction and 9% of adolescents scored poor or fair self-rated health. The proportion of all three variables was higher among girls and increased with the age in both and between genders. Preliminary results showed a positive association between greenness and life satisfaction, and a direct association between urbanization and health complaints. **CONCLUSIONS** In times of increasing urbanization and reduced availability of green areas, characterizing the association between urbanization, greenness and perceived health is revealed to be the challenge for future Public Health interventions. Redefining urban spaces accordingly requires an active collaboration among different disciplines and the final users. Coherently with the recent studies, communities can be involved through qualitative approaches. **MAIN MESSAGE** The topic of urban nature is becoming central for healthy and sustainable urban planning, not the least for the health of population groups like adolescents and children.

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Theme: **Children's health**

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**P-0316**

**Prenatal exposure to mixtures of persistent environmental chemicals and fetal growth outcomes in Western Australia**

**Presenter:** Nina Lazarevic, The University of Queensland, Brisbane, Australia

**Authors:** N. Lazarevic<sup>1</sup>, A. G. Barnett<sup>2</sup>, P. D. Sly<sup>1</sup>, A. C. Callan<sup>3</sup>, A. Stasinska<sup>4</sup>, J. S. Heyworth<sup>4</sup>, A. L. Hinwood<sup>5</sup>, L. D. Knibbs<sup>1</sup>;

<sup>1</sup>The University of Queensland, Brisbane, AUSTRALIA, <sup>2</sup>Queensland University of Technology, Brisbane, AUSTRALIA, <sup>3</sup>Edith Cowan University, Perth, AUSTRALIA, <sup>4</sup>The University of Western Australia, Perth, AUSTRALIA, <sup>5</sup>Environmental Protection Authority Victoria, Melbourne, AUSTRALIA.

Background: Environmental chemicals have been implicated in the etiology of impaired fetal growth; however, few studies have assessed the effects of chemical mixtures or considered the possibility of non-monotonic exposure–response relationships for chemicals that act through the endocrine system. Methods: We assessed exposure to polybrominated diphenyl ethers, organochlorine pesticides, metals, and perfluoroalkyl substances in blood and urine samples collected two weeks prior to delivery in 166 non-smoking pregnant women, and subsequent birth weight, length, and head circumference of neonates who were part of the Australian Maternal Exposures to Toxic Substances (AMETS) study. We used Bayesian structured additive regression models with spike–slab priors to estimate mixture effects, identify important exposures, and model non-linearity in exposure–response relationships. Results: An increase in cesium exposure measured in whole blood from the 10th to 90th percentile was associated with a reduction in both birth weight (-236.5 g, 90% credible interval: -458.1 to -6.5 g) and the proportion of optimal birth weight (-8.6%, 90% credible interval: -14.8 to -0.4%), after adjusting for potential confounders. We identified several other chemicals and mixtures that may be associated with fetal growth, some non-linearly; however, 90% credible intervals contained the null. Conclusions: Using a Bayesian penalised regression method that is robust to multicollinearity, we assessed the shapes of exposure–response relationships, controlled for confounding by co-exposure, and estimated the single and combined effects of a large mixture of correlated environmental chemicals on fetal growth. While exposure concentrations in the AMETS study were generally low, our findings suggest that cesium exposure is associated with a reduction in birth weight. The potential for non-monotonic relationships between environmental chemicals and fetal growth outcomes warrants further study.

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Theme: **Children's health**

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**P-0317**

**Postnatal exposure to PM<sub>2.5</sub> and growth in early childhood**

**Presenter:** Antonella Zanobetti, Harvard T.H. Chan School of Public Health, Boston, United States

**Authors:** J. Vanoli<sup>1</sup>, B. Coull<sup>1</sup>, S. Ettinger de Cuba<sup>2</sup>, P. Fabian<sup>3</sup>, F. Carnes<sup>3</sup>, M. Massaro<sup>3</sup>, A. Poblacion<sup>2</sup>, I. Kloog<sup>4</sup>, A. Zanobetti<sup>1</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>2</sup>Boston University, School of Medicine, Boston, MA, <sup>3</sup>Boston University School of Public Health, Boston, MA, <sup>4</sup>Ben-Gurion University of the Negev, Beer Sheva, ISRAEL.

**Background:** Evidence has linked pre and postnatal air pollution exposure with children's weight; however, studies assessing the effects on children's growth trajectories are lacking and not consistent. We investigated the role of time-varying postnatal 90 days average spatio-temporal fine particulate matter (PM<sub>2.5</sub>) as an effect modifier on sex-specific growth trajectories in early childhood and the magnitude of the impact at different ages.

**Methods:** We included children recruited to the Boston-based Children's HealthWatch cohort from 2009 through 2014 (0 to 6 years old). Weight values were obtained from electronic health records at each hospital visit, (number of boys=1859, girls=1601). We applied generalized additive mixed models adjusting for individual and maternal confounders. We examined effect modification by 1) comparing weight trajectories with factor-smooth interaction between age and PM<sub>2.5</sub> quartiles, and 2) using varying-coefficient models allowing for smooth non-linear interaction between age and PM<sub>2.5</sub>. Additionally, we stratified by birthweight status. **Results:** We found no differences in growth trajectories by different levels of PM<sub>2.5</sub>. Using varying-coefficient models, we found that PM<sub>2.5</sub> characterized as a continuous exposure significantly modified the association between growth trajectories and weight in boys, with a positive association between PM<sub>2.5</sub> and weight in children less than 3 years and a negative association afterwards. In boys, for each 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub> we found a 2.6% increase (95% CI: 0.8, 4.6) in weight at 1 year of age and a -0.6% (95% CI: -3.9, 2.9) at 5 years. We found similar but smaller changes in girls. Stratification by birthweight status suggests that most of the effects were in low birthweight children. **Conclusions:** The study shows that in young children the non-linear effect of continuous postnatal PM<sub>2.5</sub> modify weight trajectories. Birthweight status is an effect modifier of the air pollution-weight relationship.

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Theme: **Children's health**

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**P-0318**

### **A Cross Sectional Study To Assess Sleep Hygiene Among School going adolescents**

**Presenter:** Lavanya Sekhar, Department of Physiology, Sri Ramachandra Medical College and Research Institute, Sri Ramachandra Institute of Higher Education (SRIHER), Chennai, India

**Authors:** Lavanya Sekar<sup>1</sup>, Priscilla Johnson<sup>1</sup>, Sheela Ravinder<sup>1</sup>, Mathangi.D.C<sup>2</sup>; <sup>1</sup> Department of Physiology, Sri Ramachandra Medical College and Research Institute, Sri Ramachandra Institute of Higher Education (SRIHER), Chennai, Tamil Nadu, India; <sup>2</sup> Department of Mind Body Medicine & Life Sciences, Sri Ramachandra Medical College and Research Institute, Sri Ramachandra Institute of Higher Education (SRIHER) Chennai, Tamil Nadu, India.

**INTRODUCTION:** Sleep is a physiological process which is required for good physical, mental and social well being (Beebe, 2011). A good sleep is essential to maintain body's circadian rhythm. Sleep deprivation can disrupts body's homeostasis leading to various ill effects like heart disease, diabetes, depression, accidents, impaired cognition, and a poor life quality. In recent days, lifestyle modifications have increased the prevalence of sleep disturbances especially among adolescents. As adolescence is the vital transitional phase where an individual have to determine their future both personal and professionally, any disturbance in sleep would affect their health and also would affect their academic performance. So the current study focused to assess sleep hygiene among school going adolescents. **AIM & OBJECTIVE:** To assess the sleep hygiene and pattern among going adolescents

To analyse the risk factors of compromised sleep hygiene and pattern among going adolescents

**METHODOLOGY:** This cross sectional study analysed the sleep pattern among school going adolescents (n=278) using Pittsburgh Sleep Quality Index (PSQI) which differentiates poor (Global PSQI Score >5) from good (Global PSQI Score <5) sleep by measuring seven domains. Then the Sleep Hygiene among these adolescents was analysed using 13 item Sleep Hygiene Index Inventory tool. **RESULTS:** The current study shows that the prevalence of sleep deprivation among the study participants were 52.17% and the average sum of global PSQI score was above 5 indicating poor sleep index. There was a positive correlation ( $R^2 = 0.2535$ ) between poor sleep hygiene and Global Sleep quality index. Also we found that participants with higher caffeine intake, stress, Inconsistent bed timing, uncomfortable sleeping ambience and longer exposure to screen time (Television & electronic gadgets) had greater PSQI scores. **CONCLUSION** The current study explicitly states that sleep deprivation is one of the global burden among adolescents and better understanding of sleep hygiene and sleep pattern will help to reduce the incidence of sleep related lifestyle disorders.

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Theme: **Climate change**

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**P-0319**

### **Infectious diseases surveillance in the context of climate change: assessment of public health surveillance capacity in Nepal**

**Presenter:** Dinesh Bhandari, University of Adelaide, Adelaide, Australia

**Authors:** D. Bhandari<sup>1</sup>, P. Bi<sup>1</sup>, J. B. Sherchand<sup>2</sup>, O. S. von Ehrenstein<sup>3</sup>, M. Dhimal<sup>4</sup>, S. Hanson-Easey<sup>1</sup>;  
<sup>1</sup>University of Adelaide, Adelaide, AUSTRALIA, <sup>2</sup>Public Health Research Laboratory, Institute of Medicine, Tribhuvan University, Kathmandu, NEPAL, <sup>3</sup>Fielding School of Public Health, University of California, Los Angeles, CA, <sup>4</sup>Nepal Health Research Council, Kathmandu, NEPAL.

The changing dynamics of infectious disease transmission under the influence of global environmental change, urbanization, population growth and increasing trends of travel and migration are challenging the conventional approach of disease surveillance, highlighting a need for inter-sectoral participation and interdisciplinary collaboration.

A qualitative exploratory study design will be adopted to assess the capacity of the public health surveillance system in Nepal to examine impacts of climate change on infectious diseases transmission. A scoping review of related scientific journal articles and pertinent documents was carried out to identify major elements relevant to climate change and infectious disease surveillance. An evaluation framework was then designed, which will be utilized to analyse interview transcripts of epidemiologists, surveillance officers, infectious disease experts and policy makers from the Epidemiology and Disease Control Division, Nepal. We identified 10 major documents, including 6 peer reviewed articles, 2 surveillance guidelines (issued by the US Center for Disease Control and Prevention and the World Health Organisation) and 2 conference proceedings describing major themes and components relevant to public health surveillance (environmental health surveillance and disease surveillance). However, we did not identify any literature that provides a comprehensive framework for infectious disease surveillance in consideration with changing climate. Hence, we took pragmatic approach incorporating the concepts of environmental health surveillance and disease surveillance- in addition to policies relevant to climate change and human health- to propose a comprehensive framework of infectious disease surveillance in a changing climate. We are now using this framework to evaluate the capacity of infectious disease surveillance systems in Nepal in the context of climate change. Findings from our qualitative study will be presented. We propose a comprehensive framework for infectious disease surveillance in the context of climate change, which can be utilized for evaluation of infectious disease surveillance capacity in the context of changing climate.

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Theme: **Climate change**

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**P-0320**

### **Suicide Behavior and Meteorological Characteristic in Hot and Arid Climate**

**Presenter:** Shaked Yarza, Soroka University Medical Center, Beer-Sheva, Israel

**Authors:** S. Yarza<sup>1</sup>, A. Vodonos<sup>2</sup>, L. Hassan<sup>1</sup>, H. Shalev<sup>1</sup>, V. Novack<sup>1</sup>, L. Novack<sup>1</sup>;

<sup>1</sup>Soroka University Medical Center, Beer-Sheva, ISRAEL, <sup>2</sup>Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA.

**Background:** Suicidal behavior is determined by the consequence of an interaction between biological, psychological and sociological factors, as well as between individual and environmental effects. Fluctuations in meteorological factors can modify human behavior and effect suicidal rates. We hypothesize that high temperatures can be associated with an increase rate of suicidal attempts.

**Methods:** We included all patients admitted to Soroka University Medical Center (SUMC) due to suicide attempts between the years 2002-2017 and were residents of Southern Israel. We computed two sets of regression models: a time stratified case-crossover design to control for seasonality and individual differences; then, time-series analyses to calculate the incidence rate ratio (IRR) and the cumulative effect of temperature on the daily incidences of ER admissions after suicide attempts. We stratified the analyses by demographic variables to identify significant individual differences

**Results:** Suicide attempts were associated with a 5 °C increase during the summer season (OR 1.59, 95% CI 1.22-2.08) and a 5 °C increase in all seasons was associated with those who have made multiple attempts (OR 1.18, 95% CI 1.0005-1.38). The cumulative effect of 5° C increment is associated with more suicide attempts over 2 days (IRR 1.10, 95% CI 0.98; 1.24) and 5 days (IRR 1.04, 95% CI 1.00;1.08). The associations were greater for patients with psychiatric diagnosis and patients with multiple attempts.

**Conclusion:** High temperatures and low amounts of precipitations are evidently of great impact on people's susceptibility to suicidal behavior, especially for individuals who have had a prior suicide attempt.

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Theme: **Climate change**

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**P-0321**

### **Congenital Anomalies Associated with Oil and Gas Drilling, Resource Extraction, and Water Production: A Population-Based Retrospective Cohort Analysis**

**Presenter:** Mary D Willis, Oregon State University, Corvallis, United States

**Authors:** M. D. Willis, M. Kile, S. Carozza, P. Hystad;  
Oregon State University, Corvallis, OR.

Background: Oil and gas extraction-related activities produce air and water pollution that contains known and suspected teratogens (e.g. benzene, methanol, diesel particulate matter) that could create an increased risk of congenital anomalies (birth defects). Using a population-based birth cohort in Texas, one of the highest producers of oil and gas, we investigate associations between in utero exposure to oil and gas extraction and odds of congenital anomalies.

Methods: We acquired birth certificate information in Texas between 1999 and 2009 (n=2,234,138), which was linked to the statewide congenital anomaly surveillance system (n=86,315 cases). Using full address data, we attached maternal residences at delivery to the coordinates of active oil and gas extraction sites. To examine different aspects of extraction processes, we built residential exposure metrics using tertiles of inverse distance-squared weighting within 5km: drilling site count, gas production, oil production, and water production. In logistic regression models, we calculate odds of any congenital anomaly and 10 specific organ sites using two control groups: 1) mothers living 5-10km of an active well, and 2) 5km of future drilling sites (but which is not yet operational). All models controlled for a comprehensive set of maternal characteristics and spatial-temporal variation to control for potential unmeasured contextual factors.

Results: Using the temporal control group, we observe increased odds of a congenital anomaly associated with drilling-related exposures in the top tertile: 1.26 (95% CI: 1.21, 1.31) for site count; 1.08 (95% CI: 1.04, 1.12) for oil; 1.19 (95% CI: 1.16, 1.23) for gas, and 1.17 (95% CI: 1.14, 1.20) for water. Associations are similar, but attenuated, with the spatial control group. For specific organ sites, we observe that cardiac and circulatory defects are consistently associated with all metrics.

Conclusions: Increased odds of congenital anomalies were consistently associated with drilling-related exposures in this large population-based study.

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**P-0322**

**Characterization of Heat Index Experienced by Individuals Residing in Urban and Rural settings**

**Presenter:** Suwei Wang, Virginia Tech, Blacksburg, United States

**Authors:** S. Wang<sup>1</sup>, C. Y. Wu<sup>2</sup>, M. B. Richardson<sup>3</sup>, B. F. Zaitchik<sup>4</sup>, J. M. Gohlke<sup>1</sup>;

<sup>1</sup>Virginia Tech, Blacksburg, VA, <sup>2</sup>Troy University, Troy, AL, <sup>3</sup>University of Alabama at Birmingham, Birmingham, AL, <sup>4</sup>Johns Hopkins University, Baltimore, MD.

Background Heatwave warning systems rely on measurements taken at weather stations (WS), which do not reflect variation in temperature and humidity experienced by individuals moving through indoor and outdoor locations. We examined whether neighborhood measurement improved the prediction of individually experienced heat index in an urban vs. rural location. Methods Participants (residents of Birmingham, AL [N=89] and Wilcox County, AL [N=88]) wore thermometers clipped to their shoe for 7 days. Shielded thermometers/hygrometers were placed outdoors within participant's neighborhoods (N=43). Nearest WS and neighborhood thermometers were matched to the participant's home address. Heat index (HI) was estimated from participant thermometer temperature and WS humidity per person-hour (HI[individual]), WS temperature and humidity (HI[WS]), or neighborhood temperature and humidity (HI[neighborhood]). Linear mixed models were fitted to determine the predictive value of WS and neighborhood HI for estimating HI[individual] in the urban and rural location. Results For all participants, a model with HI[neighborhood] alone explained the most variance in HI[individual]. A 1°C increase in HI[neighborhood] was associated with a 0.20°C [95%CI (0.19, 0.21) increase in HI[individual] in models adjusting for individual-level demographic factors. After adjusting for ambient condition differences, we found HI[individual] was heightened in the rural location compared to the urban location, particularly during non-rest hours (5am-midnight), when wind speed is higher, and on weekends. Both WS and neighborhood measurements underestimated the amount of time the participants experienced HI in the National Weather Service (NWS) Extreme Danger risk category compared to HI[individual]. Neighborhood measurements were better estimates of time spent in Danger and Extreme Danger NWS risk categories compared to WS. Conclusions Neighborhood measurements improved the prediction of individually-experienced HI, suggesting microclimates within neighborhoods are an important contributor to HI experienced by individuals.

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Theme: **Climate change**

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**P-0323**

### **Ethnic group differences in perceptions of climate change, adaptive behaviours and vulnerability in central and southern China**

**Presenter:** Ying Zhang, School of Public Health, Faculty of Medicine and Health, University of Sydney, Camperdown, NSW, Australia

**Authors:** H. Ye<sup>1</sup>, H. Li<sup>1</sup>, H. Zhou<sup>1</sup>, F. Chen<sup>1</sup>, Y. Zhang<sup>2</sup>;

<sup>1</sup>South-Central University for Nationalities, Wuhan, CHINA, <sup>2</sup>School of Public Health, Faculty of Medicine and Health, University of Sydney, Camperdown, NSW, AUSTRALIA.

**Background/Aim:** Limited empirical climate change research has been focused on ethnic minority groups, especially in China. Our study aims to provide more evidence to assist policy making to reduce the health impacts from climate change in Chinese ethnic minority population through understanding their perceptions, adaptive behaviours, vulnerability as well as contributing factors. **Methods:** Cross-sectional surveys were conducted in 2018-2019 in selected ethnic minority regions in four provinces (Hubei, Yunan, Chongqing and Hainan) in central and southern China. We used multilevel sampling to collect data from four ethnic minority groups (Naxi, Li, Tujia, Miao) and Han group in the study regions. We performed descriptive analyses of characteristics of the participants, univariate comparison between ethnic minority groups and Han group, and multivariate logistic regression models to estimate adjusted Odds Ratios (OR) of influencing factors for climate change understanding, adoption of adaptive behaviours and vulnerability, adjusting for confounders. **Results:** A total of 3,052 participants were included with a mean age of 47.0 and 64% were male. Compared with Han group, all ethnic minority groups had a significantly lower level of climate change understanding, but a higher proportion of perceived increase in local extreme weather events, and more self-reported symptoms during heat. Ethnic minorities were less likely to take adaptive behaviours and the most acceptable adaptations varied across groups. Ethnic minority (OR=11.51, 6.13-21.62), 60 and older (OR=1.07, 1.04-1.10), poor health status (OR=9.35, 4.26-20.50), no self-reported poverty (OR=0.31, 0.15-0.62), and taking adaptive actions in advance (OR=0.03, 0.01-0.09) could significantly affect the vulnerability. **Conclusions:** Our study has proved a higher level of vulnerability to climate change among the ethnic minority groups compared with Han group in central and southern China. Findings have significant implications for policy development to reduce health inequity by increasing the resilience to future risks from climate change and extreme weathers among ethnic minorities.

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**P-0324**

**Lack of women in climate-health leadership in the Global South: Are we missing an opportunity to effectively tackle climate change?**

**Presenter:** Aparna Lal, Australian National University, Canberra, Australia

**Authors:** A. Lal<sup>1</sup>, A. W. Lill<sup>2</sup>, E. Wilford<sup>1</sup>;

<sup>1</sup>Australian National University, Canberra, AUSTRALIA, <sup>2</sup>external consultant, Canberra, AUSTRALIA.

Background: Women bear the brunt of the health impacts of climate change in many regions. The scientific evidence base that informs health policy and practice to manage these risks needs to adequately reflect the knowledge, experience, and leadership of women. Methods: The main aim of this study was to examine the leadership of women in peer-reviewed climate-change research as measured by the gender of lead authors. A multinomial logistic regression adjusting for the number of papers in each region, gender, and the region was used to examine the effect of gender, with the group of papers with Impact Factor of <2 as the comparison group. Results: A total of 993 articles from 1991-2018 (August) with lead author affiliations spanning 72 countries were included. Globally, women comprise <40% of scientists who lead publications on climate change and human health. Overall, papers published in very high-impact journals (Impact Factor>13) were linked to a low proportion of female researchers as first authors (25%). Males were over two times as likely to lead articles in these top journals compared to papers with the lowest-ranked IF. While North America has the highest number of articles published, Asia and Europe have the most papers (24%) with very high Impact Factors (IF>13). Over time, we show that the proportion of women as lead authors has increased, with the biggest percentage change seen in Asia and Oceania, although this rate of increase is much slower than the growth of research in this area. Conclusions: There are gender and geographic disparities in the scientific evidence base around climate and health. This may contribute to women's underrepresentation at the policymaking table potentially hindering effective and sustainable tackling of climate change. We need greater inclusion in climate-health leadership, particularly in the Global South to inform better climate change policy decisions.

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Theme: **Climate change**

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**P-0325**

### **Prenatal Exposure to Ambient Air Temperature and Risk of Early Delivery**

**Presenter:** Faige Spolter, The Hebrew University of Jerusalem, Jerusalem, Israel

**Authors:** F. Spolter<sup>1</sup>, I. Kloog<sup>2</sup>, M. Dorman<sup>2</sup>, L. Novack<sup>3</sup>, O. Erez<sup>3</sup>, R. Raz<sup>1</sup>;

<sup>1</sup>The Hebrew University of Jerusalem, Jerusalem, ISRAEL, <sup>2</sup>Ben-Gurion University of the Negev, Beer Sheva, ISRAEL, <sup>3</sup>Soroka University Medical Center; Ben-Gurion University of the Negev, Beer Sheva, ISRAEL.

#### Background:

Preterm birth is a major determinant of adverse health consequences. Often, the specific cause of preterm birth is unclear. However, there are known genetic, behavioral, socioeconomic and environmental risk factors. Considering climate change, temperature is an important factor to consider. Several studies have focused on associations of ambient air temperature (Ta) with risk of preterm birth. Climates studied and methods used varied and results have been inconsistent. Few studies included early-term births.

#### Aims:

To investigate the association of prenatal exposure to Ta with preterm and early-term birth in a semi-arid climate in Israel.

#### Methods:

All singleton deliveries at the Soroka Medical Center, Be'er Sheva, Israel, with estimated conception dates between May 2004 and March 2013 (N=62,547) were linked to prenatal Ta estimates from a spatiotemporally resolved model, with daily 1 km resolution. We used time-dependent Cox regression models with weekly mean Ta throughout gestation, adjusted for calendar month and year of conception, ethnicity, SES and population density. Effect modification by fetal sex and ethnicity was examined using interaction terms and stratified.

#### Results:

Ta was positively associated with late preterm birth (31+0/7 - 36+6/7 weeks of gestation), with increased risk in the upper Ta quintile as compared to the middle Ta quintile, hazard ratio (HR) = 1.31, 95% CI = 1.11 - 1.56. Ta was also associated with early term birth (37+0/6 - 38+6/7 of gestation), with increased risk in the upper Ta quintile as compared to the middle Ta quintile, HR = 1.24, 95% CI = 1.13 - 1.36. Ta was more strongly associated with late preterm birth for female fetuses than for male fetuses (HR = 1.50, 95% CI = 1.17-1.94 and HR = 1.17, 95% CI = 0.97-1.41, respectively).

#### Conclusion:

Prenatal exposure to high Ta is associated with a higher risk of early delivery in southern Israel.

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**P-0326**

### **The Impacts of Climate Change on Human Health: Quantification of the Risk in Chile**

**Presenter:** Daniela Quiroga-Vergara, GreenlabUC, DICTUC S.A. Department of Industrial and Systems Engineering, Pontificia Universidad Catolica de Chile, Santiago, Chile

**Authors:** D. Quiroga-Vergara<sup>1</sup>, J. Valdes<sup>1</sup>, L. Cifuentes<sup>2</sup>;

<sup>1</sup>GreenlabUC, DICTUC S.A. Department of Industrial and Systems Engineering, Pontificia Universidad Catolica de Chile, Santiago, CHILE, <sup>2</sup>Department of Industrial and Systems Engineering, Pontificia Universidad Catolica de Chile, Santiago, Chile., Santiago, CHILE.

**Background** The association between temperature and mortality has been widely established in literature. The aim of this study is to quantify the premature deaths attributable to temperature variations (heat or cold) due to climate change in order to provide results that can be easily interpreted by policy makers. The focus of the study is the Chilean territory, an interesting country to analyze due to its extremely diverse climates. **Methods** We estimated the mortality risk attributable to temperature variation by fitting a standard time-series Poisson model for each of the main cities, controlling for pollution, influenza, trends and day of the week. Temperature and mortality association is estimated with a distributed lag non-linear model. Consecutively, we estimated the number expected deaths by 2050 for such mortality risks using temperature projections. **Results** Temperature is responsible for a 0.7% increase in future expected mortality. The largest impact is located in the central region, where up to 1% of additional deaths are expected to occur due to rising temperatures. Interestingly, the opposite is observed in some regions. For example, in the North, 3.3% fewer deaths are expected to occur during the winter months. The minimum mortality temperature (MMT) varied from the 60<sup>th</sup> percentile in the central region, to the 80<sup>th</sup>-90<sup>th</sup> in the northern and southern regions, where temperatures tend to be more extreme. **Conclusions** Main results show a high contribution of cold temperatures in risk, with exception of the extreme southern region. Temperature is responsible of a substantial fraction of future deaths, however, opposite to expected, in certain regions as temperatures rise, fewer deaths occur, mainly due to average temperature lying below the estimated MMT. The heterogeneity of the results highlights the need of geographical-based policies, evidencing important implications for the planning of public-health interventions related to climate change.

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**P-0327**

**Current and projected healthcare costs for emergency department presentations under the changing climate**

**Presenter:** Berhanu Yazew Wondmagegn, The University of Adelaide, Adelaide, Australia

**Authors:** B. Y. Wondmagegn<sup>1</sup>, J. Xiang<sup>1</sup>, K. Dear<sup>1</sup>, S. Williams<sup>1</sup>, A. Hansen<sup>1</sup>, D. Pisaniello<sup>1</sup>, M. Nitschke<sup>2</sup>, J. Nairn<sup>3</sup>, B. Scalley<sup>4</sup>, A. Xiao<sup>5</sup>, L. Jian<sup>5</sup>, M. Tong<sup>1</sup>, H. Bambrick<sup>6</sup>, J. Karnon<sup>7</sup>, P. Bi<sup>1</sup>;

<sup>1</sup>The University of Adelaide, Adelaide, AUSTRALIA, <sup>2</sup>South Australian Department of Health and Wellbeing, Adelaide, AUSTRALIA, <sup>3</sup>Australian Bureau of Meteorology, South Australia, Adelaide, AUSTRALIA,

<sup>4</sup>Metropolitan Communicable Disease Control, Department of Health, Western Australia, Perth, AUSTRALIA,

<sup>5</sup>Epidemiology Branch, Department of Health, Western Australia, Perth, AUSTRALIA, <sup>6</sup>School of Public Health and Social Work, Queensland University of Technology, Queensland, Brisbane, AUSTRALIA,

<sup>7</sup>College of Medicine and Public Health, Flinders University, South Australia, Adelaide, AUSTRALIA.

**Background:** Existing studies have documented the link between emergency department (ED) presentations and high ambient temperatures; however, there is a lack of evidence about the temperature-cost dependencies and cost impact to the healthcare system. **Methods:** A time series analysis using distributed lag nonlinear models was used to explore the temperature-ED presentations and temperature-cost relationships and to estimate temperature-, cold-, and heat-attributable effects in Adelaide, South Australia. The potential impacts of future climate under different representative concentration pathway (RCP) emission scenarios were estimated for two future periods (2034-2037 and 2054-2057). **Results:** It is estimated that the number of baseline (2014-17) heat-attributable ED presentations was approximately 3,633 (95% empirical confidence interval (eCI): 694.7, 6,498.4) with associated ED costs of AU\$4.7 million (95% eCI: 1.8, 7.5). Under RCP8.5 and with a constant population, heat-attributable ED presentations were projected to increase by 2.0% (95% eCI: 1.1, 2.9) and ED costs by 2.0% (95% eCI: 1.1, 2.8) during 2054-57. Non-significant declines in cold-attributable ED presentations and costs were observed. Under the three RCPs and assuming a medium population increase, the percentage increases in excess heat-attributable effects would range from 5.5% (95% eCI: 2.0, 9.1) to 7.5% (95% eCI: 3.1, 11.9) for ED presentations, and from 1.9% (95% eCI: 0.9, 2.8) to 2.5% (95% eCI: 1.3, 3.7) for ED costs during 2034-2037. Under RCP8.5, ED presentations and costs will increase by 14.7% (95% eCI: 6.9, 22.3) and 5.0% (95% eCI: 2.6, 7.1) during 2054-2057, respectively. There may be no change in cold-attributable deaths. **Conclusions:** Projected climate change is likely to have a substantial effect on the healthcare system with an increase in heat-associated emergency presentations and the associated costs. Greater health system resources will be required to meet these challenges unless effective adaptation strategies and public health prevention actions are adopted.

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**P-0328**

### **The Relationship between Ambient Temperature and Renal Disease Morbidity in Vietnam: A Case-Crossover Study**

**Presenter:** Lingzhi Chu, Yale School of Public Health, New Haven, United States

**Authors:** L. Chu<sup>1</sup>, R. Dubrow<sup>1</sup>, D. Phung<sup>2</sup>;

<sup>1</sup>Yale School of Public Health, New Haven, CT, <sup>2</sup>School of Medicine, Griffith University, Brisbane, Queensland, AUSTRALIA.

**Background/Aim:** Under a warming climate, increasing concerns are focused on impacts of high temperatures on health. This project aims to assess relationships between temperature and humidity and renal disease morbidity in Vietnam.

**Methods:** We obtained daily hospital admission data (2000-2015) from 14 provincial and city hospitals across Vietnam, along with province-level weather data. Using a case-crossover design, we assessed relationships between temperature (daily mean, maximum, and minimum temperature, and heat index), relative humidity, and heatwave events and urolithiasis, acute renal disease, and other renal disease. We evaluated lagged and cumulative effects. To evaluate effects of prolonged extreme heat, we analyzed heatwave days defined as three or more consecutive days with daily maximum temperature  $\geq 95^{\text{th}}$  percentile, starting with the third day.

**Results:** This study included 107,266 cases of renal disease during warm seasons. In same-day models, higher temperatures were significantly associated with increased urolithiasis risk, but not with increased risk for acute or other renal diseases. The odds ratios (OR) for urolithiasis generally decreased with increasing lag days. Among cumulative measures, 4-day average temperature showed the strongest association with urolithiasis. Our optimal model included 4-day average temperature and same-day heatwave day. For urolithiasis, the OR per 5°C increase in 4-day average of mean temperature was 1.18 (95% confidence interval: 1.07, 1.30), and the OR for being a heatwave day was 1.13 (1.04, 1.23). Results for maximum temperature, minimum temperature and heat index models were similar.

**Conclusions:** Exposure to high temperature is a risk factor for urolithiasis. This effect is not limited to temperature on the same day, but extends to previous days. The greatest risk is conferred by cumulative exposure in the past four days, with a same-day heatwave day adding to the risk.

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**P-0329**

### **A Systematic Review on Lagged Association in Environmental Studies**

**Presenter:** Pin Wang, The Chinese University of Hong Kong, Hong Kong SAR, China

**Authors:** P. Wang<sup>1</sup>, X. Zhang<sup>2</sup>, M. Hashizume<sup>3</sup>, W. Goggins<sup>1</sup>, C. Luo<sup>1</sup>;

<sup>1</sup>The Chinese University of Hong Kong, Hong Kong SAR, CHINA, <sup>2</sup>The University of Hong Kong, Hong Kong SAR, CHINA, <sup>3</sup>The University of Tokyo, Tokyo, JAPAN.

The delayed association in environment-health studies has been acknowledged in recent years. However, the misspecification of lag dimension in time-series models, particularly distributed lag non-linear models (DLNM), would induce considerable deviation of effect estimate. This study reviewed the existing climate-health English literature with time-series and case-crossover design published during 2000-2019 to summarize the statistical methodologies used and the reported delays of association between meteorological variables and 14 common causes of morbidity and mortality. Generalized linear or additive model was the most widely employed method for regression analysis. Different types of lag design were adopted for infectious disease modeling, including cross-correlation analysis, single lag model, moving average lag model, unconstrained or polynomial distributed lag model, and DLNM, whereas studies on non-communicable diseases predominantly used DLNM to assess the delays of association. For infectious outcomes, the association of daily mean temperature was found to be lagged for one to two weeks for influenza, followed by two to five weeks for diarrhea, and eight to twelve weeks for dengue fever. Meanwhile, the association of both cardiovascular and respiratory diseases with hot temperatures lasted for less than five days, whereas the association of cardiovascular diseases with cold temperatures was observed for ten to twenty days. Additionally, rainfall, as a potential risk factor for infectious diseases, showed a four to eight weeks' lagged association with diarrheal diseases, while the effect was further delayed to eight to twelve weeks for vector-borne diseases. This is the first systematic review that comprehensively provides epidemiological evidence on the delay of association of common meteorological parameters. Biologically plausible and reasonable definition of effect lag in the modeling process is warranted in further environmental epidemiological studies.

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**P-0331**

### **A Systematic Review of Incidence of Acute Myocardial Infarctions Among Coastal Communities Before and After Hurricane Landfall**

**Presenter:** Casey Kalman, George Washington University, Washington, United States

**Authors:** C. Kalman;  
George Washington University, Washington, DC.

**Objective:** As climate change continues to influence the frequency and intensity of cyclonic storms, the impact of hurricanes on coastal communities is increasing, leading to growing financial and human costs. Cardiovascular events are shown to be associated with stressful events such as natural disasters and have been shown to increase after earthquakes. To better understand the impact these hurricanes will have on the health of coastal communities, a systematic review of the literature was carried out examining the relationship between hurricanes and cardiovascular events among adults living in coastal areas. **Methods:** The process for this review was outlined by the Navigation Guide. We performed a systematic search of epidemiology literature and identified distinct criteria used to determine which studies would be included. Each study was rated for risk of bias and examined for quality and strength of evidence before coming to a determination of the overall quality and strength of the evidence. **Results:** We identified 6 cross-sectional epidemiological studies published in peer-reviewed journals that met the inclusion criteria. Four of the five studies focused on Hurricane Katrina while the fifth focused on Hurricane Sandy. We rated the current body of evidence to be of moderate to low quality. **Conclusions:** While individuals studies show a strong association between hurricanes and increased incidence of cardiovascular events, the body of evidence is not robust enough to assume generalizability of the results. More research needs to be done in order to better understand the relationship between hurricanes and incidence of cardiac events.

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**P-0332**

**Sea Level Rise, Chemical Contamination, and Endangered Species: How potential flooding of coastal superfund sites increase the vulnerability of species and ecosystems**

**Presenter:** Casey Kalman, Union of Concerned Scientists, Washington, United States

**Authors:** C. Kalman, J. Carter;  
Union of Concerned Scientists, Washington, DC.

Background: There are 262 superfund sites located within 1000 meters of the Gulf and East coasts of the United States. These toxic sites are contaminated with hazardous materials known to have adverse health effects. These coastal sites are of concern in that they are projected to see increases in the frequency and intensity of flooding as sea levels rise, and as storms become more severe. With increased flooding comes greater risk of water and soil contamination from superfund sites as well as heightened vulnerability of surrounding communities. Methods: Using a bathtub model, we estimated the extent of the 100-year floodplain for the years 2040, 2060, 2080, and 2100 given projected sea level rise expected under various climate scenarios. With the resulting extents, we identified coastal superfund sites likely to be at-risk of future flooding. We then performed a demographic analysis of communities living around these sites. Utilizing GIS software and python scripting, a buffer analysis was performed at distances of 1, 3, and 5 miles around the superfund sites. The demographics of these areas were then compared to state and national statistics to understand the level to environmental justice communities could be disproportionately vulnerable to chemical exposure from flooding of coastal superfund sites. Results: We identified close to 100 superfund sites likely to experience flooding as a result of sea level rise. Furthermore, the communities living around these sites tend to be made up of a greater proportion of low-income households and communities of color. Conclusions: As Earth's climate changes and sea levels rise, the potential for flooding of coastal superfund sites increases, as well as the likelihood of chemical contamination of nearby groundwater and soil. Such contamination would have effects on the health of the surrounding communities and likely have a disproportionate impact on environmental justice communities.

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**P-0333**

**Assessing satellite-derived spring phenology for public health applications**

**Presenter:** Yan Dong, School of Remote Sensing and Information Engineering, Wuhan University, Wuhan, China

**Authors:** Y. Dong<sup>1</sup>, C. Jiang<sup>2</sup>, L. Meng<sup>1</sup>, A. Sapkota<sup>2</sup>;

<sup>1</sup>School of Remote Sensing and Information Engineering, Wuhan University, Wuhan, CHINA, <sup>2</sup>Maryland Institute for Applied Environmental Health, School of Public Health, University of Maryland, College Park, MD.

Background: Timing shifts in spring phenological events, such as leaf-out and flowering, may alter pollen season dynamics, consequently impacting pollen allergic diseases including asthma. Satellite-derived spring phenology, measuring the start of season (SOS) from regional to global, is important to study the risk of pollen allergy at large spatial scales. However, different SOS products are likely to provide inconsistent spring onset dates. Whether SOS products that exhibit such limitations affect outcomes in health studies is rarely discussed. Methods: In the northeastern United States, SOS metrics from MODIS Land Change Dynamic (MLCD) and eMODIS Remote Sensing Phenology (eMODIS) products of 2009 to 2014 were used to characterize differences in SOS under different spatial scales and vegetation coverage. Furthermore, a univariate linear regression model was built between changes in SOS (early: < -7, normal: -7 to 7 and late: > 7) and crude rates of hospitalization for asthma in counties over the Northeast. Results: MLCD and eMODIS products showed significant differences in SOS at both pixel and county levels, which were 16 and 17 days, respectively. Their SOS differences varied by the degree of vegetation coverage, tending to be higher in areas with lower vegetation coverage. Results of regression analysis showed the late SOS, indicating later onset of spring, was significantly associated with a decrease in asthma hospitalization rate. This association was true for both types of SOS, but was stronger when using the eMODIS-SOS. Conclusions: Although MLCD and eMODIS products perform differently in determining spring onset dates, they may lead to similar outcomes in applications by providing changes in SOS. Therefore, the use of relative changes of SOS is a better choice for public health research.

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**P-0334**

### **Assessing the association between meteorological factors and mental disorders in summer using Mesonet, a refined weather monitoring system, in New York State**

**Presenter:** Xinlei Deng, Department of Environmental Health Sciences, University at Albany, the State University of New York, Rensselaer, United States

**Authors:** X. Deng<sup>1</sup>, J. Brotzge<sup>2</sup>, W. Zhang<sup>1</sup>, B. Ye<sup>3</sup>, I. Ryan<sup>1</sup>, Y. Qu<sup>4</sup>, S. Lin<sup>1</sup>;

<sup>1</sup>Department of Environmental Health Sciences, University at Albany, the State University of New York, Rensselaer, NY, <sup>2</sup>New York State Mesonet, University at Albany, the State University of New York, Albany, NY, <sup>3</sup>Department of Epidemiology and Biostatistics, University at Albany, the State University of New York, Rensselaer, NY, <sup>4</sup>Guangdong Cardiovascular Institute, Guangdong Provincial People's Hospital, Guangzhou, CHINA.

**Background** While the mental health impacts of temperature and humidity have been reported in some studies, little is known about the impact of solar radiation, precipitation, or the joint effect of multiple meteorological factors. Furthermore, existing studies were usually based on weather observations from limited monitoring sites. This study aimed to investigate both the independent and joint effects of multiple weather factors on mental disorders based on high-resolution weather data from Mesonet. **Methods** In this time-stratified case-crossover study, we evaluated the association of mental disorders with temperature, relative humidity, solar radiation, and precipitation while controlling for PM<sub>2.5</sub>, O<sub>3</sub>, and holidays using conditional logistic regression. Weather data (2017) was obtained from 126 Mesonet sites, a refined and comprehensive weather monitoring system. Outpatient records for mental disorders during summer were obtained from the New York State discharge data and assigned the weather measures from the nearest site. We assessed both the independent and joint effects of extreme conditions (>90<sup>th</sup>) of these weather factors. **Results** All extreme weather conditions, including temperature, solar radiation, precipitation, and humidity, significantly increased excess risks (ER%) for mental disorders on lag 3-4 days in summer, with ERs range from 7.7% to 14.9%. However, we observed a protective effect on the same day with high solar radiation. The joint effect of the extreme conditions of temperature, solar radiation, and humidity showed the highest ER% (18.5%, 95% CI: 4.7%-34.1%) for mental disorders. The risk of mental disorders increased dramatically when temperature exceeded 79 °F, solar radiation 977 W/m<sup>2</sup>, precipitation 0.88 inches, and relative humidity 89%. **Conclusions** Our findings indicate a strong joint effect from temperature, solar radiation and humidity on mental disorders. Humidity had the greatest impact of all individual weather factors. The thresholds we identified will help public health preparedness planning.

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**P-0335**

**Social disparities in the risk of preterm birth during an extreme heat event**

**Presenter:** Lara Cushing, San Francisco State University, San Francisco, United States

**Authors:** L. Cushing<sup>1</sup>, R. Morello-Frosch<sup>2</sup>, A. Hubbard<sup>2</sup>;

<sup>1</sup>San Francisco State University, San Francisco, CA, <sup>2</sup>University of California, Berkeley, CA.

Background: Climate change is increasing the frequency and intensity of heatwaves and there is evidence that exposure to high temperatures increases the risk of preterm birth. Previous studies show greater heat-related health impacts among people of color and raises the possibility that climate change could worsen existing racial disparities in preterm birth rates. Our objective was to assess the impact of extreme heat on preterm birth across racial/ethnic groups while taking into account neighborhood landcover characteristics that can influence local microclimates. Methods: We conducted a retrospective cohort study of pregnant women with spontaneous singleton births in Harris County, Texas, USA (Houston metropolitan area) during a time period that included an extreme heat event (2007-2011). We used survival analysis to model the risk of preterm birth (<37 completed weeks) versus staying pregnant up to a week after extremely hot days, controlling for individual risk factors, secular and seasonal trends. Race/ethnicity and high-heat risk related neighborhood landcover (no water, <5% tree canopy cover, >60% impervious surface) were considered as effect modifiers. Results: We found an elevated risk of preterm birth associated with extreme heat the day prior to delivery. Risk estimates varied with extreme heat definitions (Hazard Ratio [95% Confidence Interval]: 1.17 [1.04, 1.32] for daily maximum apparent temperature  $\geq 40^{\circ}\text{C}$  vs.  $< 20^{\circ}\text{C}$ ; and 1.09 [0.98, 1.21] for days with maximum and minimum temperatures above the 99<sup>th</sup> percentile of historical [1971-2000] summer months). Censoring at earlier gestational ages suggested an even greater effect prior to the 36<sup>th</sup> week of pregnancy. Neither maternal race/ethnicity nor residence in neighborhoods with heat-trapping land cover characteristics modified observed associations. Conclusions: Our environmental justice approach to assess the health impacts of climatic changes found evidence that an extreme heat event increased the risk of preterm birth in this highly acclimatized population.

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**P-0336**

**Climate change awareness and tree planting as mitigation measure in a rural West African Community**

**Presenter:** Alhaji A Aliyu, AHMADU BELLO UNIVERSITY, ZARIA, Nigeria

**Authors:** A. A. Aliyu<sup>1</sup>, A. A. Gobir<sup>1</sup>, A. A. Abubakar<sup>1</sup>, C. Esekhaigbe<sup>2</sup>, I. A. Joshua<sup>2</sup>, K. O. Adagba<sup>2</sup>, N. S. Muhammad<sup>2</sup>, N. V. Omole<sup>3</sup>, J. M. Ibrahim<sup>3</sup>, G. A. Nmadu<sup>3</sup>;  
<sup>1</sup>AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA, <sup>2</sup>AHMADU BELLO UNIVERSITY TEACHING HOSPITAL, ZARIA, NIGERIA, <sup>3</sup>KADUNA STATE UNIVERSITY, KADUNA, NIGERIA.

Climate change awareness and tree planting as mitigation measure in a rural West African Community  
Background: Africa is under significant threat from climate change. In accordance with the Paris Agreement, after 2020, the global community has agreed to major emission reduction programs. Reforestation can complement these emission reduction strategies. Due to carbon sequestration of forests, reforestation has remained a climate mitigation tool. However, at individual and community level, such mitigative response are possible when individuals understand climate change and its impacts. Education is thus an essential element of the global response to climate change. This study was therefore conducted to assess Climate change awareness and tree planting amongst members of a rural West African Community. Methods: A cross-sectional, community based descriptive study conducted among household heads in Nasarawan Buhari, a rural agrarian community in Nigeria. An interviewer-administered questionnaire was used to collect data from 104 household heads, selected using systematic random sampling technique. Data was analyzed using IBM SPSS (version 20). Results: A majority of the respondents were males (79.8%) and their mean age was  $40.6 \pm 12.6$  years. Half (50%) were aware of climate change and their main source of information was radio (63.5%). Most (98.1%) use fire wood for cooking in their households. Only a minority (27.9%) planted a tree in the past 1 year preceding the study. Climate change awareness was not a determinant of tree planting ( $P=0.827$ ) Conclusion: Half of respondents were aware of climate change but most use firewood for household cooking. Tree planting is practiced by few. There is need for a climate change education campaign that will elaborate the relationship between deforestation/reforestation and climate change and encourage use of clean cooking methods and tree planting. Key words: Climate awareness, tree planting, rural West African Community

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**P-0337**

### **Association between ambient apparent temperature & respiratory disease hospital admission in Cape Town, South Africa**

**Presenter:** Christian Lueme Lokotola, University of Pretoria, Pretoria, South Africa

**Authors:** C. Lokotola<sup>1</sup>, C. Y. Wright<sup>2</sup>, J. Wichmann<sup>1</sup>;

<sup>1</sup>University of Pretoria, Pretoria, SOUTH AFRICA, <sup>2</sup>South African Medical Research Council, Pretoria, SOUTH AFRICA.

Background: Ambient temperature related respiratory disease mortality was largely demonstrated but the risk of hospitalization increase is not clear. The objective of this study was to investigate cold & heat effects of apparent temperature (Tapp) & respiratory disease hospitalization in Cape Town. Methods: Time-series quasi-Poisson regression models with distributed lag non-linear model were applied. Models were adjusted for air pollution, day of the week, public holidays, seasonal and long-term trends. Different lag periods for Tapp were investigated. Susceptibility by sex & age groups (<15 years, 15-64 years and ≥65 years) was investigated. Results: In total, 58 317 hospitalizations were included in the study. Cold temperature (16 °C to 10 °C) was associated with RR 1.32 (95% CI: 1.13, 1.52) in all ages. Short-term & delayed effects of cold temperature were observed. Children & females were the most vulnerable population subgroups, RR 1.31 (1.03, 1.67) & RR 1.43 (1.17, 1.73), respectively. There is no significant difference (p<0.05) in the risk of RD hospital admission between population subgroups. Conclusions: The study contributes to evidence that cold temperature is associated with the risk of respiratory disease hospital admissions in Cape Town, South Africa. The results help to inform adaptation strategies for climate change in Cape Town. Keywords: apparent temperature, respiratory diseases, hospital admission, Cape Town, South Africa

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**P-0338**

**Association between apparent temperature & unintentional injury in Cape Town, Durban & Johannesburg, South Africa: 2001-2007**

**Presenter:** Christian Lueme Lokotola, University of Pretoria, Pretoria, South Africa

**Authors:** C. Lokotola<sup>1</sup>, C. Y. Wright<sup>2</sup>, J. Wichmann<sup>1</sup>;

<sup>1</sup>University of Pretoria, Pretoria, SOUTH AFRICA, <sup>2</sup>South African Medical Research Council, Pretoria, SOUTH AFRICA.

Introduction: Numerous studies have reported on cold & hot temperature health effect, but little is known on the effect of apparent temperature (Tapp) on unintentional injury in the African continent. This study investigated association between ambient apparent temperature & traffic road and pedestrians' unintentional injuries in Cape Town, Durban & Johannesburg, South Africa. Methods: Time-series analysis was conducted using quasi-Poisson regression models with a distributed lag non-linear model (DLNM) component over lag 0-7, 0-14 and 0-21 days. Models were adjusted for season, long-term trend & public holidays. Meta-analysis investigation applied pooled estimates by sex & ages groups. Model sensitivity and susceptibility by sex and age groups (<15 years, 15-64 years and ≥65 years) were investigated. Results: Overall, there were 11 176 injuries (3 257 from Cape Town, 4 221 from Johannesburg and 3 699 from Durban). Both cold & hot Tapp were associated with injury in all cities. The 14-65 years old group was the most affected. Hot Tapp was associated with increased unintentional injury at Johannesburg, RR 1.73 (1.02, 2.92) while cold has short-term effect (lag0-7) at Durban, RR 1.22 (1.05, 1.41). There was protective effect at Cape Town, RR 0.65 (0.44, 0.95) for all ages. Conclusions: Abnormal cold & hot temperature were associated with the risk of unintentional injury mostly for traffic road & pedestrians' accidents. Early warning system should be developed for risk assessment & effective public health policy for climate change adaptation. Keywords: climate change; cold & heat; unintentional injury; South Africa.

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**P-0339**

### **Physiological Equivalent Temperature (PET) Index and cardiovascular and respiratory hospital admissions in Ahvaz, southwest of Iran**

**Presenter:** Maryam Dastoorpoor, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, Islamic Republic of

**Authors:** M. Dastoorpoor<sup>1</sup>, N. Khodadadi<sup>1</sup>, N. Khanjani<sup>2</sup>;

<sup>1</sup>Ahvaz Jundishapur University of Medical Sciences, Ahvaz, IRAN, ISLAMIC REPUBLIC OF, <sup>2</sup>Kerman University of Medical Sciences, Kerman, IRAN, ISLAMIC REPUBLIC OF.

Physiological Equivalent Temperature (PET) Index and cardiovascular and respiratory hospital admissions in Ahvaz, southwest of Iran  
Background: Evidence has shown that climate change may have adverse effects on human health. Although Ahvaz is one of the hottest cities in the world, there have been no studies on the effect of ambient heat on hospital admission rates. The purpose of this study was to investigate the relation between Physiologically Equivalent Temperature (PET) and cardiovascular and respiratory hospital admissions in Ahvaz. Methods: Distributed Lag Non-linear Models (DLNM) combined with quasi-Poisson regression were used to investigate the effect of PET on hospital admissions. In this study the effect of time trend, air pollutants (NO<sub>2</sub>, SO<sub>2</sub> and PM<sub>10</sub>), and weekdays were adjusted. Results: The results demonstrated that low PET values (6.4°C, 9.9°C and 16.9°C) in lags 0, 0-2, 0-6, 0-13 and 0-20, significantly decreased the risk of hospital admissions for total cardiovascular diseases, hypertension, ischemic heart diseases, cardiovascular admissions in men, women and less than 65 year olds. Also, low PET values significantly decreased the risk of hospital admissions for total respiratory diseases, respiratory diseases in men and women, chronic obstructive pulmonary disease (COPD) and bronchiectasis. In contrast, low PET values in all lags except lag 0-30 significantly increased the risk of hospital admissions for asthma and strokes. High PET values (43.6°C and 45.4°C) increased the risk of cardiovascular and ischemic heart diseases in men. Conclusions: The results indicate that in Ahvaz which has a warm climate, cold stresses are more involved in cardiovascular and respiratory hospital admissions; and cold stress decreased overall cardiovascular and respiratory hospital admissions, except for asthma and stroke.

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## ABSTRACT E-BOOK

Theme: **Climate change**

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**P-0340**

**The impact of ambient temperature on adverse pregnancy outcomes in Ahvaz, Iran; 2008-2018**

**Presenter:** Maryam Dastoorpoor, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, Islamic Republic of

**Authors:** M. Dastoorpoor<sup>1</sup>, N. Khodadadi<sup>1</sup>, N. Khanjani<sup>2</sup>;

<sup>1</sup>Ahvaz Jundishapur University of Medical Sciences, Ahvaz, IRAN, ISLAMIC REPUBLIC OF, <sup>2</sup>Kerman University of Medical Sciences, Kerman, IRAN, ISLAMIC REPUBLIC OF.

The impact of ambient temperature on adverse pregnancy outcomes in Ahvaz, Iran; 2008-2018  
AbstractBackground: There are few epidemiological studies on the relation between temperature changes and adverse pregnancy outcomes. The purpose of this study was to determine the relation between Diurnal Temperature Range (DTR), Physiological Equivalent Temperature (PET) and Universal Thermal Climate Index (UTCI) with adverse pregnancy outcomes including stillbirth, low birth weight (LBW), preterm labor (PTL), spontaneous abortion (SA), preeclampsia and gestational hypertension in Ahvaz, Iran. Methods: Distributed Lag Non-linear Models (DLNM) combined with quasi-Poisson regression were used to investigate the effect of DTR, PET and UTCI on adverse pregnancy outcomes. In this study the effect of time trend, air pollutants (NO<sub>2</sub>, SO<sub>2</sub> and PM<sub>10</sub>), and weekdays were adjusted. Results: Cold thermal stress in the DTR index (the 1<sup>st</sup> percentile (2.7 C°) compared to 25<sup>th</sup> percentile (11.9 C°) significantly increased the risk of abortion in the cumulative lags of 0-6, 0-13 and 0-21. High PET (45.4 C°, lag = 0) caused a significant increase in risk of stillbirth. Also, high levels of PET (45.4, 43.6, 42.5 C°, lag = 0-6) and low levels of PET (9.9, 16.9 C°, lags=0, 0-13, 0-21) significantly increased the risk of LBW. But, low levels of PET (6.4, 9.9, 16.9 C°, lags = 0-6, 0-13) reduced the risk of gestational hypertension. Low values of UTCI index (11.6 C°, lags = 0-6, 0-13) caused significant increase in risk of preterm labor. Finally, hot thermal stress in the UTCI index significantly increased the risk of stillbirth in 0-13 lag. Conclusions: The results of this study showed that hot and cold thermal stress are associated with increased risk of stillbirth, LBW, PTL and SA; in Ahvaz.

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**P-0341**

**Short-term effects of heat and cold in urban, sub-urban and rural municipalities of Italy - a national approach.**

**Presenter:** Francesca Katherine de'Donato, Lazio Regional Health Service - ASL Roma 1, Rome, Italy

**Authors:** F. K. de'Donato<sup>1</sup>, M. Scortichini<sup>1</sup>, M. Pappagallo<sup>2</sup>, S. Marchetti<sup>2</sup>, M. Stafoggia<sup>1</sup>, M. Renzi<sup>1</sup>, M. Davoli<sup>1</sup>, L. Frova<sup>2</sup>, P. Michelozzi<sup>1</sup>;

<sup>1</sup>Lazio Regional Health Service - ASL Roma 1, Rome, ITALY, <sup>2</sup>Italian National Institute of Statistics, Rome, ITALY.

**Background.** The short-term effects of heat and cold on mortality are well known, however most evidence comes from studies conducted in urban areas and less is known on the effects in rural and suburban areas. The aim is to estimate the association between temperature and all-cause mortality at national level in Italy. **Methods.** Daily all-cause mortality for the 8,092 municipalities of Italy were collected for the period 2006 to 2015. A satellite-based spatiotemporal model was developed to estimate daily mean temperature at 1x1km resolution. Conditional Poisson regression models were fit to estimate the risk in mortality for variations (increase/decrease) in temperature (lag0-10) at province level. A DLNM approach was used to account for the non-linear association. Results were then pooled with a random-effects meta-analysis. Associations were estimated for increases (75-99<sup>th</sup> percentile) and for decreases (25<sup>th</sup> to the 1<sup>st</sup> percentile) in mean temperature and by age, sex and level of urbanization of the municipalities. **Results.** In the study period 6,552,257 deaths occurred in Italy (40% are aged 85+, 55% occur in non-urban municipalities). The risk in mortality for temperature increases was of 1.27 (IC95%: 1.23, 1.31) and of 1.19 (IC95%: 1.23-1.31) for temperature decreases. Some heterogeneity in the effects of heat and cold were observed across Italy; with strongest effects of heat in central-southern regions and no clear geographical pattern for cold effects. In summer, the elderly and women were most at risk. Effects estimates were similar in rural and urbanized municipalities for both heat and cold in Italy. **Conclusions.** The study confirms a significant risk of extreme temperatures (heat and cold) on all-cause mortality at national level and provides evidence of effects in both urban, sub-urban and rural municipalities.

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**P-0343**

**Climate change physiology and psychology: What can we learn from a lab-based heat exposure experiment with young adults**

**Presenter:** Rachel Bi, Nanjing Foreign Language School, Nanjing, China

**Authors:** J. Yang<sup>1</sup>, R. Bi<sup>2</sup>, Q. Gao<sup>1</sup>, M. Liu<sup>1</sup>, Z. Zhu<sup>2</sup>, Z. Ding<sup>3</sup>, Q. Wang<sup>3</sup>, M. Liu<sup>3</sup>;  
<sup>1</sup>Nanjing University, Nanjing, CHINA, <sup>2</sup>Nanjing Foreign Language School, Nanjing, CHINA, <sup>3</sup>Jiangsu Provincial Center for Disease Prevention and Control, Nanjing, CHINA.

Background Intensive heatwaves are more frequent globally due to changing climate. There is evidence that heat exposure can not only induce acute physiological reactions, but also potentially enhance climate change belief. Theories such as “visceral fit” attempt to explain the phenomenon by proposing that feeling warm physically strengthens the belief in global warming. However, no study has yet drawn the line between physiological and psychological reactions in a lab-based heating environment. Methods Sixty-five healthy freshmen (43 females, 22 males) from Nanjing, China participated the study with 30 dollars as reward for each. Participants stayed in a climate chamber for around 2 hours, during which time temperature in the chamber climbed up from 25°C to 40°C. Physiological signals including heart rate variability, skin temperature, blood pressure and blood oxygen saturation were recorded during the experiment. Self-reported climate change belief and psychological distance of climate change were collected from each participant before, during and after the heat exposure. Physiological and psychological data were integrated to reveal their embedded links. Results Physiological indicators reflecting human body heat stress (such as skin temperature and blood pressure) increase gradually as the chamber got warmer. However, the psychological impact of heat exposure varies between participants a lot. On group average, heat exposure reduces the psychological distance of climate change and enhances the belief, but the effect is not significant enough and disappears immediately after the heat exposure. We are planning to use the individual physiological response and other socio-economic factors to explain the variation in the next stage. Conclusions Our findings so far do not fully support the hypothesis that heat experience increase climate change belief. Many confounding variables together with temperature may lead to the change of climate change perceptions. Taking physiological responses into consideration will enrich our understanding of the mechanism behind.

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**P-0344**

**A systematic review on health effects following long-term exposure to temperature**

**Presenter:** Klea Katsouyanni, National and Kapodistrian University of Athens, Athens, Greece

**Authors:** K. Katsouyanni<sup>1</sup>, E. Samoli<sup>1</sup>, A. Analitis<sup>1</sup>, S. Zafeiratou<sup>1</sup>, A. Gasparrini<sup>2</sup>, M. Stafoggia<sup>3</sup>, S. Rao-Skirbekk<sup>4</sup>, A. Monteiro<sup>5</sup>, K. Dimakopoulou<sup>1</sup>, S. Rodopoulou<sup>1</sup>, A. Schneider<sup>6</sup>;

<sup>1</sup>National and Kapodistrian University of Athens, Athens, GREECE, <sup>2</sup>London School of Hygiene and Tropical Medicine, London, UNITED KINGDOM, <sup>3</sup>Lazio Regional Health Service, Rome, ITALY, <sup>4</sup>Norwegian Institute of Public Health, Oslo, NORWAY, <sup>5</sup>Universidade do Porto, Porto, PORTUGAL, <sup>6</sup>Helmholz Zentrum Munchen, Munich, GERMANY.

**Background/Aim** Health effects of long-term exposure to temperature have only recently received attention. We performed a systematic review to assess health associations with long-term (exceeding three months) exposure to temperature metrics in the framework of the EXHAUSTION project. **Methods** We performed a systematic search in PubMed and Web of Science databases up to October 2019. The search resulted in 61 studies meeting inclusion criteria from the 2946 records screened. We identified 14 studies including total mortality, 16 including cardiovascular outcomes, 11 including respiratory outcomes, 16 with birth outcomes and 15 on outcomes other than those above. **Results** Studies investigating annual mortality changes in relation to annual temperature metrics show that extreme and variable temperature is associated with adverse health outcomes at an annual level, indicating that aggregate effects of temperature extremes cannot be attributed to short-term mortality displacement. Studies on cardiovascular mortality show stronger associations with low rather than high temperature, whilst those on blood pressure report that in populations living in warmer climates levels tend to be lower. Studies on respiratory outcomes generally report effects of both heat and cold, but they are limited in number and use diverse health endpoints. Several studies report on birth outcomes as well as other outcomes with less consistent results. Air pollution interaction effects have not been assessed in any study. Other potential effect modifiers that were investigated in a limited number of studies, indicate stronger effects among the elderly and socially deprived. **Conclusions** Our review revealed gaps in previous research related to the study of long-term effects of temperature. More and better designed studies are needed. The investigation of effect modification by air pollutants and other environmental factors will add valuable information for policy decisions on climate change adaptation and mitigation.

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**P-0345**

**Associations between ambient temperature and asthma exacerbations among children in Philadelphia, PA.**

**Presenter:** Leah H Schinasi, Drexel University, Philadelphia, United States

**Authors:** L. H. Schinasi<sup>1</sup>, C. Kenyon<sup>2</sup>, K. Moore<sup>1</sup>, Y. Zhao<sup>1</sup>, S. Melly<sup>1</sup>, M. Maltenfort<sup>2</sup>, A. V. Diez Roux<sup>1</sup>, C. B. Forrest<sup>2</sup>, A. J. De Roos<sup>1</sup>;

<sup>1</sup>Drexel University, Philadelphia, PA, <sup>2</sup>Children's Hospital of Philadelphia, Philadelphia, PA.

**Background:** Relationships between extreme temperatures and asthma exacerbation risk, especially among children, remain unclear.

**Objective:** We estimated associations between daily mean temperature and asthma exacerbation risk among children (ages 0 - 18) living in Philadelphia, PA.

**Methods:** We constructed a time series of daily asthma exacerbation events recorded in primary care, emergency department, or hospitalization encounters at the Children's Hospital of Philadelphia, February 1, 2011 - December 31, 2016, linked with daily meteorological data. We used quasi-Poisson time series regression models to estimate associations of mean daily temperature with the risk of asthma exacerbation. We modeled temperature using distributed lag nonlinear functions for up to a 30 day lag, and adjusted for mean relative humidity (lag 0), long term and annual temporal trends, day of the week, and major U.S. holidays. We ran analyses for all clinical encounters, and also stratified by encounter type.

**Results:** On average, there were 22 daily asthma exacerbation events, and mean daily temperatures ranged from -12.2° to 33.6° Celsius. Overall trends suggested higher risk of exacerbation when mean daily temperatures were highest, although effect estimates were imprecise. These associations were restricted to primary care or emergency department encounters. For example, relative to 14.4° C days (the median), the cumulative rate of asthma exacerbation when mean daily temperatures were 32.0° C (99.9<sup>th</sup> percentile of the distribution) were: 3.2 (0.7-15.1) for primary care visits, 1.8 (0.8-3.9) for ED visits, and 1.0 (0.3 - 3.0) for inpatient visits.

**Conclusion:** Extremely hot temperatures may increase the risk of asthma exacerbations among children. These associations may be restricted to less severe asthma exacerbations that do not result in hospitalization.

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**P-0346**

### **The Acute Effect of Heatwaves on Preterm and Early-term Birth in 53 U.S Metropolitan Areas in the 1980s: A Matched Case-Control Study**

**Presenter:** Mengjiao Huang, School of Community Health Sciences, University of Nevada, Reno, United States

**Authors:** M. Huang<sup>1</sup>, M. J. Strickland<sup>1</sup>, H. A. Holmes<sup>2</sup>, H. H. Chang<sup>3</sup>, L. A. Darrow<sup>1</sup>;

<sup>1</sup>School of Community Health Sciences, University of Nevada, Reno, NV, <sup>2</sup>Department of Physics, University of Nevada, Reno, NV, <sup>3</sup>Rollins School of Public Health, Emory University, Atlanta, GA.

**Background** The effect of heatwaves on adverse birth outcomes is not well understood and may vary by how heatwaves are defined. **Objectives** To examine acute associations between various heatwave definitions and preterm and early-term birth in 53 metropolitan areas in the U.S during the 1980s. **Methods** Using national vital records from 53 metropolitan areas between 1982 to 1988, singleton preterm (<37 weeks) and early-term births (37-38 weeks) were matched (1:1) to controls who completed at least 37 weeks or 39 weeks of gestation, respectively. Matching variables included location, maternal race, and maternal education. 40 heatwave definitions were created based on temperature and humidity data, including binary indicators for exposure to sustained heat, number of high heat days, and measures of heat intensity (average degrees over threshold) based on the 97.5<sup>th</sup>ile of area-specific temperature and apparent temperature, or 85<sup>th</sup>ile of positive excessive heat factor (EHF). Heatwave exposure in the 7-days preceding birth (for cases) and corresponding gestational window (for controls) was assessed in relation to preterm and early-term birth. Odds ratios for heatwave exposures were estimated using conditional logistic regression adjusting for maternal age, marital status, and seasonality. **Results** There were a total of 615,329 and 1,293,813 preterm and early-term births in the analyses. Across heatwave definitions, exposure to heatwaves in the week before delivery was consistently associated with increased odds of early-term birth. Odds ratios increased across categories of increasing number of hot days, and minimum consecutive days of heat. For example, exposure to  $\geq 3$  days over 97.5<sup>th</sup>ile of apparent mean temperature in the past week compared to zero days, was associated with a 3.8% (95%CI: 2.6%-5.1%) increase in the odds of early-term birth. Effect estimates for preterm birth were generally consistent with a null association. **Conclusions** Preliminary results suggest heatwaves were associated with early-term birth but not preterm birth.

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**P-0347**

### **Climate Change Adaptive Capacity as Modified by Identity, Experience and Health Status in the Eastern Caribbean**

**Presenter:** Steve D Whittaker, Yale University, New Haven, United States

**Authors:** S. D. Whittaker<sup>1</sup>, N. Deziel<sup>1</sup>, Q. Edwards<sup>2</sup>, M. Bell<sup>1</sup>;

<sup>1</sup>Yale University, New Haven, CT, <sup>2</sup>Clarence Fitzroy Bryant College, Basseterre, SAINT KITTS AND NEVIS.

As health systems evolve in the face of climate change impacts, residents of the Eastern Caribbean small island states remain especially vulnerable to compromised health status. This study explored adaptive capacity as well as pro-health attitudes and behaviors among residents, age 15 to 75 years, in St. Kitts & Nevis between 2015 and 2019. Bivariate and multivariate logistic regressions were used to assess the likelihoods of capacity building across community members. Of 392 survey participants, at least 35% reported impacts of storms, droughts, high heat or vector borne diseases in their community. The most commonly reported adaptive behaviors were spending less time outdoors (52%), employing additional water storage (54%), taking cooler baths (57%), reducing clothing layers (59%), relying on natural ventilation (60%), and using air conditioning (AC) or fan (80%). Persons 30 years and older were more likely to initiate health-protective home repairs (OR: 2.37; 95%CI: 1.53, 3.69), eliminate mosquito breeding sites (OR: 2.63; 95%CI: 1.73, 4.02), install pest barriers (OR: 2.08; 95%CI: 1.38, 3.16), or wear less clothing (OR: 2.01; 95%CI: 1.31, 3.11) than younger residents. LGBTQ persons were more likely to initiate health-protective home repairs (OR: 2.17; 95%CI: 1.20, 3.85), eliminate mosquito breeding sites (OR: 2.70; 95%CI: 1.52, 5.00), reduce clothing layers (OR: 2.33; 95%CI: 1.22, 4.55), or use sunscreen (OR: 2.17; 95%CI: 1.06, 4.17) than non-LGBTQ individuals. Health professionals were more likely to initiate health-centric home repairs (OR: 7.58; 95%CI: 4.24, 14.02), eliminate mosquito breeding sites (OR: 6.45; 95%CI: 3.56, 12.22), physically intervene to help someone threatened by extreme weather (OR: 4.08; 95%CI: 2.31, 7.21), or install pest barriers (OR: 8.51; 95%CI: 4.26, 18.99) relative to non-health professionals. Results reflect the critical importance of demographics - sex, sexuality, age, and profession - as a modifier of risk perception and management.

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**P-0348**

### **Insights and Injustice: Identity-Driven Perceptions of Resilience Against Natural, Built and Social Hazards in the Eastern Caribbean**

**Presenter:** Steve D Whittaker, Yale University, New Haven, United States

**Authors:** S. D. Whittaker<sup>1</sup>, N. Deziel<sup>1</sup>, L. Naraine<sup>2</sup>, M. Bell<sup>1</sup>;

<sup>1</sup>Yale University, New Haven, CT, <sup>2</sup>Clarence Fitzroy Bryant College, Basseterre, SAINT KITTS AND NEVIS.

Human health is inextricably linked to natural, built and social environs. Under the threat of climate change impacts, residents of Eastern Caribbean small island developing states (ECSIDS) are particularly susceptible to environmental factors, many of which may interact with vulnerable identities to yield or exacerbate poor health. This study evaluated views around various health aspects among St. Kitts & Nevis (SKN) residents, ages 15 to 75, from 2015 to 2019. Bivariate and multivariate logistic regressions were used to assess the likelihood of perceived resilience and vulnerability. Non-LGBTQ+ individuals were more likely than LGBTQ+ residents to perceive storm impacts in their communities (OR: 2.45; 95%CI: 1.11, 5.09), and had worse post-storm access to electricity (OR: 2.06; 95%CI: 1.02, 4.00) and worse post-storm waste management (OR: 2.05; 95%CI: 1.12, 3.70). LGBTQ+ residents more so than non-LGBTQ+ persons, considered water quality to be worse after a storm (OR:2.45; 95%CI: 1.11, 5.09). Non-LGBTQ+ residents were, relative to LGBTQ+ individuals, (a) less likely to perceive residential areas (OR: 0.46, 95%CI: 0.26, 0.83) and (b) more likely to perceive occupational settings (OR: 2.75; 95%CI: 1.54, 5.00) as being in worse conditions after a storm. Persons at least thirty years old had higher odds, compared to younger persons, of perceiving a decline in the condition of residential areas after storm activity (OR: 2.37; 95%CI: 1.53, 3.69), and viewing quality of transportation as worse post-storm (OR: 1.60; 95%CI: 1.07, 2.42). Health status (morbidity) did significantly influence how participants reported their own resilience when faced with various hazards. Findings have implications for how identity shapes climate change vulnerability and perceptions, thus supporting the rationale for further research into the resilience of potentially marginalized communities.

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**P-0350**

**Indoor temperature impacts on cognition and daytime sleepiness in Detroit, Michigan, USA**

**Presenter:** Carina J. Gronlund, University of Michigan Institute for Social Research, Ann Arbor, United States

**Authors:** C. J. Gronlund<sup>1</sup>, K. Ketenci<sup>1</sup>, T. G. Reames<sup>2</sup>, M. S. O'Neill<sup>3</sup>, P. S. Larson<sup>1</sup>, K. Sol<sup>1</sup>, Z. Rowe<sup>4</sup>, J. Schott<sup>5</sup>;

<sup>1</sup>University of Michigan Institute for Social Research, Ann Arbor, MI, <sup>2</sup>University of Michigan School for the Environment and Sustainability, Ann Arbor, MI, <sup>3</sup>University of Michigan School of Public Health, Ann Arbor, MI, <sup>4</sup>Friends of Parkside, Detroit, MI, <sup>5</sup>Ecoworks, Detroit, MI.

**Introduction:** The burden of heat- and cold-associated mortality is significant in the U.S. and globally. However, the impact of temperature on non-emergency health effects is unclear. Prior research suggests associations between extreme indoor temperatures and both cognition and sleep. These associations are potentially stronger in U.S. households facing energy poverty, i.e., living in inadequately weatherized homes and/or lacking resources to afford heating and cooling. We examined short-term associations between indoor temperatures and cognitive function and daytime sleepiness in residents of low-to-moderate income areas of Detroit, Michigan.

**Methods:** A temperature monitor recorded hourly temperatures in the homes of 29 participants from August-October, 2019. Participants were telephoned 2-5 times and administered tests of cognitive function (forward and backward number recall, word list immediate and delayed recall after a 5- minute delay) and questions from the Epworth Sleepiness Scale. Indoor temperatures were available for 15 participants and 40 person-days of cognition and sleepiness tests. Associations were estimated using fixed effects models with nonlinear distributed hourly lags of temperature up to 24 hours prior to testing.

**Results:** Indoor temperatures ranged from 16-35 C. Associations between temperature and sleepiness or forward number and word list recall scores were not significant. Point estimates, however, were consistent with hypothesized deleterious effects at both high and low temperatures. For backwards number recall scores (scale of 0-3 points), at the time of the test (lag 0), for 35 C vs. 25 C, we observed a -0.54 point change in score ( $p = 0.06$ ), i.e., worse ability to recall, with evidence of additional effects from temperatures at earlier hours.

**Conclusions:** Low-to-moderate income Detroit residents experience high indoor temperatures in the summer and fall, and indoor temperature may influence cognitive function. Further research on indoor temperatures and health is warranted to inform weatherization and utility assistance policies.

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**P-0351**

**Rainfall variability and risk of infectious diseases in young children: a global analysis**

**Presenter:** Anna Dimitrova, Vienna Institute of Demography, Vienna, Austria

**Authors:** S. Mcelroy<sup>1</sup>, T. Benmarhnia<sup>1</sup>, A. Dimitrova<sup>2</sup>;

<sup>1</sup>UCSD, San Diego, CA, <sup>2</sup>Vienna Institute of Demography, Vienna, AUSTRIA.

Preventable infectious diseases, such as pneumonia and diarrhea, are the leading cause of child death under the age of five worldwide. Populations in low- and middle-income countries bear the brunt due to poor living conditions which are conducive to such diseases. Increasing climate variability due to climate change will undermine future efforts to control infectious diseases. This paper provides new empirical evidence on the link between climate variability and human infectious diseases, focusing on symptoms of cough, fever and diarrhea in children under the age of five. We use the most recent Demographic and Health Surveys (DHS) for 20 low- and middle-income countries (n=450,000) in combination with high resolution climate data. A standardised measure of precipitation anomalies is constructed, which allows assessing the relationship between both dry and wet spells and the selected symptoms. Multi-level logistic regression with a random effect for the primary sampling unit and sampling weights and meta-analysis techniques are employed in the study. The preliminary results show that excessive precipitation raises the risk of diarrhoea, cough and fever among children under five years of age in 12 of the 20 countries examined. Unimproved sanitation and unsafe drinking water sources were key drivers of these associations. Effect measure modification analysis reveals that sharing a toilet with other families modifies the risk of these three diseases. As a next step, we plan to conduct a meta-analysis examining standardized precipitation anomalies and these three health outcomes to generate a pooled estimate of risk across all LMICs in the study. The present study calls for urgent action to expand water supply and improve access to safe sanitation facilities in the world's poorest countries.

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**P-0352**

**Associations of extreme temperatures with hospitalizations and post-discharge deaths due to stroke: is hyperlipidemia a mediator?**

**Presenter:** Shilu Tong, shanghai children's medical center, shanghai, China

**Authors:** Z. Xu<sup>1</sup>, J. Cheng<sup>2</sup>, S. Tong<sup>3</sup>;

<sup>1</sup>University of Queensland, brisbane, AUSTRALIA, <sup>2</sup>Queensland University of Technology, brisbane, AUSTRALIA, <sup>3</sup>shanghai children's medical center, shanghai, CHINA.

Background: Evidence suggests that individuals with pre-existing hyperlipidemia may be more likely to have cardiovascular disease events during heat exposure. Objective: To assess the effects of extreme temperatures (i.e., heat and cold) on hospitalizations and post-discharge deaths due to stroke amongst individuals with and without pre-existing hyperlipidemia. Methods: People who were hospitalized for stroke from 1<sup>st</sup> January 2005 to 31<sup>st</sup> December 2013 in Brisbane, Australia, and died from stroke within two months after discharge were included in this cohort study. We used moving average temperature over two days to assess heat effect on hospitalizations and post-discharge deaths for stroke, and moving average temperature over eight days to assess cold effect in the final analysis. The effects of extreme temperatures on hospitalizations and post-discharge deaths due to stroke in patients with and without pre-existing hyperlipidemia were quantified using a time-stratified case-crossover design with conditional logistic regression. Results: There were 11,469 hospitalizations for stroke during the study period, and 2,270 (19.79%) of them died within two months after discharge. Significant effect of heat on hospitalizations for stroke was observed only in individuals with pre-existing hyperlipidemia (odds ratio (OR): 1.85; 95% confidence interval (CI): 1.07 - 3.19), and significant effect of cold on hospitalizations was found in individuals without pre-existing hyperlipidemia (OR: 1.60; 95% CI: 1.03 - 2.47). Males appeared to be more vulnerable to the effects of heat and cold on hospitalizations for stroke than females. No significant effect of heat or cold on post-discharge deaths from stroke was observed. Conclusions: This study suggests that hyperlipidemia may be on the pathway through which heat exposure increases the risk of stroke hospitalizations. If this finding is confirmed in other studies, future heat adaptation measures may need to target individuals with hyperlipidemia.

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**P-0353**

**Government actions and incidence of arboviruses(dengue, zika, chikungunya):a comparative analysis in Bazil from 2015 to 2019**

**Presenter:** RENILDA PRESTES, CEAC -HC -FMUSP, São Paulo, Brazil

**Authors:** R. PRESTES, T. NERY;  
CEAC -HC -FMUSP, São Paulo, BRAZIL.

The increase in the flow of people to Brazil, resulting from events such as the World Cup, Carnival, Olympics and others, culminated in the expansion of communicable diseases such as fever by the vírus zika, chikungunya, dengue, among others according to Ministry of Health ( MS). These exanthematic diseases have common symptoms such as fever, rash and arthralgia lasting up to 10 days, being transmitted by the mosquito of the genus Aedes, where the humans are in an accidental host position. For diagnosis, in Brazil, in addition to clinical considerations, there are laboratory tests funded by the government in units referred by the Unified Health System. Zika, chikungunya, and dengue are arboviruses that do not have a specific vaccination. All of these arboviruses must be compulsorily notified to MS information systems that, through these epidemiological data, plan actions to prevent and control these diseases. Objective: Analyze epidemiological data on arboviruses in the period 2016-2019. Descriptive study with analysis of MS databases and government actions. Results: in the years that more government actions were undertaken, such as in 2016, there was a reduction in the incidence in the following year in the three arboviruses of 84.04% (dengue), 68% (chicungunya) and 66% (zika). In detriment, when there was a decrease in government actions, as in 2019, the incidence increased in relation to the previous year: of Dengue in about 580%, Chikungunya in about 66%. Zika, in 2019, remained unchanged in terms of incidence, with the same number of government actions observed in the previous year. The results demonstrate that entomoepidemiological surveillance must be active to support preventive and mosquito control actions that carry flaviviruses, as well as to prevent outbreaks and the spread of these diseases.

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**P-0354**

**Role of large-scale weather phenomena on spatio-temporal variation of extreme heat events (EHEs) across 150 most populated cities of the world**

**Presenter:** Linze Li, Maryland Institute for Applied Environmental Health, College Park, United States

**Authors:** L. Li, C. Jiang, R. Remigio, A. Sapkota;  
Maryland Institute for Applied Environmental Health, College Park, MD.

Prior studies have shown that frequency of extreme heat events (EHEs) are increasing in response to climate change. It remains unclear how large scale weather phenomenon such as El Nino Southern Oscillation (ENSO) may impact spatial and temporal variability of EHEs, particularly among major urban cities of the world where majority of world population reside. We extracted meteorological data (1989-2017) for the 150 most population cities of the world from the Global Historical Climatology Network (GHCN) database through National Climate Data Center (NCDC) data portal. We used 20 years (01/1980-12/1999) of daily meteorological data (maximum temperature) to calculate calendar day and location-specific 95th percentile thresholds to define EHEs. We characterized phases of ENSO (El Nino, La Nina, and Neutral) and applied ordinary least squares regression to estimate changes in frequency of EHEs across time and phases of ENSO. Globally, we found an overall increasing trend with EHEs frequency with a significantly accelerated rate after 1996. Metropolitan locations in the African Region had the highest EHEs frequency in 2000s ((10.5 EHEs/spring, IQR: 6.3-19.7 EHEs/spring), (9.3 EHEs/summer, IQR: 3.3-16.2 EHEs/summer), (12.3 EHEs/fall, IQR: 4.3-15.0 EHEs/fall, (10.8 EHEs/winter, IQR: 6.0-16.6 EHEs/winter)). EHEs had the highest frequency during La Nina summer months with a noted exception for South East Asian Region. Bangkok had the fastest EHEs growth trend in fall (0.297 (95% CI: 0.204, 0.389)). Kyiv had the fastest EHEs growth trend in summer (0.229 (95% CI: 0.150, 0.308)). Metropolitan locations in North Temperature took up 60% in the top 10 fastest EHEs growth trend locations in spring and summer, while locations in North Tropic took up 75% in fall and winter.

Our results characterized temporal variation and impact of ENSO on EHEs frequency in the 150 most populated metropolitan locations. Future studies investigating EHEs related health impact need to consider phases of ENSO.

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**P-0355**

**Ambient temperature and stroke hospitalization: causal analysis with empirical dynamic modelling**

**Presenter:** Fang Guo, School Of Public Health, Li Ka Shing Faculty Of Medicine, The University Of Hong Kong, Hong Kong, Hong Kong

**Authors:** F. Guo<sup>1</sup>, R. Cooper<sup>2</sup>, K. Lau<sup>3</sup>, L. Tian<sup>1</sup>;

<sup>1</sup>School Of Public Health, Li Ka Shing Faculty Of Medicine, The University Of Hong Kong, Hong Kong, HONG KONG, <sup>2</sup>Centre College, Danville, KY, <sup>3</sup>Division of Neurology, Department of Medicine, The University of Hong Kong, Hong Kong, HONG KONG.

**Background:** In the climate change context, the role of ambient temperature in stroke attack has drawn much research interest. However, prior epidemiologic evidence from mechanistic model-based regressions remains mixed. Inferring causation on these findings is a big challenge. **Methods:** Here we applied a novel approach, empirical dynamic modeling (EDM), to explore the causality between air temperature and stroke onset in Hong Kong from 2004-2011. EDM, a data-driven analysis scheme using convergent cross mapping (CCM) to detect causal pairs and multivariate S-map to quantify effect strength, is based on state space reconstruction for nonlinear dynamical systems where climate-health relations may accommodate. **Results:** By comparing with surrogate data to exclude seasonality, CCM determined that daily mean temperature and its deviation from previous week were potential drivers for hemorrhagic stroke (HS) hospitalization. Yet, no significant causal signal was identified for ischemic stroke (IS). S-map further found that daily mean temperatures ranging from 8.8°C to 31.8°C drove HS counts in a negative manner with the protective effect being stronger on warmer days. By contrast, temperature swings within a week showed a positive forcing in HS and a cooling trend may be more adverse than warming scenario. Also, we traced that mean temperature drove HS with delayed effects of 2 to 17 lagged days, while the impact of short-run temperature swings on HS could persist over the lagged period from 6 to 15 days. The strength of temperature-HS link peaked on the closest lag day of exposure. The effect strengths varied through time and by exposure levels, implying the nonlinearities internal to the system. **Conclusion and Significance:** Our analyses support that HS attack may be more sensitive to temperature condition than IS. We envision this EDM method could offer insights for epidemiologic studies to move beyond correlation when assessing health effects of climatic exposure.

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**P-0356**

### **The Impact of foehn winds on mental health hospitalizations in Bern, Switzerland: A 35-year time-series study**

**Presenter:** Marvin Bundo, 1. Climate Change and Health, Institute of Social and Preventive Medicine (ISPM), University of Bern. 2 Oeschger Center for Climate Change Research, University of Bern, Bern, Switzerland

**Authors:** M. Bundo<sup>1</sup>, E. de Schrijver<sup>1</sup>, A. Federspiel<sup>2</sup>, J. Luterbacher<sup>3</sup>, O. Franco<sup>4</sup>, T. Müller<sup>5</sup>, A. Vicedo-Cabrera<sup>1</sup>;

<sup>1</sup>. Climate Change and Health, Institute of Social and Preventive Medicine (ISPM), University of Bern. 2 Oeschger Center for Climate Change Research, University of Bern, Bern, SWITZERLAND, <sup>2</sup>Translational Research Center, University Hospital of Psychiatry and Psychotherapy, University of Bern, Bern, SWITZERLAND, <sup>3</sup>1. World Meteorological Organization, Science and Innovation Department, Geneva, SWITZERLAND 2. Department of Geography, Justus Liebig University Giessen. 3. Centre for International Development and Environmental Research, Justus Liebig University Giessen, Giessen, GERMANY, <sup>4</sup>Cardiometabolic Health, Institute of Social and Preventive Medicine (ISPM), University of Bern, Bern, SWITZERLAND, <sup>5</sup>1. Translational Research Center, University Hospital of Psychiatry and Psychotherapy, University of Bern. 2. Privatklinik Meiringen, Bern, SWITZERLAND.

**Background/Aim:** The foehn is a warm, dry wind typically found in mountainous regions. It has been previously associated with increased symptoms of depression, anxiety, headaches, traffic incidents and suicide incidence. While this phenomenon is frequent in the Swiss Alps, limited evidence exists on its impact on mental health in Switzerland, where neuropsychiatric diseases contribute more than one third of the total burden of disease. This study aimed at investigating the short-term association between foehn winds and mental health hospitalizations (MHH) in Bern, Switzerland, across 35 years of time. **Methods:** We collected individual information on MHH (71,931) in the University Hospital of Bern between 1973-2008, and daily meteorological data, including episodes of foehn winds, for its catchment area. We applied conditional quasi-Poisson regression with distributed lag linear models to assess the association between episodes of foehn winds and MHH (accounting to 3 days of lag) adjusted by temperature. We obtained risk estimates for all cases, by sex, age and before/after 1990. **Results:** Episodes of foehn winds were associated with a 5.0% (95% CI: 0.0%, 11.0%) increased risk of MHH. This association seemed to be independent from temperature, which showed to be smaller (3.0% (95% CI: 0.0%, 6.0%) for every 10°C-increase). No evidence of interaction was found between foehn winds and temperature. Slightly larger risk estimates associated to foehn winds were found in females, age group ≥65 years and after 1990. **Conclusions:** Our preliminary findings suggest that foehn winds episodes would negatively affect health conditions of patients with mental disorders in Bern, Switzerland. It has important implications for public health, as populations of the Swiss Alps are frequently exposed to this phenomenon. Specific public health policies should be implemented in order to protect this vulnerable population sub-group during these conditions.

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**P-0357**

### Heat Exposure and Emergency Department Visits to US Children's Hospitals

**Presenter:** Shengzhi Sun, Boston University, Boston, United States

**Authors:** S. Sun<sup>1</sup>, A. Bernstein<sup>2</sup>, K. Weinberger<sup>3</sup>, P. Sheffield<sup>4</sup>, K. Spangler<sup>1</sup>, G. Wellenius<sup>1</sup>;  
<sup>1</sup>Boston University, Boston, MA, <sup>2</sup>Harvard TH Chan School of Public Health, Boston, MA, <sup>3</sup>University of British Columbia, Vancouver, BC, CANADA, <sup>4</sup>Icahn School of Medicine at Mount Sinai, New York, NY.

**Background**Evidence for association between heat and child morbidity is limited. We aimed to estimate the association of heat with cause-specific emergency department (ED) visits and quantify burden attributable to heat among children in a large network of US children's hospitals. **Methods**We calculated daily numbers of ED visits from 47 US children's hospitals and estimated daily maximum ambient temperature at the population-weighted centroid of the county in which the hospital is based using the Parameter-elevation Relationships on Independent Slopes Model from May to September 2016 to 2018. We first used a distributed lag non-linear model to estimate the association between heat and cause-specific ED visits to each hospital, and subsequently pooled hospital-specific results using random-effect meta-analyses regression. We calculated the relative risk (RR) for extreme heat, estimated by comparing the risk for the 95<sup>th</sup> percentile versus the temperature of minimum morbidity (MMT), and attributable fraction (AF) for heat, defined as all days with temperatures above the MMT. **Results** There were 3,812,395 ED visits to 47 US Children's hospitals during the study period. A day of extreme heat was associated with higher RRs of ED visits for multiple specific causes and for all-causes combined. For example, we observed RRs of 1.83 (95% CI: 1.48, 2.28) for heat, light, and volume depletion, 1.21 (95% CI: 1.15, 1.28) for injuries and poisonings, and 1.17 (95% CI: 1.09, 1.25) for all-causes. If causal, the corresponding AFs for these three disease categories were 31.0%, 17.7%, and 11.8%, respectively. RRs were more pronounced among non-white patients [RR: 1.21 (95% CI: 1.17, 1.26)] and hospitals located in US Northeast [RR: 1.34 (95% CI: 1.16, 1.54)]. **Conclusions**Days of extreme heat are associated with higher relative risk for ED visits for all-cause and various cause-specific diseases and are responsible for a substantial fraction of summertime ED visits in US children.

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**P-0358**

**Difference in heat-stroke ambulance visit risk by month in Japan**

**Presenter:** Yasushi Honda, University of Tsukuba, Tsukuba, Japan

**Authors:** Y. Honda<sup>1</sup>, K. Oka<sup>2</sup>, Y. Hijioka<sup>2</sup>;

<sup>1</sup>University of Tsukuba, Tsukuba, JAPAN, <sup>2</sup>National Institute for Environmental Studies, Tsukuba, JAPAN.

**Aim:** Comparison of the all-cause mortality risk between early summer and late summer has been done and risk reduction was observed in late summer. This was considered as an adaptation to heat. Here, we evaluate the seasonal adaptation effect on heatstroke morbidity by comparing the risk from early summer to late summer. **Methods:** We obtained the data of heatstroke ambulance visit from Fire and Disaster Management Agency, Japan and temperature data from Japan Meteorological Agency for 47 prefectures in Japan. Using smoothing spline with the degree of freedom being 6, we evaluated the relation between daily maximum temperature and number of heatstroke ambulance visits for July, August, and September. Then, we calculated the risk ratio (August vs July and September vs July) at 30 degC and 35 degC. **Results and Discussion:** At 30 degC, the August risk ranged from 0.46 to 1.08, and the mean was 0.73; the September risk ranged from 0.21 to 0.59, and the mean was 0.38. At 35 degC, the August risk ranged from 0.55 to 1.02, and the mean was 0.72; the September risk ranged from 0.22 to 0.58, and the mean was 0.38. At both temperature levels, the risk in August was more than 25% lower than July. It is worthy of note that the daily maximum temperature was higher in August on average (30.9 degC vs 31.9 degC). The risk in September was even lower; 62 % lower than July. We speculate that this adaptation includes both physiological adaptation and behavioral adaptation (proper air-con use, or avoiding unnecessary outside activities).

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**P-0359**

**Inter-disciplinary assessment of greenspace health benefits applying the ecosystem services framework to urban heat reduction in Boston, MA**

**Presenter:** Koen F Tieskens, Boston University, Boston, United States

**Authors:** K. F. Tieskens, I. Smith, R. B. Jimenez Celsi, L. R. Hutyra, M. P. Fabian;  
Boston University, Boston, MA.

Background Vegetation is an indispensable component in cities for mitigation of negative health effects of urban exposures such as polluted air and urban heat islands. While there is epidemiology evidence showing urban vegetation exposure is associated with health benefits, knowledge on the underlying causal pathways is limited. We leveraged the ecosystem services framework (ESF) to bridge inter-disciplinary gaps between ecology and public health, and linked evapotranspiration produced by urban vegetation to heat-related exposure risks in Boston, MA. Methods ESF conceptualizes the benefits of nature as an outcome of supply and demand of services provided by ecosystems (ESS). We modeled hourly latent heat flux of tree canopy in Boston as the supply of heat reduction provided by ecosystems at 30 meter resolution. We mapped demand by calculating a risk score as a function of population, ambient temperature, and population vulnerability across multiple sociodemographic dimensions. Comparing the two products revealed to what extent the heat-reducing capacity of urban vegetation meets demand for this service by Boston residents. Results Our results generated fine scale metrics to quantify urban vegetation supply and demand in the context of heat exposure, and revealed spatial patterns of mismatch across Boston. Many areas where risk of heat-related health impacts was high received relatively low protection from extreme heat from surrounding trees, and these hotspots appeared mainly around large affordable housing complexes. Conclusions By applying an interdisciplinary ecosystem services framework, we generated a fine scale greenspace metric that reflects its direct impact on heat reduction. This novel metric can be used in environmental epidemiology studies across a range of heat related health outcomes, improving greenspace exposure assessment, and potentially advance analyses towards a causal pathway between urban vegetation and health.

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**P-0360**

**Impact of luban cyclone on malaria in almahrah in Yemen**

**Presenter:** Abdullah Salem Bin Ghouth, Hadramout University College Of Medicine, Mukalla, Yemen

**Authors:** A. S. Bin Ghouth<sup>1</sup>, Y. A. Baheshm<sup>2</sup>, W. Al-Delaimy<sup>3</sup>;

<sup>1</sup>Hadramout University College Of Medicine, Mukalla, YEMEN, <sup>2</sup>National malaria control Program (NMPC), Hadramout (Yemen), Mukalla, YEMEN, <sup>3</sup>Chair, ISEE Eastern Mediterranean Chapter. Department of Family Medicine and Public Health . University of California, San Diego, CA.

Background: Because of the climate change, there are more impacting southern Yemen. Luban was the most recent cyclone with devastating impacts in 2018. We wanted to estimate the impact of this cyclone on malaria in Almahrah area to plan future anti malaria interventions. Methods: An independent epidemiological and evaluation team developed to review the reports and the available documents and to conduct site visits and accordingly a technical report is prepared with a clear recommendations. Findings: Incidence of malaria in Al-Mahrah was 16/1000 in 2017 and 10/1000 in 2018 but the highest incidences were observed in Al-Ghydah district in 2017 (38/1000) and in Sayhout in 2018 (39/1000). High malaria incidence in Sayhout may be due to discontinuation of anti malaria interventions in 2014 and the impact of climate changes (Luban cyclone in 2018). In the current outbreak in Sayhout all forms of severe malaria were reported: malaria related deaths, cerebral malaria, severe anemia and malaria in pregnancy and among infants. . Conclusions: Malaria in Sayhout and Al-Ghydah districts represented the highest burden of malaria in Al-Maharah. It frequents cyclones hit the coastal areas of Al-Mahrah since 2015 to 2018 when the last Luban cyclone occurred. These climate changes complicate the epidemiology of malaria in Al-Mahrah and lead to a malaria epidemic especially when treatment programs are discontinued. Key Words: Malaria, climate change, Epidemiology

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**P-0361**

### **Social Vulnerability and Flood Exposure during Hurricane Sandy**

**Presenter:** Wil Lieberman-Cribbin, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** W. Lieberman-Cribbin<sup>1</sup>, P. Sheffield<sup>1</sup>, R. M. Schwartz<sup>2</sup>, B. Liu<sup>1</sup>, E. Taioli<sup>1</sup>;

<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Zucker School of Medicine at Hofstra-Northwell, Great Neck, NY.

Background: Hurricane Sandy caused widespread health and economic impacts in the greater New York City (NYC) area. While these impacts may vary across different communities, analyses understanding and identifying community-level vulnerability are lacking. We compared resilience measures and Hurricane Sandy flooding data to quantify the extent of community-level disparities. Methods: The 2010 Social Vulnerability Index (SVI) was downloaded from the Centers for Disease Control and Prevention to provide a resilience measure at the census tract level across NYC, Long Island and Westchester Counties. The overall SVI captures four dimensions: Socioeconomic, Household Composition, Minority Status/Language, and Housing/Transportation, resulting in a summed percentile ranking for each census tract, where a higher score indicates a greater social vulnerability. Flooding for the same census tracts were obtained from the Federal Emergency Management Agency Modeling Task Force Hurricane Sandy Impact Analysis. Results: 771 census tracts (26.3%) experienced flooding due to Hurricane Sandy, and 533 (69%) of these tract were located in NYC. The overall SVI index (mean±SD) was higher ( $7.70 \pm 1.94$ ) in NYC tracts than non-NYC tracts ( $5.32 \pm 1.80$ ), and higher in tracts experiencing flooding in NYC ( $7.2 \pm 2.10$ ) compared to non-NYC tracts that experienced flooding ( $5.05 \pm 1.74$ ). In NYC, 23.0% of census tracts were >75<sup>th</sup> percentile of both overall SVI and mean flood height, while 30.6% of tracts met this criteria in non-NYC. Conclusion: The social vulnerability and resilience of communities affected by Hurricane Sandy differed across NYC and Long Island, with a clear division among NYC and non-NYC study areas, and again among flooded areas in NYC and flooded areas outside NYC. There exists an urban population with high SVI and flood exposure at the highest risk, and actions must be taken to reduce disparities in social vulnerability and bolster community-level resilience.

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**P-0362**

### **Climate Change Research in the Arctic Must Include Polar Native Communities**

**Presenter:** David F. Goldsmith, George Washington University, Washington, United States

**Authors:** D. F. Goldsmith<sup>1</sup>, M. Levitsky<sup>2</sup>, K. Hedges<sup>2</sup>, B. S. Hillsberg<sup>3</sup>, P. Weihe<sup>4</sup>;

<sup>1</sup>George Washington University, Washington, MD, <sup>2</sup>Workplace Health Without Borders, Toronto, ON, CANADA, <sup>3</sup>Centers for Medicare & Medicaid Services, Baltimore, MD, <sup>4</sup>University of the Faroe Islands, Torshavn, FAROE ISLANDS.

Background: Concern about the melting of polar ice has tended to highlight wildlife, but not humans. However, research on Arctic climate change is crucial for developing effective public health policies for native communities who reside in the polar region. These include Inuit, Alaskan Natives, and Sami in Norway. Because there has been a dramatic rise in sea levels and a loss of sea ice in the Arctic, our intent is to share the needed epidemiology to address this issue. We aim encourage collaborative research from climate change among the indigenous communities of Canada, US, Norway, Sweden, Russia, Denmark, Iceland, and Greenland. Methods: We examined the epidemiology literature suggesting where climate change might have the most impact on native health. We considered the research methods needed to conduct polar health studies. Findings: Arctic climate change appears to be linked with snowmobile trauma and hunting injuries, village relocation and adolescent mental health impacts, zoonotic infections, especially from sled dogs, tuberculosis and other environmental infections, housing deterioration and cold injury, skin cancer and immunocompromise, mosquito and tick-borne infections, food-borne botulinum outbreaks, contamination and alterations in diet, alcoholism, diabetes, and asthma. Because many workers in northern mining and oil extraction industries include native employees, we must assess whether climate modification and workplace exposures interact. Measuring the amounts of exposure to an altered environment and appropriate comparison groups are research challenges to valid health studies. Including native children in any study will require utmost sensitivity. Synthesis/conclusions: We will emphasize effective communication with native communities and northern governments leading to ethical public health studies. We hope to encourage the development of new epidemiology research and curricula for international Arctic health in order to measure impacts of climate change on indigenous residents.

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**P-0363**

**Stability and Uncertainty by the definition of extreme heat events (EHEs) considering stochastic missing daily observation: a case of 150 megacities around the world with the baseline of daily maximum temperature during 1980 to 1999**

**Presenter:** Linze Li, Institute of Applied Environmental Health, College Park, United States

**Authors:** L. Li;  
Institute of Applied Environmental Health, College Park, MD.

Extreme heat events (EHEs) can contribute to heat-related morbidity and mortality rates. With the temperature keeps growing under climate change in the last several decades, people with respiratory and cardiopulmonary disorders will become more vulnerable to EHE exposures. However, the thresholds of EHEs can be fluctuated easily by the definition of 95<sup>th</sup> percentile calculated from the long time series daily maximum temperature (TMAX) data with monthly window filtering due to the missing observation. Trying to quantify the difference, we chose all 166 meteorological stations with TMAX data around the world from National Climate Data Center (NCDC) Data Portal between 1980 to 1999. Then we compared the difference of thresholds using raw TMAX dataset and fitting results of Gaussian distribution model. Finally, we stochastic sampled data with 95<sup>th</sup>, 90<sup>th</sup>, 80<sup>th</sup>, 70<sup>th</sup> and 60<sup>th</sup> of the raw data for 500 times separately, calculated the threshold of EHEs and evaluated the stability of the experimental results. TMAX data for most stations has the good fitting results of model. The average of thresholds difference between the raw TMAX dataset and model results was -1.74°C (IQR: -6.08°C - 2.98°C). For different seasons, average of thresholds difference is 0.61°C (IQR: -4.15°C - 5.45°C) in spring, -1.42°C (IQR: -5.05°C - 2.04°C) in summer, -2.23°C (IQR: -8.63°C - 1.49°C) in fall, and -4.0°C (IQR: -8.63°C - 1.49°C) in winter. The average difference of the Gaussian distribution thresholds had no obvious changes with proportion of sampled data from 95<sup>th</sup> to 60<sup>th</sup>, while the standard deviation of average difference had significant increase in instability from 0.70°C to 2.50°C. Our results characterized the effects by stochastic missing observation when calculating the thresholds of EHEs. This finding suggests the consideration of EHEs thresholds when exploring the relationship between EHEs and human outcomes by public health agencies and researchers.

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**P-0364**

**Hot under the collar: The association between daily temperature and temperature deviations with violent criminal behavior**

**Presenter:** Jesse D Berman, University of Minnesota School of Public Health, Minneapolis, United States

**Authors:** J. D. Berman;  
University of Minnesota School of Public Health, Minneapolis, MN.

**Background:** Criminal behavior is a significant public health threat, serving as both cause and consequence of violent actions. Violent assaults constitute over 1 million emergency room visits annually and represent the 8<sup>th</sup> leading cause of non-fatal injuries. However, the underlying environmental causes of violent behavior are still poorly understood. Our study investigates the role that daily temperature and temperature deviation plays on the risk of crime incidence. We further consider the ongoing debate as to whether temperature affects crime through a temperature-aggression relationship or by modifying routine activities. **Methods:** We used a hierarchical time series model to estimate the risk of criminal behavior associated with daily temperature and daily departure from normal temperatures in 436 U.S. counties. Departure from normal temperatures denote the deviation of daily temperature from the expected conditions. Daily crime incidence was acquired from the FBI's National Incidence Based Reporting System and daily weather data from gridMET. We explored seasonality of crime risks and estimated linear and non-linear exposure-response relationships. **Results:** We found each 10°C increase in daily mean temperature increased the risk of violent crime by 11.92% (95% CI: 11.57, 12.27) and each 10°C increase in departure from normal temperatures increased violent crime risk by 10.37% (95% CI: 10.05, 10.69). The exposure response curve revealed increasing risk with absolute daily temperature until flattening off above 25°C. For departure from normal temperatures, we observed a strong linear relationship with crime, and significantly higher risk during fall and winter seasons. Similar overall effects, but with lower risk, were observed for non-violent property crime. **Conclusions:** Our results suggest that short-term changes in daily temperature may be associated with greater risk of criminal behavior. Based on the exposure-response curves and seasonal trends, our findings provide evidence of a routine activities pathway, rather than the temperature-aggression hypothesis.

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**P-0365**

**Heat, Medical Fragility, and Child Morbidity in a U.S. Urban Setting**

**Presenter:** Maria Teresa Herrera, Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** M. Herrera<sup>1</sup>, B. Girma<sup>1</sup>, B. Liu<sup>2</sup>, L. Schinasi<sup>3</sup>, J. Clougherty<sup>3</sup>, P. Sheffield<sup>1</sup>;

<sup>1</sup>Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Department of Population Health Science and Policy, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>3</sup>Department of Environmental and Occupational Health and Urban Health Collaborative, Dornsife School of Public Health, Drexel University, Philadelphia, PA.

**Background:** The majority of research on ambient heat and health has highlighted vulnerability of older populations. Studies of ambient heat and children's health is an emerging focus area. We aim to explore the risk of high ambient temperatures to children aged 0-18 in New York City, examining inpatient and emergency department (ED) admissions from 2005- 2011 during the warm season months (May -September). We also explore an initial definition of medically fragile children to further characterize heat vulnerability. **Methods:** We apply a time-stratified, case-crossover design, using conditional logistic regression to estimate percent excess ED (n=2,252,550) and inpatient (n=228,006) admission risks for same-day exposure, controlling for relative humidity. We also conduct subgroup analysis stratifying by age (0-4, 5-12, and 13-18 years old) and by medical fragility, as defined by the Feudtner Pediatric Complex Chronic Conditions (CCC) classification system. We report relative risk and its 95% confidence interval (RR (95%CI)) per 13°F increase in ambient temperature. **Results:** Same-day heat exposure is significantly associated with a greater percent excess risk (RR) of ED admission for children across all age groups [RR = 2.0 (1.8 - 2.3)], and within each age group. A statistically-significant increased risk of inpatient admission was observed only among children aged 13-18 [RR= 1.9 (0.4 - 3.4)]. Children without medical fragility showed a significantly increased percent risk of ED visit [RR= 0.5 (-2.3 - 3.4)], but not of inpatient admission [RR = 1.5 (-0.4 - 3.4)]. The associations for ED [RR= 0.5 (-2.3-3.4)] or inpatient admissions [RR= 1.5 (-0.4 - 3.4)] were not significant among children with medical fragility. **Conclusions:** Additional work will better characterize childhood vulnerability and redefine the concept of medically-fragile children as it pertains to heat exposure.

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**P-0366**

**Impact of monsoon variability on under-five diarrheal disease risk in Nepal**

**Presenter:** Nicholas A Adams, University of Maryland School of Public Health, College Park, United States

**Authors:** N. A. Adams<sup>1</sup>, S. Mathews<sup>1</sup>, M. Dhimal<sup>2</sup>, A. Sapkota<sup>1</sup>;

<sup>1</sup>University of Maryland School of Public Health, College Park, MD, <sup>2</sup>Nepal Health Research Council, Kathmandu, NEPAL.

**Background:** Previous studies have suggested that extreme weather events, specifically heavy precipitation, are associated with increased risk of infectious disease, including diarrhea. Countries within the Asia Pacific Region (APR) account for a large burden of diarrheal diseases, as access to protected water sources are limited and populations are exposed to heavy monsoon rainfall annually. While prior studies have investigated association between extreme weather events and diarrheal disease in the region, there is a paucity of data regarding how monsoon dynamics (onset, withdrawal, and length) and phases of El Niño Southern Oscillation (ENSO) impacts diarrheal disease burden in high risk countries within the APR region, such as Nepal. **Methods:** Monthly counts of under-five diarrheal disease cases were collected from 75 districts in Nepal between 2002 and 2014. Monsoon onset and withdrawal dates for the entire country were obtained from Nepal's Department of Hydrology and Meteorology and Monthly Oceanic Niño Index values were collected from the National Weather Service's Climate Prediction Center and used to indicate phases of ENSO. A total of 5,379 observations of monthly counts were included in the analysis. **Results:** There were a total of 7,955,034 under-five diarrheal disease cases during the 2002-2014 period in Nepal. The mean monthly case rate was 2962/100,000 in years with normal monsoon withdrawal, compared to 4854 and 4917/100,000 in years with late and very late withdrawal dates, respectively. Mean monthly case rate of 4958/100,000 was observed during strong La Niña phases compared to 3793/100,000 in ENSO-neutral phases. Geographic variability also appears to impact diarrheal disease risk, as the mean monthly case rate was significantly higher in districts located in the mountainous regions of the country (5259/100,000) than in the plains (3322/100,000) or hilly regions (3621/100,000) Results from further analysis investigating the combined role of monsoon anomaly and ENSO phases will be presented.

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**P-0367**

**Examining Heat-Related Emergency Department Visits in North Carolina, 2009-2017**

**Presenter:** Lauren Thie, NC DHHS, Raleigh, United States

**Authors:** L. Thie<sup>1</sup>, K. Hawaldar<sup>2</sup>, A. Christensen<sup>1</sup>;  
<sup>1</sup>NC DHHS, Raleigh, NC, <sup>2</sup>UNC-CH, Chapel Hill, NC.

Background: Climactic changes in heat are expected to affect patterns of heat-related illness (HRI) in North Carolina. In order to understand patterns in HRI over time, we assessed the frequency and distribution of HRI emergency department (ED) visits across North Carolina during 2009-2017. Methods: Using a previously validated ICD-9/ICD-10 and chief complaint-based case definition, we identified visits from the North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT) from January 1, 2009 to December 31, 2017. The analysis used a generalized linear model for time series of counts with R package tscount. A poisson model was used with response variable as number of daily HRI ED visits. We assessed whether number of peaks (i.e., aberrations) increased annually from 2009 to 2017. Finally, to assess whether length of the heat season increased annually 2009 to 2017, the duration between date of the first peak and last peak were compared annually. Results: Most emergency department visits occurred during summer months. Monthly distributions for each year were similar. During 2010 and 2015, the monthly highs occurred slightly earlier than other years. In the Poisson model, controlling for maximum monthly temperature, the coefficient for year was positive with a significant p-value, suggesting an expected increase in the number of HRI ED visits over time. No significant distribution in the number of peaks by year or duration of heat season was observed. Conclusions: The model demonstrated a significant increase in the number of HRI ED visits over time. The results of this study reinforce the strong relationship between increasing temperatures and HRI, and suggests that as temperatures continue to increase, the incidence of HRI will likewise increase.

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**P-0368**

**Effect of Relative Humidity and Temperature on PM<sub>2.5</sub> Concentrations in Kampala, Uganda**

**Presenter:** Samuel Etajak, Makerere University School of Public Health, Kampala, Uganda

**Authors:** S. Etajak<sup>1</sup>, L. Atuyambe<sup>1</sup>, W. Bazeyo<sup>1</sup>, F. Walyawula<sup>1</sup>, A. Nyabigambo<sup>1</sup>, A. Kumie<sup>2</sup>, K. Dessie<sup>3</sup>, J. Partz<sup>4</sup>, J. M. Samet<sup>5</sup>, K. Berhane<sup>6</sup>;

<sup>1</sup>Makerere University School of Public Health, Kampala, UGANDA, <sup>2</sup>Addis Ababa University, Addis Ababa, ETHIOPIA, <sup>3</sup>University of Southern California, Los Angeles, CA, <sup>4</sup>University of Wisconsin, Wisconsin, WI, <sup>5</sup>University of Colorado, Colorado, CO, <sup>6</sup>Columbia University, New York, NY.

**Background** Scientific evidence reveals that exposure to small particulate matter of 2.5 microns or less in diameter (PM<sub>2.5</sub>) is very detrimental to health thus resulting in increased risks of cardiovascular and respiratory disease, and cancers. There are three factors that have important effect on PM<sub>2.5</sub> mass concentration: domestic pollutant emission sources, external sources outside of the country, and the meteorological conditions. We aimed assessing the effect of relative humidity and temperature on PM<sub>2.5</sub> concentrations from 2018 to 2019 using the Beta Attenuation monitor 1022. **Methods** We measured the relative humidity, temperature, ambient PM<sub>2.5</sub> concentrations prospectively from October 2017 to December 2019 using the Beta Attenuation Monitor (BAM) 1022 (Met One Instruments, Inc) at the Eastern Africa GEOHealth Hub air quality monitoring station, that installed at Makerere University School of Public Health Roof top building at height of 15 metres above the ground level, Kampala Uganda. **Results** The findings showed that annual averages of PM<sub>2.5</sub>, Ambient Temperature (AT) and Relative Humidity (RH) in 2018 was 41.3 µg/m<sup>3</sup>, 23.10C and 72.0% and in 2019 was 38.5 µg/m<sup>3</sup>, 23.80C and 71.9% respectively. The results showed that the annual averages for PM<sub>2.5</sub>, Ambient Temperature (AT) and Relative Humidity (RH) in 2018 and 2019 was about the same. The findings also revealed that every unit increase in relative humidity increased PM<sub>2.5</sub> concentrations by 29.3% and every unit increase in ambient temperature reduced PM<sub>2.5</sub> concentrations by 2.14). Notably also in 2018 and 2019 the daily PM<sub>2.5</sub> average concentrations decreased when RH reached high a threshold 80%. **Conclusion** The daily PM<sub>2.5</sub> average concentrations decreased when the relative humidity reached a high threshold of 80% in 2018 and 2019 in Kampala Uganda. **Funding Sources:** NIH Fogarty International Center, NIEHS, CDC/NIOSH, Canada's IDRC, GACC Grant # 5R24 TW009552 [AAU]; 5R24 TW009548 [USC]; 1U01TW010094 [AAU]; 1U2RTW010125 [USC]

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**P-0369**

**Physiological changes before dialysis treatments can potentially mediate the effects of extreme heat events on hospital admission risk**

**Presenter:** Richard V Remigio, University of Maryland, College Park, College Park, United States

**Authors:** R. V. Remigio<sup>1</sup>, R. Turpin<sup>1</sup>, J. Rainmann<sup>2</sup>, P. Kotanko<sup>2</sup>, F. Maddux<sup>3</sup>, L. Usvyat<sup>3</sup>, X. He<sup>1</sup>, A. Sapkota<sup>1</sup>;

<sup>1</sup>University of Maryland, College Park, College Park, MD, <sup>2</sup>Renal Research Institute, New York, NY,

<sup>3</sup>Fresenius Medical Care, Waltham, MA.

Typical thermoregulatory response to elevated temperatures among healthy individuals include reduced blood pressure and perspiration. However, individuals living with end-stage renal disease (ESRD) are susceptible to physiological fluctuations that may increase their risk of mortality. As such, the underlying mechanism for extreme heat-related hospital admissions among individuals with ESRD undergoing hemodialysis (HD) is relatively unclear. Traditional mediation analysis was used to decompose the total effect between extreme heat and hospital admissions. We hypothesize that the exposure-outcome pathway is mediated by systolic blood pressure before HD treatment (preSBP) and inter-dialytic weight gain (IDWG). This study used records from ESRD patients treated at Fresenius Kidney Care clinics from 2003 to 2012 (n= 7962). Calendar day- and location-specific temperature thresholds were calculated to identify extreme heat events (EHEs) during the study period. We fitted Cox proportional hazards models with time-dependent covariates to estimate the association between EHEs and hospitalization using varying lag structures (lag0, lag1, and lag2). We examined preSBP and IDWG as mediators using VanderWeele's difference method for each lag structure. Extreme heat exposure for each lag structure increased the hazard risk (HR) of hospital admission after model adjustments (lag2: adjusted HR= 1.09, 95% confidence interval, 1.01- 1.19; lag1: 1.08, 0.99- 1.17; and lag0: 1.16, 1.07- 1.26). In lag1 models, preSBP and IDWG significantly (p<0.05) mediated 22.54% and 1.81% of its adjusted association, respectively, and 42.16% when both are included. In lag0 models, IDWG significantly mediated -19.10% of its adjusted association, suggesting a potential protective pathway against same-day EHE effects. This work has provided a step forward to understanding potential physiological linkages between extreme heat and hospitalization. Concomitant changes in blood pressure and IDWG may have possible antagonistic effects on extreme heat-related admission. Such findings could be critical in discerning potential interventions to minimize the impact of extreme heat among ESRD patients.

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**P-0370**

**Air pollution exposure management at the city level - the ICARUS approach**

**Presenter:** Dimosthenis Sarigiannis, Aristotle University of Thessaloniki, Department of Chemical Engineering, Environmental Engineering Laboratory, Thessaloniki, Greece

**Authors:** D. Chapizanis<sup>1</sup>, A. Gotti<sup>2</sup>, S. Karakitsios<sup>1</sup>, D. Sarigiannis<sup>1</sup>;

<sup>1</sup>Aristotle University of Thessaloniki, Department of Chemical Engineering, Environmental Engineering Laboratory, Thessaloniki, GREECE, <sup>2</sup>EUCENTRE, European Centre for Training and Research in Earthquake Engineering, Pavia, ITALY.

Technology innovations create possibilities to capture exposure-related data at a great depth and breadth. Considering, though, the substantial hurdles involved in collecting individual data, this study introduces a first-of-a-kind approach to simulating human movement and interaction behaviour for assessing personalised exposure to air toxicants, using Agent Based Modelling (ABM). A city scale ABM was developed for the metropolitan area of Thessaloniki, Greece in order to feeds into population-based exposure assessment without imposing prior bias, basing its estimations onto emerging properties of the behaviour of the computerised autonomous decision makers (agents) that compose the city system. Population statistics, road and buildings networks data were transformed into human, road and building agents, respectively. Survey outputs with time-use patterns were associated with human agent rules, aiming to model representative to real-world behaviours. Time-geography of exposure data, derived from a local sensors campaign, was used to inform and enhance the model. As a prevalence of an agent-specific decision-making, virtual individuals of different sociodemographic backgrounds express different spatiotemporal behaviours and their trajectories are coupled with spatially resolved pollution levels. Personal exposure was evaluated by assigning PM concentrations to human agents based on coordinates, type of location and intensity of encountered activities. Study results indicated that PM<sub>2.5</sub> inhalation adjusted exposure between housemates can differ by 56.5% whereas exposure between two neighbours can vary by as much as 87%, due to the prevalence of different behaviours. This study provides details of a new methodology that permits the cost-effective construction of refined time-activity diaries and daily exposure profiles, accounting for different microenvironments and sociodemographic characteristics. The proposed method leads to a refined exposure assessment model, addressing effectively vulnerable subgroups of population. It can be used for evaluating the impacts of different public health policies prior to implementation reducing, therefore, the time and expense required to identify efficient measures.

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**P-0371**

### Analyzing New York City 311 Call Center Data related to Hurricane Sandy

**Presenter:** Wil Lieberman-Cribbin, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** W. Lieberman-Cribbin<sup>1</sup>, N. Alpert<sup>1</sup>, A. Eugene<sup>1</sup>, R. M. Schwartz<sup>2</sup>, B. Liu<sup>1</sup>, E. Taioli<sup>1</sup>;

<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Zucker School of Medicine at Hofstra-Northwell, Great Neck, NY.

Background: Hurricane Sandy made landfall on October 29 2012 and caused immediate health and economic impacts in the greater New York City (NYC) area. However, the long-term consequences of the storm are not fully understood. We analyzed NYC 311 data to quantify the extent of Hurricane Sandy related concerns in NYC. Methods: Data from NYC 311 Call Center Inquiry and Service Requests were downloaded from the NYC Open Data website (9/1/2010-3/20/20). We included only calls containing the keyword: "Sandy". Descriptive analyses were conducted to understand the characteristics of the 311 calls, including the date, agency contacted, the geographic location of the caller if available, a brief description and the resolution of each call. Results: Eighty percent of the 78,541 calls specific to Hurricane Sandy were made in 2012, representing 2.1% of all 311 calls in 2012. The top three contacted agencies were 311 Call Center (36.1%), Department of Education (16.2%), and City Hall (13.6%). The main call-in reasons were to obtain information about the City's response to Hurricane Sandy (36.0%), public school openings/closings related to Sandy (14.9%), and locations of walk-in centers offering assistance with recovery services (11.2%). There were 231 service requests made between 9/1/2012 and 12/31/2017 about destroyed buildings due to Sandy, of which 95.9% occurred in 2013. Calls were from Queens (83%), Staten Island (15%) and Brooklyn (2%), with the majority occurring in the Breezy Point neighborhood of Queens (62.6%). Conclusion: The 311 call center plays an important role in receiving and disseminating information about hurricane preparedness and recovery/relief in both the immediate and long-term aftermath of Hurricane Sandy. Evidenced by Hurricane Sandy calls persisting into 2020, ongoing efforts must be made to enhance disaster preparedness and resilience in communities, in addition to immediately responding to needs of communities after natural disasters.

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**P-0372**

### **Modification of the Cardiovascular Effects of Temperature by Neighborhood Socio-Economic Deprivation**

**Presenter:** Sebastian Thonet Rowland, Columbia University, New York, United States

**Authors:** S. T. Rowland<sup>1</sup>, M. Kioumourtzoglou<sup>1</sup>, A. Just<sup>2</sup>, A. Boehme<sup>1</sup>, A. Wilson<sup>3</sup>, J. Rush<sup>2</sup>;

<sup>1</sup>Columbia University, New York, NY, <sup>2</sup>Mount Sinai Environmental Medicine and Public Health, New York, NY, <sup>3</sup>Colorado State University, Boulder, CO.

**Background:** Ambient daily temperature, both elevated and low, has been associated with daily cardiovascular mortality; studies have consistently observed larger associations for neighborhoods of higher socio-economic deprivation (NSED). However, no study has assessed whether NSED modifies the timing of this effect. We investigated how NSED modifies the association between daily temperature and risk of myocardial infarction (MI) in New York City (NYC).

**Methods:** We used 2000-2015 MI hospitalization and residence data from the Statewide Planning and Research Cooperative System (SPARCS) dataset of the New York Department of Health. Temperature and relative humidity came from the North American Land Data Assimilation System (NLDAS) at 11x14 km<sup>2</sup> resolution. We aggregated data to 42 neighborhoods defined by NYC Department of Health. We estimated NSED with a Neighborhood Deprivation Index (NDI), from principal components analysis of US Census variables. We employed a time series design with a distributed lag nonlinear model for 14 days lag of temperature. We controlled for seasonality, long-term trends, relative humidity, NDI, and random effects for neighborhood. We then stratified by NDI quartile.

**Results:** We observed 329,457 MI hospitalizations over the study period. Same-day high temperature was nonlinearly associated with MI; an increase from mean temperature (12.3°C) to the 95<sup>th</sup> percentile (28°C) was associated with a 7.0% increase (95%CI: 3.7, 10.4%) in MI hospitalization rate. The second quartile of NDI showed the largest association (8.6%; 95%CI: 5.2, 12.0%); the least deprived quartile had the smallest association (6.0%; 95%CI: 2.6, 9.4%). For all subpopulations, only same-day temperature was statistically significant.

**Conclusion:** Our findings suggest that same-day temperature is associated with daily MI rates, across levels of NDI, and this was strongest in the second-most-deprived neighborhoods. The timing of the association was consistent across quartiles of NDI. Further research is needed to elucidate factors that provide resilience to heat exposure.

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**P-0373**

**Climate Change and Health: New approaches are expected from epidemiologists**

**Presenter:** Wael Al-Delaimy, UC San Diego, San Diego, United States

**Authors:** W. Al-Delaimy;  
UC San Diego, San Diego, CA.

Climate change is becoming mainstream in public health research given the direct impact on health from extreme weather, heat waves, and other indirect health impacts. The usual approaches in epidemiology study design and analyses are not as effective given the gravity of climate change that some termed as an existential threat. Epidemiologists are therefore expected to pursue a paradigm shift in their approach to deal with this threat from climate change. The aim of this presentation is to provide two approaches as examples of how epidemiologists engage this public health threat. One approach is health policy communication. This is not a strength of most epidemiologists and not taught in graduate schools of public health. The International Network for Epidemiology and Policy (INEP) was formed to address this gap and one of its first tasks was to address Climate Change Health Policy. The process of this initiative from the 24 international epidemiology societies who are members of INEP and up to the publication of a policy brief will be described. The second approach is a collaboration with non-traditional partners such as faith leaders, social scientists, ecologists, politicians and physical scientists to address climate change from a multidisciplinary perspective. The common focus would be community engagement. This will be demonstrated through a partnership with the Pontifical Academy of Science that culminated in a Nature Springer Book to be published inclusive of a diverse group of authors and notable Nobel Laureates in Chemistry and Biology.

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**P-0374**

### **The Comparison of Heat-Related Health Outcomes between Patients Reporting/Not-Reporting a Social Security Number**

**Presenter:** Jihoon Jung, University of Washington, Seattle, United States

**Authors:** J. Jung<sup>1</sup>, C. K. Uejio<sup>2</sup>, T. E. Adeyeye<sup>3</sup>, K. W. Kintziger<sup>4</sup>, C. Duclos<sup>5</sup>, K. Reid<sup>5</sup>, M. Jordan<sup>5</sup>, J. T. Spector<sup>1</sup>, T. Z. Insaf<sup>3</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>Florida State University, Tallahassee, FL, <sup>3</sup>New York State Department of Health, Albany, NY, <sup>4</sup>University of Tennessee, Knoxville, TN, <sup>5</sup>Florida Department of Health, Tallahassee, FL.

This study quantified the relationship between air temperature and five different types of heat sensitive health outcomes (cardiovascular disease, dehydration, heat-related illness, renal disease, and respiratory disease) with daily emergency (ED) visits and hospitalizations in Florida, U.S. We examined whether the associations of heat exposure with health outcomes were modified by birth sex, age, or race/ethnicity. Finally, health disparities between patients reporting/not reporting a masked social security number (SSN) were investigated. The study focused on the warm season (May through September) from 2008 to 2012 in Florida. We devised separate case-crossover models for each health outcome, type of healthcare visit (emergency department, hospitalization), and patients reporting/not reporting SSN. We used a bidirectional time-stratified design with a rolling 28 day comparison window. Referent periods were extracted from  $\pm 7$ ,  $\pm 14$ , and  $\pm 21$  days to remove the weekly and seasonal cycles of health outcomes. A conditional logistic regression then calculated heat exposure's odds ratios (ORs) for a unit risk factor change. Each stratified model also considered potential effect modification by birth sex, age, or race/ethnicity. The results show that most relationships between extreme heat and health outcomes were similar between subpopulations. However, we found differential risks of ED visits by birth sex and some evidence of inequalities between patients reporting/not reporting a SSN. Birth sex modified the effect of heat exposure on dehydration ED visits (Males: 1.078, 95% CI: 1.074~1.082; Females: 1.060, 95% CI: 1.056~1.063) and hospitalizations (Males: 1.063, 95% CI: 1.060~1.066; Females: 1.054, 95% CI: 1.052~1.057). Patients not reporting a SSN between the ages of 25 and 44 exhibited a higher dehydration ED visit OR (1.139, 95% CI: 1.103~1.177) than the patients reporting a SSN (1.079, 95% CI: 1.073~1.084). This study provides insights on the health disparities between people reporting/not reporting a SSN.

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**P-0375**

### **Changes in Timing of Spring Onset and Increased Risk of Asthma Hospitalization in Maryland: Harbinger of Climate Change**

**Presenter:** Amir Sapkota, University of Maryland School of Public Health, College Park, United States

**Authors:** A. Sapkota<sup>1</sup>, Y. Dong<sup>2</sup>, G. Asrar<sup>3</sup>, Y. Zhou<sup>4</sup>, X. Li<sup>4</sup>, F. Coats<sup>5</sup>, A. Spanier<sup>6</sup>, J. Matz<sup>7</sup>, L. Bielory<sup>8</sup>, A. Breitenother<sup>1</sup>, C. Mitchell<sup>9</sup>, C. Jiang<sup>1</sup>;

<sup>1</sup>University of Maryland School of Public Health, College Park, MD, <sup>2</sup>Wuhan University, Wuhan, CHINA,

<sup>3</sup>Joint Global Change Research Institute, College Park, MD, <sup>4</sup>Iowa State University, Ames, IA, <sup>5</sup>Aerobiology, Nepean, ON, CANADA, <sup>6</sup>University of Maryland School of Medicine, Baltimore, MD, <sup>7</sup>Chesapeake Clinical Research Inc., Baltimore, MD, <sup>8</sup>Hackensack Meridian School of Medicine at Seton Hall University, Nutley, NJ, <sup>9</sup>Maryland Department of Health, Baltimore, MD.

**ABSTRACT Introduction:** The proposed association between climate change and increased burden of allergic diseases are based on three different thematic observational studies that have linked i) increased CO<sub>2</sub> concentration with higher pollen production, ii) warmer air/surface temperatures with early spring onset and longer pollen season, and iii) higher pollen exposure with increased risk of asthma hospitalizations. Yet empirical evidence collectively linking climate change with pollen season and asthma exacerbation is still lacking.

**Methods:** We used general additive (GAM, quasi Poisson), and mixed effect (negative binomial) models to investigate the association between changes in timing of spring onset (SOS)- detected using satellite observation - and risk of asthma hospitalization in Maryland during 2001-2012. To characterize the underlying mechanism, we further investigated the relationship between changes in SOS and springtime tree pollen dynamic (timing of pollen season onset, timing and intensity of peak pollen concentration, and pollen season length).

**Results:** In the unadjusted model, very early (Incident Rate Ratio (IRR): 1.17, 95% Confidence Interval (CI): 1.07-1.28) and late (IRR: 1.07, 95% CI: 1.00-1.15) onset of spring were associated with increased risk of asthma hospitalization. When the analysis was adjusted for extreme heat event and PM<sub>2.5</sub> concentration, the risk remained significant for very early SOS (IRR: 1.10, 95% CI: 1.02-1.20), but not for late SOS (RR: 1.03, 95% CI: 0.97-1.11). We further observed that very early SOS is significantly associated with the length for Birch and Oak pollen season ( $p < 0.05$ ).

**Conclusion:** Our results show that ongoing changes in timing of spring onset that are tied to climate variability and change increases risk of asthma hospitalization. Our result serve as a wake-up call to public health and medical communities regarding the need to anticipate and adapt to the ongoing changes in the timing and severity of the spring allergy season.

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**P-0376**

### **The Relationship between Ambient Temperature and Sickle Cell Disease-Related Hospital Admissions in South Carolina**

**Presenter:** Natalie Crnosija, UMD, College Park, United States

**Authors:** N. Crnosija<sup>1</sup>, E. Rigterink<sup>1</sup>, J. Yanosky<sup>2</sup>, N. Sieck<sup>1</sup>, R. Ezeugoh<sup>1</sup>, T. Wen<sup>2</sup>, R. Puett<sup>1</sup>;  
<sup>1</sup>UMD, College Park, MD, <sup>2</sup>Pennsylvania State University, Hershey, PA.

#### Background

Sickle cell disease (SCD) is the most common inherited blood disorder in the United States and impacts millions of people globally. Climate change may significantly impact the health of these individuals; however to date, very limited research has examined the relationship between weather and sickle cell disease hospitalizations.

#### Methods

We evaluated the association between temperature and SCD-related hospital admissions among residents of South Carolina (SC) between 2003 and 2006. Daily temperature data were obtained from the US National Climatic Data Center for the most proximal weather station to each patient's residential address at the time of hospital admission. We restricted to first hospitalization for each patient. We used a semi-symmetric bidirectional case-crossover design to examine the relationship between hospital admissions and temperatures (continuous, extreme high and low temperatures) for 0 to 7 days prior (for case period) and an equivalent 7 days during the same month. Conditional logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs).

#### Results

Among 1,937 individuals with at least one SCD hospital admission, the mean age was 24 years, and the median annual household income in the census tract of residence was about \$37,000. The OR between hospital admission and temperature on the day prior to hospital admission was 1.01 (95%CI: 0.99,1.03), the OR for temperatures above 80 degrees F on the day prior was OR: 1.38 (95%CI:0.95,2.01), and for temperatures below 32 degrees F on the day was OR was 1.00 (95%CI:0.66,1.50). The associations for all other time windows that we investigated were similar.

#### Conclusions

In this dataset of SCD-related hospital admissions, we observed no strong relationship between temperature and hospital admission, however a weak positive relationship was observed for temperatures below freezing on days immediately prior to the hospital admission. Further investigation is warranted.

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Theme: **Climate change**

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**P-0377**

### **The joint effects of monsoon rainfall anomalies and natural disasters on food insecurity in Nepal: Implications for a changing climate**

**Presenter:** Amir Sapkota, University of Maryland School of Public Health, College Park, United States

**Authors:** H. Randell<sup>1</sup>, C. Jiang<sup>2</sup>, X. Liang<sup>3</sup>, R. Murtugudde<sup>3</sup>, A. Sapkota<sup>2</sup>;

<sup>1</sup>Pennsylvania State University, University Park, PA, <sup>2</sup>University of Maryland School of Public Health, College Park, MD, <sup>3</sup>University of Maryland, College Park, MD.

Background Food insecurity is a key global health challenge that is likely to be exacerbated by climate change. Populations experiencing an increased frequency of extreme weather events may be particularly vulnerable to other threats including natural disasters. In this study, we assessed how exposure to an earthquake followed by monsoon rainfall anomalies impacted household food insecurity in Nepal. Methods We linked 2016 Nepal Demographic and Health Survey data to district level 2015 Nepali earthquake data and rainfall anomalies during the 2015 monsoon season. Using logistic regression models, we exploited variation in exposure to the earthquake and rainfall anomalies to isolate the independent and joint effects of each set of conditions. Results Overall, 32% of households reported moderate/severe food insecurity. Among households not severely impacted by the earthquake, negative and positive rainfall anomalies were associated with a 41%, and 15% predicted probability of moderate/severe food insecurity, respectively. Surprisingly, this relationship was reversed in districts severely impacted by earthquake, with a 21% and 40% predicted probability of moderate/severe food insecurity observed among households experiencing negative and positive rainfall anomalies, respectively. Conclusion Among households not severely impacted by earthquake, negative monsoon rainfall anomalies (lack of rain) likely disrupted agricultural productivity and increased food insecurity. In contrast, we found an increased rate of moderate/severe food insecurity associated with greater rainfall in earthquake affected districts. Rainfall events disproportionately increased landslides in the earthquake impacted areas, which likely damaged hilly roads and limited the distribution of food aid. While Nepal received large amounts of food aid to assist with recovery from the earthquake, extreme weather events such as floods and droughts are unlikely to garner similar levels of assistance. Without sufficient resources for adaptation and recovery, more frequent and severe rainfall anomalies tied to climate change will leave Nepalis increasingly vulnerable to food insecurity.

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## ABSTRACT E-BOOK

Theme: **Climate change**

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**P-0379**

**Hurricane-related health impacts and modification by community resilience**

**Presenter:** Jaime Madrigano, RAND, Arlington, United States

**Authors:** J. Madrigano, T. Ruder, R. Chari;  
RAND, Arlington, VA.

**Background:** The public health impacts of hurricanes and floods are significant. While the death toll from hurricanes and floods has climbed in recent years, mortality, alone, is a poor indicator of human impacts. Official death counts are known to be an underestimate, and mortality from direct exposure to a hurricane event is just the tip of the iceberg for public health impacts. Few studies have quantified excess morbidity across a range of outcomes from hurricane events. Further, little is known about community factors that may mitigate the health impacts of hurricanes.

**Methods:** Emergency department (ED) visit data for New Jersey communities impacted by Hurricane Sandy was obtained from the Healthcare Cost and Utilization Project. A two-stage Bayesian hierarchical model was used to estimate the increase in risk for respiratory, cardiovascular, and renal cause visits due to Hurricane Sandy. We examined how community-level resilience characteristic modified this association, after adjusting for storm severity.

**Results:** In the months following the storm, there was an increase in ED visits for all causes we examined, ranging from 5.6% (95% PI: 3.0, 8.4) for chronic renal disease to 18.9% (95% PI: 15.9, 22.0) for chronic obstructive pulmonary disease (COPD). The effect of the storm on ED visits decreased by 3.1% (95% PI: 1.1, 5.0) for COPD and by 3.0% (95% PI: 0.6, 5.3) for chronic renal disease for a standard deviation increase in community resilience. Social and environmental domains of resilience drove this association.

**Conclusions:** Severe hurricane events are associated with excess morbidity risk across a wide range of causes. Community-level resilience measures explain some spatial variation in health impacts due to extreme weather events. Increasing community resilience has the potential to mitigate health impacts from hurricanes, reduce healthcare utilization, and result in healthcare cost reductions.

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Theme: **Climate change**

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**P-0381**

**Metabolomics signatures of the short-term exposure to air pollution and temperature**

**Presenter:** Feiby Nassan, Harvard T. H. Chan School of public Health, Boston, United States

**Authors:** F. Nassan<sup>1</sup>, R. S. Kelly<sup>2</sup>, P. Koutrakis<sup>1</sup>, P. S. Vokonas<sup>3</sup>, J. A. Lasky-Su<sup>2</sup>, J. D. Schwartz<sup>1</sup>;  
<sup>1</sup>Harvard T. H. Chan School of public Health, Boston, MA, <sup>2</sup>Channing Division of Network Medicine; Brigham and Women's Hospital, Harvard Medical School, Boston, MA, <sup>3</sup>VA Normative Aging Study, VA Boston Healthcare System, School of Medicine and School of Public Health, Boston University, Boston, MA.

**Background/Aim:** Short-term exposures to air pollution and temperature have been reported to be associated with inflammation and oxidative stress. However, mechanistic understanding of the affected metabolic pathways is still lacking and the existing literature on the short-term exposure of air-pollution on the metabolome is limited. We aimed to determine the changes in the blood metabolome and the associated pathways related to short-term exposure to outdoor air pollution and temperature. **Methods:** We performed mass-spectrometry based untargeted metabolomic profiling of plasma samples from a large and well-characterized cohort of men (the Normative Aging Study) to identify metabolic pathways associated with short-term exposure to PM<sub>2.5</sub>, NO<sub>2</sub>, O<sub>3</sub>, and temperature (one, seven-, and thirty-day average of central site monitors). We used multivariable linear mixed-effect regression and independent component analysis (ICA) while simultaneously adjusting for all exposures and correcting for multiple testing. **Results:** Overall, 456 white men provided 648 blood samples, in which 1,158 metabolites were quantified, between 2000 and 2016. Average age and body mass index were 75.0 years and 27.7 kg/m<sup>2</sup>, respectively. Only 3% were current smokers. In the adjusted models, PM<sub>2.5</sub>, NO<sub>2</sub>, and temperature showed multiple statistically significant associations with several metabolites (40 metabolites for PM<sub>2.5</sub>, 100 metabolites for NO<sub>2</sub>, 1 metabolite for O<sub>3</sub>, and 14 metabolites for temperature). We identified eight metabolic pathways (glycerophospholipid, sphingolipid, glutathione, beta-alanine, pyrimidine, butanoate, propanoate, and methionine, cysteine, SAM and taurine metabolisms) perturbed with short-term exposure to air pollution and temperature. These pathways were involved in inflammation and oxidative stress, immunity, and nucleic acid damage and repair. **Conclusions:** We identified several significant metabolites and metabolic pathways associated with short-term exposure to air pollution and temperature; using an untargeted approach. This is the first study to report an untargeted metabolomic signature of temperature exposure, the first to use ICA, and the largest study to derive a metabolomic signature of air pollution.

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**P-0382**

**'No rain, no harvest, no food': Impacts of droughts on undernutrition among children aged under five in Ethiopia**

**Presenter:** Anna Dimitrova, Vienna Institute of Demography, Vienna, Austria

**Authors:** A. Dimitrova;  
Vienna Institute of Demography, Vienna, AUSTRIA.

Chronic seasonal crop and livestock loss due to heat stress and rainfall shortages can pose a serious threat to human health, especially in Sub-Saharan Africa where subsistence and small-scale farming dominate. Young children are particularly susceptible to undernutrition when households experience food insecurity because nutritional deficiencies affect their growth and development. With crop yields projected to be affected by climate change, this can potentially pose serious health impacts on children. However, the evidence is inconclusive and rather limited to small-scale local contexts. Furthermore, little is known about the differential impacts of climatic shocks on health of population subgroups. This study aims to investigate the impacts of climate variability on child health using data from three nationwide Demographic and Health Surveys (DHS) for Ethiopia conducted in 2005, 2011 and 2016 (n=22,467). Undernutrition, measured as stunting, wasting and being underweight among children under five, is used as a health indicator. Climate variability is measured by the Standardized Precipitation Evapotranspiration Index (SPEI), a multi-scalar drought index. This study finds a negative association between SPEI and the risk of stunting and being underweight, especially for children exposed to droughts during the first two years of life. The climate impacts vary with population subgroups whereby boys and children whose mothers have no formal education are more vulnerable to drought exposure. Those living in the rural area and whose households are engaged in agricultural activities are also more likely to be affected. This suggests that nutritional intervention should target these particularly vulnerable groups of children.

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Theme: **Climate change**

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**P-0383**

**Impact of Climate Change on Health & adaptation strategies in India**

**Presenter:** Sushil Singh, ICMR-NIREH, Bhopal, India

**Authors:** S. Singh, K. Soni, M. Sharma, R. Tiwari;  
ICMR-NIREH, Bhopal, INDIA.

Introduction: According to UNIDO, Climate Change is likely to have a greater impact on India compared to other countries, on account of the unique combination of its geography, diverse population characteristics and extremely high carbon-based energy dependence. Besides the vector borne diseases that could expand its occurrences, other infections that are related to varying temperature and humidity indices are also imminent threats to human health. With increasing pollution, respiratory diseases and allergies will be aggravated. Objective:- To know the climate change impacts and adaptation strategies on health in India. Method & Result:- Impact of climate change on human health can be increased mortality due to heat/cold waves, floods, droughts, cyclones, poisonous gases, and also increased health problems due to vectors, contaminated food and water, malnutrition due to reduced food production. Health adaptation strategies:•Develop disease profile of communities and weather based early warning systems•Up scaling of disaster management preparedness to check epidemic outbreaks•Early case detection and quick control with focus on areas where coverage is low or has not reached•Strengthening supportive systems for environment management•Public awareness on Health and Climate Change•Strengthening supply chain management•Capacity building of health personnel and institutions to integrate Climate Change Climate change and urbanization are changing the world and need to address the issues. There are a few examples of Indian cities for adaptation aspects as follows:- •Surat- Urban Health and Climate Resilience Centre•Ahmedabad- Heat Action Plan•Gorakhpur- Urban Community Based Micro Resilience Model•Panaji: Waste education for school children•Bhopal: Bus Rapid Transit System contributing to reduction in emissions. Conclusion: - Indian cities have started taking steps to address climate change mitigation and adaptation. Integrated Diseases Surveillance Programme is to be implemented

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Theme: **Climate, temp and mortality**

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**P-0384**

**Temporal change in minimum mortality temperature from 1969-2018: a multi-country multi-city study**

**Presenter:** Yeonseung Chung, Korea Advanced Institute of Science and Technology, Daejeon, Korea, Republic of

**Authors:** D. Yang<sup>1</sup>, Y. Chung<sup>1</sup>, T. Dang<sup>2</sup>, A. Tobias<sup>3</sup>, F. Sera<sup>4</sup>, A. Gasparrini<sup>4</sup>, B. Armstrong<sup>4</sup>, M. Hashizume<sup>5</sup>, Y. Honda<sup>6</sup>, O. behalf of the MCC collaborative network<sup>4</sup>;

<sup>1</sup>Korea Advanced Institute of Science and Technology, Daejeon, KOREA, REPUBLIC OF, <sup>2</sup>University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, VIET NAM, <sup>3</sup>Spanish Council for Scientific Research (CSIC), Barcelona, SPAIN, <sup>4</sup>London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM, <sup>5</sup>The University of Tokyo, Tokyo, JAPAN, <sup>6</sup>Tsukuba University, Tsukuba, JAPAN.

**Background:** Minimum mortality temperature (MMT) is an important indicator to assess the temperature-mortality association, indicating adaptation to climate. Limited evidence is available about the temporal change of the MMT and its determinants. **Methods:** We collected data for temperature and mortality from 478 cities in 20 countries from 1969-2018. We estimated time-varying temperature-mortality associations for each community, using a generalized linear model with Poisson distribution. We pooled the time-varying associations by country to derive the country-specific time-varying MMT using multivariate meta-regression and Monte Carlo simulation. We assessed the temporal trend of MMT and the effects of community-level indicators on the trend using random-effects meta-regression. **Results:** The temporal change of MMT varied by country, with some countries showing increasing trend (South Korea, Japan, Taiwan, UK, Netherlands, US) while others showed decreasing trend (Spain, Portugal, Romania, Czech, Estonia, Canada, Australia) or roughly constant trend (German, Swiss, Sweden, Norway, Finland, Ireland, Kuwait) over the last decades. Globally, the MMT has increased ( $p$ -value $<0.01$  for a linear trend). The country-specific MMT estimate ranged from 13.4 (95%CI: 7.9, 19.3) to 30.5 (12.2, 41.0) °C in 2000 while it ranged from 17.3 (13.2, 23.4) to 35.5 (25.4, 43.7) in 2010. Lower latitude (i.e., closer to the equator) and higher annual average temperature were associated with larger positive slope of linear trend of MMT ( $p$ -values $<0.01$ ). **Conclusions:** The temporal change of MMT varied by country. Population adaptation under climate change depends on country-specific factors and climate conditions. Future prediction of MMT should account for the country-specific and climate-dependent adaptation.

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**P-0385**

### **Burden of cause-specific mortality attributable to heat and cold: a multicity time-series study in Jiangsu Province, China**

**Presenter:** Yiqun Ma, Yale University, New Haven, United States

**Authors:** Y. Ma<sup>1</sup>, L. Zhou<sup>2</sup>, K. Chen<sup>1</sup>;

<sup>1</sup>Yale University, New Haven, CT, <sup>2</sup>Nanjing University of Information Science and Technology, Nanjing, CHINA.

**Background:** Previous epidemiological studies primarily examined the temperature-related all-cause mortality or mortality of cardiovascular diseases (CVD) and respiratory diseases. However, evidence on the heat- and cold-effect on mortality from other specific causes is limited. This paper aimed to systematically examine the association of heat and cold with a comprehensive spectrum of plausible causes of death, and to estimate the mortality burdens attributable to heat and cold in 11 cities in Jiangsu, China. **Methods:** Distributed lag non-linear models were applied to estimate city-specific temperature-mortality associations, and then meta-analysis was conducted to pool the estimates. **Results:** A total of 1,368,648 cases of death were included in this study. Both extreme heat and cold were associated with increased mortality risks from all-cause, CVD, respiratory diseases, nervous diseases, and external causes. Short-term exposure to extreme heat and cold were associated with excess burden of mortality for several specific diseases, accounting for 15.12% (95% eCI, 1.96-23.55%) for myocardial infarction, 14.26% (95% eCI, 10.62-16.74%) for stroke, 27.22% (95% eCI, 19.73-31.36%) for hypertensive heart disease, 25.79% (95% eCI, 16.74-30.68%) for chronic obstructive pulmonary disease, and 29.17% (95% eCI: 4.94-34.87%) for Alzheimer's and dementia. Diabetes was only associated with extreme heat, with 11.71% (95% eCI, 1.97-17.46%) of diabetes mortality attributable to heat. In total, 11.43% (95% eCI, 9.41-13.30%) of mortality was attributable to heat and cold, with 4.16% (95% eCI, 3.05-5.16%) attributable to heat and 7.27% (95% eCI, 5.82-8.50%) attributable to cold, and about 70% of this overall temperature-related mortality burden were found in 6 aforementioned specific causes and about 10% of mortality burden in external causes.

**Conclusions:** Extreme heat and/or cold are associated with increased risks of mortality from a wide range of causes, including previously identified causes in cardiorespiratory diseases and under-studied causes such as diabetes and Alzheimer's and dementia.

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Theme: **Climate, temp and mortality**

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**P-0386**

**Social inequalities differences in the association between summer temperatures and mortality in the city of Turin, northwest of Italy. A distributed lag non-linear time series analysis from 1982 to 2018**

**Presenter:** Marta Ellena, Ca' Foscari University, Venice, Italy

**Authors:** M. Ellena;  
Ca' Foscari University, Venice, ITALY.

Social inequalities differences in the association between summer temperatures and mortality in the city of Turin, northwest of Italy: a distributed lag non-linear time series analysis from 1982 to 2018  
Aim To investigate social inequalities in the association between summer temperatures and mortality in the city of Turin for the period 1982-2018. As a measure of and socioeconomic position, we used the educational level, the marital status, the employment status and the number of dwelling's occupants of the deceased, diversifying the analysis by gender and sub-categories.  
Methods Mortality data are represented by individual all-causes mortality counts for the summer periods from 1982 to 2018. Socioeconomic position and daily mean temperature were assigned to each deceased. A time series Poisson regression with distributed lag non-linear models was fitted to capture the complex nonlinear dependency between mortality and summer temperatures.  
Results The mortality risk grows with age in both genders, and we found a statistically significant association for all the age-groups. With regards to education, the higher risk corresponded to the highest educational levels. Temperature-mortality association was more evident for non-mate people than for married people, with higher risks for women. Results on the employment status highlighted a strong association over people retired from work and in people in other conditions. For the number of dwelling occupants, we found a strong association for those who lived in a crowded environment, followed by people who lived in an isolated context.  
Conclusions Associations between heat and mortality are unequal across different aspects of social vulnerability, and, inter alia, factors influencing the population vulnerability to temperatures can be related to demographic, social, and economic aspects. A better knowledge of these effect modifiers is needed to identify the axes of inequality across the most vulnerable population groups.

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**P-0387**

**Association between heat warnings and mortality among older adults in the United States**

**Presenter:** Kate R Weinberger, University of British Columbia, Vancouver, Canada

**Authors:** K. R. Weinberger<sup>1</sup>, K. R. Spangler<sup>2</sup>, M. N. Eliot<sup>3</sup>, G. Kalloo<sup>2</sup>, C. J. Gronlund<sup>4</sup>, M. S. O'Neill<sup>4</sup>, J. L. White-Newsome<sup>5</sup>, B. Anderson<sup>6</sup>, F. Dominici<sup>7</sup>, G. A. Wellenius<sup>2</sup>;

<sup>1</sup>University of British Columbia, Vancouver, BC, CANADA, <sup>2</sup>Boston University School of Public Health, Boston, MA, <sup>3</sup>Brown University School of Public Health, Providence, RI, <sup>4</sup>University of Michigan, Ann Arbor, MI, <sup>5</sup>The Kresge Foundation, Troy, MI, <sup>6</sup>Colorado State University, Fort Collins, CO, <sup>7</sup>Harvard T.H. Chan School of Public Health, Boston, MA.

Background: Heat warnings are issued in advance of forecast periods of extreme heat in order to protect the public's health. However, little evidence is available regarding their effectiveness in reducing mortality. We investigated the association between heat warnings and mortality among older adults living in populous counties across the United States, 2006-2016. Methods: In each county, we matched days with heat warnings to days without heat warnings on month and maximum heat index (within 2 degrees Fahrenheit). We additionally restricted the pool of potential days without heat warnings to those more than three days before or after a day with a heat warning. We used a log-linear mixed effect Poisson model with a random intercept for county to estimate the association between heat warnings and daily all-cause mortality counts among Medicare beneficiaries age 65 and older, adjusting for year, day of week, and federal holidays. Results: We identified at least one pair of days with and without heat warnings in 249 populous counties (defined as those with a 2010 population size greater than 250,000). Across these counties, we did not observe evidence of a reduction in mortality on heat warning days (percent change in risk of mortality comparing days with versus without heat warnings: -0.06 [95% confidence interval: -1.06, 0.95]). However, in a sub-analysis of counties with data on heat response plans, results varied by heat response plan presence and time period. Conclusions: Overall across the study counties we did not observe a lower risk of mortality on days with heat warnings, but our results provide initial evidence that the effectiveness of heat warnings may vary by county characteristics. The identification of factors associated with differing heat warning effectiveness is critical in light of projected future increases in temperature due to climate change.

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**P-0389**

**A study on the relationship between monthly temperature and cause of death in Kyoto and Sapporo, Japan from 1995 to 2017**

**Presenter:** Masao Kanamori, Ritsumeikan University, Kusatsu-city, Shiga-ken, Japan

**Authors:** M. Kanamori<sup>1</sup>, Y. Honda<sup>2</sup>;

<sup>1</sup>Ritsumeikan University, Kusatsu-city, Shiga-ken, JAPAN, <sup>2</sup>University of Tsukuba, Tsukuba-city, JAPAN.

**Aim:** To observe the effect of monthly temperature on mortality from non-communicable diseases (NCDs) such as cancer, cerebrovascular disease, respiratory disease and unintentional injuries (ICD-10 coding), we investigated monthly temperature and monthly death records in Kyoto, the central Japan, and in Sapporo, the northern area of Japan from 1995 to 2017. **Methods:** The observation period is divided into three periods from 1995-2002, 2003-2015, and after 2016. Then, a log-linear model of mortality was separately calculated in each period. We calculated adjusted mortality using the 2015 census data. The relationship between monthly mean of daily maximum temperature (DMT) and mortality was obtained by linear model using the logarithm of mortality as the dependent variable. **Results and Discussion:** The mortality from NCDs varied by disease and city. Cancer mortality due to cold was least affected. Injury mortality due to cold was different in both cities. RRs and 95 percent CIs at 3 percentile of monthly mean of DMT, 8.0 degrees Celsius in Kyoto and -2.0 degrees Celsius in Sapporo were as follows; Cerebrovascular diseases 1.40(1.17-1.63), 1.32(1.15-1.49); Heart diseases 1.74(1.51-1.97), 1.38(1.17-1.54); Respiratory diseases 1.54(1.34-1.74), 1.43(0.94-2.01); Malignant Tumor 1.07(0.98-1.16), 1.04(0.91-1.11); Unintentional injuries 3.12(2.10-4.13), 1.66(1.36-1.89). In Sapporo, seasonal changes tended to decrease with increasing winter temperatures. There are limited data on how rising temperatures affect deaths from injuries. **Conclusions:** Seasonal effect modification in cold was found to greatly affect the risks in lower temperature range. In Kyoto, the number of extremely hot summer days exceeding 35 degrees Celsius increases, and the daily maximum temperature rises. It is noteworthy that a slight increase in heart disease and injury mortality was observed in the summer. The relationship between injury mortality and abnormally warm temperatures needs to be investigated in detail. This work was supported by JSPS KAKENHI Grant Number JP17K01829.

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**P-0390**

**The effect of deforestation and climate change on all-cause mortality and unsafe work conditions due to heat exposure in Indonesia**

**Presenter:** June T. Spector, University of Washington, Seattle, United States

**Authors:** N. H. Wolff<sup>1</sup>, L. R. Zeppetello<sup>2</sup>, L. A. Parsons<sup>2</sup>, D. S. Battisti<sup>2</sup>, T. Kroeger<sup>3</sup>, Y. J. Masuda<sup>3</sup>, J. T. Spector<sup>2</sup>;

<sup>1</sup>The Nature Conservancy, Brunswick, ME, <sup>2</sup>University of Washington, Seattle, WA, <sup>3</sup>The Nature Conservancy, Arlington, VA.

Background: Previous studies that have focused primarily on urban, industrialized country settings have found that excess heat exposure can increase the risk of all cause mortality, heat-related illnesses, and occupational injuries. Little research has examined how the combined effects of deforestation and climate change on heat exposure can adversely impact population health and work conditions in low latitude, industrializing countries. Methods: We conducted a modeling study using data at 1km<sup>2</sup> resolution comparing 2002 and 2018 forest cover and temperature conditions in the Berau Regency, Indonesia. We used spatially explicit population data to estimate impacts of warming between 2002 and 2018, and after applying 1, 1.5, and 2°C of global warming to 2018 temperatures, on all-cause mortality and unsafe work conditions. Results: From 2002 to 2018, deforestation increased mean daily maximum temperatures by 0.95 (95% CI 0.92 to 0.97) °C. Mean daily temperatures increased by a population-weighted 0.86°C, accounting for an estimated 7.3%-8.5% of all-cause mortality in 2018. Unsafe work time increased by 0.31 (95% CI 0.30 to 0.32) hours per day in deforested areas compared to 0.03 (95% CI 0.03 to 0.04) hours per day in areas that maintained forests. Under 2°C of global warming, deforested areas may lead to an estimated 24% of all-cause mortality and result in up to five unsafe work hours per day compared to 2018. Conclusions: Heat effects from deforestation and climate change have already started affecting the health of populations in low-latitude, industrializing countries, and future warming may result in substantial additional health impacts.

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Theme: **Climate, temp and mortality**

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**P-0392**

**Potential effect modifiers of temperature variability-related mortality**

**Presenter:** Hayon Michelle Choi, Yale university, New Haven, United States

**Authors:** H. Choi<sup>1</sup>, W. Lee<sup>2</sup>, M. Bell<sup>1</sup>;

<sup>1</sup>Yale university, New Haven, CT, <sup>2</sup>Seoul National University, Seoul, KOREA, REPUBLIC OF.

Potential effect modifiers of temperature variability-related mortality  
**Background/Aim**In relation to climate change, extreme temperature events are known to be associated with increased mortality. Temperature variability (TV) is also known to increase the risk of human mortality. Several studies have reported various factors such as temperature, demographic characteristics, and local climate as potential modifiers of TV-mortality risk. However, there was a lack of comprehensive and potential modifiers at the community scale discussed. Since investigating potential modifiers may contribute to establishing better public health interventions, the study aims to investigate possible modifiers of temperature variability-related mortality using multinational datasets.  
**Methods**Daily mortality and weather data over 400 cities of 24 countries were collected. We calculated TV from the standard deviation of the minimum and maximum temperatures during the exposure days. Two-stage analyses were used to assess the relationship between TV and mortality. The meta-regression was used to assess the association between the potential modifiers and the TV-related mortality. The potential modifiers were grouped into three different categories: Climate, Air quality, and Socio-economic status. ResultsTV-mortality risk was modified by regional characteristics: average temperature variability, average temperature, regional climate, economic status, population, air pollutions, and environmental factors.  
**Conclusions**Community scale characteristics may modify the temperature variability-mortality relationship, and this study suggest the possible mechanisms of the modifiers.

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**P-0393**

**Urbanization and Vulnerability to Heat-Mortality: Different Roles of Urbanization between Urban and Rural Districts in South Korea; A Nationwide Time-series Study.**

**Presenter:** Whanhee Lee, Seoul National University, Seoul, Korea, Republic of

**Authors:** W. Lee<sup>1</sup>, M. Choi<sup>1</sup>, K. Ebi<sup>2</sup>, H. Kim<sup>1</sup>;

<sup>1</sup>Seoul National University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>University of Washington, Seattle, WA.

Background/Aim: Although urbanization has been an important topic in heat vulnerability studies, the complex role of urbanization, which can be different in urban and rural regions, has rarely been studied. We investigated the disparate roles of urbanization between urban and rural areas. Methods: We collected nationwide daily data for all 229 local authority districts in South Korea during 2011-2017. The districts were classified into urban (147 districts) and rural (82 districts) areas, based on the administrative districts. We applied three demographic variables (percentage of the urban population, population number, and population density) as urbanization indicators and also used medical-social environment indices to explain the role of urbanization. Results: There was no evident difference in the heat-mortality risk between urban and rural areas, and the role of urbanization was different in urban and rural areas; the higher urbanization level was associated with lower heat-mortality risk in rural areas, however, with lower heat-mortality risk in urban areas (i.e. the U-shaped relationship). The number of beds in hospital per person was associated with this U-shaped relationship, and the linkage was more evident in urban areas than in rural areas, and in the highest urbanized areas within urban areas. Meanwhile, the lower quality of health-related life and lower social gatherings were related to higher heat-mortality risk in rural areas. Conclusions: We found the urbanization level was linked in the opposite direction to the heat vulnerability in urban and rural areas, and the lower accessibility to hospital beds observed in rural and the highest urbanized areas was associated with higher heat vulnerability. Furthermore, regional indicators related to heat vulnerability were also heterogeneous between urban and rural areas. These results can contribute to understanding the complex role of urbanization in heat vulnerability and to establish evidence-based region-specific policies.

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## ABSTRACT E-BOOK

Theme: **Climate, temp and mortality**

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**P-0394**

**Does climatic zone of birth modify the temperature-mortality association of London inhabitants? An analysis during the warm period 2004-2013.**

**Presenter:** Dimitris Evangelopoulos, King's College London, London, United Kingdom

**Authors:** D. Evangelopoulos<sup>1</sup>, A. Analitis<sup>2</sup>, C. Giannakopoulos<sup>3</sup>, K. Katsouyanni<sup>1</sup>;

<sup>1</sup>King's College London, London, UNITED KINGDOM, <sup>2</sup>National and Kapodistrian University of Athens, Athens, GREECE, <sup>3</sup>National Observatory of Athens, Athens, GREECE.

**Background:** It is known that on days with high temperatures higher mortality is observed and there is a minimum mortality temperature (MMT) point which is higher in places with warmer climate. This indicates some population adaptation to local climate but information on how quickly this adaptation will occur under climate change is lacking.

**Methods:** To investigate this, we associated daily mortality data with temperature during the warm period in 2004-2013 for deaths among London inhabitants born in five climatic zones (UK, Tropical, Sub-tropical, Boreal and Mixed). We fitted Poisson regression with distributed-lag non-linear models for each climatic zone group separately to estimate group-specific exposure-response associations and MMTs. We report relative risks of death comparing the 95<sup>th</sup> percentile (21 °C) and maximum (25 °C) of the temperature distribution in London with the zone-specific minimum mortality temperature.

**Results:** No heat-related mortality was observed for people born in countries with Sub-tropical and Mixed climates. We observed an increase of 26%, 35% and 39% in the risk of death at 25 °C compared to the MMT in people born in the UK, Tropical and Boreal climate respectively. The minimum mortality temperatures in these groups ranged from 15.9 to 17.7 °C.

**Discussion:** Our findings imply that people born in different climatic zones do not adapt fully to their new environment within their lifetime. This implies that populations may not adapt readily to climate change and will suffer increased effects from heat. In the presence of climate change, policy makers should be aware of delayed process of adaptation.

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**P-0395**

**Temperature-Mortality Projections in Kuwait: The Immediate Future 2021-2060**

**Presenter:** Barrak Alahmad, Harvard T.H. Chan School of Public Health, Harvard University, Boston, United States

**Authors:** B. Alahmad<sup>1</sup>, W. Lee<sup>2</sup>, W. Bouhamra<sup>3</sup>, P. Koutrakis<sup>1</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Harvard University, Boston, MA, <sup>2</sup>Institute of Environmental Health, College of Public Health, National Taiwan University, Taipei, TAIWAN, <sup>3</sup>Gulf University for Science and Technology (GUST), Kuwait City, KUWAIT.

**Background-**A number of climate forecasting studies have shown that the Arabian Peninsula could be uninhabitable by the end of the century due to extreme hot temperatures that will exceed the threshold of human adaptability. However, these studies did not use country-specific mortality rates and assumed a business-as-usual climate change scenario (RCP8.5). We have done previous analyses in Kuwait using historical mortality data and found an alarming increase in the risk of all cause and cardiovascular mortality among vulnerable subpopulations within the range of current temperatures. **Objective-**We aimed to extend the temperature-mortality relationship into the immediate future climate from 2021 to 2060 in Kuwait under an intermediate emission scenario (RCP4.5), which is a reasonable scenario that considers some climate mitigation policies. **Methods-**We used an ensemble of 15 RCP4.5 models that forecasted future daily meteorological data from the CMIP5 initiative of the IPCC. We applied bias correction to the monthly temperature means using historical weather data from 2006 to 2016 obtained from Kuwait Airport. We constructed a time-series of historical and future daily average temperatures, and projected attributable excess mortality for cold and hot temperatures derived from distributed lag non-linear models compared to non-optimal temperatures. For this analysis, we made two key assumptions: no population change and no adaptation. **Results-**The average increase in mean temperature by 2060 is 1.84°C. Comparing the 2051-2060 period to the 2006-2016 historical period, the heat-attributable mortality will substantially increase in the future by 2.95% (95% empirical confidence interval [eCI]=0.15 to 9.41), whereas, the mortality due to cold weather will also increase, but with more uncertainty around the estimated percentage of relative excess mortality (3.31%, 95% eCI=-3.13 to 15.97). **Conclusions-**In inherently hot regions, we still see an increase in mortality burdens due to hot temperatures even for less extreme future climate scenarios.

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**P-0396**

**The physiological equivalent temperature (PET) Index and non-accidental and cardiovascular respiratory disease mortality in Ahvaz, Iran**

**Presenter:** Maryam Dastoorpoor, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, Islamic Republic of

**Authors:** M. Dastoorpoor<sup>1</sup>, N. Khodadadi<sup>1</sup>, N. Khanjani<sup>2</sup>;

<sup>1</sup>Ahvaz Jundishapur University of Medical Sciences, Ahvaz, IRAN, ISLAMIC REPUBLIC OF, <sup>2</sup>Kerman University of Medical Sciences, Kerman, IRAN, ISLAMIC REPUBLIC OF.

Background: Climate change may be associated with human morbidity and mortality through direct and indirect effects. Ahvaz is one of the hottest cities in the world. The aim of this study was to investigate the relation between Physiologically Equivalent Temperature (PET) and non-accidental, cardiovascular and respiratory disease mortality in Ahvaz, Iran. Methods: Distributed Lag Non-linear Models (DLNM) combined with quasi-Poisson regression were used to investigate the effect of PET on deaths. In this study the effect of time trend, air pollutants (NO<sub>2</sub>, SO<sub>2</sub> and PM<sub>10</sub>), and weekdays were adjusted. Results: The results showed that in cold stress (the PET index, 1st percentile (2.7 C°) relative to 25th percentile (11.9 C°)) the risk of non-accidental mortality in men and the 65-74 year olds; and also total respiratory mortality, respiratory mortality in men, in people under 65 and the 65-74 year olds; significantly decreased in the cumulative lags of 0, 0-2, 0-6 and 0-13. In contrast, heat stress (the PET index, 99th percentile (44.9 C°) relative to 75th percentile (43.4 C°)) significantly increased the risk of total cardiovascular mortality (CVD), cardiovascular mortality in men and the elderly, ischemic heart disease and cerebrovascular disease mortality in lags 0 and 0-2. Conclusions: It seems that high PET values increase the risk of cardiovascular mortality, while low PET values have a protective effect on mortality, especially respiratory mortality in Ahvaz.

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Theme: **Climate, temp and mortality**

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**P-0398**

**Impact of population aging on future temperature-related mortality under climate change: A multi-country multi-city study**

**Presenter:** Kai Chen, Yale School of Public Health, New Haven, United States

**Authors:** K. Chen<sup>1</sup>, F. Sera<sup>2</sup>, A. Gasparrini<sup>2</sup>, A. Vicedo-Cabrera<sup>3</sup>;

<sup>1</sup>Yale School of Public Health, New Haven, CT, <sup>2</sup>London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM, <sup>3</sup>Institute of Social and Preventive Medicine, and Oeschger Center for Climate Change Research, University of Bern, Bern, SWITZERLAND.

**Background** While many studies have projected future health impacts under climate change scenarios; limited research has quantified the impact of population aging on these projections. We aim to assess the impact of population aging on future temperature-related mortality under both climate and population changes in a multi-country multi-city setting.

**Methods** We collected daily data on meteorology and mortality from 729 cities in 42 countries from the MCC Collaborative Research Network. We estimated the city-specific temperature-mortality associations in two-stage time-series analyses using quasi-Poisson regression with distributed lag nonlinear models and multivariate meta-regression. We then obtained age-specific associations and bias-corrected temperatures from five general circulation models to estimate temperature-attributable fractions of mortality in the baseline (2010-2019) and future (2090-2099) under two climate-only scenarios (Representative Concentration Pathway (RCP4.5 and RCP8.5) and two combined climate-population scenarios (RCP4.5-Shared Socioeconomic Pathway (SSP)2 (low aging scenario) and RCP8.5-SSP5 (high aging scenario)), assuming no changes in population vulnerability. We quantified the impact of population aging as the difference in the change in attributable fractions (future minus baseline) between the RCP-specific pairs of climate-only and climate-population scenarios.

**Results** Preliminary results show that population aging will lead to an overall increase of 13.2% (95% CI: 5.0 to 18.9) in temperature-related mortality fractions in 2090-2099 compared with 2010-2019 under RCP4.5-SSP2. Under RCP8.5-SSP5, population aging will result in a substantial increase of 21.8% (-36.7 to 45.7) mortality fractions globally. Significant increases in mortality fractions due to population aging are found in most countries in North America, Europe, East Asia, and Australia, whereas positive but imprecise changes are observed in most countries in Central and South America, South Africa, Middle-East Asia, and South-East Asia.

**Conclusions** Our preliminary findings suggest that the progressive aging of the population will constitute an important driver for a larger impact of non-optimal temperatures under a warmer future climate.

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Theme: **Climate, temp and mortality**

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**P-0399**

**Heatwave-health vulnerability in Adelaide: Analysis of mortality and morbidity outcomes**

**Presenter:** Blesson Mathew Varghese, The University of Adelaide, Adelaide, Australia

**Authors:** B. M. Varghese<sup>1</sup>, M. Beaty<sup>2</sup>, P. Bi<sup>1</sup>, J. Nairn<sup>3</sup>;

<sup>1</sup>The University of Adelaide, Adelaide, AUSTRALIA, <sup>2</sup>Department of Health, Melbourne, AUSTRALIA,

<sup>3</sup>Australian Bureau of Meteorology, Adelaide, AUSTRALIA.

Background: Heatwaves are of increasing concern due to its impacts on population health (mortality/morbidity). As heatwave-impacts varies between populations and locations, evidence concerning the places and people vulnerable at a local level is critical for effective policy, planning, and interventions, especially in a warming climate. This study part of a larger national research aimed to investigate heatwave-associated mortality and morbidity (using general practitioner-GP visits) in Adelaide and identify the drivers of heatwave-vulnerability. Methods: Data on mortality (2007-2017), GP visits (2011-2016), heatwaves (Excess Heat Factor-EHF), and vulnerability factors (socio-demographic, health-risk, and environmental) were obtained from the Australian Bureau of Statistics, Bureau of Meteorology, and Geoscience Australia. Heatwave effects on mortality and morbidity outcomes at the Statistical Area Level 2 (SA2) geography (representing suburbs) were estimated using a case-crossover design. Results are reported as relative risks (RRs) in heatwaves periods compared with non-heatwave periods. Effect modification by individual- and area-level factors were also assessed. Results: Mortality increased during heatwaves (RR 1.08; 95%CI: 1.04-1.12) but varied spatially. Higher RRs were found in areas with a greater proportion of renters, inaccessibilities (access to vehicle/internet), less vegetation, newer houses, and prevalence of respiratory and psychological diseases. Risks were elevated among individuals with limited English-speaking ability, diabetes, asthma/chronic obstructive pulmonary diseases and those using antidepressants, anxiolytics and sedative medications. Preliminary analysis of GP visits with EHF reveals a significant decrease in GP visits (RR 0.98; 95%CI:0.98-0.99) during low-intensity heatwaves, which increased during severe/extreme heatwaves (RR 1.14; 95%CI: 1.13-1.15). Analysis of the individual- and area-level drivers of heatwave-related GP visits is ongoing. Conclusions: Our results, leveraging a substantive person and area-level dataset, show that heatwaves increase mortality and place a greater burden on primary care services (GPs) in Adelaide. Attention to the spectrum of identified heatwave-vulnerability drivers is key for developing effective and efficient prevention strategies.

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**P-0400**

**How the impact of heat and cold on mortality has changed in Switzerland during the last 50 years: a nationwide analysis.**

**Presenter:** Evan de Schrijver, 1.Institute of Social and Preventive Medicine, university of Bern. 2.Oeschger Center for Climate Change Research (OCCR), University of Bern, Bern, Switzerland

**Authors:** E. de Schrijver<sup>1</sup>, M. Bundo<sup>1</sup>, M. S. Ragettli<sup>2</sup>, F. Sera<sup>3</sup>, A. Gasparrini<sup>3</sup>, O. H. Franco<sup>4</sup>, A. M. Vicedo-Cabrera<sup>1</sup>;

<sup>1</sup>Institute of Social and Preventive Medicine, university of Bern. 2.Oeschger Center for Climate Change Research (OCCR), University of Bern, Bern, SWITZERLAND, <sup>2</sup>1.Swiss Tropical and Public Health Institute, Basel, Switzerland . 2.University of Basel, Basel, SWITZERLAND, <sup>3</sup>Department of Public Health, Environments and Society, London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM, <sup>4</sup>Institute of Social and Preventive Medicine, university of Bern, Bern, SWITZERLAND.

Background: Although previous studies quantified the effect of non-optimal ambient temperatures on mortality, many were limited to urban areas and short periods of time. By applying state-of-the-art methodologies and high-resolution nationwide data available in Switzerland, we aimed to assess trends in mortality attributable to heat and cold during the last five decades across the full Swiss geography. Methods: We collected daily mortality and derived population-weighted daily mean temperature from 2.2km-grid maps for each Swiss municipality between 1969 and 2017. We performed separate time series analyses with conditional quasi-Poisson regression and distributed lag non-linear models to obtain the corresponding temperature-mortality associations for each Canton and decade. We then pooled them through multivariate longitudinal meta-regression and calculated the corresponding excess mortality attributable to non-optimal temperatures. The analysis was repeated across categories of sex, age and main causes. Results: Between 1969 and 2017, overall all-cause excess mortality associated to non-optimal temperatures was 6.24%(95%CI,5.58-6.78) which translates into 3,714 annual excess deaths. Cold-related mortality represented a larger fraction compared to heat (5.89%(95%CI,5.26-6.42), versus 0.36%(95%CI,0.30-0.40)), amounting to 3,588 and 218 annual deaths, respectively. Cold-related mortality increased over the last five decades (5.17% to 6.43%) while for heat an increasing trend was observed until 1998 (0.23% to 0.40%), when it reached a plateau to present years. Similar trends were observed for sex, age and main causes. Conclusion: This first Swiss-wide study found a substantial mortality burden attributed to non-optimal temperatures. Despite the progressive warming of climate, our findings suggest that heat-related mortality remained constant during the last two decades possibly due to the recent implementation of public health measures, while cold-related mortality, which represents a larger burden, increased during the last 50 years. Future analyses will seek to identify potential vulnerability factors and adaptive mechanisms to non-optimal temperatures in Switzerland.

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**P-0405**

**Vulnerability patterns to heat and cold across Europe: a spatial two stage analysis of temperature-mortality risks in 800 urban areas**

**Presenter:** Ana Maria Vicedo Cabrera, University of Bern - Institute of Social and Preventive Medicine, Bern, Switzerland

**Authors:** A. Vicedo Cabrera<sup>1</sup>, R. Schneider dos Santos<sup>2</sup>, F. Sera<sup>2</sup>, A. Gasparrini<sup>2</sup>;

<sup>1</sup>University of Bern - Institute of Social and Preventive Medicine, Bern, SWITZERLAND, <sup>2</sup>London School of Hygiene and Tropical Medicine, London, UNITED KINGDOM.

Background: Despite efforts of previous multi-location studies to characterize temperature vulnerability patterns across large regions, evidence on spatial variation of risks and its drivers remains patchy, as geographical coverage was limited to locations with available observed health data. This study offers a comprehensive geographical assessment of the differences in vulnerability to non-optimal temperature across a representative sample of 800 European cities. Methods: We firstly estimated the exposure-response associations in 150 cities of 14 European countries for which observed daily temperature-mortality data was collected in the MCC Collaborative Research Network. Second, we developed a novel spatial multivariate meta-regression model that characterizes risk in terms measurable meta-predictors and residual spatial structures. The meta-predictors were represented by city-level factors available in the European Union (EU) database Urban Data Platform (UDP), including environmental, socio-economic, and infrastructural characteristics. We then used the selected meta-regression model to predict temperature-mortality associations in the 800 cities, with a full coverage of the EU region. Results: The predicted mortality risks showed large geographical heterogeneity across Europe, with relative risks in the range 1.00-2.30 for heat and 1.22-2.07 for cold, respectively. Heat-related mortality displayed a clear geographical distribution, with an increasing North-South gradient and a high-risk area in Central Europe, while a more diffuse pattern was observed for cold. The geographical variation is largely explained by a set of meta-predictors, specifically gross domestic product, annual levels of particulate matter, and access to green areas. Conclusions: This first EU-wide analysis on temperature-related mortality provided a comprehensive picture of the geographical distribution of vulnerability to heat and cold. We found clear geographical differences in risks associated with non-optimal temperature, with the identification of areas of high vulnerability. These differences seem partly explained by measurable urban characteristics. These findings can contribute to the design and implementation of EU-wide public health and climate policies.

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**P-0406**

### **Projection of temperature-related total and cardiovascular mortality under different climate and population scenarios by the end of the 21<sup>st</sup> century in Bavaria, Germany**

**Presenter:** Masna Rai, Helmholtz Zentrum München-German Research Centre for Environment and Health, Munich, Germany

**Authors:** M. Rai<sup>1</sup>, S. Breitner<sup>1</sup>, K. Wolf<sup>1</sup>, A. Peters<sup>1</sup>, A. Schneider<sup>1</sup>, K. Chen<sup>2</sup>;

<sup>1</sup>Helmholtz Zentrum München-German Research Centre for Environment and Health, Munich, GERMANY,

<sup>2</sup>Yale School of Public Health, New Haven, CT.

Background: Global warming is anticipated to result in larger heat- but less cold-related mortality. Thus, it remains unclear whether the net temperature-related mortality burden will increase in the future. We aimed to project the heat-, cold-, and net temperature-related total and cardiovascular mortality across five Bavarian districts. Methods: We applied location- and age-specific exposure-response functions (ERFs) to project temperature-related mortality during the future period 2083-2099 compared to the baseline period 1990-2006 under combinations of five climate (constant climate, Representative Concentration Pathway [RCP]2.6, RCP4.5, RCP6.0, RCP8.5) and six population scenarios(constant population, Shared Socioeconomic Pathway [SSP]1, SSP2, SSP3, SSP4, SSP5) assuming no adaptation. We further performed projections using location-specific overall all-age ERFs.Results: The net temperature-related mortality increased under most scenarios with the highest increment under SSP5-RCP8.5 by 19.61% (95% empirical CI(eCI): 11.78, 30.91) for total and 11.24% (95%eCI: 1.04, 23.29) for cardiovascular mortality. When considering the age-effect and population aging, even under a favourable SSP2-RCP2.6 scenario, the net-mortality increased by 9.33% (95%eCI: 5.94, 12.76). In contrast, when not accounted for, net-mortality decreased by 0.23% (95%eCI: -0.64, 0.14). This was similarly observed for cardiovascular mortality. Furthermore, the climate-only effect was inconsiderable, whereas the population-only effect showed a high, up to 17.35% (95%eCI: 11.46, 22.70) increment in total deaths. Likewise, the increments in cardiovascular mortality under SSP5-constant climate (11.47% (95%eCI: 2.58, 19.57)) and SSP5-RCP8.5 (11.24% (95%eCI: 1.04, 23.29)) were similar.Conclusion: The elderly population, highly vulnerable to both heat and cold, is projected to be about four folds the younger population. Thus, the combined effect of global warming and population aging contributed to a projected increase in temperature-related total and cardiovascular deaths for all SSP-RCP scenarios. The population-effect dominated the climate-effect. Mitigation, age- and cause-specific adaptation strategies targeting the vulnerable groups might greatly reduce the future temperature-related mortality burden.

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**P-0407**

**Variation in heat-related mortality risks: a longitudinal global analysis**

**Presenter:** Francesco Sera, London School of Hygiene and Tropical Medicine, London, United Kingdom

**Authors:** F. Sera, K. Arbutnott, A. Haines, A. Gasparri;  
London School of Hygiene and Tropical Medicine, London, UNITED KINGDOM.

Background/Aim: The analysis of temporal variation in heat and cold related mortality is important in understanding potential population adaptation to temperature effects. While studies have examined temporal changes in specific locations, no study has provided an assessment at a global scale. In this contribution, we used a two-stage longitudinal design to evaluate and describe the reduction of the heat-related mortality (HRM) in 37 countries. Methods: We collected daily time series of mortality and mean temperature between 1990 and 2016 in 725 locations nested in 37 countries. For each city, we fitted a quasi-Poisson model with distributed lag non-linear model for temperature (lag 3 days) in 3-year subsets of the data. At the second-stage we used multilevel-multivariate meta-regression models to evaluate the effects of time-periods and countries on the derived set of splines coefficients. The modelled splines coefficients were used to estimate country and period specific 99th percentile relative risk (RR) relative to country-specific median daily temperature and heat-related attributable fractions (AF%). Results: The multilevel-multivariate meta-regression indicated that heat-related mortality risk trend is heterogeneous across countries ( $p < 0.001$ ). A declining trend of heat-related AF% (yearly AF% change) was found for Switzerland (-0.17%), Netherlands (-0.09%), France (-0.06%), Spain (-0.05%), Portugal (-0.05%), Japan (-0.05%) and US (-0.014%), Australia (-0.07%), South Korea (-0.04%), Brazil (-0.04%), Norway (-0.02%), Canada (-0.03%), Mexico (-0.03%), Germany (-0.02%); while a tendency for an increasing trend was observed in UK (+0.02%), Finland (+0.10), Estonia (+0.05), Peru (+0.32%) Chile (+0.31%), Italy (+0.05%) and Greece (+0.22%). Conclusion: We found that while HRM reduced in some populations over time, other populations experienced little or no attenuation in heat related risk. Understanding this heterogeneity can give valuable insights into potential differences in adaptation, important for public health planning and policy in the context of climate change. On behalf of the MCC Collaborative Research Network

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**P-0409**

**Temperature-mortality associations by age and cause: a multi-country multi-city study**

**Presenter:** Antonio Gasparinni, London School of Hygiene & Tropical Medicine, London, United Kingdom

**Authors:** N. Scovronick<sup>1</sup>, F. Sera<sup>2</sup>, A. Gasparinni<sup>2</sup>;

<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM.

Studies have consistently identified differences in temperature-mortality relationships by age and cause of death. However, evidence is sparse, mostly coming from investigations with limited geographical scope and using disparate epidemiological designs. Here, we assess this issue using data from 537 cities in 33 countries from the Multi-Country Multi-City (MCC) Collaborative Research Network. We apply a flexible two-stage design. In the first stage, we estimated age and cause-specific temperature-mortality associations by location using distributed lag non-linear models. In the second stage, for each cause, we pooled location-specific estimates in novel dose-response multivariate meta-regressions, allowing modelling continuous age-varying risks from different age grouping across locations. Pooled heat-related relative risks (RR) for 99th and 1st percentile versus minimum mortality temperature (MMT), were 1.14 (95%CI:1.09-1.20) for cardiovascular, 1.27 (95%CI:1.16-1.38) for respiratory, and 1.11 (95%CI:1.07-1.15) for other causes. Corresponding RR for cold (1st percentile versus MMT) were 1.39 (95%CI:1.32, 1.46), 1.33 (95%CI:1.24-1.43), and 1.17 (95%CI:1.13-1.20), respectively. Age-specific risks showed differential patterns by cause. Predicted heat-related RR for 25 and 75-year-olds increased from 1.06 to 1.11 for cardiovascular, but they were stable across age groups for respiratory and other causes. The picture was different for cold, with strong age-trends for cardiovascular (1.13 to 1.40) and other causes (1.02 to 1.16), while no variation by age was found for respiratory mortality. There is evidence of higher heat-related risks in high versus low income countries, especially at young age. This study found important differences in temperature-related mortality by age and cause across the globe. Associations were higher for respiratory causes, compared to cardiovascular, but present for other causes as well. Age differences were stronger for cold-related mortality, with older people more at risk in particular for cardiovascular causes, while respiratory mortality showed no age patterns for either heat or cold. On behalf of the MCC Collaborative Research Network

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**P-0410**

**Anomalously warm temperatures are associated with increased injury deaths**

**Presenter:** Robbie M Parks, The Earth Institute, Columbia University, New York, United States

**Authors:** R. M. Parks<sup>1</sup>, J. E. Bennett<sup>2</sup>, H. Tamura-Wicks<sup>2</sup>, V. Kontis<sup>2</sup>, R. Toumi<sup>3</sup>, G. Danaei<sup>4</sup>, M. Ezzati<sup>2</sup>;  
<sup>1</sup>The Earth Institute, Columbia University, New York, NY, <sup>2</sup>MRC Centre for Environment and Health, Imperial College London, London, UNITED KINGDOM, <sup>3</sup>Space and Atmospheric Physics, Imperial College London, London, UNITED KINGDOM, <sup>4</sup>Harvard T.H. Chan School of Public Health, Boston, MA.

Temperatures that deviate from the long-term local norm affect human health, and are projected to become more frequent as the global climate changes. There are limited data on how such anomalies affect deaths from injuries. In the present study, we used data on mortality and temperature over 38 years (1980-2017) in the contiguous USA and formulated a Bayesian spatio-temporal model to quantify how anomalous temperatures, defined as deviations of monthly temperature from the local average monthly temperature over the entire analysis period, affect deaths from unintentional (transport, falls and drownings) and intentional (assault and suicide) injuries, by age group and sex. We found that a 1.5 °C anomalously warm year, as envisioned under the Paris Climate Agreement, would be associated with an estimated 1,601 (95% credible interval 1,430-1,776) additional injury deaths. Of these additional deaths, 84% would occur in males, mostly in adolescence to middle age. These would comprise increases in deaths from drownings, transport, assault and suicide, offset partly by a decline in deaths from falls in older ages. The findings demonstrate the need for targeted interventions against injuries during periods of anomalously warm temperatures, especially as these episodes are likely to increase with global climate change.

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## ABSTRACT E-BOOK

Theme: **Climate, temp and mortality**

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**P-0411**

**Temperature and morbimortality due to respiratory and cardiovascular diseases in Brazil and future impacts by global warming scenarios**

**Presenter:** Ludmilla V Jacobson, Fiocruz, Rio de Janeiro, Brazil

**Authors:** L. V. Jacobson<sup>1</sup>, B. Oliveira<sup>1</sup>, I. Silveira<sup>2</sup>, W. Junger<sup>2</sup>, A. Gasparini<sup>3</sup>, S. Hacon<sup>1</sup>;  
<sup>1</sup>Fiocruz, Rio de Janeiro, BRAZIL, <sup>2</sup>UERJ, Rio de Janeiro, BRAZIL, <sup>3</sup>London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM.

**Aim:**This study aims to evaluate the association between temperature and morbimortality due to respiratory and cardiovascular diseases in the Brazilian capitals cities in the baseline period from 2000 to 2010 and to evaluate the future impacts of this relationship according to Global Warming scenarios of 1.5°C, 2°C and 4°C. **Methods:**It was an ecological time-series study in the 26 Brazilian capitals cities and the Federal District. Health outcomes were daily counts of deaths and daily counts of hospital admissions due to respiratory diseases in the elderly aged 60 or more, and cardiovascular diseases in adults aged 45 or more. The exposure variable was the daily mean temperature from ERA-INTERIM reanalysis project. The associations were estimated from a two-stage time series analysis method. The results were presented as overall effects of 21 days for mortality and overall effects of 7 days for hospitalization. The impact projections were calculated using the daily mean temperature modelled from the Eta-HadGEM2S Regional Model, projected to rise in the future RCP8.5 scenario. The following periods for the Global Climate Change were considered: (i) baseline - 1965 to 2005; (ii) Global warming of 1.5°C - 2010 to 2039; (iii) Global warming of 2°C - 2040 to 2069; Global warming of 4°C - 2070 to 2099. We assumed a constant population growth for the future projections. **Results and Conclusions:**Our results suggest that climate change has the potential to produce a substantial increase in mortality and hospital admissions related to the association of temperature with respiratory and cardiovascular outcomes in the target population in most Brazil capital cities. Projections about the impact will be of increased hospitalizations and deaths attributable to temperature, as global warming increases, especially the increment in the excess of deaths attributable to extreme heat.

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Theme: COVID

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**P-0413**

### **Sociodemographic characteristics associated with influenza vaccination among adults in the United States**

**Presenter:** Sericea Stallings-Smith, University of North Florida, Jacksonville, United States

**Authors:** Sericea Stallings-Smith DrPH, Carley Robinson MPH, and Grace Kambach MPH Candidate

Background: Media attention surrounding COVID-19 has resulted in public demand for a vaccine. However, it is uncertain why many adults do not get vaccinated for seasonal influenza despite its effectiveness in reducing illness, medical visits, and mortality. Aim: The aim of this study was to investigate the association between sociodemographic characteristics and self-reported uptake of influenza vaccine within the past 12 months among a representative sample of adults ages  $\geq 18$  years in the United States. Methods: Data were obtained from the Behavioral Risk Factor Surveillance System (BRFSS) for 2018. Multivariable logistic regression was utilized to investigate the association between the sociodemographic exposures of age, sex, race, education level, income, and the outcome of influenza vaccine uptake. Statistical models were adjusted for demographic factors, as applicable. Sample weights were included to account for the complex survey design of the BRFSS. Results: The study population included 416,934 participants of whom 51% were female, 64% were Non-Hispanic White, and 51% earned an income of  $\geq \$50,000$ . When compared to ages 18-24 years, influenza vaccination was increasingly more likely for older age groups, with participants  $\geq 65$  years having the highest odds of vaccination (odds ratio [OR]=4.20; 95% confidence interval [CI]=3.97-4.45). When compared to males, females had higher odds of influenza vaccine uptake (OR=1.25; 95% CI=1.22-1.29). All racial groups except Asian participants were less likely to get an influenza vaccine when compared to Non-Hispanic Whites. Lower odds of influenza vaccination were observed among participants with less than high school (adjusted OR [aOR]=0.71; 95% CI=0.68-0.73) or high school education (aOR=0.71; 95% CI=0.67-0.74) and among all income groups who earned  $< \$50,000$ . Conclusions: Influenza vaccination uptake is lower among young adults, males, individuals with a high school education or less, and an income  $< \$50,000$ . Educational efforts regarding the importance and safety of influenza vaccination should target these specified groups.

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Theme: **COVID**

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**P-0414**

**corona viral disease: a threat to global health, economy and political stability**

**Presenter:** Motunrayo Dasuki, Reynolds construction company, Ibadan, Nigeria

**Authors:** M. Dasuki;  
Reynolds construction company, Ibadan, NIGERIA.

Coronavirus is a group of viruses that cause several types of respiratory disease, such as mers and sars. The current outbreak, which began in the Chinese province of Wuhan in december, is a novel strain, dubbed 2019-nCoV. Unlike the previous viral disease outbreaks that were easily contained, this current covid 19 is significant because of its' rapid spread and high mortality rate therefore WHO declared a state of emergency on the disease. Covid 19=  $I \leq 1.5m (d1, d2, d3, d4 \dots dn)$ . Where I=index case, 1.5 metres distance is the magnetic field outside which the susceptibility of contact to be infected by the virus is reduced. If thorough interventions are not deployed and cultural practices that promote good health emphasized, spread is inevitable. Boarder porosity is a major spread factor especially in African countries where borders are not well manned, not all boarders are legal. This can enhance the transmission of this deadly disease. Africa's porous land borders remain a cause for concern among policy makers and health professionals, who fear that unchecked migration and transport between countries could spread the virus quickly. Also religious practices could enhance the spread of the deadly disease. Prayer pattern in some religions around the world encourages crowding and clustering of people together. Climate change definitely has an impact on the outbreak of infectious diseases says Eike Hertig at the University of Augsburg Germany. Political systems will also be hampered. It is unique because it can be transmitted through election materials. Crowding and clustering cannot be divorced from electioneering. International observers for elections will not be free to cross countries to authenticate electioneering process. Economic shortage cannot be avoided, according to a report published on the 9<sup>th</sup> of March 2020, 'the state giant oil Saudi Aramco led financial losses, dropping by 10% on Riyadh's Tadawul stock exchange.

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**P-0416**

**Assessing population needs for more COVID-19 information across New York State**

**Presenter:** Wil Lieberman-Cribbin, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** W. Lieberman-Cribbin, N. Alpert, E. Taioli;  
Icahn School of Medicine at Mount Sinai, New York, NY.

Background: The novel coronavirus (COVID-19) is a potentially fatal respiratory infection that originated in Wuhan, China in December 2019 and has since rapidly spread around the world causing widespread concern. New York State (NYS) currently has 142 confirmed cases. As the number of confirmed cases and those quarantined have increased, individuals have relied on public resources to learn about COVID-19. We analyzed trends in NYS and New York City (NYC) data to quantify COVID-19 related concerns. Methods: Data from NYC 311 Call Center Inquiry was downloaded from the NYC Open Data website (12/1/2019-3/10/20) to provide information about COVID-19 related calls across NYC. This dataset contains the date of the call and a brief description. Calls containing the keyword: "Coronavirus" were included. Additionally, the "interest over time" of the search term "Coronavirus" across NYS was extracted from Google Trends from 12/1/19 to 3/10/2020. Results: 1955 COVID-19 related calls were placed to 311, constituting 0.14% of all 311 calls in this time period. The proportion of COVID-19 related calls increased over time: January: 51 [0.011% of all 311 calls]; February: 783 [0.195%]; March: 1121 [1.054%]. The majority of calls sought information on COVID-19 (52.5%), with subsets gathering information regarding recent travel to Hubei Province in China (825 calls, 42.2%) and the Middle East (103 calls, 5.27%). This spike in 311 calls parallels an increase in "interest over time" of "Coronavirus" across NYS according to Google Trends, which has exponentially increased since the end of February 2020, and has peaked at the time of abstract submission. Conclusion: Interest in and queries about COVID-19 have increased sharply since December 2019, culminating in a current peak of information-seeking behavior across NYS and NYC. Accordingly, it is vital that public health officials provide clear and up-to-date information about protective measures and health related protocols.

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Theme: **COVID**

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**P-0418**

### **Spatial distribution of COVID-19 importation risk in South Asia against health emergency preparedness capacity and vulnerability**

**Presenter:** Sakib Imtiaz, Ronin Institute, Montclair, United States

**Authors:** S. Imtiaz;  
Ronin Institute, Montclair, NJ.

The 2019 novel coronavirus outbreak has become a global security threat that requires both national and regional level preparedness and response mechanism. This study aims to assess the relative risk of importation of COVID-19 against the capacity and vulnerability of South Asian countries, specifically the member countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka) of the South Asian Association for Regional Cooperation (SAARC). Capacity of the South Asian countries to detect and respond to COVID-19 outbreak was determined using the WHO International Health Regulations (IHR) Monitoring and Evaluation Framework. Assessment includes the average scores of the indicators from all capacities, excluding those of the capacities on food safety, chemical events, and radiation emergency. Vulnerability of these countries to such type of disease has been determined by the Infectious Disease Vulnerability Index. Prediction of the risk of case importation is based on the data on volume of air travel departing from airports in top ten COVID-19 infected countries and directed to the countries of South Asia. Number of infected individuals in each of the country included all confirmed cases recorded until March 04, 2020 in order to calculate the relative risk of case importation. The study presents a comparative analysis among the countries based on their risk, capacity and vulnerability. Among the South Asian countries, India, the country with highest importation risk has highest capacity to respond to outbreaks. Afghanistan is the most vulnerable country which has lowest risk of case importation, whereas it has the second lowest capacity. On the other hand, Nepal has the lowest capacity with moderate risk. Bhutan shows no risk of case importation. IHR indicator analysis indicates highest vulnerable countries need to focus more on the improvement of their capacity on health service provision, legislation and financing, risk communication, and points of entry.

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Theme: **COVID**

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**P-0419**

### **Relationships between Local Vegetation Level and Human Mobility Patterns during COVID-19 for Maryland, USA**

**Presenter:** Seulkee Heo, Yale University, New Haven, United States

**Authors:** S. Heo, M. L. Bell;  
Yale University, New Haven, CT.

Background: Human mobility is a significant factor for disease transmission. Little is known about if built environment influence mobility during the COVID-19 pandemic. We investigated a potential effect of local vegetation level on mobility reductions during the COVID-19 pandemic in Maryland, USA. Methods: Our study regions included 193 minor civil divisions (MCDs) in Maryland. We obtained mobility data from Facebook Data for Good, which aggregate information of people using Facebook app on their mobile phones with location history active. The user's movement between two locations during a given time window at the 4.9km by 4.9km spatial scale was used to calculate the number of users traveled into a region for each day between March 11, 2020 and April 26, 2020. The mobility change for a region for each day was estimated as percent change in the number of users traveling into that region in the daytime (8am - 4pm) compared to the average number of users traveled into that region during the same daytime window and the same day of the week between February 24, 2020 and March 10, 2020. Each MCD's vegetation level was estimated as the average Enhanced Vegetation Index level through January 1, 2020 and March 31, 2020. Results: Among 193 study regions, user's movement were observed in 53 regions, which had higher population and percent impervious area. The daily percent changes in the number of users traveling into those 53 regions declined during the study period. This mobility reduction was significantly higher in regions with the lowest level of EVI indicating lower vegetation level (p-value=0.041). Conclusions: Mobility reduction during the COVID-19 pandemic in Maryland was less in regions with higher vegetation level. Future studies will need to investigate changes in health effects of green space during a pandemic and who are disproportionately affected by such changes.

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Theme: **COVID**

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**P-0420**

**The COVID-19 Pandemic and the Need to Advance in Science Communication**

**Presenter:** Frederico Peres, FIOCRUZ, Rio de Janeiro, Brazil

**Authors:** F. Peres;  
FIOCRUZ, Rio de Janeiro, BRAZIL.

### ABSTRACT

The COVID-19 pandemic is a major challenge that has as one of its key-determinants the ability to adequately communicate with different population groups and institutions on a global scale. In this context, science communication is strategic to engage people into risk management, damage mitigation and recovery initiatives. This presentation aims to identify major scientific literacy demands of health and risk messages on COVID-19 from official campaigns designed by international organizations and leading institutions such as the World Health Organization (WHO), the Centers for Disease and Control (CDC) and the United Nations (UN). A health literacy load analysis was performed and contextualized in the current global scenario of science and health communications, characterized by extreme political and ideological polarization, the influence of behavioral cognitive biases and the amplified dissemination of fake news, influencing the way in which individuals seek, comprehend, evaluate and make meaning of relevant information about the pandemic. As a coping strategy, there is an urgent need to advance in science communication in terms of their health and scientific literacy demands, considering the existing polarized context and the determinants of trust among different population groups from different parts of the globe. One strategy is to promote the creation of cultural circuits that facilitate the signification processes of health and risk messages on COVID-19 among different population groups, during the crisis and in the post-crisis, opening a truly dialogic process between academics, communicators, practitioners, authorities and communities. Otherwise, the only substantial knowledge produced in the scope of this unprecedented pandemic will be the correct way to wash hands. Key words: Science Communication; COVID-19; Health Literacy.

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## ABSTRACT E-BOOK

Theme: COVID

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**P-0421**

### IMPACT OF COVID-19 AND STRICT HOME CONFINEMENT RELATED CHANGES IN AIR POLLUTION, NOISE, AND PHYSICAL ACTIVITY ON CARDIOVASCULAR HEALTH FOR BARCELONA CITIZENS

**Presenter:** Sarah Koch, Barcelona Institute of Global Health (ISGlobal), Barcelona, Spain

**Authors:** S. Koch, S. Khomenko, M. Cirach, M. Ubalde-Lopez, L. Hidalgo, G. Vich, C. Daher, M. Nieuwenhuijsen;  
Barcelona Institute of Global Health (ISGlobal), Barcelona, SPAIN.

**Background:** To decelerate the infection rate of the coronavirus disease 2019 (COVID-19), the Spanish Government implemented strict home confinement measures. Within weeks, changes in environmental exposures and health behaviours were observed. We aimed to estimate the impact of COVID-19 related changes in air pollution, noise and physical activity exposures on cardiovascular health for Barcelona-citizens.

**Methods:** In a quantitative health impact assessment for Barcelona residents (age $\geq$ 20 years; n=1,361,973), we assessed the impact of changes in nitrogen dioxide (NO<sub>2</sub>) as a proxy for air pollution, and walking-related physical activity on the incidence of stroke and myocardial infarction (MI) events for the period of strict home confinement from 15<sup>th</sup> March to 25<sup>th</sup> April 2020. Additionally, we assessed the impact of changes in road-traffic noise on annoyance, a known short-term effect associated with cardiovascular health when noise reductions are maintained for longer periods.

**Results:** During confinement, NO<sub>2</sub> levels were reduced by 59% (95% CI: 52-64%) at a mean concentration of 13 $\mu$ g/m<sup>3</sup> (SD:4.7 $\mu$ g/m<sup>3</sup>). Physical activity dropped by 94% (SD: 2.2%). We estimated that 1% (95% CI: 1-2%) of expected stroke and 2% (95% CI: 2-3%) of expected MI events were avoided due to the decrease in NO<sub>2</sub>. In contrast, an additional 9% of expected stroke (95% CI: 0-20%) and MI events (95%CI: 3-16%), respectively, were estimated due to the decrease in physical activity. Noise levels were reduced by 9% (SD: 0.1%), averaging at 59dB L<sub>den</sub> (SD: 2.5dB L<sub>den</sub>), which was estimated to reduce the percentage of highly annoyed citizens by 45% (SD: 3.0%).

**Conclusions:** The health impact of the drastic reduction in physical activity appears to outweigh the reduction in NO<sub>2</sub> on stroke and MI events during six weeks of strict home confinement. Long-term effects of noise reductions on stroke and MI events via a decrease in noise-annoyance still needs to be further assessed.

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**P-0422**

### **Environmental Cadmium, Influenza-related Mortality in U.S. Adults, and Implications for the COVID-19 Pandemic**

**Presenter:** Howard Hu, University of Washington School of Public Health, Seattle, United States

**Authors:** H. Hu<sup>1</sup>, C. Sack<sup>1</sup>, M. Sirén<sup>2</sup>, S. Park<sup>3</sup>;

<sup>1</sup>University of Washington School of Public Health, Seattle, WA, <sup>2</sup>JGK Memorial Research Library, Helsinki, FINLAND, <sup>3</sup>University of Michigan School of Public Health, Ann Arbor, MI.

**Background/Aim:** Cadmium exposure is widespread, accumulates in the body, triggers pulmonary inflammation, is associated with decrements in respiratory function, and has been shown to enhance lung injury by respiratory syncytial virus. Our aim was to examine the association of cadmium burden with influenza-related mortality in U.S. adults. **Methods:** This prospective cohort study of the National Health and Nutrition Examination Survey (NHANES) included 7179 and 8682 participants aged 45 years and older enrolled from NHANES-3 and NHANES 1999-2006, respectively. Associations were evaluated between urinary and blood concentrations of cadmium and mortality from influenza and pneumonia during a median follow-up of 17.3 years (NHANES-3) and 11.4 years (NHANES 1999-2006). Survey-weighted Cox proportional hazard models were used to compute hazard ratios (HRs) comparing the mortality experience of individuals at the 80<sup>th</sup> v. the 20<sup>th</sup> percentile of the distribution of cadmium biomarker levels. **Results:** In NHANES-3 (141 deaths from influenza/pneumonia, incidence rate=1.24 per 1000 person-years), creatinine-corrected cadmium was associated with a hazard ratio (HR) of 1.16 (95% CI, 1.07-1.26; P=0.0004) after adjustment for age, sex, race/ethnicity, education, body mass index, serum cholesterol, and hypertension. The HR was 1.23 (95% CI, 1.07-1.43; P=0.005) when the analysis was restricted to never smokers. In NHANES 1999-2006 (56 deaths from influenza/pneumonia, incidence rate=0.59 per 1000 person-years), blood cadmium was associated with an adjusted HR of 1.16 (95% CI, 0.98-1.37; P=0.08); and 1.69 (95% CI, 0.97-2.97; P=0.07) in never smokers. The pooled HRs combining both datasets were 1.16 (95% CI, 1.08-1.25); and 1.26 (95% CI, 1.09-1.45) in never smokers. **Conclusions and Relevance:** Higher cadmium burden is associated with higher mortality from influenza/ pneumonia among middle-aged and older adults in the US general population. Higher cadmium burdens may also worsen outcomes from COVID-19 infections.

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**P-0423**

**Tactical Urbanism for COVID-19, Equity, and Health**

**Presenter:** David Rojas-Rueda, Colorado State University, Fort Collins, United States

**Authors:** D. Rojas-Rueda;  
Colorado State University, Fort Collins, CO.

Tactical Urbanism for COVID-19, equity, and health Background. The COVID-19 pandemic has impacted daily-life activities around the world. Several countries have implemented mitigation strategies (MS) to reduce COVID-19 transmission (e.g., physical distancing, stay-at-home orders, reduced large gatherings). Urban built environment interventions, through tactical urbanism (TU), can support COVID-19 MS and, at the same time, promote equity and healthy urban design. Aim. Develop a conceptual framework and guidance for tactical urbanism to support COVID-19 mitigation strategies and opportunities for equity and urban health. Methods. Conceptual framework and critical analysis. Results. COVID-19 MS has reduced motorized traffic, improving air quality, traffic noise, and traffic incidents. MS has also reduced access to public spaces translating into less physical activity opportunities. Vulnerable populations, such as the elderly, socially deprived communities, and people with underlying health conditions, have been reported to be more impacted by COVID-19. TU interventions like expanding sidewalks and bike lanes; implementing temporary open streets; lowering speed limits; promoting biking and bike-share; designating bike shops as essential services; shifting from actuated to fixed traffic signals; adjusting traffic signal timing; establishing on-sidewalk queuing and dedicated delivering/loading zones; restricting access to areas where physical distancing is not possible; prioritizing active and public transport (PT) for essential workers; implementing PT back-door boarding and waived fares; providing clear and accessible TU signaling; providing transport access to testing sites and other services beyond cars; providing homeless shelter; and prioritizing TU for vulnerable communities, among others, can help reduce COVID-19 transmission and promote a healthy and equitable urban design. Conclusions. Tactical urbanism offers an opportunity to support COVID-19 mitigation strategies and provide co-benefits reducing risk factors of non-communicable diseases, traffic incidents, and the need for health services. Tactical urbanism interventions should be prioritized for vulnerable communities and considered as a low-cost, short-term action with a vision for long-term interventions.

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**P-0424**

### Characterizing the Relationship between Social Determinants of Health and Air Quality

**Presenter:** Ram Gouripeddi, University of Utah, Salt Lake City, United States

**Authors:** L. Hall, R. Gouripeddi;  
University of Utah, Salt Lake City, UT.

**Background:** Much of health is determined by peoples' social determinants of health (SDH) and environments. Understanding them gives a more realistic model for risk stratification and the true complexity of patient populations, which may lead to more effective patient, family, and community engagement. For example, in the current COVID-19 pandemic African Americans are experiencing worse outcomes due to existing medical issues, less access to healthcare, and a higher likelihood to work unstable jobs. At the same time, there is likely an increased severity in COVID-19 cases following long-term exposure to air pollution. The objective of this study was to find relationships between SDH and environmental factors independent of a particular disease.

**Methods:** Using the Factors Affecting Communities and Enabling Targeted Services model, we compiled SDH data for Utah census tracts from the American Community Survey data for the years 2012-2016. We assigned daily air quality measurements (AQ) for each of these census tracts based on the closest Environmental Protection Agency monitoring station. We performed clustering on the cleaned dataset using the Python package scikit-learn and visualized the obtained clusters with Tableau. We used the elbow method to obtain an optimum number of clusters and used the values for each variable in the clusters' centroid to discover relationships between SDH and environment. **Results:** We obtained 10 distinct clusters of SDH and AQ. Clusters of census tracts with bad air tended to have higher proportions of individuals who were non-white, non-college educated, lower income, and lacking insurance.

**Conclusion:** This analysis suggests a tangible relationship between poor AQ and SDH. Next steps include using modeled AQ data for finer spatial granularity and expanding timeframe and locations. The relationship between SDH and AQ irrespective of the disease is worth exploring further. The whole is more than the sum of its parts.

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Theme: COVID

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**P-0425**

**Ultraviolet radiation decreases COVID-19 growth rates: Global causal estimates and seasonal implications**

**Presenter:** Jonathan Proctor, Harvard University, Cambridge, United States

**Authors:** J. Proctor;  
Harvard University, Cambridge, MA.

Nearly every country is combating the 2019 novel coronavirus (COVID-19). A central concern is whether COVID-19 transmission exhibits seasonality. If so, changing environmental conditions in coming months may shift COVID-19 infection patterns around the world. We estimate a relationship between growth of confirmed cases of COVID-19 and local environmental conditions by combining the most spatially-disaggregated global dataset of daily cases assembled to date, consisting of 3,235 administrative units across 173 countries, with a statistical model isolating random variation in daily weather conditions. Our analysis indicates a strong effect of ultraviolet radiation (UV) on daily COVID-19 growth rates: a 1 kJ m<sup>-2</sup> increase in hourly UV decreases the growth rate of confirmed COVID-19 cases by .09 percentage points ( $\pm 0.04$ ,  $p = .01$ ), with a delayed effect that manifests over two weeks. We find weak or inconsistent lagged effects of local temperature, specific humidity, and precipitation. To illustrate the seasonal implications of our findings with respect to UV, we show that estimated UV effects imply decreases in COVID-19 growth rates of 1.18 percentage points ( $\pm 0.47$ ) in the extra-tropical Northern Hemisphere and increases of 2.1 percentage points ( $\pm 0.83$ ) in the extra-tropical Southern Hemisphere between April and July 2020. Seasonality in UV dictates the inverse pattern for January 2021, with COVID-19 growth rates rising by 5.5 percentage points ( $\pm 2.18$ ) in the extratropical Northern Hemisphere and falling by 4.82 percentage points ( $\pm 1.91$ ) in the extra-tropical Southern Hemisphere, relative to April 2020. These effects are substantial when compared to the average in-sample COVID-19 growth rate of 13.21 percent. The total seasonal effect of all climate variables investigated is indeterminate in sign due to uncertainty in the effects of temperature and specific humidity. Although many factors will influence future COVID transmission, our findings suggest a need for adjustment of COVID-19 containment policies for the seasonality of UV.

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**P-0426**

### **Applying Mixtures Methods to Characterize Immune Response Patterns among High versus Low Risk COVID-19 Patients in New York City**

**Presenter:** Eva M Tanner, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** E. M. Tanner, S. Busgang, C. Berin, C. Gennings;  
Icahn School of Medicine at Mount Sinai, New York, NY.

Background: Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the novel SARS-CoV-2. In severe cases progression to hyperinflammation and death may occur. Some patients may be at increased risk of severe disease due to altered immune function from environmentally-linked chronic conditions (e.g., diabetes, COPD, asthma, obesity, hypertension, kidney-disease, cancer). Aim: Characterize patterns of immune response in relation to mortality among COVID-19 patients and evaluate differences by chronic risk-factors. Methods: We estimated an Immune Response Index (IRI) using Weighted Quantile Sum (WQS) regression to evaluate the association between 6 immune markers (interleukin-6 (IL-6), D-dimer, ferritin, neutrophils, monocytes, and the inverse of lymphocyte count) measured at hospital encounter in relation to mortality among 922 COVID-19 positive patients, ages 18-89 years, within a New York City hospital system. We hypothesized higher biomarker levels would be related to poorer outcomes and randomly split data into 40% training and 60% validation sets. Models were adjusted for age, sex, vitals, and low vs high risk groups. Stratified/interaction WQS was used to assess differences in weights and the IRI between risk groups. Results: The IRI was significantly associated with mortality ( $p=0.033$ ). Three markers accounted for 80% of the weights: IL-6 (36%), monocytes (27%), and inverse-lymphocytes (17%). There was no evidence of different IRI slopes (interaction) by risk group ( $p=0.443$ ). However, the stratified WQS analysis showed a significant association between the stratified IRI and mortality ( $p=0.007$ ), with the high-risk group accounting for 59% of the weights, and discordant immune marker weights across the risk groups. IL-6 (30%) and D-dimer (13%) were important among the high-risk group, whereas IL-6 (12%) and inverse-lymphocytes (11%) was important among the low risk group. Conclusions: Higher levels of immune markers were related to higher mortality among COVID-19 patients, but key immune markers may differ between those with and without chronic conditions.

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**P-0427**

**Exposure to COVID-19: is there a disproportionate burden on low-paid jobs in France?**

**Presenter:** Emilie Counil, Ined - French Institute for Demographic Studies, Aubervilliers, France

**Authors:** E. Counil, N. Ghoroubi, M. Khlal;  
Ined - French Institute for Demographic Studies, Aubervilliers, FRANCE.

Although a majority of COVID-19 victims are among the elderly, workers holding low-paid jobs in the essential service sectors and those who are more likely to trade their health for economic reasons may be particularly exposed. Our aim is to gather existing data suggesting a disproportionate burden of the epidemic on the lower income categories. We focus on the situation of France, which has been hard hit. Workers highly exposed to the risk of COVID-19 infection are those who routinely have close face-to-face contacts with the public/colleagues, and/or exposure to infectious agents. Prior knowledge on usual working conditions can help us highlight at-risk occupations and related risks outside the work environment during the epidemic. We analysed national data on working conditions (CT2013), exposure to occupational hazards (SUMER2017) and a flash survey conducted during the lockdown. Before the lockdown (mid-March 2020), at least 8.8 million of workers were highly exposed to Covid-19 in France. There were however sharp disparities across occupational groups. As high as 41% of the bottom quarter of earners belonged to the highly exposed group, as opposed to 12% of the top quarter of earners. Apart from health care workers and first responders, other frontline workers with low-pay such as cleaners, personal aids and cashiers are among the most exposed. The situation has yet changed during the lockdown, with teleworking, reduced hours/layoffs, and type and timing of protective measures taken by employers. Lower salary workers have been highly exposed to the risk of COVID-19 infection. They may carry a heavy health burden related to the current crisis, especially when not sufficiently protected. Their occupational risks are further compounded by their transportation and housing conditions, along with comorbidities and access to healthcare. This lays ground to greater spread and severity of the disease among working-age and older working-class adults.

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**P-0428**

**COVID-19, ambient air pollution, and environmental health inequities in Latin American cities**

**Presenter:** Josiah L Kephart, Drexel University, Philadelphia, United States

**Authors:** J. L. Kephart<sup>1</sup>, I. Avila-Palencia<sup>1</sup>, U. Bilal<sup>1</sup>, N. Gouveia<sup>2</sup>, W. T. Caiaffa<sup>3</sup>, A. V. Diez Roux<sup>1</sup>;

<sup>1</sup>Drexel University, Philadelphia, PA, <sup>2</sup>University of São Paulo Medical School, São Paulo, BRAZIL,

<sup>3</sup>Universidade Federal de Minas Gerais, Belo Horizonte, BRAZIL.

**Background:** The incidence of SARS-CoV-2 is growing in Latin American cities, where air pollution exposures and chronic diseases are often distributed inequitably. Long-term exposure to ambient air pollution has been linked to more severe COVID-19 outcomes. **Objectives:** For four major Latin American cities, we compared ambient fine particulate matter (PM<sub>2.5</sub>) concentrations during COVID-19-related lockdowns with previous years. We estimated the impact on adult mortality if current ambient PM<sub>2.5</sub> reductions were maintained long-term. **Methods:** We compared PM<sub>2.5</sub> concentrations during the first week of COVID-19-related school closures in 2020 with the same period during 2017 - 2019 in Lima, São Paulo, Santiago, and Mexico City. For each city, we estimated the impact on adult mortality if long-term PM<sub>2.5</sub> concentrations were lower proportional to the COVID-19-related reductions observed in 2020. **Discussion:** In all four cities, weekly ambient PM<sub>2.5</sub> was lower during the first week of COVID-19 school closures compared to previous years, ranging from -41% in Lima to -5% in Mexico City. In a counterfactual scenario where long-term, annual ambient PM<sub>2.5</sub> was reduced proportionally to these levels, all-cause mortality among adults aged  $\geq 30$  years would be substantially reduced: 7% lower in Lima (95% confidence interval [CI] 4% to 9%); 3% lower in São Paulo (95% CI 2% to 4%) and Santiago (95% CI 2% to 4%); and 0.6% lower in Mexico City (95% CI 0.4% to 0.8%). Ambient air pollution is responsible for 145,000 deaths annually in the region, and these deaths are often distributed inequitably. Previous efforts to reduce ambient air pollution have faced resistance due to perceived economic cost. As national and municipal governments look to relax COVID-19 restrictions while prioritizing public health, there is a critical window of opportunity to implement policies which reduce ambient air pollution, prevent chronic disease, and promote health equity in the region.

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**P-0429**

**Results on PPE access and impacts of COVID-19 in a diverse population of workers.**

**Presenter:** Irva Hertz-Picciotto, University of California, Davis, Davis, United States

**Authors:** I. Hertz-Picciotto, N. Nardone, C. Burlaza;  
University of California, Davis, Davis, CA.

Background: SARS-CoV2 (COVID-19) is the first major pandemic in 100 years. Knowledgeable experts for decades have warned about increasing spillover of novel infectious agents into human populations. The cause is clear: accelerated human encroachment into previously wildland areas reduces natural habitats, forcing new species, some carrying dangerous microbes, into closer contact with people. That this trend would produce a deadly pandemic with quick, uncontrolled spread was considered inevitable. Yet most countries were ill-prepared for the scale and intensity of this viral pandemic, which departed China in January and has reached every country.

Methods: An online survey was launched in May 2020 in the US, to document critical needs of frontline workers and the economic and family impacts on all workers, including those laid off and those working remotely. Frontline workers include a wide range of occupations including health care, food production and distribution, warehouses, retail, transportation, firefighting, police and security services, postal service, social services, home care, and some government programs. The survey includes questions about COVID-19 symptoms and testing; contact with infected persons; employment status both prior to and after March 15, industry, changes in employment, contact with the public and with co-workers, access to personal protective equipment (PPE) and other infection control measures implemented by employers; size of household, health of household members, changes to their daily lives; concerns and stresses, including financial; deaths from COVID of relatives, friends, and acquaintances; and knowledge of protective behaviors. The survey is publicized through unions, social media, associations of non-unionized workers, and other outreach.

Results: The targeted study population is large and diverse. Access to PPE, handwashing opportunities, and physical distancing will be reported by region, industry, job and demographics.

Conclusions: Findings will highlight areas of deficiency or neglect in public health systems and identify industries and jobs of highest vulnerability.

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**P-0430**

**Impact of air pollution on SARS-CoV-2 induced health outcomes - a systematic review**

**Presenter:** Regina Pickford, Helmholtz Center Munich - German Research Center for Environmental Health, Neuherberg, Germany

**Authors:** R. Pickford<sup>1</sup>, M. Woeckel<sup>1</sup>, A. Schneider<sup>1</sup>, A. Peters<sup>2</sup>;

<sup>1</sup>Helmholtz Center Munich - German Research Center for Environmental Health, Neuherberg, GERMANY,

<sup>2</sup>Helmholtz Center Munich - German Research Center for Environmental Health; Ludwig-Maximilians-Universität, Munich, Neuherberg, GERMANY.

**Background/Aim:** Several authors suggested that ambient factors, such as ambient air pollution or outdoor air temperature, might be related to the number of cases and fatalities regarding the recently discovered Severe Acute Respiratory Syndrome CoronaVirus 2 (SARS-CoV-2). Despite the rapidly increasing number of publications associations between these environmental stimuli and SARS-CoV-2 are still controversial. **Methods:** We will conduct a systematic literature review with a focus on the following hypotheses: i) High levels of ambient air pollution impair the immune defence and make humans more vulnerable to SARS-CoV-2. ii) Ambient air pollution and / or non-optimal ambient temperatures lead to (chronic) diseases which make the human body more vulnerable to SARS-CoV-2. iii) Ambient air pollutants actively transport viruses. iv) Climatic conditions like temperature or humidity affect SARS-CoV-2 related health conditions and/or have an impact on the survival of the virus in the environment. Due to the differing quality of the studies, many of which have been published with great speed, a focus will be on the quality assessment of the studies. **Results:** Currently, the number of published studies varies extremely, with the lowest number of publications for hypothesis iv). This review will give a systematic overview on the strength and robustness of the suggested hypotheses. **Conclusions:** Although there already seems to be scientific evidence implying that environmental factors such as air pollutants or air temperature impact SARS-CoV-2 related health outcomes, there is the need for further research with high quality to improve and strengthen the knowledge on these associations.

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**P-0431**

**COVID-19 national lockdown in Morocco: impacts on air quality and public health**

**Presenter:** Kenza KHOMSI, Morocco Weather Service, Casablanca, Morocco

**Authors:** K. KHOMSI;  
Morocco Weather Service, Casablanca, MOROCCO.

On 20/04/2020, 2 403 410 cases of the corona Virus were confirmed globally. The number of Morocco confirmed cases attended 2990, while 12 746 were suspected and 143 deaths were recorded. Due to the pandemic of coronavirus disease 2019 worldwide and in Morocco, almost all avoidable activities in the country are prohibited since the kingdom announced activities reduction on March 16, 2020 and then general lockdown with reduced industrial activities on March 20, 2020. This study aims at comparing the air quality status in Casablanca and Marrakech, two large cities from Morocco, before the crisis and during the lockdown situation to show whether COVID-19 forced-industrial and anthropogenic activities lockdown may have saved lives by preventing ambient air pollution than by preventing infection. We first applied a difference-in-difference approach to quantify air pollution changes in both cities due to the quarantine, then we compared reported COVID-19 mortality rate figures with the mortality rate due to poor air quality which reached 7% due to high levels of NO<sub>2</sub>, PM<sub>10</sub>, O<sub>3</sub> and SO<sub>2</sub> in Morocco. We found that, due to the quarantine, studied pollutants dropped drastically in Casablanca and Marrakech causing avoidable deaths related to air pollution to increase.

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**P-0432**

**Physical distancing due to the COVID-19 pandemic and exposome changes in the general population of Cyprus: The Exposome@Home|COVID-19 study**

**Presenter:** Konstantinos C. Makris, Cyprus University of Technology, Limassol, Cyprus

**Authors:** X. D. Andrianou, C. Konstantinou, A. Constantinou, C. A. Christophi, K. C. Makris; Cyprus University of Technology, Limassol, CYPRUS.

**Introduction:** To address the COVID-19 pandemic, non-pharmacological interventions (NPI) were implemented in Cyprus, including school closures, suspension of mass events, closures of dining and recreation areas and extensive physical distancing measures e.g. restrictions in outdoor activities and travel. **Objectives:** The objectives of this study were to: i) assess exposome changes of the general Cypriot population during the implementation of these physical distancing measures and afterwards, and ii) to describe the degree of compliance to the NPI measures. **Methods:** A survey was setup to take place in two phases (two questionnaires), i.e. when physical distancing measures were implemented (Phase A - March-April 2020) and after the end of all NPI measures (Phase B). Eligible participants were adults living at least 1 year in urban areas of the Republic of Cyprus. Questionnaires were designed to comprehensively capture exposome components such as socioeconomic status, lifestyle (e.g. physical activity), routine exposures (e.g. cleaning activities, time spent outdoors) and contacts at home/other environments (e.g. work). **Results and Discussion:** In total, 604 respondents completed the survey during Phase A (599 fulfilled the eligibility criteria). Based on preliminary analysis of the respondents characteristics, the majority were females (60%), reporting a fulltime job (66%) and being in very good health. The number of contacts at home and at work decreased during physical distancing. The median number of persons characterized as regular contacts at home was 2 and 3 during and before the measures, respectively, while majority of participants reported no physical contact with others at work during the measures (median number of contacts at work before the measures was 15). Phase A results presented the degree of compliance to the physical distancing measures, while changes in a suite of lifestyle and behavioural parameters of the human exposome, under the influence of physical distancing, were determined.

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**P-0433**

**Indoor & outdoor PM<sub>2.5</sub> concentrations in Chennai, India prior to & during the COVID-19 lockdown**

**Presenter:** Naveen Puttaswamy, Sri Ramachandra Institute of Higher Education and Research, Chennai, India

**Authors:** N. Puttaswamy<sup>1</sup>, R. Sutaria<sup>2</sup>, A. Pillarisetti<sup>3</sup>, B. Veerapan<sup>1</sup>, S. Saidam<sup>1</sup>, K. Mukhopadhyay<sup>1</sup>, S. Sambandam<sup>1</sup>, K. Balakrishnan<sup>1</sup>;

<sup>1</sup>Sri Ramachandra Institute of Higher Education and Research, Chennai, INDIA, <sup>2</sup>Respirer Living Sciences Private Limited, Mumbai, INDIA, <sup>3</sup>Emory University, Atlanta, GA.

**Background:** The Tamil Nadu Air Pollution and Health Effects follow-up study, known as TAPHE-2, is evaluating the relationship between air pollution and birth outcomes in a rural-urban cohort of 300 pregnant mothers. Due to COVID-19 related lockdowns, TAPHE-2 work has been delayed; however, continuous indoor and outdoor air monitoring data are available prior to and during the COVID-19 lockdown in and around Chennai, India.

**Methods:** Indoor concentrations of PM<sub>2.5</sub> are being measured in peri-urban Chennai, India, using Atmos, a relatively low-cost, real-time PM<sub>2.5</sub> monitor developed in India. Continuous indoor measurements are validated and calibrated by periodic collocation with gravimetric samplers. Additionally, we looked at public air quality data from Indian authorities. The combined dataset provides semi-continuous indoor and outdoor measurements before and during the lockdown.

**Results:** In six households, data exists on average for 11.6 days (SD 9.4) pre-lockdown, and for 37 days (SD 0) during the lockdown. During these periods, the mean uncorrected real-time PM<sub>2.5</sub> concentrations are 36 µg/m<sup>3</sup> (SD 40) and 24 µg/m<sup>3</sup> (SD 18), respectively. Self-reported time activity patterns - verified by changes in PM concentrations measured by the Atmos - are different, with notable changes in indoor concentrations. Ambient concentrations prior to and during the lockdown, as reported by Indian regulatory monitors in Chennai, are 38 µg/m<sup>3</sup> (SD 25) and 20 µg/m<sup>3</sup> (SD 27), respectively. There is a reasonable correlation between indoor Atmos measurements and gravimetric measurements ( $R^2 = 0.84$ ).

**Conclusions:** We took advantage of ongoing measurements to evaluate the impact of the COVID19-related lockdown on indoor and outdoor PM<sub>2.5</sub> concentrations. We note changes in time-activity patterns and indoor and outdoor concentrations of PM<sub>2.5</sub> across Chennai. Raw data from the Atmos monitor has a reasonably good correlation with gravimetric measures, indicating its potential suitability for studies of both indoor and outdoor PM concentrations.

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**P-0434**

### Epidemiology of SARS-CoV-2 Antibodies among Firefighters/Paramedics of a U.S. Fire Department

**Presenter:** Alberto Juan Caban-Martinez, University of Miami, Miller School of Medicine, Miami, United States

**Authors:** A. J. Caban-Martinez, N. Schaefer Solle, K. M. Santiago, P. Louzado Feliciano, A. Brotons, M. Gonzalez, S. Issenberg, E. N. Kobetz-Kerman; University of Miami, Miller School of Medicine, Miami, FL.

**Background/Aim:** Given the high risk of hazardous biological exposures encountered by first responders during routine patient rescue, it is critically important that fire departments have access to accurate up-to-date information on workforce exposure, infection, and illness to inform the best possible decisions while serving their communities. We estimate the point seroprevalence of SARS-CoV-2 antibodies in a frontline firefighter/paramedic workforce of a South Florida fire department located in the epicenter of a State outbreak.

**Methods:** A cross-sectional study design was used to estimate the point seroprevalence of SARS-CoV-2 antibodies using a rapid IgM-IgG combined point-of-care lateral flow immunoassay among frontline firefighters/paramedics collected over a two-day period, April 16-17, 2020. Fire department personnel were emailed a survey link assessing COVID-19 symptoms and work exposures the day prior to the scheduled drive through antibody testing at a designated fire station. Off- and on-duty firefighter/paramedic personnel drove through the fire station/training facility in their personal vehicles or on-duty engine/rescue trucks for SARS-CoV-2 antibody testing. Three firefighters/paramedics did not participate because of scheduled vacation or religious reasons.

**Results:** Among the 203 firefighters/paramedics that make up the fire department workforce, 18 firefighters/paramedics (8.9%) tested positive for SARS-CoV-2 antibodies of which 8 firefighters/paramedics (3.9%) were IgG positive only, 8 (3.9%) were IgM positive only, and 2 (0.1%) were IgG/IgM positive. The proportion of firefighters/paramedics who reported symptoms in the 2 weeks prior to antibody testing was greater among those who were positive compared to firefighters/paramedics who were antibody negative (22.2% vs. 7.7%;  $p=0.041$ ). None of the antibody positive firefighters/paramedics reported receipt of the annual flu vaccine compared to firefighters/paramedics who tested negative for SARS-CoV-2 antibodies (0.0% vs. 21.0%;  $p=.031$ ).

**Conclusions:** Rapid SARS-CoV-2 IgM-IgG antibody testing documented early- and late-stage infection in a firefighter workforce providing insight to a broader medical surveillance project on return to work for firefighters/paramedics.

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**P-0435**

**Using standardized incidence ratios to compare rates of pre-existing conditions among 7,162 people seeking care for COVID-19 at US hospitals from 2/12 - 3/28/2020**

**Presenter:** Albert H Donnay, Donnay Detoxicology LLC, Hyattsville, United States

**Authors:** A. H. Donnay;  
Donnay Detoxicology LLC, Hyattsville, MD.

Background/Aim: Protecting people at higher risk of severe COVID-19 by keeping them away from front-line jobs requires data on the risks associated with pre-existing conditions (PEC). We derived standardized incidence ratios (SIR) for “never smokers” and seven PEC for which the Centers for Disease Control (CDC) reported only unadjusted numbers in a study of 7,162 people treated for COVID-19 at U.S. hospitals in 50 states, 4 territories and Washington DC. Methods: For each PEC, we calculated the SIR overall—and for emergency departments (ED), intensive care units (ICU) and non-intensive care (non-ICU)—by dividing the observed rates that CDC reported by estimates of their prevalence among US adults. We used CDC estimates for chronic diseases of kidney (CKD), liver (CLD), and lung, diabetes mellitus (DM), cardiovascular and immunocompromised conditions, pregnancy (PRG), and current (CS) and former smoking (FS). We also added three categories for never smokers: with PEC (NS+), without (NS-), and combined (NS=). Results: Of 48 SIR, 43 were statistically significant at  $p < 0.001$ . Overall, more cases than expected were NS+[SIR=1.93], NS=[1.48], NS-[1.31], PRG [1.72], CKD [1.35] or DM [1.15]. Only NS+ and NS= also were over-represented in all care settings, with highest NS+[3.97] in ICU, second only to CKD [5.57]. Only CS and FS were under-represented overall [0.10 and 0.11] and in all care settings [CS:0.08-0.15, FS:0.07-0.34]. The difference between CS and NS+ was greatest in ICU, where NS+ SIR was 50.1 times that of CS. Conclusions: At highest risk of seeking care for COVID-19—and most in need of protection—are NS+, PRG, CKD, and DM. At lowest risk are CS and, to a lesser degree, FS, making them better suited for front-line jobs. These findings are consistent with French and Chinese COVID-19 studies and literature showing both exogenous and endogenous carbon monoxide protect against infection.

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**P-0436**

**Short-term exposure to air pollution, temperature and humidity and COVID-19 cases and mortality in 3,140 counties of the United States**

**Presenter:** Adjani A Peralta, Harvard University, Boston, United States

**Authors:** A. A. Peralta<sup>1</sup>, M. Danesh Yazdi<sup>1</sup>, H. Aminib<sup>2</sup>, J. Schwartz<sup>1</sup>;  
<sup>1</sup>Harvard University, Boston, MA, <sup>2</sup>University of Copenhagen, Copenhagen, DENMARK.

Background: In the United States, the first confirmed COVID-19 (Corona Virus Disease 2019) case was reported on January 21, 2020 in Washington State and has since continued to spread. Objective: To study the association of air pollution, temperature and relative humidity with the number of COVID-19 cases and deaths in the United States. Methods: Time-series analysis using a quasi-Poisson regression. Overall, 3,140 counties in the contiguous United States were included once two or more cases were identified between January 21<sup>st</sup> and April 30<sup>th</sup>, 2020. Daily air pollution forecasts and observations on PM<sub>2.5</sub>, NO<sub>2</sub> and O<sub>3</sub> were obtained from satellite data (CAMS and S5). Daily mean temperature and relative humidity were computed from the gridMET dataset on a 4-km x 4-km grids. We analyzed the association between daily numbers of cases and deaths attributed to confirmed COVID-19 with day of exposure and averages up to 7 days prior. Results: For each unit increase in pollutants, we found the following % higher or lower risk (95% CIs) for cases: CAMS lag 0: -0.23% (-0.24%, -0.19%), 2.12% (2.08%, 2.17%), 9.08% (8.63%, 9.53%) for PM<sub>2.5</sub>, NO<sub>2</sub> and O<sub>3</sub>, respectively; S5 lag 7 for cases: 0.25% (0.24%, 0.25%) for NO<sub>2</sub> and -0.20% (-0.22%, -0.19%) for O<sub>3</sub>. gridMET monthly average for cases: -3.76% (-4.25%, -3.27%) for temperature and -2.33% (-2.60%, -2.06%) for relative humidity. An increase in daily temperature and relative humidity showed an increase in the risk of becoming a case. Conclusions: Daily air pollution due to NO<sub>2</sub> consistently resulted in a higher diagnosis of COVID-19 while monthly temperature and relative humidity were associated with a decrease in the risk of cases and deaths. Meanwhile, daily temperature and relative humidity resulted in a higher risk at the higher end of exposure as compared to the lower end of exposure.

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**P-0437**

### Characterizing Environment Factors in Local COVID-19 Emergent Phenomenon

**Presenter:** Ram Gouripeddi, University of Utah, Salt Lake City, United States

**Authors:** R. Gouripeddi<sup>1</sup>, K. Sward<sup>1</sup>, K. Davis<sup>2</sup>, C. Cambron<sup>1</sup>, J. Horel<sup>1</sup>, J. Facelli<sup>1</sup>;

<sup>1</sup>University of Utah, Salt Lake City, UT, <sup>2</sup>Utah Department of Health, Salt Lake City, UT.

**Background:** COVID-19 emerged in December 2019 and rapidly spread into a global pandemic. Designing optimal community responses (social distancing, vaccination) is dependent on the stage of the disease progression, discovery of asymptomatic, changes in virulence of the pathogen, and current level of herd immunity. In addition, local environmental and social factors can potentially play a role in limiting transmission. Warmer weather, higher solar ultraviolet radiation, humidity levels and good air quality have all been shown to play a role in reducing community level rates for other viruses, but the effect on COVID-19 remains uncertain. Living and working in built and controlled environments may limit the effects of these natural environmental factors. As observed in previous pandemics, social determinants of health (SDOH) are likely influence the ability of individuals and families to follow COVID-19 public health guidelines and may alter health outcomes. **Methods:** In order to address these complex “What if” questions, we are extending the agent-based model, SpatioTemporal Human Activity Model (STHAM) for COVID-19 simulating transmission dynamics. **Results:** Conceptually, individuals in STHAM are represented as agents belonging to households and work organizations, and residing in particular environments. Agents have properties representing individuals’ characteristics of demographics, occupation, socioeconomic, and immune status. The environment has its own characteristics that include weather, UV radiation and air quality. Rules describe what happens when different classes of agents interact in their environment (e.g., transmission of virus based on established rates), and the type of interactions possible under different public health scenarios. **Discussion:** The principle cause of spread of COVID-19 is movement and interaction of individuals within a community. As next steps, we will evaluate our concept for the effects of the environment and selective movement of individuals across time and demographic groups in the evolution of the disease for the state of Utah.

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**P-0438**

**Random Weather Fluctuations are Associated with Reproduction Rates of SARS-CoV-2 in US Cities.**

**Presenter:** Brian Knaeble, Utah Valley University, Orem, United States

**Authors:** B. Knaeble;  
Utah Valley University, Orem, UT.

A city is a group of people. Residents select cities in part based on climate. An association between climate and reproduction numbers for SARS-CoV-2 is therefore confounded. For causal inference we harness the randomness of weather. Conditional on climate the variation in weather is random, producing a natural experiment.

We conducted a prospective study of growth in official cases of COVID-19 across US cities and observed a correlation between growth rate and the proportion of time when temperature was within an independently specified range. We controlled for confounding by conducting the analysis conditional on a historical measure of temperature.

Our study design is instructive as the statistical assumption of ignorable treatment assignment conditional on covariate data is evident from the randomness of the weather. We will present the results of our data analysis and explain how the principles behind our study design are applicable throughout the field of environmental epidemiology.

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**P-0439**

### **COVID-19 risk perception in the Czech population**

**Presenter:** Andrea Dalecka, Department of Epidemiology and Public Health, University of Ostrava, Ostrava, Czech Republic

**Authors:** Dalecká A. 1, Šlachtová H. 2, Tomášková H. 3, Maďar R. 1  
1Department of Epidemiology and Public Health, University of Ostrava, Czech Republic  
2Centre for Epidemiological Research, University of Ostrava, Czech Republic  
3Public Health Institute, Ostrava, Czech Republic

**Background:** An outbreak of the novel coronavirus disease (COVID-19) has become unprecedented health and socioeconomic threat, which is faced by all countries around the world. The SARS-CoV-2 hit the Czech Republic at the beginning of March 2020. A spread of the disease has been decelerated by quick adopting of the strict and strongly limiting government measures since March, 7. In this study, we present the first results of public risk perception study of COVID-19.

**Methods:** The web questionnaire survey was announced in the nationwide media and conducted during April. The data covered health risk perception with a focus on physical and psychological aspects, current socioeconomic situation and adoption to the lockdown. The survey was going on through the period of the outbreak to find out the risk perception development. The average values of the 5-point Likert scale were tested for differences by Mann-Whitney and Kruskal-Wallis tests on the significance level 5% and analyzed using the SW STATA v.15.

**Results:** From a sample of 9,168 Czech respondents aged 40 years in average (range 15-87 years), the present study shows that women ( $p < 0.001$ ) and elderly lonely people ( $p < 0.001$ ) perceived COVID-19 health risk significantly worse than others. Respondents who lost their jobs during pandemic (2.6%) or whose income decreased (15.3%) were psychically dealing with pandemic worse ( $p < 0.001$ ). Most of the people assessed the measures as adequate (70.4%) and believed in their effectiveness (69.4%). Among commanded restrictions, the social isolation bothered population the most.

**Conclusion:** This study contributes to understanding the risk perception as a public response to COVID-19 pandemic. Since it is considered, that coronavirus occurs in waves, the knowledge of public emotional concerns and trust can play an essential role in their adoption for restrictions in future.

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**P-0440**

**The Impact of Ambient Particulate Matter PM<sub>2.5</sub> And PM<sub>10</sub> On the Prevalence and Mortality Of SARS-Cov-2 In The Eastern Mediterranean Region.**

**Presenter:** Samantha Akram Al Awar, University of Balamand, Public Health Department, Beirut, Lebanon

**Authors:** S. A. Al Awar<sup>1</sup>, R. Bikai<sup>1</sup>, N. Abbas<sup>1</sup>, R. Karhily<sup>1</sup>, L. Abi Habib<sup>1</sup>, L. Jaalouk<sup>1</sup>, R. Yaacoub<sup>1</sup>, W. Farah<sup>2</sup>, M. Abboud<sup>2</sup>, E. Chalhoub<sup>1</sup>, M. Mrad Nakhlé<sup>1</sup>;

<sup>1</sup>University of Balamand, Public Health Department, Beirut, LEBANON, <sup>2</sup>Université Saint Joseph de Beyrouth, Beirut, LEBANON.

Background: Seven out of the top ten countries globally with the highest levels of PM<sub>2.5</sub> and PM<sub>10</sub> are located in the Eastern Mediterranean Region (EMR). Particles of several pollutants such as PM (PM<sub>10</sub> and PM<sub>2.5</sub>) can act as a vector for the spread of airborne microorganisms, including viruses, and can directly infect other people's mucosae and extended survival in the air of bioaerosols and onto surfaces causing delayed infections. Methods: The relation between the prevalence (the number of cases/ 100,000 population) and mortality rates of SARS-CoV-2 and air pollutants, specifically particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>), in the EMR was investigated. Data was collected from local and WHO databases on the average exposure to ambient PM<sub>2.5</sub> and PM<sub>10</sub>. Total cases and deaths of SARS-CoV-2 in the EMR were collected from the WHO. Results: Preliminary correlational analysis revealed a significant correlation between PM<sub>2.5</sub> and PM<sub>10</sub> and SARS-CoV-2 prevalence in the EMR (P 0.008). Conclusion: The results of our study would help to understand the epidemiology of SARS-CoV-2 in the EMR in light of air pollution levels. The latter would trigger proper implementation of laws and regulations on air pollution to have a better management of the healthcare systems facing the second wave of this pandemic.

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## ABSTRACT E-BOOK

Theme: **COVID**

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**P-0441**

### **NIH Disaster Research Response (DR2) Program's Efforts to Establish Standardized Tools for COVID-19 Research Response**

**Presenter:** Aubrey Miller, National Institutes of Environmental Health Sciences, Bethesda, United States

**Authors:** A. Miller<sup>1</sup>, S. Champ-Blackwell<sup>2</sup>, C. Keller<sup>3</sup>, M. Spittel<sup>4</sup>, S. Ramsey<sup>5</sup>, R. Kwok<sup>6</sup>, R. Rosselli<sup>5</sup>, S. Webb<sup>5</sup>, A. Bennett<sup>1</sup>, M. Justice<sup>5</sup>, J. Pakiam<sup>2</sup>, S. Arnesen<sup>2</sup>, B. Riley<sup>4</sup>;

<sup>1</sup>National Institutes of Environmental Health Sciences, Bethesda, MD, <sup>2</sup>National Library of Medicine, Bethesda, MD, <sup>3</sup>National Institute on Aging (NIA), Bethesda, MD, <sup>4</sup>National Institutes of Health, Office of Behavioral and Social Sciences Research, Bethesda, MD, <sup>5</sup>Social & Scientific Systems, Inc., Durham, NC, <sup>6</sup>National Institutes of Environmental Health Sciences, RTP, NC.

A critical need has been identified during the COVID-19 pandemic to provide research tools for investigators across the world. For example, investigators are developing and fielding new survey items assessing various COVID-19 specific domains such as symptoms, knowledge and attitudes, adherence to various mitigation behaviors, as well as socioeconomic impacts. The National Institute of Health's (NIH) Disaster Research Response (DR2) Program (<https://dr2.nlm.nih.gov/>) leads the nation in fostering improvements in processes, frameworks, and infrastructure for executing timely and complex research responses to disasters and emerging threats, including pandemics. The NIH is utilizing the DR2 network of scientists and website to collate and host a collection of tools to minimize the proliferation of one-off survey items, encourage comparisons across samples, and facilitate data integration and collaboration. These tools assist researchers in rapidly developing COVID-19 related research protocols for new or existing cohorts. Early in the COVID-19 response, DR2 organized meetings and correspondence across NIH Institutes and Centers to coordinate a process for tool collection and dissemination. Utilizing nimble and responsive teams, they rapidly redesigned the website to highlight COVID-19 related resources and provide a method for researchers to submit tools for inclusion in the database, establish a common set of domains for refined searchability, and offer links to specific items for quick access. In parallel to standing up a library of COVID-19 specific tools, NIH DR2 is leading a long-term effort to prepare common data elements, automated rapid study development systems, electronic data capture platforms, and technical support teams to support quick implementation of research for future disasters. This presentation will describe how DR2 organized its response to COVID-19, provide a demonstration of the tool repository, discuss lessons learned, and lay out long-range plans.

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**P-0442**

**Heat and COVID-19 pandemic: tackling two challenges at the same time-the example of Germany**

**Presenter:** Franziska Matthies-Wiesler, Helmholtz Zentrum Muenchen, Institute of Epidemiology, Neuherberg, Germany

**Authors:** F. Matthies-Wiesler<sup>1</sup>, A. Herrmann<sup>2</sup>, A. Schneider<sup>1</sup>, M. Herrmann<sup>3</sup>;

<sup>1</sup>Helmholtz Zentrum Muenchen, Institute of Epidemiology, Neuherberg, GERMANY, <sup>2</sup>Working Group Climate Change, Nutrition and Health, Heidelberg Institute of Global Health (HIGH), University Hospital Heidelberg, Heidelberg, GERMANY, <sup>3</sup>German Alliance for Climate Change and Health (KLUG), Munich, GERMANY.

Very hot days and heatwaves put the health of many individuals, especially of those particularly vulnerable, at risk. Exposure to heat can lead to heat stress, exhaustion and heat stroke, and can also exacerbate pre-existing health conditions such as cardiopulmonary diseases. Health effects from heat can be mostly prevented. This summer, however, heat risk is expected to coincide with SARS-CoV-2 infection risk in countries of the Northern hemisphere, as seasonality cannot be considered a key modulating factor of SARS-CoV-2 transmission at this time. A range of common characteristics of these two risks have implications on preventive measures and the health system: a) risk groups for heat effects and severe COVID-19 largely overlap: the elderly, individuals with pre-existing health conditions (especially hypertension, cardiovascular disease, pulmonary disease, kidney disease, diabetes and obesity as well as mental health issues), the socially deprived and people on medication; b) locations exposed to both risks include care homes, hospitals, outpatient services, caring relatives and vulnerable individuals living alone; c) common symptoms of heat-related illness and COVID-19 disease; d) overlaps and contraindications in preventive measures for heat health protection and for COVID-19 risk reduction. Thus, this summer heat health action plans and measures need to be adapted to address heat and COVID-19 risks at the same time. In Germany, national recommendations for heat health action plans have not been systematically implemented on regional and local level. To foster implementation of these plans and to support preparedness of the health services and the population, a portfolio of adapted information sheets has been compiled: information for a) general practitioners; b) the public; c) care home managers and d) self-protection of medical professionals working with personal protective equipment in heat. The material is published online, together with a series of webinars. Materials and lessons learnt from summer 2020 will be presented.

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## ABSTRACT E-BOOK

Theme: COVID

**P-0444**

**Health surveillance of healthcare workers exposed to SARS-Cov-2 in Milan, Italy**

**Presenter:** Michele Carugno, Dept. of Clinical Sciences and Community Health, University of Milan and Epidemiology Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy

**Authors:** M. Carugno<sup>1</sup>, A. Lombardi<sup>2</sup>, D. Consonni<sup>3</sup>, A. Bandera<sup>4</sup>, A. C. Pesatori<sup>1</sup>, A. Gori<sup>4</sup>;  
<sup>1</sup>Dept. of Clinical Sciences and Community Health, University of Milan and Epidemiology Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, ITALY, <sup>2</sup>Infectious Diseases Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, ITALY, <sup>3</sup>Epidemiology Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, ITALY, <sup>4</sup>Infectious Diseases Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico and Centre for Multidisciplinary Research in Health Science (MACH), University of Milan, Milan, ITALY.

**Background:** Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection recently became an issue of national relevance in Italy, especially in healthcare workers (HCWs) who have been exposed to the virus in times when preventive measures were not yet fully established. **Methods:** We collected occupational and clinical characteristics of all HCWs who had performed a nasopharyngeal swab for the detection of SARS-CoV-2 at the Policlinico Hospital in Milan, the capital city of Lombardy (the most affected Italian region), from February 24<sup>th</sup> to March 31<sup>st</sup> 2020. Laboratory data were collected as of April 9<sup>th</sup>. We compared frequencies of positive tests according to selected variables using chi-squared test and applied multivariable logistic regression models including gender, age class, occupation, and reported symptoms. **Results:** We found 138 test-positive HCWs out of a total of 1,573 (8.8%, 95% confidence interval [CI]: 7.4-10.3). Symptomatic subjects showed a much higher proportion of positive tests (20.2%, 95%CI: 16.7-24.1) when compared to asymptomatic ones (3.7%, 95%CI: 2.7-5.1,  $p < 0.001$ ). The strongest predictors of a positive test were fever (Odds ratio [OR] = 7.21, 95%CI: 4.45-11.7) and taste and smell alterations (OR = 29.7, 95%CI: 10.1-87.5). Fifty percent of subjects took up to 23 days (95%CI: 19-24) to become negative from first positive test. When considering occupation, the highest frequency of positive tests was detected among physicians (10.6%, 95%CI: 8.3-13.4). **Conclusions:** In a sample of HCWs exposed to confirmed cases of COVID-19, we found fever and taste and smell alterations to be strongly associated with SARS-CoV-2 infection, together with a median time to clear the virus of 23 days. The investigation in the Hospital is currently continuing by performing serological tests for identification of SARS-CoV-2 S1/S2 IgG antibodies including also the present study subjects. This will allow to assess the presence of specific antibodies to be compared with nasal swab tests.

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**P-0445**

### **Is Global Health Our Wealth? - The Odds of COVID-19-Induced Losses Against Climate Change Risks in the Eastern Caribbean**

**Presenter:** Steve D Whittaker, Yale Univeristy, Hillhouse Ave, United States

**Authors:** S. D. Whittaker;  
Yale Univeristy, Hillhouse Ave, CT.

For residents of Eastern Caribbean small island developing states (ECSIDS), perceived current realities of the covid-19 pandemic compete with pending vulnerabilities to the existential threat of climate change (CC). This is particularly evident as regional economies, health systems and access to care become increasingly challenged by the corona virus outbreak. This prelim 2020 study builds upon a health access questionnaire administered to ECSIDS residents, age 15 to 75 years, in St. Kitts & Nevis between 2015 and 2019. It qualifies survey data using media and government reports around economic losses and sector-specific contractions. Bivariate logistic regressions were used to assess odds ratios (OR) of resident unemployment or underemployment per various potential predictors including demographics, attitudes, experiences and perceptions around CC impacts. Statistical significance was set at  $\alpha=0.05$ . Of the 392 participants, almost all were assumed to be impacted by the pandemic relative to the 35% who declared some impact by storms, droughts, high heat and/or vector borne diseases. Of all the perceived CC impacts only drought was associated with covid-19-induced losses (OR: 0.53; 95%CI: 0.30, 0.94). While there were no significant sex or age differences, covid-19 effects would be associated with odds of prolonged if not irreversible job insecurity or income loss among agrarians (OR: 15.1; 95%CI: 4.07, 72.1), tourism professionals (OR: 48.0; 95%CI: 12.7, 313), manual laborers (OR: 5.16; 95%CI: 1.44, 17.7), and food handlers (OR: 5.78; 95%CI: 2.08, 15.8) - all greater than those risks linked to CC impacts. Students were less likely to be similarly affected (OR: 0.14; 95%CI: 0.05, 0.32). Results suggest that covid-19-induced losses present as a challenge distinct from perceived CC risks in the Caribbean. Findings also have implications with regard to the inextricable link between global health and ECSIDS wealth, the latter critical to resident solvency and accordingly access to healthcare.

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Theme: **COVID**

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**P-0446**

### **Environmental Aspects of COVID-19: A Review**

**Presenter:** Elishama B Yomi-Agbajor, Federal University of Agriculture, Abeokuta, Abeokuta, Nigeria

**Authors:** E. B. Yomi-Agbajor;  
Federal University of Agriculture, Abeokuta, Abeokuta, NIGERIA.

**Background:** The possible primary source of COVID-19 outbreak has been attributed to bats, probably traced to deforestation and/or compromised wildlife habitats. The linkages between Coronavirus disease and the environment are expected to be extensive. Weather conditions (precipitation, temperature and humidity), the built environment and air pollution are environmental determinants of infectious diseases' transmission. **Methods:** To assess existing knowledge on the interrelationships between COVID-19 and the environment, a literature review was performed by searching the following terms in PubMed: environment AND covid-19 AND ("covid-19 environmental factors" OR "covid-19 environmental effects") AND ("covid-19 air quality"). Articles and references were considered if they were published between 2019 and 2020, and in English. **Results:** It was found that the connections between the environment and COVID-19 have not been fully understood and little has been studied by the research community. Studies show that the Coronavirus disease is influenced by environmental conditions and conversely, has greatly impacted the environment. There is evidence that countries with generally lower yearly average temperature witness a higher number of confirmed cases of COVID-19. The pandemic has hampered the flow of economic activities, resulting in reduced commercial/industrial waste, lowered levels of carbon emission and consequently, an improvement in the air quality of cities all over the world. However, the use of face masks and gloves, and the treatment of large numbers of COVID-19 patients, has caused an upsurge in clinical waste generation. **Conclusions:** The COVID-19 crisis has ironically brought about clearer skies, strengthened ecosystem health and to some extent, restored the depleting ozone layer. Still, unsafe disposal of generated medical waste will have deleterious effects on the environment and all biota. To mitigate the spread of and fatalities caused by the disease, countries have to implement approaches suited to the peculiarities of their environment.

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**P-0448**

**Higher incidence of COVID-19 in the air-polluted regions of eight severely affected countries**

**Presenter:** Riccardo Pansini, Yunnan University of Finance and Economics, Kunming, China

**Authors:**

COVID-19 has spread in all continents in a span of just over three months, escalating into a pandemic that poses several humanitarian as well as scientific challenges. We here investigated the geographical character of the infection and correlate it with several annual satellite and ground indexes of air quality in: China, the United States, Italy, Iran, France, Spain, Germany, and the United Kingdom. Controlling for population size, we found more viral infections in those areas afflicted by high PM 2.5 and Nitrogen Dioxide values. Higher mortality was also correlated with relatively poor air quality. In Italy, the correspondence between the Po valley pollution and SARS-CoV-2 infections and induced mortality was the starkest, originating right in the most polluted European area. Air pollution appears to be for this disease a risk factor similar to smoking. This suggests the detrimental impact climate change will have on the trajectory of future respiratory epidemics.

Keywords: air pollution; COVID-19; coronavirus; virulence; risk factor; satellite air quality.

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Theme: **Heavy metal exposure**

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**P-0450**

**Children's Exposure to toxic trace elements in the Southern Peruvian Amazon**

**Presenter:** Tia Marks, University at Albany School of Public Health - SUNY, Rensselaer, United States

**Authors:** T. Marks<sup>1</sup>, W. K. Pan<sup>2</sup>, S. Pettigrew<sup>3</sup>, A. Berky<sup>2</sup>, J. Harrington<sup>4</sup>, B. J. Feingold<sup>1</sup>;

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<sup>3</sup>Albany College of Pharmacy and Health Sciences, Albany, NY, <sup>4</sup>RTI International, Research Triangle Park, NC.

Background: Exposures to toxic elements such as mercury (Hg), arsenic (As), cadmium (Cd) and lead (Pb) adversely effect health and development of children. Scant data exists on children's exposure to these elements in rapidly developing areas of Low- and Middle-Income Countries, where exposure may pose significant health threats. The Southern Peruvian Amazon of Madre de Dios (MDD) is one such region undergoing rapid changes including highway development, deforestation, agriculture, and artisanal and small-scale gold mining. Prior analysis of adult nails, an uncommon yet advantageous biomarker, revealed elevated exposures to Hg, As, Cd, and Pb among adults. Children's exposures were not assessed, yet increased activity and nutrient uptake make them a critical sub-population. Objective: To assess prevalence and risk factors for children's exposures to As, Cd, Pb and Hg in a population-based study in MDD. Methods: Follow-up (2014) of the IMAS (Investigacion de Migracion, Ambiente y Salud) Study collected surveys, nail clippings, and health metrics on members of 310 households in 46 localities across MDD. Nail-element concentrations were analyzed in children under 10 (n=104) using Inductively Coupled Plasma Mass spectrometry. Element correlations were assessed with Spearman coefficients. Associations between nail-element concentrations and demographic, environmental, and dietary factors were tested by t-tests. Results: Median nail-element levels were 247 ng/g (As), 189 ng/g (Cd), 392 ng/g (Hg), and 1144 ng/g (Pb). As-, Cd-, and Pb-nail concentrations were significantly higher in children than adults. Pb was higher in urban compared to rural children. Hg was higher in mining affected areas, while Cd was elevated in non-mining affected areas. Younger (<5 years) children had higher As and Pb exposure (p<0.05) compared to older children. There were no significant sex differences. Conclusions: MDD children are exposed to a mixture of mercury, cadmium, lead and arsenic. Future work should ascertain the public health impact of these exposures.

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Theme: **Heavy metal exposure**

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**P-0451**

**Human Biologic Monitoring based on blood donations to the National Blood Services: example of comparing an industrial area with a general population in Israel**

**Presenter:** Lior Hassan, Negev Environmental Health Research Institute (NEHRI), Beer Sheva, Israel

**Authors:** L. Hassan<sup>1</sup>, A. Moser<sup>2</sup>, E. Rorman<sup>3</sup>, L. Groisman<sup>3</sup>, Y. Naor<sup>3</sup>, E. Shinar<sup>4</sup>, R. Gat<sup>1</sup>, E. Jaffe<sup>2</sup>, V. Novack<sup>1</sup>, I. Kloog<sup>5</sup>, L. Novack<sup>1</sup>;

<sup>1</sup>Negev Environmental Health Research Institute (NEHRI), Beer Sheva, ISRAEL, <sup>2</sup>Magen David Adom Blood Services Center, Tel-Hashomer, Israel, Ramat Gan, ISRAEL, <sup>3</sup>National Public Health Laboratory, Ministry of Health, Tel Aviv, ISRAEL, <sup>4</sup>Magen David Adom Blood Services Center, Tel-Hashomer, Ramat Gan, ISRAEL, <sup>5</sup>Ben-Gurion University of the Negev, Beer Sheva, ISRAEL.

The ambient exposure does not always reflect the internal levels of pollution absorbed in the body. While human biomonitoring (HBM) could provide a valid estimate of exposure extent, it is usually an expensive and a heavily manpowered enterprise. Using samples collected during blood donations for HMB may provide a more efficient platform for a routine biomonitoring. The current study is aimed to explore the feasibility of using the national blood banking system for the purposes of HBM, to compare between residents of a suspected polluted area in northern Israel (Haifa Bay) to the rest of the country. Specifically, we will assemble a geographically representative sample of blood donors residing in the study area and match them with the general population, to test for four industry or traffic-related metals: Lead (Pb), cadmium (Cd), arsenic (As) and chromium (Cr). Furthermore, we will measure the association between biomarkers and ambient environmental exposures. Samples of whole blood from donors will be tested in the Laboratory of Public Health Services managed by the Ministry of Health. The information on donors' biomarkers levels will be linked with the air pollution and meteorological data assessed at the location of the blood collection sites (short-term exposure) and donors' permanent address (long-term exposure), as recorded by both the monitoring stations spread throughout Israel and the satellite-based exposure models. The information collected in this study could lead to environmental regulations within Haifa Bay area aimed to prevent exposure to high levels of hazardous chemicals.

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Theme: **Heavy metal exposure**

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**P-0452**

**The applicability of fingernail lead and cadmium levels as subchronic exposure biomarkers for preschool children**

**Presenter:** Allan S Oliveira, University of São Paulo - School of Public Health, São Paulo-SP, Brazil

**Authors:** A. S. Oliveira<sup>1</sup>, E. C. Pereira<sup>1</sup>, M. A. Freitas<sup>2</sup>, B. M. Freire<sup>3</sup>, R. P. Souza<sup>2</sup>, B. L. Batista<sup>3</sup>, M. S. Luz<sup>2</sup>, K. P. Olympio<sup>1</sup>;

<sup>1</sup>University of São Paulo - School of Public Health, São Paulo-SP, BRAZIL, <sup>2</sup>Institute for Technological Research - IPT, São Paulo-SP, BRAZIL, <sup>3</sup>Federal University of ABC - UFABC, São Paulo-SP, BRAZIL.

Background. Preschool children are daily exposed to metals in their homes or daycare centers (DCC). Metal exposure and health effects are associated even at low doses, and children comprise a concern group to public health. Nail metals have been studied for exposure biomonitoring and compared to other biological matrices. The aim of this study was to explore the applicability of preschool fingernail lead and cadmium levels as subchronic exposure biomarkers. Methods. Nail lead and cadmium levels (NLL and NCL) were analyzed of 1-4 year-old 592 preschool children who attended 21 DCC in São Paulo, Brazil, in 2013. These results were compared to blood lead and cadmium levels (BLL and BCL) found in a previous study. Inductively coupled plasma mass spectrometry (ICP-MS) analyses were performed for both samples. Spearman correlation tests ( $p < 0.05$ ) were used to correlated matrices levels of both metals, considering risk factors (DCC location, by vehicle traffic density and geographic region, and smoking in their homes). BLL was stratified by exposure levels (low:  $< 5 \mu\text{g.dL}^{-1}$ ; high:  $> 13.9 \mu\text{g.dL}^{-1}$ ; intermediate:  $\geq 5 \mu\text{g.dL}^{-1}$  and  $\leq 13.9 \mu\text{g.dL}^{-1}$ ). Results. NLL geometric mean was  $0.02 \mu\text{g.g}^{-1}$  (95%CI:  $0.02-0.03 \mu\text{g.g}^{-1}$ ). Positive correlations were found between: NLL-BLL ( $r=0.08$ ;  $p=0.04$ ); NLL-DCC located in high vehicle traffic density streets ( $r=0.23$ ;  $p<0.0001$ ); NLL-NCL ( $r=0.31$ ;  $p<0.0001$ ), being more expressive in DCC located in Sao Paulo's east region ( $r=0.44$ ;  $p < 0.0001$ ); and BLL-BCL ( $r=0.35$ ;  $p < 0.0001$ ). Lead exposure magnitude presented no significant impact in NLL. Conclusions. NLL should only be selected as an exposure biomarker, when an initial screening must be planned and the financial resources are scarce, especially in high traffic vehicle areas. Preschool children were exposed to lead and cadmium co-exposure, reinforcing the importance of broader studies planned to environmental contaminants exposure and not just for one chemical element. Funding by Fapesp (2011/13076-0, 2011/23272-0, 2012/21840-4, 2017/14392-9) and Capes.

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Theme: **Heavy metal exposure**

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**P-0453**

**Toxic Elements Concentrations in Costume makeup used by Brazilian Children**

**Presenter:** Fernanda Junqueira Salles, School of public Health - University of São Paulo, São Paulo, Brazil

**Authors:** F. J. Salles<sup>1</sup>, F. P. Paniz<sup>2</sup>, B. L. Batista<sup>2</sup>, K. P. K. Olympio<sup>1</sup>;

<sup>1</sup>School of public Health - University of São Paulo, São Paulo, BRAZIL, <sup>2</sup>Center for Natural and Human Sciences - Federal University of ABC, Santo André, BRAZIL.

Background. Some metallic-based pigments used as dyes in color cosmetics, like face paints, may contain toxic elements. This costume makeup can be used by adults but is also applied to children, mainly in Carnival or child parties. During the use, different levels of exposure are possible, including dermal and incidental oral routes. Objective: to determine As, Cd, Pb and Sb concentrations in face paints sold in popular stores for children's use. Methods. 95 samples of "face paints" were purchased at the largest popular trade center of the city of São Paulo, Brazil. Face paints from four different brands in different textures and colors were purchased. Extraction procedure with nitric acid was carried out using a graphite covered digester block. The toxic elements determinations were performed using an inductively coupled plasma mass spectrometer (ICP-MS). Results The geometric means were: 0.09 mg/L (0.011-1.69) for As; 0.003 mg/L (0.000004-0.4) for Cd; 0.22mg/L (0.010-11.69) for Pb; 0.009 mg/L (0.0002-2.65) for Sb. One sample exceeded the 10ppm limit for Pb in cosmetics stated by Canada and U.S. Twenty two samples exceeded the As, Cd, Pb or Sb limits of German legislation which is more stringent. White, blue and purple colors showed the highest Pb and Cd values, while lilac, brown and white showed the highest As values. The creamy samples and the professional pancakes had higher Cd and Pb values ( $p < 0.0001$ ). For As, the highest concentrations were in pancake and liquid samples ( $p < 0.0001$ ), the latter also had higher Sb values ( $p < 0.02$ ). Conclusion. Concerns of contaminated cosmetics are becoming commonplace in the beauty market, however limits for metals impurities in these products are rare, and in many countries, this regulation does not even exist. Studies with costume makeup are needed to assess health risks, considering the use both for adults and children. Funded by FAPESP (Grant:2016/11087-8).

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**P-0454**

**Arsenic metabolism association with body mass index is mediated by physical activity in Mexican women**

**Presenter:** Brenda Gamboa-Loira, Instituto Nacional de Salud Pública, Cuernavaca, Mexico

**Authors:** B. Gamboa-Loira<sup>1</sup>, M. E. Cebrián<sup>2</sup>, L. López-Carrillo<sup>1</sup>;

<sup>1</sup>Instituto Nacional de Salud Pública, Cuernavaca, MEXICO, <sup>2</sup>Cinvestav-IPN, Ciudad de México, MEXICO.

**Background/Aim:** A positive association of body mass index (BMI) with inorganic arsenic (iAs) metabolism parameters (percentage dimethylarsinic acid [%DMA] and second methylation index [SMI]) was reported in epidemiological studies, suggesting that obesity improves iAs detoxification. However, BMI is a rough indicator of obesity, which is the product of the balance between calorie intake and physical activity. Physical activity consumes methyl groups that are necessary to metabolize iAs. Therefore, our objective was to evaluate whether physical activity modifies the relationship between BMI and iAs metabolism.

**Methods:** We performed a cross-sectional secondary analysis of 800 healthy women, 20 years and over, that participated as population controls in a previous study on breast cancer in northern Mexico. Participants were interviewed about physical activity during their lifetime, and their weight and size were obtained. Concentrations of urinary arsenic metabolites were determined by high performance liquid chromatography coupled with mass spectrometry.

**Results:** In the study population, total arsenic ranged from 0.71 to 303.29  $\mu\text{g/L}$ , BMI from 14.60 to 57.81  $\text{kg/m}^2$ , and the lifetime average physical activity from 0 to 13.14 h/week. BMI was significantly and positively associated with %DMA and SMI. These associations remained after stratifying for physical activity. A significant antagonistic interaction ( $p=0.003$ ) emerged only between physical activity and SMI on BMI: BMI association with SMI differed between women with higher ( $\beta= 0.004$  95% CI: 0.001, 0.007) and lower physical activity ( $\beta= 0.011$ , 95% CI: 0.007, 0.015).

**Conclusion:** Our findings do not support a direct relationship between BMI and iAs metabolism. Physical activity appears to play an important role in iAs detoxification in obese women. This finding warrant further research.

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## ABSTRACT E-BOOK

Theme: **Heavy metal exposure**

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**P-0455**

**Conditions of home-based and informal work of jewelry and fashion jewelry production in Brazil**

**Presenter:** Fairah Barrozo, School of Public Health, University of São Paulo, São Paulo, Brazil

**Authors:** F. Barrozo, K. P. Olympio;  
School of Public Health, University of São Paulo, São Paulo, BRAZIL.

Background: The Brazilian city of Limeira locates a production center of fashion jewelry where part of the production is informal and home-based, including whole families. This study aimed to describe the exposure scenario for children living with those informal working families. Methods: A questionnaire was applied for 21 home-based and informal working households, and metals were determined in soldering powders and wires samples, using a field-portable X-ray-fluorescence analyzer. Results: Cadmium was found only in soldering powders (geometric mean (GM): 53,927.21 ppm; standard deviation (SD): 32,806.44 ppm), while lead was determined only in soldering wires (GM: 249,973.13 ppm; SD: 165,157.41 ppm). About the questionnaires, 24% used acid and soldering powder, 24% acid and soldering wire, 5% did not use chemical products and 48% used only soldering powders. In 38% of the houses, soldering powder was visible on the furniture. Also, 81% of the households did not use individual protection equipment, 43% used ventilation systems and 81% worked with doors/windows opened. Considering the workstation, 81% worked in places like kitchens, rooms, bedrooms, laundries, and backyards. In 43% of the households, the welding activities were shared with husbands, sisters, and friends. Moreover, 57% of the houses had at least one child, and the time median, which children stayed at home was 17 hours and 50 minutes/day, during the week. Conclusions: The households who use soldering wires are more exposed to lead and the ones who use soldering powders are more exposed to cadmium. As they do not use protective equipment and work in precarious places, the cadmium and lead in the welding fumes can be a health risk to the children who live in those places. Ongoing studies including health risk evaluation are crucial to understanding deeply the risks for children development. This study was funded by FAPESP (2018/18391-0) and Capes.

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**P-0456**

### **Prenatal Lead (Pb) Exposure's Effect on DNA Methylation (5mC) and Hydroxymethylation (5hmC) in Adolescent Whole Blood**

**Presenter:** Christine A Rygiel, University of Michigan, Ann Arbor, United States

**Authors:** C. A. Rygiel<sup>1</sup>, J. M. Goodrich<sup>1</sup>, W. Perng<sup>2</sup>, T. R. Jones<sup>1</sup>, M. Solano<sup>3</sup>, H. Hu<sup>4</sup>, M. M. Tellez-Rojo<sup>3</sup>, K. E. Peterson<sup>1</sup>, D. C. Dolinoy<sup>1</sup>;

<sup>1</sup>University of Michigan, Ann Arbor, MI, <sup>2</sup>Colorado School of Public Health, Aurora, CO, <sup>3</sup>National Institute of Public Health, Cuernavaca, MEXICO, <sup>4</sup>University of Washington, Seattle, WA.

Gestational lead (Pb) exposure may adversely impact offspring health through epigenetic alterations via DNA methylation (5mC), addition of a methyl group to the 5<sup>th</sup> carbon of cytosine, and hydroxymethylation (5hmC), an intermediate in oxidative demethylation associated with increased gene expression. Most current methods collectively measure 5mC and 5hmC without distinguishing between the two. This study aims to identify the association of prenatal Pb exposure at each trimester (T1, T2, T3) with 5mC and 5hmC levels at multiple cytosine-phosphate-guanine (CpG) sites within candidate regions of genes previously associated with prenatal Pb exposure (HCN2, NINJ2, RAB5A, and TPPP) in blood leukocytes of children ages 11-18 years. Participants from the Early Life Exposure in Mexico to Environmental Toxicants (ELEMENT) birth cohorts were selected (n=144) for pyrosequencing analysis following oxidative or standard sodium bisulfite treatment. Participants are 51% male with concurrent blood lead levels (BLL) averaging 3.29±4.44µg/dL and historical maternal BLL averaging 6.43±5.16µg/dL (T1), 5.66±5.21µg/dL (T2), and 5.86±4.34µg/dL (T3). 5mC levels were quantified in HCN2 (mean±SD, 81.3±9.63%), NINJ2 (36.7±22.5%), RAB5A (1.40±1.20%), and TPPP (92.5±8.03%). 5hmC levels were estimated in HCN2 (2.04±4.30%), NINJ2 (2.15±5.43%), RAB5A (0.64±0.80%), and TPPP (0.45±8.01%), providing evidence for 5hmC presence in blood leukocytes. Controlling for sex, current BLL, child's age, and pyrosequencing batch, T1 maternal BLL was associated with 5mC in HCN2 ( $\beta=-1.256$ ,  $p=0.019$ ) and NINJ2 ( $\beta=0.426$ ,  $p=0.004$ ); T2 BLL with 5mC in HCN2 ( $\beta=0.368$ ,  $p=0.028$ ) and 5hmC in NINJ2 ( $\beta=0.232$ ,  $p=0.011$ ); and T3 BLL with 5mC in HCN2 ( $\beta=0.502$ ,  $p=0.016$ ) and 5hmC in NINJ2 ( $\beta=0.372$ ,  $p=0.001$ ). No associations were identified between Pb and RAB5A and TPPP. Together, these data suggest that perinatal Pb exposure results may alter 5mC and 5hmC in blood in a gene-specific manner that persists into adolescence.

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**P-0457**

**Effect of Environmental Pollution on African Catfish, *Clarias gariepinus* from Orioke River in Ondo State, Nigeria**

**Presenter:** OLUWATOSIN ADETOLA AROJOJOYE, LEAD CITY UNIVERSITY, IBADAN, Nigeria

**Authors:** O. A. AROJOJOYE, O. O. NWAECHEFU, E. AKINOLA;  
LEAD CITY UNIVERSITY, IBADAN, NIGERIA.

Aquatic pollution is a major environmental issue worldwide. This study evaluated the extent of pollution of Ori Oke River in Orioke Iwamimo, an oil producing area in Ondo State, Nigeria by assessing the levels of lead (Pb), cadmium (Cd), copper (Cu), arsenite (As), nickel (Ni) and some oxidative stress indices in the liver and muscle of African Catfish *Clarias gariepinus* from the River. *Clarias gariepinus* from Ilesanmi Fishery in Ondo State were used as control. From the results, there was increase in the concentration of all the heavy metals analysed in the liver and muscle of *Clarias gariepinus* from Orioke River when compared with control. There was also an increase in malondialdehyde level (an index of lipid peroxidation) in the liver and muscle of *Clarias gariepinus* from Orioke River compared with control. Glutathione (GSH) concentration and glutathione-S-transferase (GST) activity decreased in the liver of fish samples from Ori Oke River compared with control. There was an induction of catalase (CAT) activity in the liver and muscle of *Clarias gariepinus* from Ori Oke River when compared with control. However there was a decrease in superoxide dismutase (SOD) activity in liver and muscle of the fish compared with control. Increase in lipid peroxidation and alterations in antioxidant status in *Clarias gariepinus* from Orioke River show that the fish were under oxidative stress. This suggests that the River is polluted. This could be dangerous to the health of people who consume fishes and other aquatic organisms from the River.

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**P-0458**

**Metals in supply water of riverine communities affected by the largest environmental disaster in Brazil: the dam collapse on Doce River**

**Presenter:** JOAO PAULO M TORRES, Rio de Janeiro Federal University, Rio de Janeiro, Brazil

**Authors:** J. M. TORRES, G. Oliveira, A. Pinheiro, D. Souza, J. Padilha, J. Souza, F. Torres, T. Paiva, R. Santelli, O. Malm;  
Rio de Janeiro Federal University, Rio de Janeiro, BRAZIL.

Considered the worst environmental disaster in Brazilian history before another dam break at the same region, the collapse of Samarco dam directly affected the Doce river. Inhabitants living along the river who relied mainly on Doce river's water supply for agriculture and human consumption faced serious risk from the mining residue. This study aimed to investigate the disaster's impact on small family farmers living in Minas Gerais and Espírito Santo state by water elemental quantification and evaluate the potential pathways of contamination by survey. In July 2016, 48 water points - including well, river and public distributed water - of 3 cities (Belo Oriente, Governador Valadares and Colatina) were sampled for determination of As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sn and Zn elements. 98% of the interviewed related using the Doce river water before the tragedy for diversified purposes, while only 36% used it after the disaster, mainly for irrigation. Fe and Mn presented concentrations above the Brazilian legislation for drinking water and irrigation in all locations, but not in all samples. All the other elements concentrations were within safe limits. Colatina, the farthest city from the dam, presented the highest values, followed by Governador Valadares and Belo Oriente.

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**P-0459**

**LINE1 methylation is differentially associated with lead exposure and job-tasks performed by electronic waste workers**

**Presenter:** Ibrahim Issah, University of Ghana, Accra, Ghana

**Authors:** I. Issah<sup>1</sup>, J. Arko-Mensah<sup>1</sup>, D. Dwomoh<sup>1</sup>, K. R. Zarins<sup>2</sup>, T. P. Agyekum<sup>1</sup>, S. Batterman<sup>2</sup>, T. G. Robins<sup>2</sup>, L. S. Rozek<sup>2</sup>, J. N. Fobil<sup>1</sup>;

<sup>1</sup>University of Ghana, Accra, GHANA, <sup>2</sup>University of Michigan, Ann Arbor, MI.

**Background/Aim:** Electronic waste (e-waste) is a pressing global public health concern due to high production volumes and inadequate management practices, which often occur in developing countries without appropriate recycling infrastructure. Exposure to a variety of chemical mixtures during informal e-waste recycling processes has been associated with adverse health outcomes affecting respiratory, cardiovascular, neurological, and reproductive systems. DNA methylation has been associated with toxic chemical exposures including heavy metals in epidemiological studies. Although e-waste contains a myriad of toxic chemicals with known health effects, DNA methylation profile of e-waste recyclers has not been studied. This study assessed the associations between cadmium (Cd), lead (Pb), and arsenic (As) concentration and methylation levels of the LINE1 gene among e-waste workers and non e-waste workers in Ghana. **Methods:** The study included 100 males e-waste workers and 51 males non e-waste workers. The participants provided extensive demographic and work-related data and biological samples. The metals were measured in blood and urine using Inductively Coupled Plasma Mass Spectrometry while LINE1 methylation levels were determined by pyrosequencing of bisulfite-converted DNA from whole blood. **Results:** There was no significant difference in LINE1 methylation between e-waste workers and non-e-waste workers (85.16% ±1.32 vs 85.17% ±1.11, p = 0.950). However, CpG1 showed significantly lower mean methylation among non-e-waste workers compared to the e-waste workers (81.70% ±1.86 vs 82.48% ±2.20, p = 0.034). In linear regression models, blood lead (B-Pb) level was significantly inversely associated with overall LINE1 methylation ( $\beta = -0.004$ ; 95%CI: -0.008, -0.0002; p = 0.038), while e-waste collectors showed significantly reduced LINE1 methylation levels ( $\beta = -1.068$ ; 95%CI: -2.040, -0.095; p = 0.032) when comparing across job-task for e-waste workers. **Conclusion:** Our results suggest that lead exposure may alter LINE1 methylation levels, and collectors, in particular, maybe at an increased risk of epigenetic alteration due to lead exposure.

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**P-0460**

**Concentrations of cadmium and lead in particulate matter in an industrial municipality of Boyacá, Colombia and its health implications**

**Presenter:** Luis C Blanco Becerra, Universidad Santo Tomas, BOGOTÁ D.C, Colombia

**Authors:** L. C. Blanco Becerra, N. I. Molina Gomez, M. F. Torres Herrera, A. E. Silva Atuesta, M. A. Diaz Salas, J. A. Alvarez Berrio;  
Universidad Santo Tomas, BOGOTÁ D.C, COLOMBIA.

Concentrations of cadmium and lead in particulate matter in an industrial municipality of Boyacá, Colombia and its health implications  
Introduction: the municipality of Nobsa is located in the Colombian department of Boyacá. Inside its urban area are located cement industries and open pit mines, which from their industrial or artisanal processes, generate particulate matter (PM) that may contain substances that affect health of their habitants. Objective: To determine cadmium and lead concentrations in particulate matter in urban area of Nobsa, Boyacá, identifying their possible health implications. Methodology: for four continuous days (24 hours each), in five points of urban area of Nobsa, PM monitoring was carried out, using Gil Air 3 personal sampling pumps in addition to real-time portable particle monitoring (Airbeam) equipment less than 2.5 microns (PM<sub>2.5</sub>). Concentrations of lead and cadmium were determined using Graphite furnace atomic absorption spectroscopy, by analyzing PM filters, which were obtained from the personal sampling pumps. Health implications were assessed by comparing file concentrations of the pollutants, against air quality guidelines of World Health Organization (WHO), in addition to estimate toxicity- hazard ratio for each metal. Results: The daily average concentration of lead, cadmium and PM<sub>2.5</sub> were 0,002 µg/m<sup>3</sup> (SD: ± 0,002), 0,213 ng/m<sup>3</sup> (SD: ± 0,168) and 9,01 µg/m<sup>3</sup> (SD: ± 2,91) respectively, for PM<sub>2.5</sub> the highest hourly values were in the time slot from 4:00 to 8:00 am. Conclusions: daily values of lead, cadmium and PM<sub>2.5</sub> did not exceed the annual standard established by WHO, however in the time slot from 0:00 to 8:00 a.m. the annual standard for PM<sub>2.5</sub> was exceeded. Toxicity- hazard ratio did not present a risk from daily exposure to the two metals, however, a medium or long-term effect is not ruled out.

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**P-0462**

**Relationship between serum ferritin level and urinary arsenic concentration**

**Presenter:** Ho yeon Kim, Seoul national university, Seoul, Korea, Republic of

**Authors:** H. Kim, C. Park, H. Lim, Y. Hong;  
Seoul national university, Seoul, KOREA, REPUBLIC OF.

relationship between serum ferritin level and urinary arsenic concentration  
background: studies on the association between serum ferritin levels (s-ft) and urinary arsenic concentrations (u-as) are scarce. the objective of this study was to investigate the relationships between these two parameters using a large-scale nationwide representative sample of the korean. methods: a nationwide cross-sectional study was conducted to examine the relationship between serum ferritin levels and urinary arsenic concentrations in 1,826 men and 1,886 women over 19 years of age (aged 20-80 years), using data from the 2008-2009 korean national health and nutrition examination survey(knhanes). we used analysis of variance (anova) or chi-square test to estimate differences in the demographic and biochemical characteristics of participants. generalized linear models were also used to examine the associations between S-Ft and U-As. results: Mean values of s-ft gradually decreased in accordance with the quartiles of u-as (P-trend<0.001). we found that increased u-as was associated with decreased s-ft ( $\beta=-0.01$ ,  $p<0.05$ ) after adjusting for age, sex, bmi, cigarette smoking, alcohol intake, physical activity, blood pressure, fasting plasma glucose, triglyceride, and high-density lipoprotein cholesterol. in a sex stratified analysis, a significant association was stronger only in male ( $\beta=-0.04$ ,  $p<0.05$ ), not in female( $\beta=0.002$ ,  $p=0.76$ ). conclusions: we found a negative relationship between s-ft and u-as in a representative population sample of korean adult. our results suggested s-ft as a marker for evaluating early effect of environmental as exposure.  
keywords: arsenic; ferritin; knhanes;

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**P-0463**

**Association between multiple urinary metals and uric acid levels in overweight and obese individuals**

**Presenter:** YaLi Xu, Huazhong University of Science and Technology, Wuhan, China

**Authors:** Y. Xu;  
Huazhong University of Science and Technology, Wuhan, CHINA.

Background: Epidemiologic studies suggest that circulating metals from the natural environment are linked with serum uric acid (SUA) levels. However, most studies were constrained to a single metal or a single assessment model. The effects of multiple metals were rarely analyzed, especially in obese individuals. Methods: We conducted a cross-sectional study including 1,221 overweight or obese participants (531 males, 690 females, mean age  $43.0 \pm 9.8$  years). SUA levels were measured by an automatic biochemical analyzer. We used linear regression, weighted quantile sum (WQS) regression, and Bayesian kernel machine regression (BKMR) models to fit multivariate models to estimate the association between 23 urinary metals and SUA levels. Results: In linear regression, after adjusting for potential confounders and other metals, two metals (uranium, zinc) showed positive associations with SUA levels in the multiple-metal model, while three metals (cadmium, cobalt, and titanium) showed negative for total participants, and cobalt, uranium, zinc for males, cadmium, cobalt, zinc for females. In WQS regression, the WQS index was significantly associated with SUA levels for both males and females (all p-values  $<0.001$ ). Copper and zinc were the most heavily positive weighing metals, while cobalt, titanium, and cadmium were the most heavily negative in all the groups. In BKMR analysis, zinc showed positive linear trends with SUA levels in all the groups. By contrast, titanium, cobalt, and cadmium showed modest negative trends in total, males, and females, separately. However, there was no significant overall-effect of these metals on SUA levels. Conclusion: When comparing the results of the above three models, urinary zinc and cadmium were considered as the most important factors that were positively and negatively associated with SUA levels, respectively. We suggest that various statistical methods should be applied to evaluate the joint effects of multiple-metal or multiple-pollutants exposures comprehensively, considering their advantages and disadvantages.

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**P-0464**

**Cadmium accumulation in the placenta associates with aberrant microRNA expression: results from a small RNA-Seq analysis**

**Presenter:** Jesse M. Tehrani, Emory University, Atlanta, United States

**Authors:** J. M. Tehrani<sup>1</sup>, E. Kennedy<sup>1</sup>, F. Tian<sup>1</sup>, A. Burt<sup>1</sup>, K. Hermetz<sup>1</sup>, T. Punshon<sup>2</sup>, B. P. Jackson<sup>2</sup>, K. Hao<sup>3</sup>, J. Chen<sup>3</sup>, T. M. Everson<sup>1</sup>, M. R. Karagas<sup>2</sup>, C. J. Marsit<sup>1</sup>;

<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Dartmouth College, Hanover, NH, <sup>3</sup>Icahn School of Medicine at Mount Sina, New York, NY.

As the master regulator of early development, the placenta is responsible for initiating changes in maternal physiology to sustain pregnancy as well as promoting fetal growth and development. MicroRNAs (miRNAs) are epigenetic post-transcriptional regulators of gene expression which participate in critical processes during early development, including embryogenesis, implantation and placentation. Cadmium is an environmental toxicant with no known biological role in humans. Human exposure primarily occurs through consumption of contaminated food or through the use of tobacco products. Gestational cadmium exposure has been associated with adverse health outcomes in newborns, but the molecular mechanisms by which these are initiated remain unclear. In this study, 281 mother-infant pairs from the New Hampshire Birth Cohort Study (NHBCS) were selected for trace element profiling and small RNA transcriptomic analysis. We identified four differentially expressed placental miRNAs (DEmiRs) were significantly associated with cadmium concentrations in placenta (FDR <0.1): miR-509-3p, miR-10b-5p, miR-10b-3p, and miR-193b-5p. For two of these four DEmiRs (miR-509-3p and miR-193b-5p), the direction of effect was consistent in an independent analysis within the Rhode Island Child Health Study (RICHs)(n=115) but were not significantly associated with placental cadmium concentrations. Bioinformatic miRNA target prediction was used to identify potential mRNAs targeted by these DEmiRs, revealing gene targets participating in various cell signaling pathways critical for placentation, angiogenesis and response to hypoxia. These results indicate that accumulation of cadmium within the placenta may disrupt fetoplacental gene expression via changes in miRNAs. Future work aims to identify associations between early life health outcomes and differential expression of cadmium-sensitive fetoplacental miRNAs.

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**P-0465**

### **Variability of essential and toxic trace elements in the follicular fluid of women undergoing in vitro fertilization (IVF)**

**Presenter:** Celeste Danielle Butts, Department of Environmental Health Sciences, University at Albany, Rensselaer, United States

**Authors:** C. D. Butts<sup>1</sup>, M. S. Bloom<sup>2</sup>, A. McGough<sup>3</sup>, N. Lenhart<sup>3</sup>, R. Wong<sup>3</sup>, E. Mok-Lin<sup>3</sup>, P. J. Parsons<sup>4</sup>, A. L. Galusha<sup>4</sup>, R. M. Yucel<sup>5</sup>, B. J. Feingold<sup>1</sup>, R. W. Browne<sup>6</sup>, V. Y. Fujimoto<sup>3</sup>;

<sup>1</sup>Department of Environmental Health Sciences, University at Albany, Rensselaer, NY, <sup>2</sup>Department of Environmental Health Sciences, University at Albany; Department of Epidemiology and Biostatistics, University at Albany, Rensselaer, NY, <sup>3</sup>Center for Reproductive Health, University of California at San Francisco, San Francisco, CA, <sup>4</sup>Laboratory of Inorganic and Nuclear Chemistry, Wadsworth Center, New York State Department of Health, Albany, NY, <sup>5</sup>Department of Epidemiology and Biostatistics, University at Albany, State University of New York, Rensselaer, NY, Rensselaer, NY, <sup>6</sup>Department of Biotechnical and Clinical Laboratory Sciences, University at Buffalo, State University of New York, Buffalo, NY.

Both essential and non-essential elements have been associated with female reproductive function in epidemiologic investigations, including those among IVF populations. To date, most investigators have used blood or urine to assess biomarkers of exposure, with few employing ovarian follicular fluid (FF). FF may offer a more direct 'snapshot' of the oocyte microenvironment, however previous studies report follicle-to-follicle variability in FF constituents which may contribute to exposure misclassification. Our objectives were to: investigate sources of trace element variability in FF among women undergoing IVF (n=34, ≤4 FF collections each; estimate biomarker reliability; and determine the minimum number of follicles to estimate mean concentrations at a 10% confidence level ( $m_{10\%}$ ). We measured As, Cd, Hg, Pb, Cu, Mn, Se, and Zn in FF samples using ICP-MS/MS and employed linear mixed models using restricted maximum likelihood to generate variability components. Sources of variability between women contributed the greatest proportion of total variance for FF As (97.2%), Hg (97.8%), Cd (52.1%), Cu (60.4%), Se (48.1%), and Zn (56.8%), compared to sources between ovaries, between follicles, and analytical variation. The proportion of variability attributable to sources between follicles differed significantly ( $p < 0.05$ ) by age, BMI, race, and cigarette smoking for Cu, Se, and Zn, by BMI and cigarette smoking for As, by primary infertility diagnosis for Hg, Cu, Se, and Zn, and by ovarian stimulation protocol for Mn and Se. To estimate  $m_{10\%}$  for Cu, Se, and Zn 4 to 5 individual follicles were sufficient, while >14 were necessary for As, Cd, Hg, Pb, and Mn. Our results suggest that while FF As and Hg are suitable biomarkers, these elements and Cd, Pb, and Mn have comparatively higher between-follicle variability than the other analytes. Our findings may help elucidate the impact of trace element exposures on IVF outcomes and inform the design of future studies.

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**P-0466**

**Vitamin D treatment during pregnancy and maternal and cord blood metal concentrations at delivery; results of a randomized controlled trial in Bangladesh**

**Presenter:** Anne Marie Jukic, NIEHS, Durham, United States

**Authors:** A. Jukic<sup>1</sup>, A. Zuchniak<sup>2</sup>, H. Qamar<sup>3</sup>, T. Ahmed<sup>4</sup>, A. Al Mahmud<sup>4</sup>, D. Roth<sup>2</sup>;

<sup>1</sup>NIEHS, Durham, NC, <sup>2</sup>University of Toronto & The Hospital for Sick Children, Toronto, ON, CANADA, <sup>3</sup>The Hospital for Sick Children, Toronto, ON, CANADA, <sup>4</sup>International Centre for Diarrhoeal Disease Research, Dhaka, BANGLADESH.

Background: Vitamin D facilitates calcium absorption, but also other essential elements such as magnesium and iron. In animal studies, vitamin D treatment also increases toxic metal absorption such as lead and cadmium. We examined maternal blood and infant cord blood levels of toxic metals in response to vitamin D supplementation. Methods: The Maternal Vitamin D for Infant Growth (MDIG) trial was a randomized, placebo-controlled, multi-arm study of maternal vitamin D supplementation during pregnancy in Dhaka, Bangladesh. Women were randomized during their second trimester to blinded weekly doses of placebo or 4,200, 16,800, or 28,000IU of vitamin D3 throughout pregnancy. Each group had 118, 141, 121, and 239 maternal blood specimens analyzed, respectively, and 100, 104, 111, and 201 infant cord blood samples. Cadmium, lead, mercury, and manganese were measured using inductively-coupled plasma mass spectrometry. We used linear regression models to calculate percent differences. Detectable versus undetectable cord blood cadmium was analyzed with log-binomial regression. Results: Maternal blood metal concentrations did not differ between treatment and placebo groups. However, compared with placebo, the 4,200, 16,800, and 28,000IU groups had infant cord blood lead levels that were 8.5% (-3.5, 22), 16% (3.3, 30), and 11% (0.4, 23) higher, respectively, and higher risk of having detectable cadmium levels, relative risk (95% confidence interval): 2.2(1.3, 3.7), 1.4(0.8, 2.5), 1.7(1.0, 2.9). Inferences were unchanged when excluding women with sufficient baseline 25OHD or excluding women who completed less than 95% of their treatment visits. Conclusions: Vitamin D supplementation from the second trimester of pregnancy did not affect maternal blood metal levels at delivery. However, higher lead and cadmium levels in cord blood were observed in some vitamin D groups. As there are no safe levels of metal exposures in infants, the observed increases in cord blood lead and cadmium concentrations require further exploration.

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**P-0467**

**Lead seasonality in humans, animals, and the natural environment**

**Presenter:** Ronnie Levin, Harvard TH Chan School of Public Health, Boston, United States

**Authors:** R. Levin;  
Harvard TH Chan School of Public Health, Boston, MA.

Higher lead burdens in warm weather occur in humans, domesticated and wild animals; land and water species; urban and rural, developed and pristine environments. The array of evidence suggests that lead seasonality is multifactorial within the natural world, including humans. Seasonally higher temperatures, solar radiation, humidity and anthropogenic pollution result in lower pH (acidification) in air, water and soil. Environmental acidification increases lead's bioavailability and mobility thus intensifying human, animal and plant exposures. In addition, lead seasonality in the biosphere is influenced by higher growth rates, slightly increased exposures, and more Vitamin D metabolism. Methodologically, we applied a One Health perspective to EPA's Integrated Science Assessments of Lead to review the published literature, supplemented with subsequent and related publications to assess data on the seasonality of lead exposure across species and through the earth's systems. Our integrated assessment suggests that: 1) 'Seasonality' is a multifactorial, terrestrial phenomenon affecting the natural world; human activities have exacerbated natural cyclicities that impact lead exposures across species. 2) To be sustainable, human lead remediation strategies must consider the total environment. 3) Global warming and climate change events may increase lead exposures and toxicity to all species throughout the natural environment.

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**P-0468**

**Trends in Arsenic Exposure among the US population: Findings from the National Health and Nutritional Examinations Survey, 2007-2016**

**Presenter:** Nimesh C Shah, Department of Epidemiology and Biostatistics, School of Public Health, Texas A&M University, College station, United States

**Authors:** N. C. Shah, N. T. Hasan, D. Han, T. Roh;  
Department of Epidemiology and Biostatistics, School of Public Health, Texas A&M University, College station, TX.

**Background & Objective:** In the US, the new maximum contamination level for arsenic (10 µg/L) in the public drinking water system was effective from 2006. The purpose of this study is to evaluate the temporal trends in arsenic exposure from drinking water among the US population. **Methods:** We analyzed data of five consecutive cycles of the National Health and Nutritional Examinations Survey (2007-2016). The concentration of total urinary arsenic was estimated by subtracting organic arsenic species (arsenobetaine and arsenocholine) from total arsenic. We restricted to subjects with arsenobetaine levels below the limit of detection to minimize the effect of a major dietary organic arsenic. The trends of arsenic exposure in children and women of childbearing age were also investigated. Separate analyses were conducted by demographic factors, smoking status, and water sources. **Results:** The overall trend in arsenic exposure in the US population was decreasing ( $p < 0.001$ ). Compared to 2007-2008, the arsenic exposure decreased by 19.3% (95% CI -29.2, -8.0) in 2015-2016. The decreasing trends in arsenic exposure were also shown in the most vulnerable populations such as children and women of childbearing age. In addition, other separate analyses showed decreasing trends over time. However, arsenic exposure was not changed significantly over the recent 10 years in well or rain cistern users. **Conclusion:** The arsenic exposure from drinking water decreased over 10 years in the US population. However, the exposure has not changed in people using wells, and legislative action and advocacy are needed to prevent arsenic exposure among well users.

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## ABSTRACT E-BOOK

Theme: **Heavy metal exposure**

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**P-0469**

**What is the current situation of blood lead levels of children living in Latin America and Caribbean Region? - preliminary results**

**Presenter:** Fernanda Junqueira Salles, University of São Paulo, Sao Paulo, Brazil

**Authors:** K. P. Olympio<sup>1</sup>, F. J. Salles<sup>1</sup>, E. C. Pereira<sup>1</sup>, K. A. Piai<sup>1</sup>, A. S. Silva<sup>2</sup>;

<sup>1</sup>University of São Paulo, Sao Paulo, BRAZIL, <sup>2</sup>Pan American Health Organization, Washington, DC, USA., WA.

Introduction. In 2017, we published the results of a review of the blood lead levels (BLL) of children living in Latin America and Caribbean (LAC) published up to 2013, and recommended the identification and control of "lead hot spots". In this study we assessed whether there had been advances in reducing BLL for the Region. Method. We conducted a literature review in PubMed and Lilacs databases (January-2014 to December-2019), searching for studies, which fulfilled the following inclusion criteria: 0-18-year-old children living in LAC; presented BLL results; and described the method used for collecting and analyzing blood. Only original papers were considered in English, Spanish and Portuguese. Reviews, commentaries, and thesis were excluded. Results. We recovered 156 papers and 45 met the selection criteria; 21 of them were carried out in Mexico. The children's BLL found in this review were in average lower than the previous period (2000-2013). Only seven studies presented children BLL mean  $\geq 10\mu\text{g/dL}$ . These higher BLL were associated with notorious sources or to occupational exposures (Mexico, Ecuador, and Brazil). Fewer countries ( $n=8$ ) published data on BLL in children, compared to the previous study ( $n=13$ ). Conclusions. Most of the BLL studies in LAC were carried out in areas with known lead exposure sources, similar to the previous period. The percentage of children at risk of lead poisoning in the Region remains unknown, because few studies (Brazil, Mexico, Puerto Rico, Jamaica, and Haiti) have published data on environmental exposure levels, and in general, the studies included small sample sizes. We maintain our recommendation to identify and control sources, and suggest the establishment of a systematic public health surveillance system for lead to bridge the knowledge gap and inform policy-making in the Region. Funding: FAPESP (2017/25424-9, 2018/18391-0) and Capes.

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Theme: **Heavy metal exposure**

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**P-0470**

**Environmental and human health implications of heavy metals in the road dust of tourist city Guilin-China**

**Presenter:** Asfandiyar Shahab, Guilin University of Technology, Guilin, China

**Authors:** A. Shahab;  
Guilin University of Technology, Guilin, CHINA.

Environmental and human health implications of heavy metals in the road dust of tourist city Guilin-China Asfandiyar Shahab College of Environmental Science and Engineering Guilin University of Technology, China, 541004 Abstract In this study, 78 road dust samples were collected from urban, industrial and tourist sites to investigate the distribution, accumulation and health risk assessment from heavy metals in Guilin city, as the famous tourist destination of China (10 million/year). Geoaccumulation index ( $I_{geo}$ ) and ecological risk index (ER) were used to investigate the road dust pollution level in urban, industrial and tourist areas. Results indicate that apart from Ni and Al, all the heavy metals comprising Pb, Zn, Ni, Cu, Cr, Cd, Fe, Mn and As were markedly higher than the corresponding background value in the three functional areas. Based on the  $I_{geo}$  index, the study area reveals uncontaminated to moderate pollution, and the industrial area was slightly more polluted and posed higher ecological risk than urban and tourist areas. Comparatively, higher pollution level was associated with Pb, Zn, Cu in the three functional sites. Furthermore, the health risk model reveals significant non-carcinogenic risks to children from Arsenic in urban, industrial and tourist areas as hazard quotient  $HQ_{ing}$  (1.64, 2.04 and 1.42) exceeds the threshold standard 1. The carcinogenic risk via ingestion ( $RI_{ing}$ ) illustrate significant risk in children from Ni, Cr and As as  $RI_{ing}$  ( $1.00E-3$ ) is considerably higher than the threshold standard ( $1.00E-6$  to  $1.00E-4$ ) in the three functional areas which ultimately have great potential to cause cancer risk while no cancer risk was observed from dermal and inhalation pathway. Keywords: Road dust; pollution level; functional areas; human health risk; tourist city

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**P-0471**

**Differential exposure to metallic mercury in children under 5 living in areas of gold mining of Antioquia, Colombia**

**Presenter:** MONICA LUCIA SOTO VELASQUEZ, Universidad de Antioquia, Medellin, Colombia

**Authors:** M. SOTO VELASQUEZ;  
Universidad de Antioquia, Medellin, COLOMBIA.

**Background:** The department of Antioquia in Colombia has the highest rates of artisanal and small-scale gold mining (ASM) mostly without mining permits. ASM is not a homogeneous process and exposure to metallic mercury can be variable, fetuses and those in early childhood are the most susceptible to its toxicity. Aim: to identify risk factors related to the body burden of mercury among children under 5 years, living, but not working, close to ASM in Colombia. **Methods:** a base-line for a cohort study was carried out with 240 children in the municipalities of Anzá, Caicedo and Sabanalarga in Colombia. Collection of sociodemographic variables and urine samples for detection of mercury levels was carried out with the consent of the legal guardian of the child. Levels equal to or greater than 5  $\mu\text{g/g}$  were considered exposed. **Results:** Fifteen (15) children had higher than admissible levels of mercury and of these, three exceeded 30  $\mu\text{g/g}$  and one was above 90  $\mu\text{g/g}$ . In Guintar and Chuscalita in the municipality of Anzá where amalgam burning is performed, the highest levels of mercury were found and, in all children, mercury was detected in urine. In Caicedo, where ASM has been nearly absent for almost 4 years levels of mercury were the lowest. Sabanalarga, where bareboat artisanal mining is practiced with little use of mercury, only one case exceeded 5  $\mu\text{g/g}$ . No differences in mercury level were found when comparing: sex, age, breastfeeding for the first 6 months of life, history of vaccination, median age, and level of schooling of the caregiver. This research revealed an environmental health problem that was not previously identified in these municipalities and points out the need for non-passive epidemiological surveillance and for actions not only with those who seem to be more exposed, but with those most susceptible

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**P-0472**

**Levels of heavy metals and rare earth elements in electronic waste workers in an informal waste recycling site in Ghana**

**Presenter:** Sylvia Akpene Takyi, University of Ghana, Accra, Ghana

**Authors:** S. A. Takyi<sup>1</sup>, N. Basu<sup>2</sup>, J. Arko-Mensah<sup>1</sup>, K. Houessionon<sup>3</sup>, P. Botwe<sup>1</sup>, D. Dwomoh<sup>1</sup>, J. Fobil<sup>1</sup>;  
<sup>1</sup>University of Ghana, Accra, GHANA, <sup>2</sup>McGill University, Montreal, QC, CANADA, <sup>3</sup>Univeristy of Abomey-Calavi, Ouidah, BENIN.

Background: The use of rudimentary tools and crude methods to recover valuable metals from e-waste at Agbogbloshie release of harmful metals such as lead, cadmium, arsenic, and mercury into the environment. These metals, even at lower doses could be toxic and may adversely impact a wide range of health outcomes including cardiovascular health to multiple organ damage in humans. Objective: This study aimed to measure and compare levels of heavy metals and rare earth elements in the blood and urine of e-waste workers at Agbogbloshie and controls (e-waste non-exposed) at Madina Zongo. Methods: Blood and urine samples collected from 100 e-waste workers and 51 controls were analyzed for heavy metals such as Arsenic (As), Lead (Pb), Cadmium and then rare earth elements namely; (Cd), Strontium (Sr), Cerium (Ce), Europium (Eu), Yttrium (Y). Simple linear regression models were used to explore relationships between occupational characteristics and metal levels. Results: The mean blood levels of Pb ( $92.35 \pm 63.69 \mu\text{g/L}$ ), Ce ( $92.35 \pm 63.69 \mu\text{g/L}$ ), and Sr ( $50.23 \pm 18.66 \mu\text{g/L}$ ) were significantly higher in e-waste workers than controls. However, mean blood Cd ( $0.94 \pm 0.64 \mu\text{g/L}$ ) and urinary As ( $88.57 \pm 64.41 \mu\text{g/L}$ ) levels were elevated in controls compared to e-waste workers. Blood levels of Eu and Y were also higher in controls than e-waste workers ( $p < 0.05$ ). Among e-waste workers, blood Pb levels were independent of the job task performed ( $p > 0.05$ ). In contrast, blood levels of As and Ce were highest collectors/sorters, followed by dismantlers and then burners. Conclusion: Although higher levels of Pb were measured in e-waste workers, the fact that higher levels of Cd, As and other rare elements were measured in controls suggests sources of exposure among the population are myriad, therefore, there is the need to conduct a larger study to determine possible sources of exposure, especially among the control and similar population.

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**P-0473**

### **An Assessment of Environmental Health Impacts of Toxic Chemical-Micronutrient Consumption in Groundwater from Dutse, Northwestern Nigeria**

**Presenter:** Adewole Michael GBADEBO, Federal University of Agriculture, Abeokuta (FUNAAB), Abeokuta, Nigeria

**Authors:** A. M. GBADEBO<sup>1</sup>, A. TUKUR<sup>2</sup>;

<sup>1</sup>Federal University of Agriculture, Abeokuta (FUNAAB), Abeokuta, NIGERIA, <sup>2</sup>Crescent University, Abeokuta, NIGERIA.

Background: Availability of water in the desired quantity and quality has been the key to human survival. This research assessed groundwater quality being consumed by the citizens of Dutse Area of Jigawa State, Northwestern Nigeria. Methods: Sixty groundwater samples (hand-dug wells and boreholes) from fifteen locations were analyzed for physical, chemical and biological parameters in order to determine their quality and potential health impact on the consumers/residents of this area. The parameters analyzed in the field were pH, Electrical Conductivity (EC) and temperature using standard methods. The sodium and potassium were analysed using flame photometer; sulphate, nitrate and phosphate using spectrophotometer; while calcium, magnesium, bicarbonate and chloride were analysed using titrimetric method. Analysis of metals in the groundwater samples was achieved through Inductively Coupled Plasma Mass Spectrometry at Activation Laboratory in Canada. Microbial load was analysed by serial dilution and counting. Results: The results showed that mean values of the physico-chemical parameters ranged as follows: pH, 5.00-7.00; temperature, 23.0-29.0 °C; EC, 190-2100 µs/cm; chloride, 34.55-690.90 mg/L; sulphate, 3.0-96.0 mg/L; bicarbonate, 20.0-60.0 mg/L; phosphate, 0.00-0.05 mg/L; nitrate, 0.05-0.47 mg/L; calcium, 18.1-462.4 mg/L; magnesium, 16.2-204.5 mg/L; sodium, 4.00-72.00 mg/L and potassium, 0.24-5.88 mg/L. The results of the heavy metal analysis shows the range of concentration of the following toxic metals: Aluminium, 20.0-853.0 µg/L; Cadmium, 0.05-0.23 µg/L; Lead, 0.87-22.8 µg/L; Mercury, 0.6-1.0 µg/L; Arsenic, 0.1-0.33 µg/L; Chromium, 0.2-0.3 µg/L; Beryllium, 0.5-1.2 µg/L and Cobalt, 0.09-0.71 µg/L. These were generally found to be within the WHO standard except in few cases. Similarly, the result of the microbial analysis shows the presence of Escherichia coli in almost all the groundwater samples. Conclusion: Cumulative effect of toxic metal in the consumed groundwater of the study area portends the risk of cancer and related diseases.

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Theme: **Heavy metal exposure**

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**P-0474**

**Methods for accounting for urine dilution in arsenic analyses: comparisons to blood arsenic**

**Presenter:** Ahlam Kifah Abuawad, Columbia University Mailman School of Public Health, New York, United States

**Authors:** A. K. Abuawad<sup>1</sup>, F. Parvez<sup>1</sup>, T. Islam<sup>2</sup>, J. Graziano<sup>1</sup>, A. Navas-Acien<sup>1</sup>, M. V. Gamble<sup>1</sup>;

<sup>1</sup>Columbia University Mailman School of Public Health, New York, NY, <sup>2</sup>Columbia University/University of Chicago Arsenic Research Office in Bangladesh, Dhaka, BANGLADESH.

**Background.** Arsenic (As) exposure remains ubiquitous affecting hundreds of millions of people worldwide. Urinary As (uAs) is an established biomarker of As exposure; urinary creatinine (uCr), a breakdown product of creatine phosphate in muscle, is excreted constantly via urine and commonly used to correct uAs for urine dilution. However, uCr levels are influenced by meat intake, muscle mass, and other factors that may also be related to As elimination. Alternative methods utilize specific gravity, which has limitations in individuals with kidney damage and diabetes. We compared uAs corrected for uCr and specific gravity vs. blood As (bAs), an increasingly used biomarker of As exposure that is unaffected by hydration status. **Methods.** We examined 539 participants from the Folic Acid and Creatine Trial (FACT) study to analyze the relationship between log-transformed total bAs and log-transformed uAs with adjustments for age, sex, and BMI, with further adjustments for uCr or specific gravity in separate models. **Results.** Median (IQR) uAs and bAs were 112.8 (133.6) and 8.41 (5.88)  $\mu\text{g/L}$ , respectively. Urinary creatinine and specific gravity were highly correlated with each other (Spearman correlation = 0.86,  $p < 0.001$ ). Regression models revealed that a log 10-unit increase in total bAs concentrations was related to 0.69, 0.72, and 0.57 increases in log-10 uAs when unadjusted for dilution factors, adjusted for uCr, and adjusted for specific gravity, respectively ( $p < 0.001$ ). **Conclusions.** We compared uAs to bAs to identify which strategy for urine dilution adjustment is appropriate in epidemiologic research and found that uCr outperforms specific gravity in predicting bAs in a Bangladeshi population exposed to high As levels in drinking water. More studies are needed in populations with different sociodemographic characteristics and levels of As exposure to evaluate the consistency of the findings and the optimization of urine dilution adjustment methods in As-related research.

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Theme: **Heavy metal exposure**

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**P-0476**

**Heavy metal concentrations in sediment, water and fish in two major rivers (Ankobra and Tano) in major farming and artisanal gold mining areas in Ghana**

**Presenter:** John Arko-Mensah, University of Ghana, School of Public Health, Accra, Ghana

**Authors:** J. Arko-Mensah, G. Awuah, J. N. Fobil;  
University of Ghana, School of Public Health, Accra, GHANA.

Heavy metal concentrations in sediment, water and fish in two major rivers (Ankobra and Tano) in major farming and artisanal gold mining areas in Ghana  
<sup>1</sup>University of Ghana, Accra, Ghana, <sup>2</sup>University of Michigan, Ann Arbor, USA  
Background: Arsenic (As), mercury (Hg) and lead (Pb) are toxic heavy metals that occur naturally in the environment. However, their levels are on the rise due to anthropogenic activities, including artisanal gold mining thus polluting fresh water bodies and posing a threat to aquatic wildlife, animals and humans. Objective: The aim of the study was to assess As, Hg and Pb concentrations in sediment, water and fishes from the Ankobra and Tano Rivers in the Western Region of Ghana, where human activities; especially artisanal gold mining are suspected of grossly polluting river bodies. Methods: Levels of As, Hg and Pb in different fish species and aquatic media (water and sediment) from the Tano and Ankobra River basins were analysed using the Atomic Absorption Spectrophotometer (AAS) Pinnacle 900T (Perkin Elmer, USA). Statistical analysis was done using Microsoft version 10 excel spread sheet and STATA software version 13 (StataCorps LP, Chicago, USA). Results: Overall, levels of heavy metals were in the order, Hg>As>Pb across study sites. Mean concentrations of Hg and As were highest in fish (2.09±1.29 mg/Kg) and (2.80±1.52 mg/Kg), followed by sediment (1.40±1.78 mg/Kg) and (0.61±0.40 mg/Kg), and water (0.09±0.36 mg/L) and (0.06±0.05mg/L) respectively. Pb levels were highest in sediment (1.46±4.26 mg/Kg), followed by water (0.14±0.10 mg/L), and then fish (0.11±0.11 mg/Kg) respectively. Conclusion: As and Hg levels in both Tano and Ankobra were above the WHO recommended levels for pristine freshwater ecosystems and may therefore pose a threat to aquatic wildlife and human health. Keywords: Tano, Ankobra, Heavy metals, artisanal

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Theme: **Heavy metal exposure**

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**P-0477**

**Evaluation of serum prestin as a new potential biomarker for hearing damage due to lead exposure in population from Tlaxcala, Mexico**

**Presenter:** SOLEDAD SOLIS-ANGELES, CINVESTAV-IPN, MEXICO CITY, Mexico

**Authors:** S. SOLIS-ANGELES<sup>1</sup>, C. A. JUÁREZ-PÉREZ<sup>2</sup>, A. CABELLO-LÓPEZ<sup>2</sup>, L. FASCINETTO-DORANTES<sup>2</sup>, G. AMPARO<sup>2</sup>, A. TORRES-VALENZUELA<sup>2</sup>, G. AGUILAR-MADRID<sup>3</sup>, L. M. DEL RAZO<sup>1</sup>; <sup>1</sup>CINVESTAV-IPN, MEXICO CITY, MEXICO, <sup>2</sup>IMSS-UIST, MEXICO CITY, MEXICO, <sup>3</sup>CLAUSTRO UNIVERSITARIO DE CHIHUAHUA, CHIHUAHUA, MEXICO.

**Aim:** Evaluate serum prestin and the relation with hearing damage in participants exposed to environmental and occupational lead from Tlaxcala Mexico. **Methods:** We conducted a cross-sectional study with 315 participants from Tlaxcala, Mexico. Blood samples were obtained in fasting conditions. Blood lead levels (BPb) were evaluated by graphite furnace atomic absorption spectrometry. Proteins were quantified in serum using a double site recognition enzyme-linked immunosorbent assay (ELISA). Auditory function was evaluated in for the frequencies 1 to 8 kHz, in a soundproof chamber. This study was approved by the IMSS's Scientific and Ethical Research Committee (2016-0601) and by CINVESTAV's Committee of Health Bioethics in Human Beings (264264). **Results:** Participants were classified according to BPb levels; group I (<10 µg/dl) with a BPb median of 6 µg/dl (IQR 3.9-7.7) and group II (>10 µg/dl) with a BPb median of 20.7 µg/dl (IQR 14.6-28.6) with significant differences between both groups. Prestin median concentration in group I was 4.63 ng/ml (IQR 0.09-14.8), and 0.13 ng/ml (IQR 0.02-12.1) for group II with statistical differences. The median hearing threshold for the group I was 13.7 dB (IQR 9.1-22.5), and group II was 17.5 dB (IQR 11.6-25). Multiple linear regression models for hearing thresholds and prestin were calculated ( $\beta$  -0.24,  $p < 0.05$ ) with an  $R^2 = 0.11$ ,  $p < 0.001$ , models were adjusted by age. **Conclusions:** Our data indicate that lead exposure is related to an increase in hearing threshold, and prestin protein decreased according to the hearing threshold increase. This is the first study to evaluate prestin as a potential biomarker for hearing damage due to lead exposure without noise exposure. Also, this study showed important differences between prestin concentration in women and men. The project was supported by CONACYT, Mexico 28746.

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**P-0478**

### **A Prospective Study of Cumulative Lead Exposure Following Pregnancy and Bone Composition among Women of the Early Life Exposure to Environmental Toxicants (ELEMENT) Mexico City Cohort**

**Presenter:** Marcela Tamayo-Ortiz, CONACYT-INSP, Cuernavaca, Mexico

**Authors:** M. Tamayo-Ortiz<sup>1</sup>, D. Watkins<sup>2</sup>, T. V. Muñoz-Rocha<sup>3</sup>, C. Osorio-Yáñez<sup>4</sup>, L. A. Torres-Olascoaga<sup>3</sup>, J. A. Tamayo-Orozco<sup>5</sup>, H. Hu<sup>6</sup>, K. E. Peterson<sup>2</sup>, M. M. Tellez-Rojo<sup>3</sup>;

<sup>1</sup>CONACYT-INSP, Cuernavaca, MEXICO, <sup>2</sup>University of Michigan School of Public Health, Ann Arbor, MI, <sup>3</sup>INSP, Cuernavaca, MEXICO, <sup>4</sup>Instituto de Investigaciones Biomédicas, Universidad Nacional Autónoma de México, Mexico, MEXICO, <sup>5</sup>Accessalud, Mexico, MEXICO, <sup>6</sup>University of Washington, Seattle, WA.

**Background:** Recent epidemiologic and basic science research indicates lead may negatively impact long term bone composition. To our knowledge, there are no longitudinal studies in women of the association between lead in bone (PbB) and bone composition: mineral density (BMD) and organic matrix (OM). Furthermore, this association could be modified by obesity, previously linked to increased BMD. **Methods:** We measured PbB in patella (trabecular-T) and tibia (cortical-C), by K x-ray fluorescence (KXRF) at one year postpartum among 101 women participating in ELEMENT between 1994-2004. In 2017 we performed iDXA scans to analyze body composition and determine z-scores of BMD of the lumbar spine (T) and femur (C) and Speed of Sound-MiniOmni scans to obtain OM z-scores of radius (T) and tibia (C) bone. Obesity was defined as a BMI of  $\geq 30$ . We examined the association between PbB exposure (patella and tibia in separate models) and z-scores for the 4 bone z-scores (BMD and SOS) simultaneously using multivariate models adjusted for BMI, parity and menopause status, and subsequently stratified by obesity. **Results:** Patella PbB had a mean (SD) of 13.36 (11.30)  $\mu\text{g}$  lead/g bone mineral and tibia PbB of 10.97 (8.47)  $\mu\text{g}$  lead/g bone mineral. Mean (SD) BMD Z-scores were lumbar spine -0.17 (1.14), femur 0.77 (0.95); and for OM: radius -0.38 (1.47), tibia 0.34 (1.28). Overall, tibia PbB was negatively associated with all bone z-scores except lumbar spine, however there was no statistical significance. There was a strong negative association between BMI and z-scores for OM and lumbar spine BMD, but positive for femur BMD. In stratified models tibia PbB was negatively associated with tibia BMD (-0.05 (95% CI:-0.09, -0.01) in non-obese women (n=57), but not in obese women. **Conclusions:** PbB may have a long-term negative impact on lower BMD in cortical bone, with obesity masking the association.

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Theme: **Heavy metal exposure**

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**P-0479**

**Trends in arsenic, nickel and lead concentrations within particulate matter in Sao Paulo, Brazil**

**Presenter:** K.A. Piai, School of Public Health, University of Sao Paulo, Brazil., Sao Paulo, Brazil

**Authors:** K. d. Piai, A. C. Nardocci, K. P. Olympio, T. Nogueira;  
School of Public Health, University of Sao Paulo, Brazil., Sao Paulo, BRAZIL.

**Background.** Potentially Toxic Elements (PTE), such as arsenic, nickel, and lead in the atmospheric Particulate Matter (PM) is recognized as a serious concern to human health due to its potential to induce carcinogenic and non-carcinogenic effects. The vehicular traffic is the major environmental source to these pollutants in urban areas. This study aimed to analyze PTE concentrations trends in PM<sub>10</sub>, in Sao Paulo, Brazil. **Methods.** The dataset from the Environmental Agency of the State of Sao Paulo, composed by few air quality stations data, as part of specific studies of PTE concentrations, was analyzed. PTE concentrations were sampled in a place located near a congested avenue, throughout the years 2002, 2006, 2009, and 2012. PM samples were collected using a Dichotomous air sampler (47-mm diameter Teflon filter) and the elemental analysis was performed by energy dispersive X-ray fluorescence. Linear regression was applied to evaluate these trends and the t-Student test was used to verify the significance of the model. **Result.** Arsenic annual mean concentration indicated a downward trend ranging from 4.1 (2002) to 3.4 ng/m<sup>3</sup> (2012). Lead also showed the same trend, ranging from 38.5 (2002) to 24.6 ng/m<sup>3</sup> (2012). On the other hand, the Nickel did not show this trend, the values ranged from 7.6 (2002) to 10.2 ng/m<sup>3</sup> (2012). The statistical analysis indicated significant correlations in winter/autumn seasons. Pearson's correlations for Lead-Arsenic ranged from 0.79 to 0.87 (p<0.01) in the winter and autumn, respectively. Additionally, for Lead-Nickel these values ranged from 0.61 to 0.56 (p<0.01), while for As-Ni ranged from 0.47 to 0.57 for the same seasons (p<0.01). **Conclusion.** Our findings indicate that PTE concentrations are high and reinforce the importance of further studies on metals exposure and health risks of all population beyond the evaluation of public policies for risk management. **Funding:** CAPES, CNPq, FAPESP.

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**P-0480**

**BKMR-CMA: A Novel R Command for Mediation Analysis in Environmental Mixture Studies**

**Presenter:** Aijin Wang, Columbia University Mailman School of Public Health, New York, United States

**Authors:** A. Wang<sup>1</sup>, K. L. Devick<sup>2</sup>, J. F. Bobbs<sup>3</sup>, A. Navas-Acien<sup>1</sup>, B. A. Coull<sup>4</sup>, L. Valeri<sup>1</sup>;

<sup>1</sup>Columbia University Mailman School of Public Health, New York, NY, <sup>2</sup>Mayo Clinic, Scottsdale, AZ, <sup>3</sup>Kaiser Permanente Washington Health Research Institute, Seattle, WA, <sup>4</sup>Harvard T.H. Chan School of Public Health, Boston, MA.

Background: Bayesian kernel machine regression (BKMR) is becoming a popular approach for studying the joint effect of environmental mixtures on health outcomes allowing for variable selection, which is particularly useful when continuous exposures display moderate correlations. An R package, `bkmr`, has been developed to implement this method. Recently, BKMR-causal mediation analysis (BKMR-CMA) has been proposed to estimate direct and indirect effects of mixtures through a hypothesized mediator. However, the current `bkmr` R package only allows the output of total effects of the mixtures. Method: We introduce two new commands within the `bkmr` package 1) BKMR-CMA: a command that allows the estimation of direct and indirect health effects of multiple environmental exposures through a single mediator; 2) BKMR-MI: a command that is used for valid estimation of environmental mixture effects and evaluation of uncertainty in the presence of missing data, which are imputed using multiple imputation techniques. The new commands also produce effective visualizations of the estimated causal effects and dose-response relationships. Results: The new computational approaches complement the existing `bkmr` package by allowing the study of direct and indirect effects and accounting for missing data in the estimation of the exposure effects. We illustrate the use of these novel commands in an environmental epidemiology study investigating the effects of metal mixtures on cardiovascular outcomes through a cardiovascular biomarker. Conclusion: Both BKMR-CMA and BKMR-MI are available on Github, and are expected to facilitate the conduct of reproducibility of mediation analysis in environmental epidemiology research.

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## ABSTRACT E-BOOK

Theme: **Heavy metal exposure**

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**P-0481**

### **Reliability and Variability of Metal Measurements in Permanent Tooth Enamel**

**Presenter:** Vy T Nguyen, Harvard T.H. Chan School of Public Health, Boston, United States

**Authors:** V. T. Nguyen<sup>1</sup>, A. J. Specht<sup>1</sup>, F. Bidlack<sup>2</sup>, T. Punshon<sup>3</sup>, B. P. Jackson<sup>3</sup>, M. G. Weisskopf<sup>1</sup>;  
<sup>1</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>2</sup>Forsyth Institute, Cambridge, MA, <sup>3</sup>Dartmouth College, Hanover, NH.

**Background:** The enamel of permanent teeth forms in well-defined developmental periods and can be used to reconstruct early-life exposures to metals. However, little is known about how consistent metal measurements are when derived from the same tooth. We evaluated the reliability and variability of metal measurements within permanent tooth enamel to aid in its use as a biomarker for metals. **Methods:** Twenty-two tooth samples (4 incisors, 7 canines, 3 premolars, 4 first or second molars, 4 third molars) from the Metal Exposures and Alzheimer's Disease Study were analyzed for aluminum (Al), arsenic (As), cadmium (Cd), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), nickel (Ni), and zinc (Zn) using laser ablation inductively coupled plasma mass spectrometry. Up to three laser ablation lines in the enamel were analyzed per tooth. Metal levels were normalized to calcium to account for variability in tooth mineralization and log-transformed due to skewed distributions. Adjusting for tooth type, we calculated the intraclass correlation coefficient (ICC) between ablation lines in enamel capturing overall exposures and the coefficient of variation (CV) across five segments of an ablation line capturing exposures over time. **Results:** ICCs were greater than 0.70 for most metals: Al (0.73), As (0.99), Fe (0.96), Pb (0.95), Mn (0.85), and Ni (0.90). ICCs were lower for Cd (0.52), Cu (0.61), and Zn (0.44). CVs were highest for Cd (61-154%), between 12-30% for Mn, Ni, As, and Pb, 12-44% for Al and Fe, 35-64% for Cu, and 78-107% for Zn. **Conclusions:** Repeated measurements of overall exposures in enamel are consistent for most metals. Higher CVs suggest more variation in metal measurements over time. These results can facilitate using permanent teeth as a biomarker for early-life exposures to metals.

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**P-0482**

### **Arsenic methylation capacity is associated with locus-specific DNA methylation: an epigenome-wide association study among adults with low-to-moderate arsenic exposure in the United States**

**Presenter:** Anne Bozack, Department of Environmental Medicine and Public Health & Division of Pulmonary Medicine, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** A. Bozack<sup>1</sup>, M. Tellez-Plaza<sup>2</sup>, K. Haack<sup>3</sup>, M. Gamble<sup>4</sup>, A. Domingo-Relloso<sup>5</sup>, J. G. Umas<sup>6</sup>, L. Best<sup>7</sup>, J. Yracheta<sup>7</sup>, M. O. Gribble<sup>8</sup>, A. Cardenas<sup>9</sup>, W. Goessler<sup>10</sup>, W. Tang<sup>11</sup>, M. Fallin<sup>12</sup>, S. A. Cole<sup>3</sup>, A. Navas-Acien<sup>4</sup>;

<sup>1</sup>Department of Environmental Medicine and Public Health & Division of Pulmonary Medicine, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Biomedical Research Institute INCLIVA, Hospital Clinico Universitario de Valencia, University of Valencia & Department of Environmental Health Sciences, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>3</sup>Department of Genetics, Texas Biomedical Research Institute, San Antonio, TX, <sup>4</sup>Department of Environmental Health Science, Columbia University, New York, NY, <sup>5</sup>Spanish National Center for Epidemiology, Carlos III Health Institute & Department of Environmental Medicine and Public Health & Division of Pulmonary Medicine, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>6</sup>MedStar Health Research Institute & Center for Clinical and Translational Sciences, Georgetown/Howard Universities, Washington, DC, <sup>7</sup>Missouri Breaks Industries Research, Eagle Butte, SD, <sup>8</sup>Department of Environmental Health, Emory University, Atlanta, GA, <sup>9</sup>Division of Environmental Health Sciences, School of Public Health, University of California, Berkeley, Berkeley, CA, <sup>10</sup>Institute of Chemistry, University of Graz, Graz, AUSTRIA, <sup>11</sup>Department of Environmental Health Sciences, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>12</sup>Department of Mental Health & Wendy Klag Center for Autism and Developmental Disabilities, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD.

**Background/Aims:** Chronic Arsenic (As) exposure remains a global health problem. Adverse health effects persist decades after arsenic exposure has ended, suggesting a role for epigenetic dysregulation. Methylation of inorganic arsenic (iAs) to monomethylarsonate (MMA) and dimethylarsinate (DMA) by arsenic(III) methyltransferase (AS3MT) decreases toxicity and facilitates urinary excretion. Whether arsenic methylation is associated with DNA methylation is unknown. **Methods:** We measured DNA methylation at >850,000 loci in 2,325 participants in the Strong Heart Study, a population-based study of American Indian adults exposed to low-moderate levels of arsenic in drinking water. Arsenic methylation was measured as the proportion of arsenic metabolites in urine: iAs%, MMA%, and DMA%. Blood DNA differentially methylated positions (DMPs) associated with each arsenic metabolite were tested using linear models. Gene ontology (GO) analysis was conducted using GOMeth adjusting for array coverage. Models were adjusted for estimated cell type proportions, age, sex, BMI, smoking, education, estimated glomerular filtration rate, and study site. **Results:** In adjusted models, we identified 84 and 13, 46 and 22, and 112 and 25 CpGs associated with iAs%, MMA%, and DMA% at  $P_{FDR} < 0.05$  /  $P_{Bonferroni} < 0.05$ , respectively. Seventeen FDR-significant CpGs were common between arsenic metabolites, including 4 CpGs annotated to AS3MT and 13 CpGs located within 650 kilobase pairs up- or downstream of the AS3MT gene and annotated to CNNM2, WBP1L, C10orf95, NT5C2, CALHM1, and TRIM8. Top GO terms overrepresented among genes containing iAs% DMPs were related to muscle hypertrophy; top GO terms associated with MMA% and %DMA% were related to response to tumor cells and regulation of protein catabolic processes. **Conclusions:** In an epigenome-wide association study, we identified CpGs associated with % arsenic metabolites within a gene region covering AS3MT. Further research is needed to understand the relationship between DNA methylation of AS3MT, gene expression, arsenic methylation capacity and health.

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## ABSTRACT E-BOOK

Theme: **Heavy metal exposure**

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**P-0483**

**Arsenic Exposure and Human Blood DNA Methylation and Hydroxymethylation Profiles in Two Diverse Populations from Bangladesh and Spain**

**Presenter:** Arce Domingo-Relloso, Spanish National Center of Epidemiology, Madrid, Spain

**Authors:** A. Domingo-Relloso<sup>1</sup>, S. Kiihl<sup>2</sup>, A. Bozack<sup>3</sup>, J. A. Casasnovas<sup>4</sup>, Z. Soriano<sup>4</sup>, T. Garcia-Barrera<sup>5</sup>, J. L. Gomez-Ariza<sup>5</sup>, F. Parvez<sup>6</sup>, A. Siddique<sup>7</sup>, H. Shahriar<sup>7</sup>, M. Udin<sup>7</sup>, T. Islam<sup>7</sup>, A. Navas-Acien<sup>8</sup>, M. Gamble<sup>6</sup>, M. Tellez-Plaza<sup>1</sup>;

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**Background:** Dysregulations in DNA methylation (5mC) associated to arsenic (As) have been reported, however, DNA hydroxymethylation (5hmC) changes associated to high or low-dose As exposures have rarely been studied. **Methods:** In this study, 30 healthy men aged 43-55 from the Aragon Workers Health Study (AWHS)(Spain) and 31 men aged 31-50 from the Folic Acid and Creatinine Trial (FACT) (Bangladesh) donated blood in 2011-13 and 2009-10, respectively, for DNA 5mC and 5hmC profiling using the InfiniumMethylation EPIC array. Oxidative bisulfite conversion in AWHS and TET-assisted bisulfite conversion in FACT were used to distinguish 5mC from 5hmC. We used established R packages (MLML2R, minfi, sva) for data processing, batch effects and cell heterogeneity corrections. ICPMS was used to measure total blood As in both populations and total urinary As in AWHS. Graphite furnace-AAS was used to measure total urinary As in FACT. Arsenic speciation (inorganic As, MMA, DMA and arsenobetaine) was conducted by HPLC-ICPMS in urine for FACT and AWHS. We ran linear regression models on the logit2-transformed 5mC and 5hmC proportions as outcomes, and log-transformed As variables as predictors, to identify differentially methylated or hydroxymethylated positions (DMPs, DHPs). **Results:** The median (IQR) of urinary sum of inorganic As ( $\mu\text{g/L}$ ) was 12.5 (6.8, 22.2) for AWHS and 89.6 (62.0, 161.2) for FACT. At a 0.01 nominal p-value cut-off, there were 20 and 60 common DMPs between the two populations for total urine and blood As, respectively. The corresponding overlap of DHPs was 76 and 36 for urine and blood As, respectively. The top DMP and DHP were found for urinary sum of inorganic arsenic (cg24299306, FDR=0.01) and urinary total As (cg05912299, FDR=0.33), respectively, in AWHS (not statistically significant in FACT). **Conclusions:** Common epigenetic signatures, both for 5hmC and 5mC, emerged in two populations exposed to very different As doses.

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Theme: **Heavy metal exposure**

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**P-0484**

### **Biomonitoring of metals in inhabitants of Northern Chile: implications of surveillance in areas with historical exposures**

**Presenter:** Sandra Cortes, Pontificia Universidad Católica de Chile. Departamento de Salud Pública. Advanced Center for Chronic Diseases. Centro de Desarrollo Urbano Sustentable, Santiago, Chile

**Authors:** S. Cortes<sup>1</sup>, J. Ríos<sup>2</sup>, C. Leiva<sup>3</sup>, P. Medel<sup>2</sup>, J. Astaburuaga<sup>4</sup>, L. Villarroel<sup>5</sup>, M. Torres<sup>5</sup>;  
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**Background:** The presence of toxic metals in human populations is strongly associated with chronic diseases and should be monitored especially in communities with a history of chronic exposures as occurs in northern Chile. **Objective:** to establish concentrations and prevalence of exposure to metals in residents of the city of Antofagasta, Chile, and its main risk factors. **Methods:** a cross-sectional study in Antofagasta was made. The sample (1203 adults) had populational representability at the city level. Sociodemographic information, health status, and sources of exposure to metals were collected in the participants. Urinary Inorganic Arsenic (InAs), Cadmium (Cd), Chromium (Cr) and Mercury (Hg) levels, and Lead (Pb) in blood were measured using NIOSH methodology by Inductively coupled plasma atomic emission spectroscopy (ICP-AES). **Results:** The sample had an average age of 42.7 years, with an average residence time in the city of 30 years, predominantly women (54.5%), high smoking (51.5%), high occupation rate in mining activities (22.6%). Using cutoff used by the health authorities (35µg /L for urinary InAs, the prevalence was 8% in adults and 12.3% in children. However, 75% of the population has levels below 21.9 µg / L. The main factors associated with high levels of urinary inorganic arsenic in adults were sex ( $\beta= 3.12$ , IC 95% 0.2-6.05 for males) and low schooling ( $\beta= 7.1$ , IC 95% 0.4-14.6 in people having less 8 y of education). People residing more than 500 meters from fixed sources had higher InAs levels. Other metals are below risk levels defined by health authorities. **Conclusions** It is urgent that in this city all the sources related to InAs must be verified and develop social interventions and environmental health surveillance in order to reduce involuntarily exposure to this metalloid.

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**P-0485**

**Principal Components Analyze and Score por exposure tercile in metals combined effects - Comparison of methods in a birth cohort - PIPA Project - Brazil**

**Presenter:** Nataly Damasceno Figueiredo, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

**Authors:** N. Figueiredo, M. Araujo, A. Natividade, C. Froes;  
Federal University of Rio de Janeiro, RIO DE JANEIRO, BRAZIL.

Despite the population is simultaneously exposed to multiple metals that may be toxic to human health, evidence on the combined effect of exposure to these metals is still limited. This study aims to compare two methods of analyze the combined effects of lead (Pb), Mercury (Hg), Arsenic (As) and Cadmium (Cd) concentration at mother's blood and birth weight. Methods: This study is part of the PIPA project (Childhood and Environmental Pollutant Project), whose pilot study was carried out from October 2017 to August 2018. To evaluate the combined exposure, the Principal Component Analysis (PCA) that originated was used to an explanation component and the classification of the exposure by score based on the tertiles of concentration. For the outcome, weight adequacy for gestational age was considered. Results: 135 babies were part of the study, of which 8.11% were small for gestational age. Among the metals analyzed there is a good correlation between Cd and Pb ( $R = 0.471$   $p < 0.001$ ), Cd and Hg ( $R = 0.425$   $p < 0.001$ ) and Pb and Hg ( $R = 0.427$   $p < 0.001$ ). The analysis of main components with the mother's blood generated a factor to describe the metals included in the analysis, presenting an OR = 0.821 (95% CI 0.385 - 1.750). In comparison to the result obtained with the analysis by exposure score, a similar result is verified, however with a broader confidence interval OR = 0.733 (95% CI = 0.096 - 5.616). Both analyzes show similar results. However new studies with a greater number of participants could reinforce this methods effectivity to combined effects of environmental pollutants. The PIPA Project cohort will start in the year 2020 and allow greater power of analysis.

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**P-0486**

**Lead Pb exposure assessment in dried blood spots using Total Reflection X-Ray Fluorescence TXRF**

**Presenter:** Veronica Rodriguez Saldana, McGill University, Sainte Anne de Bellevue, Canada

**Authors:** V. Rodriguez Saldana, N. Basu;  
McGill University, Sainte Anne de Bellevue, QC, CANADA.

Whole blood remains the most used biomarker for lead (Pb) biomonitoring, however, blood sampling has several limitations, including its invasive nature. Dried Blood Spots (DBS) have been applied as an alternative to traditional methods for decades, but there are gaps that have prevented them to be adopted in biomonitoring programs, such as their small sample volume. There are microanalytical techniques that require a low volume (<10  $\mu$ L) to perform the analysis, such as Total Reflection X-Ray Fluorescence (TXRF), however, this approach has not been evaluated yet. This study aimed to validate and apply a method to assess Pb exposure using DBS samples and TXRF. First, we developed a method testing different parameters including digestion and extraction procedures, and the use of different internal standards. Next, we validated our method evaluating several validation parameters, and we compared our results with standardized guidelines. Finally, we applied our method with samples from two cohorts. The limits of detection and quantification of the method were 0.28 and 0.69  $\mu$ g/dL, respectively. The overall precision and accuracy of the method were 14.88 % (9.92-19.14 %) and 111.14 % (97.03-129.70 %), respectively. The Bland-Altman plot indicated a good agreement between ICP-MS and TXRF, with a mean of differences of -0.02  $\mu$ g/dL. These results demonstrate that TXRF is a good alternative to traditional methods for the analysis of Pb in DBS samples and it alleviates challenges such as the low volume of sample, analytical interferences, and sample throughput.

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Theme: **Heavy metal exposure**

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**P-0488**

**Correction of hematocrit in the analysis of lead (Pb) in dried blood spots using potassium measurements**

**Presenter:** Veronica Rodriguez Saldana, McGill University, Sainte Anne de Bellevue, Canada

**Authors:** V. Rodriguez Saldana, N. Basu;  
McGill University, Sainte Anne de Bellevue, QC, CANADA.

Dried blood spots (DBS) is an advantageous sampling tool that has been widely applied in Pb exposure assessment. The benefits of this technique are numerous, including low invasiveness, feasibility, and low costs. Yet, this approach has been challenged by limitations, which prevent this tool to be established in Pb biomonitoring programs, such as the "hematocrit (Hct) effect". The Hct effect refers to how the differences in Hct in the DBS result in an uneven blood spreading through the filter paper. One of the approaches to cope with this effect that has demonstrated reliability, is the use of potassium as a marker of Hct. The goal of this study is to explore the potential of potassium measurements as a correction factor for the Hct effect in the analysis of Pb in DBS, to improve the agreement between whole blood and DBS. We validated a method to assess potassium in DBS using atomic absorption. We built a calibration curve of whole blood samples with a range of Hct levels (0.25-0.60) and a fixed concentration of Pb and we created DBS using an aliquot of these samples. We measured Pb levels and the Hct content (using potassium in the case of DBS) in the whole blood and DBS samples. We obtained a correction factor from the calibration curves of whole blood and DBS. Finally, we evaluated the agreement between whole blood and DBS before and after the correction of Pb concentrations in DBS. The limits of detection and quantification of the method to determine potassium were 1.76 and 5.80 ppm, respectively. The precision and accuracy were 0.02-0.33% and 92.2-124.7%, respectively. The agreement analysis between whole blood and DBS samples before correction showed a bias value of 0.6 µg/dL (LoA: -3.0- 4.2), while the bias after correction was 0.2 µg/dL (LoA: -3.8- 3.4).

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**P-0489**

### **Prenatal Co-Exposure to Methylmercury and Inorganic Arsenic**

**Presenter:** Sarah Rothenberg, Oregon State University, Corvallis, United States

**Authors:** S. Rothenberg;  
Oregon State University, Corvallis, OR.

**Background/Aim:** In the human body, arsenite is transported into cells through membrane channel proteins (i.e., aquaporins), while mercury decreases the permeability of aquaporins by binding to thiol groups. Thus exposure to mercury (through fish ingestion) may affect the metabolism of arsenite. This pilot study is focused on pregnant mothers, because the fetal period is considered the most vulnerable exposure window for methylmercury and arsenic.

**Methods:** In 2019, 45 healthy pregnant mothers (<21 weeks gestation) were enrolled at a hospital in Eugene, Oregon. After providing written informed consent, biomarkers were collected (blood, urine and hair samples). Blood methylmercury concentrations were determined, while arsenic species were analyzed in urine [inorganic arsenic, dimethylarsinic acid (DMA), and monomethylarsonic acid (MMA)]. A tap water sample was brought from home for analysis of arsenic. We investigated unadjusted associations between blood methylmercury and urine arsenic species [%MMA (of total arsenic) and %DMA (of total arsenic)].

**Preliminary Results:** All tap water arsenic concentrations were below the detection level (<2 ppb); however the sum of urine arsenic species (= inorganic As + DMA + MMA) averaged 3.0 ppb (median: 2.5 ppb, range: 0.31-11 ppb, unadjusted for specific gravity). These values were comparable to other cohorts of pregnant mothers in the U.S. and Europe, where drinking water arsenic levels were low. Urine %MMA (of total arsenic) was inversely correlated with  $\log_{10}$  blood methylmercury (Pearson's  $r$ : -0.25,  $p=0.12$ ), while urine %DMA (of total arsenic) was positively correlated with  $\log_{10}$  blood methylmercury (Pearson's  $r$ : 0.15,  $p=0.35$ ).

**Conclusions:** Although trends were non-significant, associations between urine arsenic species and blood methylmercury were suggestive. Analyses of specific aquaporins are ongoing, which may provide insight into these preliminary findings.

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**P-0490**

**Concentrations of chromium and lead in particulate matter less than 10  $\mu\text{m}$  at a gym near a vehicular traffic intersection and its health implications in gym's users in Bogotá, Colombia**

**Presenter:** Luis Camilo Blanco Becerra, Universidad Santo Tomas, BOGOTÁ D.C, Colombia

**Authors:** L. C. Blanco Becerra, Y. A. Garavito Gamboa, A. M. Mosquera Mongui, J. A. Alvarez Berrio; Universidad Santo Tomas, BOGOTÁ D.C, COLOMBIA.

Introduction: physical activity prevents from cardiovascular and mental diseases. To meet this goal, an appropriate external or internal environment must be available, where a good air quality is an important condition to develop the physical activity. Objective: to determine chromium and lead concentrations in particulate matter less than 10  $\mu\text{m}$  at a gym near a vehicular traffic intersection and its health implications in gym's users in Bogotá, Colombia. Methodology: for sixteen days (excluding Saturday, Sunday and holydays), from 7 a.m. to 9 p.m., at a gym near a vehicular traffic intersection, where public and private transport circulate,  $\text{PM}_{10}$  monitoring was carried out, using a Gil Air 3 personal sampling pump. Concentrations of lead and chromium were determined using graphite furnace atomic absorption spectroscopy, by analyzing  $\text{PM}_{10}$  filters, which were obtained from the personal sampling pump. Health implications were assessed by comparing the concentrations of the pollutants, against air quality guidelines of World Health Organization (WHO). Results: the daily average concentration of  $\text{PM}_{10}$ , lead and chromium were  $225,02 \mu\text{g}/\text{m}^3$  (SD:  $\pm 152,54$ ),  $0,002 \mu\text{g}/\text{m}^3$  (SD:  $\pm 0,002$ ) and  $0,50 \text{ ng}/\text{m}^3$  (SD:  $\pm 0,43$ ) respectively. Conclusions: all the daily values of  $\text{PM}_{10}$  exceed the 24 hours air quality guideline of  $50 \mu\text{g}/\text{m}^3$  as well as annual mean concentration of  $20 \mu\text{g}/\text{m}^3$  established by WHO. Daily concentrations of lead did not exceed WHO's standard, but chromium in 60% of the days with reading exceeded WHO's annual average of  $0,25 \text{ ng}/\text{m}^3$ . Although users of the gym only spend in average between 2 to 3 hours inside this place, they could be exposed to important concentrations of  $\text{PM}_{10}$  and chromium. These results are relevant because when users are doing physical activity, they are breathing more air that contains these pollutants, which could affect their health in the long term.

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**P-0491**

### **Follow-up of Elevated Blood Lead Levels and Sources in Children at One and Six Years of Age in Benin: A Cohort Study**

**Presenter:** Shukrullah Ahmadi, Université de Paris, Centre of Research in Epidemiology and Statistics/CRESS, INSERM, INRA, Paris, France

**Authors:** S. Ahmadi<sup>1</sup>, R. Zoumenou<sup>2</sup>, B. Le Bot<sup>3</sup>, S. Durand<sup>3</sup>, N. Fiévet<sup>4</sup>, P. Ayotte<sup>5</sup>, A. Massougbodji<sup>2</sup>, J. Alao<sup>6</sup>, M. Cot<sup>4</sup>, P. Glorennec<sup>3</sup>, F. Bodeau-Livinec<sup>7</sup>;

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**Background/Aim:** Lead has detrimental health effects on children including reduced cognitive and behavioural development. A high prevalence (58%) of elevated Blood Lead Levels (BLLs) (>50 µg/L) was observed in 685 one-year-old infants in semi-rural Benin in 2011-13. These children were reassessed in 2016-18 to assess sources of exposure and reductions in BLLs. **Methods:** BLLs were analyzed by inductively coupled plasma mass spectrometry (n=425). Sources were assessed through a questionnaire. BLLs and prevalence of elevated BLLs at six years of age are described and compared to BLLs measured in 2011-13. Multivariate linear and quantile regressions were conducted to determine associations between potential sources of lead and BLLs. **Results:** The prevalence of elevated BLLs (>50 µg/L) was 59.5% [GM 56.4 µg/L, 95% CI: 54.1 - 58.7] at six years of age compared to 54.8% [GM 56.5 µg/L, 95% CI: 53.4-59.6] at one year of age. The prevalence of children with BLLs >100 µg/L decreased from 14.4% at one year of age to 8.2% at six years of age (p<0.001). Consumption of peanuts was associated with an increment in BLLs both in the lowest (25<sup>th</sup>) and highest (90<sup>th</sup>) percentiles of BLLs. Consumption of bushmeat killed by lead bullets was associated with increments in the higher percentile (75<sup>th</sup>) of the distribution of the BLLs. Presence of activity with the potential use of lead in the house or neighbourhood was also associated with increased BLLs. These potential sources of lead were common: 10% reported eating peanuts more than once per month, almost 19% reported current meat consumption, and 14% reported the presence of activity with the potential use of lead. **Conclusion:** We confirm the persistently high prevalence of elevated BLLs in this rural, non-mining site, in south Benin. These results highlight the need for prevention strategies to decrease lead exposure in this population of children.

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**P-0492**

**Health risk assessment of human exposure to heavy metal using hair and nail as biosamples**

**Presenter:** Kamlika Gupta, Indian Institute of Technology, Bombay, Mumbai, India

**Authors:** K. Gupta, D. Pullokarar, H. C. Phuleria;  
Indian Institute of Technology, Bombay, Mumbai, INDIA.

Background Particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>) linked heavy metals exposures have been associated with an increased risk of cardiovascular and respiratory diseases. Biomonitoring of human hair and nail can be instrumental in quantifying the toxicological effects of such heavy metals, owing to non-invasive nature. The present study aims to examine heavy metals in human hair and nails in adult men and male children and to investigate the factors affecting their increased levels. Method Hair and nails samples (N=40) were collected from consenting men (25-70 years) and male children (5-14 years) from four different neighborhoods in urban Mumbai (Borivali, Powai, Chembur, and Mulund). Using Inductively Coupled Plasma-Mass Spectrometry (ICPMS), heavy metals such as Lead, Cadmium, Arsenic, Calcium, Zinc, Nickel, Manganese and Iron were quantified after acid-assisted microwave digestion. A structured questionnaire was used to collect information on demography, commute behavior, occupational hours and type of work, medical history, and dietary intake. Results Out of the trace metals studied, Pb emerged as the dominant metal, followed by Mn, As, Cd and Ni. The mean levels of Pb were found to be highest in Powai (0.02769±0.000997 ug/g of hair). Across all the sites, near-road heavy metal concentrations were significantly higher than those away from the road [Pb (36.23% higher), Cd (10.41% higher), and Ni (6.54% higher)]. Our results suggest that ambient air pollution and vehicular sources are responsible for heavy metals exposure in urban areas. Conclusion This novel study can bridge the gap between knowledge of metal toxicity and its quantifiable exposures in the human population as a result of particulate matter pollution in urban areas. It will not only help in understanding the extent of heavy metal exposures but will also help to expand the current repository of information on the heavy metal fraction of particulate matter and its stark detrimental effects on human health.

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**P-0493**

### **The Toxic Legacy of an Industry and it's Impacts on a Native American Tribe**

**Presenter:** Oyemwenosa Avenbuan, New York University Langone School of Medicine, Environmental Medicine, New York, United States

**Authors:** O. Avenbuan<sup>1</sup>, D. DeFreese<sup>2</sup>, J. Zelikoff<sup>1</sup>;

<sup>1</sup>New York University Langone School of Medicine, Environmental Medicine, New York, NY, <sup>2</sup>Ramapough Lenape Nation, Ringwood, NJ.

From the early 1960s through the late 1970s, millions of gallons of paint sludge and other toxic materials were dumped by a large car manufacturing plant into abandoned mines, forested areas, and lands near homes in Ringwood, NJ. As a result, upper Ringwood became riddled with toxic metals in the soil, water and air. This placed a large environmental burden on the people who have lived on this land for generations, the Ramapough Lenape Turtle Clan Nation. Samples of soil, water, plants, and fish from this partially-remediated 500 acre Superfund site (from community-identified areas) were collected by citizen scientists and NYU graduate assistants. Soil samples were collected at different sites throughout upper Ringwood and analyzed for metal contents using a XRF and ICP-OES. Additionally, drinking water samples were collected, at different timepoints, from a local church and tested for metals concentration using an ICP-MS. Results showed that both As and Pb were found in several different soil samples collected around the Ringwood church, at levels exceeding the NJ soil standards of 19 and 400 mg/kg, respectively. Additionally, Pb levels - exceeding the national and federal standard of 15 ppb - were found in drinking water from the church, depending on the faucets tested. As Ramapough children play at the Church area; the Tribes' tradition of growing their own food; and the fact that both heavy metals can cause acute and chronic diseases, the results were quickly reported back to the community, local governing body and media. These never-before identified contaminated water findings has led to the decision to switch the church water source from a local (previously-untested well) to the municipal water supply. This study demonstrates the importance of community-academic partnerships and citizen science for protecting the environmental health of marginalized populations. This study is supported by NYU NIEHS Center ES-000260-5.

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**P-0494**

### **Airborne Metal Exposure and Risk of Hypertension in the Sister Study**

**Presenter:** Jing Xu, National Institute of Environmental Health Sciences, Durham, United States

**Authors:** J. Xu, A. J. White, N. M. Niehoff, K. M. O'Brien, D. P. Sandler;  
National Institute of Environmental Health Sciences, Durham, NC.

Background Hypertension-related disease burden is a major challenge globally, and an estimated 1.56 billion adults will be affected by hypertension by 2025. Environmental factors, such as metals, could be risk factors for hypertension. However, the relationship between airborne metals and hypertension is rarely studied. Methods 49,876 women in the Sister Study cohort were included in this study. Census-tract airborne metal concentrations (arsenic, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, selenium, and antimony) from the 2005 National Air Toxics Assessment database were linked to participants' enrollment residential address. Hypertension was defined as high systolic ( $\geq 140$ ) or diastolic ( $\geq 90$ ) blood pressure (measured by trained examiners at enrollment) or taking anti-hypertensive medication. Logistic regression was used to estimate adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the association between individual metals and hypertension, with and without co-adjustment for other metals. Quantile-based g-computation was used to estimate the joint effect of the overall metal mixture. Results Risk of hypertension was higher among women of higher exposure to arsenic (OR<sub>quartile 4 vs 1</sub>=1.11, 95%CI=1.05,1.18), lead (OR<sub>quartile 4 vs 1</sub>=1.11, 95%CI=1.04,1.17), chromium (OR<sub>quartile 4 vs 1</sub>=1.07, 95%CI=1.01,1.14), cobalt (OR<sub>quartile 4 vs 1</sub>=1.07, 95%CI=1.01,1.14), and manganese (OR<sub>quartile 4 vs 1</sub>=1.07, 95%CI=1.01,1.13). Selenium was associated with lower risk of hypertension (OR<sub>quartile 4 vs 1</sub>=0.92, 95%CI=0.87,0.98). Results were similar with mutual adjustment for other metals. Race modified the associations, with greater ORs in non-white participants compared with non-Hispanic white participants. The joint effect of increasing all ten metals by one quartile was 1.04 (95%CI=0.98,1.10). Conclusion We found that living in areas of higher exposure to arsenic, lead, chromium, cobalt, and manganese was related to higher risk of hypertension, whereas exposure to selenium was inversely related to the risk of hypertension.

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**P-0495**

**Maternal Cadmium Exposure and Neurobehavior in Children up to Age 8 Years: The HOME Study**

**Presenter:** Weili Yang, University of Cincinnati, Cincinnati, United States

**Authors:** W. Yang<sup>1</sup>, A. M. Vuong<sup>2</sup>, C. Xie<sup>1</sup>, K. N. Dietrich<sup>1</sup>, M. R. Karagas<sup>3</sup>, B. P. Lanphear<sup>4</sup>, J. M. Braun<sup>5</sup>, K. Yolton<sup>6</sup>, A. Chen<sup>1</sup>;

<sup>1</sup>University of Cincinnati, Cincinnati, OH, <sup>2</sup>University of Nevada Las Vegas, Las Vegas, NV, <sup>3</sup>Geisel School of Medicine at Dartmouth, Lebanon, NH, <sup>4</sup>Simon Fraser University, Burnaby, BC, CANADA, <sup>5</sup>Brown University, Providence, RI, <sup>6</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH.

**Background:** It is unclear whether cadmium (Cd) exposure during fetal brain development is associated with child neurobehavior. This study examined the potential associations between Cd exposure during pregnancy and neurobehavior among children. **Methods:** We used data from 276 children in the Health Outcomes and Measures of the Environment (HOME) Study, a well-established prospective pregnancy and birth cohort. We measured maternal urinary Cd concentrations at 26 weeks of gestation. For cognitive function, we assessed Mental Development Index (MDI) and Full-Scale Intelligence Quotient (FSIQ) using the Bayley Scales of Infant Development-II, the Wechsler Preschool and Primary Scales of Intelligence-III, or the Wechsler Intelligence Scales for Children-IV at ages 1, 2, 3, 5, and 8 years. We assessed child behaviors using the Behavior Assessment System for Children-2 at ages 2, 3, 4, 5, and 8 years, yielding four composite measures: Externalizing Problems, Internalizing Problems, Behavioral Symptoms Index, and Adaptive Skills. We used linear mixed models with covariate adjustment to estimate the associations between maternal urinary Cd concentrations and child neurobehavior. **Results:** We categorized study participants into three groups based on maternal urinary Cd concentrations (Group 1: < limit of detection (LOD), Group 2: 0.06-0.22 µg/g creatinine, Group 3: >0.22-1.73 µg/g creatinine). In linear mixed models adjusting for maternal and child characteristics, maternal urinary Cd levels were not significantly associated with cognitive function at ages 1, 2, 3, 5, and 8 years or with behavioral composite measures at 2, 3, 4, 5, and 8 years. **Conclusions:** No significant associations were observed between maternal urinary Cd and cognitive or behavioral measures in children at 1 to 8 years of age in this study.

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**P-0496**

**Impact of Elevated Lead levels on the risk of Malaria and Anaemia among children in the Ahafo mining areas of Ghana**

**Presenter:** Latifatu Abubakar Alhassan, Kintampo Health Research Centre, Kintampo, Ghana

**Authors:** L. A. Alhassan, S. Gyaase, S. K. Tchum, A. Kwaku Poku;  
Kintampo Health Research Centre, Kintampo, GHANA.

Background/Aim: World Health Organization (WHO) identifies Lead as one of the top ten chemicals of “major public health concern”. Elevated Lead levels (ELL) is associated with anaemia. Malaria and Lead poison do not only overlap but have major effect on the health of children, especially those under five years. Despite these harmful effects of Lead, there is paucity of data from sub Saharan Africa where malaria is high. We sought to assess the association between ELL, with malaria or anaemia among children under five years in a mining area in Ghana at two time points. Methods: A cross sectional survey was conducted in 2006/2007 to ascertain the baseline characteristics of malaria, anaemia and ELL. In 2012, a follow up survey was conducted on the prevalence of these parameters. Results: A total of 2,518 children below 5 years were involved in the study at the two-time points; 1,646 and 872 from 2006 and 2012 year points respectively. The prevalence of ELL was 43.4% and 22.7% in 2006 and 2017 respectively. The prevalence of anaemia was 53.9 % and 35.7 % in 2006 and 2012 respectively. The prevalence of malaria was 22.6% and 26.7 respectively in 2006 and 2012 respectively. Adjusting for sex, household size and socioeconomic status, children, with anaemia were significantly more likely to have ELL (OR-1.19, 95% CI (1.01-1.14, p= 0.043). Children with malaria parasites greater than 5000parasites/ $\mu$ L were 36% more likely to have ELL (95% CI 0.94-1.84, p=1.090) Conclusions: The prevalence of ELL in the study area is high. There was a weak evidence to support an association of ELL with anaemia or malaria. Efforts are required to implement interventions to minimize the burden of ELL.

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**P-0497**

**Prenatal exposure to metals and newborn telomere length: modification by maternal antioxidant intake**

**Presenter:** Whitney Cowell, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** W. Cowell;  
Icahn School of Medicine at Mount Sinai, New York, NY.

Background/Aim: Telomere length (TL) predicts the onset of cellular senescence and correlates with longevity and age-related disease risk. While telomeres erode throughout life, adults display fixed ranking and tracking of TL, supporting the importance of the early environment in determining inter-individual variability across the life course. Given their guanine-rich structure, telomeres are highly susceptible to oxidative stress (OS). We examined maternal metal exposure, which can induce OS, in relation to newborn TL. We also considered the modifying role of maternal antioxidant intake. Methods: Analyses included 106 mother-newborn pairs enrolled in the Boston and New York City-based PRogramming of Intergenerational Stress Mechanisms (PRISM) pregnancy cohort. We measured As, Ba, Cd, Ni, and Pb in maternal late-pregnancy urine by ICP-MS and quantified relative leukocyte TL (rLTL) in cord blood using qPCR. We used weighted quantile sum (WQS) regression to estimate the metal mixture - rLTL association and conducted repeated holdout validation to improve the stability of estimates across data partitions. We examined models stratified by high (> median) versus low ( $\leq$  median) maternal antioxidant intake, estimated from Block98 Food Frequency Questionnaires. We considered urinary creatinine, week of urine collection, maternal age and race/ethnicity as covariates. Results: In adjusted models, urinary metals were inversely associated with newborn rLTL ( $\beta_{WQS}=-0.13$ , 95% CI: -0.20, -0.06). The top metals contributing to the negative association included Ba (weight: 0.32), Cd (0.28) and Pb (0.27). In models stratified by antioxidant intake, the significant inverse association between metals and rLTL remained only among mothers with low antioxidant intake (low:  $\beta_{WQS}=-0.20$ , 95% CI: -0.34, -0.05; high:  $\beta_{WQS}=-0.04$ , 95% CI: -0.19, 0.11). Results were similar in unadjusted models. Conclusions: Relative LTL was reduced among newborns of mothers with higher exposure to metals during pregnancy. Higher maternal antioxidant intake may mitigate the negative influence of metals on newborn rLTL.

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**P-0498**

**Lead Exposure is Associated With Poor Working Memory in 12-Year Old Chinese Children**

**Presenter:** Olivia M. Arnold, University of Pennsylvania, School of Nursing, Philadelphia, United States

**Authors:** O. M. Arnold, J. Liu;  
University of Pennsylvania, School of Nursing, Philadelphia, PA.

Background: Low-level lead exposure has been linked to decreased IQ and poorer academic achievement. Fewer studies, however, have examined associations between low-level lead exposure and executive function outcomes, especially for adolescents. The purpose of this study is to test whether childhood and/or adolescent low-level lead exposure is related to executive function outcomes in 12-year old Chinese children. Methods: This study used data from the China Jintan Cohort group where 820 children participated. Blood lead levels (BLLs) were measured twice when the participants were 3-5 years old (Wave I) and again at 11-12 years old (Wave II). Neurocognitive outcomes were assessed at only Wave II using Working Memory Measurement Software (WM). Four tests were used to measure visuospatial and numeric working memory, including dot trajectory, dot memory, box transform memory, and a digit span test. These individual scores can be summed to create a total WM score. Correlations and linear regressions were used to examine bivariate relationships between age 3-5 BLLs and age 11-12 WM scores as well as between age 11-12 BLLs and WM scores. Results: Mean BLLs for ages 3-5 and 11-12 years were low (6.43 mcg/dl and 3.12 mcg/dl, respectively). Pearson correlations showed no significant relationships between age 3-5 BLLs and age 11-12 WM scores. There were significant cross-sectional correlations between age 11-12 BLLs and total WM scores ( $R = -0.0751$ ,  $p = 0.0331$ ) and dot memory scores ( $R = -0.0853$ ,  $p = 0.0152$ ). In bivariate analyses, age 11-12 BLLs were significant predictors of age 11-12 total WM scores ( $\beta = -0.2923$ ,  $p = 0.033$ ) and dot memory scores ( $\beta = -0.1381$ ,  $p = 0.015$ ). Conclusions: This study showed that adolescent lead exposure is associated with reduced working memory abilities. However, this association was not observed for early lead exposure on adolescent working memory. These results suggest that efforts to prevent lead exposure in adolescence could reduce neurocognitive deficits.

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**P-0499**

**Medical Diagnosis of Diabetes and Blood Lead Levels, NHANES 2013-2016**

**Presenter:** Dana Buckholz, National Cancer Institute, Rockville, United States

**Authors:** D. Buckholz, S. Mahabir, K. Herrick, G. Lai, C. DellaValle;  
National Cancer Institute, Rockville, MD.

Background: Although blood lead levels have decreased in the US population since the 1970s after the ban of lead in gasoline and paint, widespread lead exposures still persist. Lead exposure has been shown to induce insulin resistance in rodents, but epidemiologic evidence of metabolic effects in humans is limited. We investigated the association between blood lead levels and diabetes using data from the National Health and Nutrition Examination Survey (NHANES), a cross-sectional nationally representative survey. Methods: Using two survey cycles of NHANES, 2013-2014 (n=2,854) and 2015-2016 (n=2,872), we evaluated participants 19 years or older who self-reported doctor-diagnosed diabetes and had a valid blood lead measurement. Blood lead levels ( $\mu\text{g}/\text{dL}$ ) were categorized into quartiles based on survey cycle. We estimated odds ratios (ORs) and 95% confidence intervals (CIs) using survey weighted logistic regression models in SAS, and adjusted for potential confounders including gender, age, race/Hispanic origin, family poverty income ratio and BMI. Tests for linear trend were conducted using the median value of each lead quartile as a continuous variable. Results: We identified 241 and 256 individuals with diabetes in NHANES 2013-2014 and 2015-2016, respectively. Blood lead levels were not associated with diabetes overall. ORs for individuals in the highest quartile of blood lead measurements compared to the lowest quartile were 0.88 (95% CI = 0.59 - 1.31;  $P_{\text{trend}} = 0.89$ ) and 0.91 (95% CI 0.67 - 1.23;  $P_{\text{trend}} = 0.95$ ) for NHANES 2013-2014 and NHANES 2015-2016, respectively. Conclusion: In these nationally representative data, we did not observe any statistically significant associations between blood lead levels and diabetes. Given the limitations with cross-sectional surveys, these findings need to be confirmed in further well-designed investigations.

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**P-0500**

### **Executive Functions in School Children from Montevideo, Uruguay and their Associations with Concurrent Low-level Arsenic Exposure**

**Presenter:** Gauri Desai, University at Buffalo, Buffalo, United States

**Authors:** G. Desai<sup>1</sup>, G. Barg<sup>2</sup>, M. Vahter<sup>3</sup>, E. I. Queirolo<sup>2</sup>, F. Peregalli<sup>4</sup>, N. Mañay<sup>4</sup>, A. E. Millen<sup>1</sup>, J. Yu<sup>1</sup>, K. Kordas<sup>1</sup>;

<sup>1</sup>University at Buffalo, Buffalo, NY, <sup>2</sup>Catholic University of Uruguay, Montevideo, URUGUAY, <sup>3</sup>Karolinska Institutet, Stockholm, SWEDEN, <sup>4</sup>University of the Republic of Uruguay, Montevideo, URUGUAY.

Background: Arsenic is a known childhood neurotoxicant, but its neurotoxicity at low exposure levels is still not well established. Our cross-sectional study aimed to test the association between low-level arsenic exposure and executive functions (EF) among children in Montevideo. We also assessed effect modification by arsenic methylation capacity, a susceptibility factor for the health effects of arsenic, and by B-vitamin intake, which impacts arsenic methylation. Methods: Arsenic exposure was assessed as the specific gravity-adjusted sum of urinary arsenic metabolites (U-As) among 255 ~7 year-old children, and methylation capacity as the proportion of urinary monomethylarsonic acid (%MMA). B-vitamin intake was calculated from the average of two 24-hour dietary recalls. EF was measured using three tests from the Cambridge Neuropsychological Test Automated Battery - Stockings of Cambridge (SOC), Intra-dimensional/extra-dimensional shift task (IED), and Spatial Span (SSP). Generalized linear models assessed associations between U-As and EF measures, adjusting for age, sex, maternal education, possessions score, Home Observation for Measurement of the Environment Inventory score, season, and school clusters. A "B-vitamin index" was calculated using principal component analysis. Effect modification by the index and urinary %MMA was assessed in strata split at the respective medians of these variables. Results: The median (range) U-As and water arsenic levels were 9.9 µg/L (2.2, 47.7) and 0.45 µg/L (0.1, 18.9) respectively. U-As was inversely associated with the number of stages completed ( $\beta = -0.02$ ; 95% CI: -0.03, -0.002) and pre-executive shift errors ( $\beta = -0.08$ ; 95% CI: -0.14, -0.02) of the IED task, and span length of the SSP task ( $\beta = -0.01$ ; 95% CI: -0.02, -0.004). There was no clear pattern of effect modification by B-vitamin intake or urinary %MMA. Conclusion: Low-level arsenic exposure may adversely affect executive function among children but additional, including longitudinal, studies are necessary to confirm these findings.

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**P-0501**

**Correlation between environmental low-dose cadmium exposure and early kidney amage: a comparative study in an industrial zone vs. a living quarter in Shanghai, China**

**Presenter:** Hong Chen, Tongji University, Shanghai, China

**Authors:** Y. Jin, Y. Lu, H. Chen, H. Zhao, Y. Shen, X. Kuang;  
Tongji University, Shanghai, CHINA.

To investigate heavy metal exposure in the environment of an industrial zone vs. a living quarter in Shanghai and heavy metal accumulation in the body of the residents, and explore the relationship between the heavy metal source, urine cadmium (Cd) content and early kidney damage (EKD). An automobile industrial zone in Northwest Shanghai and a living quarter in the central urban area of Shanghai were selected as the sampling sites to detect the concentration of PM<sub>2.5</sub> and the content of heavy metals. One hundred and sixty-eight residents selected from the industrial zone were used as the exposure group, and 168 residents selected from the living quarter were used as the control group. Living habits, drinking water and food sources, and occupational exposure to heavy metals of the residents in the two groups were investigated and recorded. Blood lead and urine Cd, manganese (Mn), mercury (Hg) and arsenic (As) levels in the body of the residents in the two groups were determined. The correlation of urine Cd with urine NAG, mAlb, KIM-1 and Cd-MT was analyzed. The urine Cd level in the residents of the exposure group was significantly higher than that in those of the control group. Cd was more likely to accumulate in the human body than lead and other heavy metals investigated. Serum Cys-C and urine NAG, mAlb, KIM-1 and Cd-MT levels in the exposure group were significantly higher than those in the control group. Urine Cd, mAlb and KIM-1 were correlated with urine Cd-MT in the exposure group. With drinking water, food and occupational exposure adjusted, the difference of Cd content in the body of the residents between the two groups may be probably due to different PM<sub>2.5</sub> contents in the environment arising from the industrial pollution.

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**P-0502**

### **Associations between Childhood Toenail Manganese Concentrations and Neurodevelopment in Rural Appalachian Ohio**

**Presenter:** Kaitlin Vollet Martin, University of Kentucky, Lexington, United States

**Authors:** K. Vollet Martin<sup>1</sup>, K. N. Dietrich<sup>2</sup>, H. Sucharew<sup>3</sup>, K. Brunst<sup>2</sup>, D. R. Smith<sup>4</sup>, E. N. Haynes<sup>1</sup>;  
<sup>1</sup>University of Kentucky, Lexington, KY, <sup>2</sup>University of Cincinnati, Cincinnati, OH, <sup>3</sup>Cincinnati Children's Hospital, Cincinnati, OH, <sup>4</sup>University of California, Santa Cruz, Santa Cruz, CA.

**Background:** Manganese (Mn) is necessary in trace quantities; however, at increased exposure levels the metal poses a risk to neurologic functions. While there is no universally accepted biomarker of Mn exposure, toenails are novel, noninvasive measures that represent cumulative exposure. The Communities Actively Researching Exposure Study (CARES) is an established pediatric cohort in eastern Ohio which includes children aged 7-9 living near industrial sources of excess Mn exposure. This study aims to understand the relationship between Mn exposure, quantified through toenails, and neurodevelopmental outcomes among CARES participants.

**Methods:** Toenail samples collected from participating children were analyzed for Mn content. Trained team members administered the Wechsler Intelligence Scale for Children-IV (WISC-IV), the Behavioral Assessment System for Children-2 (BASC2), and the Behavior Rating Inventory of Executive Functions (BRIEF). We assessed linear relationships between toenail Mn concentrations and Intelligence Quotient (IQ) and behavioral scores. Quartiles of the distribution for toenail Mn were represented with categorical variables and multiple regression models were ran to assess nonlinearity. Critical confounders such as blood lead and serum cotinine were included.

**Results:** Exposure and outcome data were available for 404 children. Our study suggests a nonlinear relationship among boys, with lower Working Memory IQ scores observed among those with low ( $\beta = -3.46$ ; 95% CI -7.54, 0.62) and high ( $\beta = -5.07$ ; 95% CI -9.86, -0.29) levels of toenail Mn. The effect of Mn on the global executive function and BRIEF composite scales was 4 to 6 times greater among girls compared to boys, respectively.

**Conclusions:** Toenails appear to be a valuable biomarker for Mn exposure. Gender is a crucial factor with regards to the neurotoxicology of Mn. Future research is needed to further elucidate the toxicokinetics of Mn in toenails as well as the mechanisms behind the influence of gender on the relationship between Mn and neurodevelopment.

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**P-0503**

**Association between lead in umbilical cord blood and neurodevelopment at 6 months of age - PIPA Project / Rio de Janeiro / Brazil.**

**Presenter:** Monica S Araujo, Federal University of Rio de Janeiro, rio de janeiro, Brazil

**Authors:** M. S. Araujo;  
Federal University of Rio de Janeiro, rio de janeiro, BRAZIL.

Brazil. Background/Aim: Environmental exposure to heavy metals in urban areas has been associated with adverse effects on child health. To investigate the effects of environmental pollutants on maternal-child health and to test viability for a birth cohort study, a pilot study (PIPA pilot study) was conducted from October 2017 to August 2018, at the Maternity School of the Federal University of Rio de Janeiro, Brazil. This study aims evaluate the association between lead concentration in umbilical cord blood and neurodevelopment at 6 months of age. Methods: Lead concentrations in umbilical cord blood were measured by inductively coupled plasma mass spectrometry (ICP-MS), in 117 umbilical cord blood. Infant's neurodevelopment was evaluated using Denver Developmental Screening Test II (DDST-II) at six months old (n=41). It was analyzed the association between the proportion of failures identified in the DDST-II at the sixth month of age and the concentration of lead in umbilical cord blood divided into tertiles, the first tertile being the reference value. Results: The proportion of failures in DDST-II was 31.7% at six months of age. It was observed for the 2<sup>o</sup> tertile RR = 0.593 p <0.595 (CI: 0.188-1.872) and for the 3<sup>o</sup> tertile RR = 0.735, p <0.999 (CI: 0.199-2.714). At one month old (n=54) and three months old (n=54), the failure performed respectively 18.5 % and 24.1 %. Conclusion: There is an increase in the proportion of failures according to the age at which the assessment was made, although not statistically significant. The small number of newborns evaluated can justify these results. More follow-up studies with a higher number of children are needed to better assess the relationship between lead levels and neurodevelopment.

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## ABSTRACT E-BOOK

Theme: **Heavy metal health**

**P-0504**

**Prenatal exposure to mercury and risk of pediatric liver injury**

**Presenter:** Nikolaos Stratakis, Keck School of Medicine of USC, Los Angeles, United States

**Authors:** N. Stratakis<sup>1</sup>, K. Margetaki<sup>1</sup>, D. V. Conti<sup>1</sup>, E. Garcia<sup>1</sup>, R. Grazuleviciene<sup>2</sup>, L. Maitre<sup>3</sup>, R. Slama<sup>4</sup>, C. Thomsen<sup>5</sup>, M. Vafeiadi<sup>6</sup>, D. Valvi<sup>7</sup>, J. Wright<sup>8</sup>, Y. Zhao<sup>1</sup>, M. B. Vos<sup>9</sup>, M. Vrijheid<sup>3</sup>, K. Berhane<sup>10</sup>, R. McConnell<sup>1</sup>, L. Chatzi<sup>1</sup>;

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<sup>3</sup>ISGlobal, Barcelona, SPAIN, <sup>4</sup>University Grenoble Alpes, Grenoble, FRANCE, <sup>5</sup>Norwegian Institute of Public Health, Oslo, NORWAY, <sup>6</sup>University of Crete, Heraklion, GREECE, <sup>7</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>8</sup>Bradford Institute for Health Research, Bradford, UNITED KINGDOM, <sup>9</sup>Emory University, Atlanta, GA, <sup>10</sup>Columbia University, New York, NY.

**Background/Aim:** Non-alcoholic fatty liver disease (NAFLD) is the most common liver disease in children. Emerging evidence from animal models suggests that mercury (Hg) might exert hepatotoxic effects. However, human evidence is scarce. We aimed to evaluate the association between prenatal Hg exposure and serum biomarkers of liver injury in childhood and examine the hypothesis that inflammation might play a role in this association. **Methods:** The study included 872 mothers and their children (mean [SD] age: 7.8 [1.3] years) from six European population-based birth cohorts, as part of Human Early-Life Exposome (HELIX) project. Hg levels were assessed in maternal whole blood. We measured alanine aminotransferase (ALT), aspartate aminotransferase (AST), and gamma-glutamyltransferase (GGT) levels in child serum. We also assessed eight inflammatory cytokines and adipokines previously linked to liver injury (TNF- $\alpha$ , IFN- $\gamma$ , IL-1 $\beta$ , IL-6, IL-8, IL-12, IP-10 and leptin) in child plasma. **Results:** Median (IQR) maternal Hg concentration was 2.0 (1.1-3.6)  $\mu\text{g/L}$ . Eighty-five mothers (9.8%) had high Hg concentration (above the value that corresponds to the current U.S. EPA reference level, 5.8  $\mu\text{g/L}$ ). Mean (SD) levels of ALT, AST, and GGT in children were 15.7 (6.4), 31.2 (9.1) and 12.5 (3.5) U/L, respectively. Seventy-two children (8.3%) had elevated ALT based on clinical cutoffs for liver injury ( $\geq 22.1$  U/L for females and  $\geq 25.8$  U/L for males). High maternal Hg concentration was associated with 10.4% increase in ALT (95% CI: 1.9%-19.7%) and a 2-fold increase in the risk for elevated ALT (OR 2.0, 95% CI: 1.0-3.9). Using a novel latent variable analysis, we identified a cluster of children at risk for current liver injury (OR 5.3, 95% CI: 2.7-9.7) that was characterized by high maternal Hg exposure and increased plasma levels of TNF- $\alpha$ , IL-1 $\beta$ , IL-6 and IL-8. **Conclusions:** Prenatal exposure to mercury may be a risk factor for pediatric liver injury and NAFLD development.

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Theme: **Heavy metal health**

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**P-0505**

### **Residential Dust Lead Levels and the Risk of Childhood Lead Poisoning in United States Children**

**Presenter:** Joe M Braun, Brown University, Providence, United States

**Authors:** J. M. Braun<sup>1</sup>, K. Yolton<sup>2</sup>, N. Newman<sup>2</sup>, D. Jacobs<sup>3</sup>, M. Taylor<sup>4</sup>, B. Lanphear<sup>5</sup>;

<sup>1</sup>Brown University, Providence, RI, <sup>2</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>3</sup>National Center for Health Housing, Columbia, MD, <sup>4</sup>Macquarie University, Sydney, AUSTRALIA, <sup>5</sup>Simon Fraser University, Burnaby, BC, CANADA.

**Background and Aim:** The United States Environmental Protection Agency (EPA) recently lowered the residential dust lead hazard standards for floors and windowsills from 40 to 10  $\mu\text{g}/\text{ft}^2$  and 250 to 100  $\mu\text{g}/\text{ft}^2$ , respectively, while maintaining post-abatement clearance standards promulgated in 2001 (floors:40  $\mu\text{g}/\text{ft}^2$  and windowsills:250  $\mu\text{g}/\text{ft}^2$ ). With this discrepancy, children could continue living in homes with significant lead hazards. We examined whether this discrepancy increases children's blood lead concentrations and risk of lead poisoning.

**Methods:** We used data from a prospective cohort of pregnant women and their children living in homes built before 1978 in the Cincinnati, OH area (HOME Study, 2003-2006). Among 250 children, we conducted 455 repeated clinical and residential assessments at ages 1 and 2 years, at which time we measured residential floor and windowsill dust lead loadings ( $\mu\text{g}/\text{ft}^2$ ), as well as children's venous blood lead concentrations ( $\mu\text{g}/\text{dL}$ ). Using linear regression with generalized estimating equations, we estimated blood lead concentrations and risk of blood lead concentrations  $>5\mu\text{g}/\text{dL}$  at various dust lead loadings.

**Results:** Compared to children living in homes with floor dust lead loadings of 10  $\mu\text{g}/\text{ft}^2$ , those living in homes with floor dust lead loadings of 40  $\mu\text{g}/\text{ft}^2$  had 26% higher (95% CI:15, 38; p-value<0.001) blood lead concentrations and a two-fold risk for having blood concentration  $>5 \mu\text{g}/\text{dL}$  (RR:2.10; 95% CI:1.44, 3.06) after confounder adjustment. The results were similar for windowsill dust lead, but weaker. When extrapolating our findings to all U.S. children age 1-5 years, we estimated that 6.9% (95% CI: 1.5, 17.2) of cases of blood lead concentrations  $>5 \mu\text{g}/\text{dL}$  are attributable to having floor dust lead loadings between 10 and  $<40 \mu\text{g}/\text{ft}^2$ .

**Conclusions:** The EPA's residential dust lead regulatory standards place children at increased risk of lead poisoning. We recommend using more protective dust lead standards to protect children from lead exposure.

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Theme: **Heavy metal health**

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**P-0506**

**Arsenic in Private Well Water and Birth Outcomes in the United States**

**Presenter:** Catherine M Bulka, University of North Carolina, Chapel Hill, United States

**Authors:** C. M. Bulka<sup>1</sup>, M. Scannell Bryan<sup>2</sup>, M. A. Lombard<sup>3</sup>, S. M. Bartell<sup>4</sup>, D. K. Jones<sup>5</sup>, P. M. Bradley<sup>6</sup>, V. M. Vieira<sup>4</sup>, D. T. Silverman<sup>7</sup>, M. J. Focazio<sup>8</sup>, P. L. Toccalino<sup>9</sup>, J. D. Ayotte<sup>3</sup>, M. O. Gribble<sup>10</sup>, M. Argos<sup>2</sup>;  
<sup>1</sup>University of North Carolina, Chapel Hill, NC, <sup>2</sup>University of Illinois at Chicago, Chicago, IL, <sup>3</sup>United States Geological Survey, Pembroke, NH, <sup>4</sup>University of California, Irvine, CA, <sup>5</sup>United States Geological Survey, Salt Lake City, UT, <sup>6</sup>United States Geological Survey, Columbia, SC, <sup>7</sup>National Cancer Institute, Shady Grove, MD, <sup>8</sup>United States Geological Survey, Reston, VA, <sup>9</sup>United States Geological Survey, Sacramento, CA, <sup>10</sup>Emory University, Atlanta, GA.

**Background/Aim:** Prenatal exposure to drinking water with arsenic concentrations  $>50$   $\mu\text{g/L}$  has been associated with adverse birth outcomes. However, evidence is sparse at concentrations  $\leq 50$   $\mu\text{g/L}$ . As a collaborative effort by public health experts and geologists, we used machine learning techniques to characterize arsenic concentrations in private wells, which are unregulated for contamination, and evaluated associations with birth outcomes throughout the conterminous U.S. **Methods:** Groundwater arsenic concentrations from  $\sim 20,000$  private wells were used to develop several machine learning models, including random forest classification (RFC). Probabilistic model predictions, along with private well usage data, were linked by county to all certificates of live birth from 2016 ( $n=3.4$  million). Mixed-effects models were fit to term birthweight and gestational age, adjusting for potential confounders and incorporating random intercepts for spatial clustering. As a sensitivity analysis to account for uncertainty in machine learning predictions, mother-infant pairs were randomly assigned to discrete private well arsenic categories ( $\leq 5$ ,  $>5$  to  $\leq 10$ , or  $>10$   $\mu\text{g/L}$ ) based on residential county. This process was repeated 10 times with estimates combined using Rubin's rules. **Results:** We generally observed non-significant inverse associations with term birthweight. For instance, in sensitivity analyses of RFC predictions, we found that relative to mothers expected to have private well arsenic concentrations  $\leq 5$   $\mu\text{g/L}$ , mothers assigned concentrations  $>5$  to  $\leq 10$   $\mu\text{g/L}$  gave birth to infants that weighed 1.6 (95% CI: -9.9, 6.6) grams less whereas those assigned to  $>10$   $\mu\text{g/L}$  gave birth to infants that weighed 2.4 (95% CI: -9.9, 5.1) grams less. Associations with gestational age were null. **Conclusion:** In this large nation-wide study, we did not detect a significant association of the modeled spatial distribution of arsenic in private wells with adverse birth outcomes. Measurement error stemming from a lack of individual-level information on primary water source and consumption levels likely obscured the true associations.

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Theme: **Heavy metal health**

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**P-0507**

**Respiratory conditions in children exposed to mining waste dust, a cohort study in Bruminha project**

**Presenter:** Renan Duarte dos Santos Saraiva, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

**Authors:** R. D. Saraiva, A. d. Santos, N. D. Figueiredo, C. I. Asmus;  
Federal University of Rio de Janeiro, Rio de Janeiro, BRAZIL.

**Background/aim:** On January 25<sup>th</sup>, 2019, the tailings dam I of the “Córrego do Feijão” mine, owned by Vale, collapsed in Brumadinho, state of Minas Gerais, Brazil. This disaster reached a vast territorial extension and produced a 12 million m<sup>3</sup> of mining rejects, with accumulation and dissemination of mud and dust in the affected areas and exposing the local population to metal residues. Children are one of the more susceptible groups to the toxic effects of metal waste. This study evaluates the toxic effects of metal residues exposure on the respiratory system of 0-4 years old children living in the affected areas. **Methods:** This is a prospective cohort that will follow 200 children for 4 years. We will apply baseline and follow-up questionnaires to collect sociodemographic and health information from parents and children, besides clinical assessment of children and collection of biological samples for the measurement of Arsenic, Cadmium, Lead and Mercury in urine (in the 1st and 2nd years) and blood (in the 3rd and 4th years) matrices. The obtained data will be analyzed using frequency measures and regression models. **Expected results:** The first field stage is foreseen for May 2020, where it is intended to outline a pattern and profile of exposure to metals and their effects on the respiratory and immune systems in the population studied. **Conclusions:** This summary presents a proposal for investigating the occurrence of respiratory disorders in children living in communities affected by the disaster in Brumadinho and it intends to contribute to the priority setting related to the development of surveillance and health care actions for these populations.

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Theme: **Heavy metal health**

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**P-0508**

### **Association of blood lead and cadmium levels with the age of menarche and menopause using the Korea National Health and Nutrition Examination Survey**

**Presenter:** Juyeon Lee, Korea university, Seoul, Korea, Republic of

**Authors:** J. Lee, D. Huh, J. Lee, J. Choi, K. Moon;  
Korea university, Seoul, KOREA, REPUBLIC OF.

Background Heavy metal accumulation in the body can cause many health problems, among them lead (Pb) and cadmium (Cd) are well-known as reprotoxic substances. However, very limited information has been reported exposure to environmental heavy metals directly affects reproductive life span of female. This study aimed to investigate the association between exposure to environmental lead and cadmium and the age at menarche and menopause of the general population in South Korea. Methods We selected subjects among 22,629 females who participated in the 2010~2017 (exclude 2014, 2015) Korean National Health and Nutrition Examination Survey. We calculated odds ratio (OR) and 95% confidence interval of proportion of the girls who started their menarche and women who stepped into the menopause stage by continuous levels of blood lead and cadmium and quartiles of them. Results The geometric mean (GM) of blood lead and cadmium levels were 1.02 µg/dL and 0.28 µg/L (10~15 years of age 516 girls), respectively. And the GM of blood lead and cadmium levels were 1.85 µg/dL and 1.33 µg/L (46~55 years of age 1,004 women), respectively. In adjusted logistic regression models, as the blood lead levels increased, the proportion of the menarche has significantly decreased [OR=0.24 (0.09, 0.64)]. On the other side, the proportion of the menopause has significantly increased [OR=4.51 (2.52, 8.06)]. In addition, as the blood cadmium levels increased, the proportion of the menarche has significantly increased [OR=2.78 (1.31, 5.94)], and proportion of the menopause stage has significantly decreased [OR=0.43 (0.27, 0.70)]. Conclusions Our results suggested two novel insights. Firstly, higher blood lead levels could delay menarche and cause early menopause. Secondly, higher blood cadmium levels could cause early menarche and delay menopause. Consequently, exposure to environmental lead and cadmium may affects reproductive life span of female.

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Theme: **Heavy metal health**

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**P-0509**

**Environmental exposure to manganese and other trace metal(loid)s in air: associations with cognitive and motor functions.**

**Presenter:** LAURA RUIZ-AZCONA, UNIVERSITY OF CANTABRIA, SANTANDER, Spain

**Authors:** L. RUIZ-AZCONA, B. MARKIV, A. EXPÓSITO, I. FERNÁNDEZ-OLMO, M. SANTIBAÑEZ; UNIVERSITY OF CANTABRIA, SANTANDER, SPAIN.

Background/Aim: Maliaño, Cantabria (Spain) is a 10,000 inhabitants community with elevated air-Mn from ferroalloy industrial emissions (annual arithmetic mean=781 ng/m<sup>3</sup>; reference guideline from WHO <=150 ng/m<sup>3</sup>). The capital of the region (Santander, 172,000 inhabitants) is 7 km from the industrial emission source (IES). Our objective was to determine the blood levels of Mn, As and Pb in adult healthy volunteers, and to explore the associations between residence distance from the IES, blood levels, and their cognitive and motor function. Methods: Ongoing cross-sectional study analyzing the first 29 volunteers: 19 women and 10 males, mean age 47.2 years. Cognitive and motor function was assessed by 5 and 3 tests respectively. Cognitive crude scores were standardized according to NEURONORMA norms. Distance from the IES was categorized into "<=1.5 km" versus ">1.5 to <10 km from the IES". Spearman's rho coefficient ( $r_s$ ) was used for correlations. Results: Means for Mn, As and Pb blood levels ( $\mu\text{g/L}$ ) were 8.34; 8.22 and 11.65 respectively. As ( $r_s=-0.590$ ,  $p=0.001$ ) and Pb ( $r_s=-0.465$ ,  $p=0.011$ ) were correlated with lower distance from the IEM. Regarding cognitive function, statistically-significant mean differences were obtained for "WAIS Digit Span Backward" (1.44 points lower when living <=1.5 km,  $p=0.017$ ) and "Verbal Fluency Test Initial Letter P" (4.21 points lower,  $p=0.042$ ). WAIS Digit Span forward (NEURONORMA) was correlated negatively with Mn levels ( $r_s=-0.410$ ,  $p=0.027$ ). Regarding motor function, Grooved Pegboard was inversely correlated with distance (the closer the residence to the IES, the longer the time to complete the test:  $r_s=-0.38$ ,  $p=0.043$ ), mean difference=10.32 more seconds in highly exposed. For none of the rest of analyses, significant results were obtained against the hypothesis of worse cognitive or motor function as a function of distance from the IES, or blood levels. Conclusions. Our results suggest poorer cognitive and motor function, especially in terms of proximity to IES.

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Theme: **Heavy metal health**

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**P-0510**

### **A Multipollutant Longitudinal Study of the Association between Urinary Tungsten and Incident Diabetes in a Rural Population**

**Presenter:** Emily Riseberg, Tufts University School of Medicine, Boston, United States

**Authors:** E. Riseberg<sup>1</sup>, K. James<sup>2</sup>, M. Woodin<sup>3</sup>, R. Melamed<sup>4</sup>, T. Alderete<sup>5</sup>, L. Corlin<sup>1</sup>;

<sup>1</sup>Tufts University School of Medicine, Boston, MA, <sup>2</sup>Colorado School of Public Health, Aurora, CO, <sup>3</sup>Tufts University, Medford, MA, <sup>4</sup>University of Chicago, Chicago, IL, <sup>5</sup>University of Colorado Boulder, Boulder, CO.

**Background/Aim:** Tungsten (W) is a transitional metal found in soil, water, food, and air. Cross-sectional analyses indicate that W is associated with fasting glucose (FG) levels. We conducted the first longitudinal analysis assessing the association between W and incident diabetes, accounting for arsenic (As), lead (Pb), and cadmium (Cd) coexposure. **Methods:** We analyzed data from 1684 individuals residing in rural Colorado (USA) and participating in the San Luis Valley Diabetes Study. Participants' diabetes status, FG (mg/dL), and urinary concentrations of W, As, Pb, Cd, and creatinine were assessed between one and seven times over 14 years. Metal concentrations ( $\mu\text{g/L}$ ) and FG were natural log-transformed. We assessed longitudinal associations between  $\ln W$  exposure and  $\ln FG$  using linear mixed effect models with a random intercept for each participant. We assessed the association between baseline  $\ln W$  exposure and incidence rate of diabetes using Fine and Gray competing risk regression (competing event=all-cause mortality). An evidenced-based directed acyclic graph (DAG) was used to determine covariates (age, ethnicity (Hispanic/not), sex, education (<12/12/>12 years), smoker status (current/former/never), alcohol intake (g/week), carbohydrates (g/day), body mass index, urine creatinine ( $\mu\text{g/g}$ ),  $\ln As$ ,  $\ln Pb$ , and  $\ln Cd$ ). **Results:** At the first examination, 48% of participants were Hispanic, 53% were female, the mean age was 54 years (standard deviation=12), the median W concentration was 0.22  $\mu\text{g/L}$  (25<sup>th</sup>=0.20; 75<sup>th</sup>=0.59), and the median FG level was 99 mg/DL (25<sup>th</sup>=92; 75<sup>th</sup>=115). Of 1387 participants without diabetes at baseline (mean time at-risk=9.2 years), 398 individuals developed diabetes (incidence=3 cases/100 person-years) and 301 died before developing diabetes.  $\ln W$  exposure was not associated with  $\ln FG$  (0.1% decrease in  $\ln FG$  for a doubling in  $\ln W$ ; 95%CI= 0.2% decrease-0.0% increase) or the incidence rate of diabetes (subdistribution hazard ratio=1.02, 95%CI=0.90,1.15). **Conclusion:** Accounting for metal coexposures, competing risks, and DAG-determined covariates, we observed no association between W and diabetes.

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**P-0511**

**Effects of heavy metal mixture exposure on hematological and biomedical parameters mediated by oxidative stress**

**Presenter:** Jing Xu, Department of Epidemiology and Biostatistics, Institute of Basic Medical Sciences Chinese Academy of Medical Sciences, School of Basic Medicine Peking Union Medical College, Beijing, China

**Authors:** J. Xu<sup>1</sup>, M. Zhao<sup>1</sup>, X. Liu<sup>2</sup>, Q. Xu<sup>1</sup>;

<sup>1</sup>Department of Epidemiology and Biostatistics, Institute of Basic Medical Sciences Chinese Academy of Medical Sciences, School of Basic Medicine Peking Union Medical College, Beijing, CHINA, <sup>2</sup>Jinzhou Medical University, Jinzhou, CHINA.

**Background** Heavy metal mixture pollution is currently a serious global environmental health concern. The toxicity of heavy metal mixture is mainly mediated by oxidative stress. However, the effects of heavy metal mixture exposure on hematological and biochemical parameters mediated by oxidative stress are unclear. **Methods** Our cross-sectional study had a final sample of 585 participants who were divided into exposure and non-exposure groups according to whether their areas of residence were near the ferroalloy factory. The assessment of internal heavy metal exposure markers was based on blood concentrations of chromium, lead, and manganese. Linear regression models were used to explore the relationships between heavy metal mixture exposure, hematological and biochemical parameters, and oxidative stress parameters. Furthermore, mediation analysis was conducted to evaluate the mediation effects of oxidative stress on the relationship between heavy metal mixture exposure and hematological or biochemical parameters. **Results** Compared with participants who were not exposed to heavy metal mixture, those who were exposed had greater levels of hematological (e.g., white blood cell and red blood cell markers) and biomedical (e.g., liver function markers, glucose, and lipid metabolism markers) parameters ( $p < 0.05$ ), whereas levels of platelet markers were lower in participants who were exposed to heavy metal mixture ( $p < 0.05$ ). We observed significant mediation effects of oxidative stress on the association between exposure status (exposure vs. no exposure group) and hematological parameters (e.g., red blood cell markers, platelet markers, and white blood cell markers) as well as biomedical parameters (e.g., liver function markers, glucose and lipid metabolism markers).

**Conclusion** Heavy metal mixture exposure is associated with hematological and biochemical parameters, and oxidative stress potentially mediates this relationship.

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**P-0513**

**The association of blood mercury levels with interference control in 6 years old children**

**Presenter:** Yoonyoung Jang, Seoul National University, School of Medicine, Seoul, Korea, Republic of

**Authors:** Y. Jang<sup>1</sup>, J. Kim<sup>2</sup>, Y. Lim<sup>3</sup>, K. Lee<sup>1</sup>, B. Kim<sup>4</sup>, C. Shin<sup>5</sup>, Y. Lee<sup>6</sup>, Y. Hong<sup>7</sup>;

<sup>1</sup>Seoul National University, School of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Department of Psychiatry, Hanyang University Medical Center, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Section of Environmental Health, Department of Public Health, University of Copenhagen, Copenhagen, DENMARK, <sup>4</sup>Division of Child and Adolescent Psychiatry, Department of Psychiatry, Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>5</sup>Department of Pediatrics, Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>6</sup>Department of Pediatrics, Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>7</sup>Environmental Health Center, Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF.

**Background:** Human bodies are constantly exposed to heavy metals like mercury due to industrialization and environmental pollution. The health effects of mercury have been a common concern. In particular, children need to be more careful because they are in the stage of growth and development. However, there is no firm consensus about the effects of mercury on neurodevelopment in children. **Methods:** We describe the association between blood mercury concentrations in 6 years old children (N = 574) and with the Stroop color and word test(SCWT) scores based on the Environment and Development of Children (EDC) study, a prospective cohort study. In the SCWT, the color word score represents the subject's ability to control cognitive interference. Univariate analysis and multivariate analysis consisting of three models were performed with different variables and stratification of gender was also conducted. **Results:** There was no statistically significant association between the log-transformed prenatal and postnatal blood mercury levels and the ability of interference control in 6 years old children (N = 396). However, when stratified by gender, girl's color-word test score in Model 1 showed a decrement by -3.71 points for each log-transformed blood mercury increment (p-value = 0.0765). This trend persisted in Model2 (Beta: -3.76, p-value = 0.0766) and Model3 (Beta: -4.06, p-value = 0.0547). **Conclusions:** The result suggests that mercury exposure may affect interference control especially in girls. The color-word score in the SCWT is a score obtained by suppressing the automated reaction to read letters under the condition that the color of word and letter do not match and reflecting the frontal lobe suppression process. The analysis showed that the ability to control cognitive interference may decrease with an increment of log blood mercury concentration.

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**P-0515**

### **Disentangling the Impacts of Cadmium Exposure and Smoking Behavior on Age-Related Cognitive Decline in a Representative U.S. Sample**

**Presenter:** Tara E. Jenson, Zilber School of Public Health, University of Wisconsin - Milwaukee, Milwaukee, United States

**Authors:** T. E. Jenson<sup>1</sup>, I. Driscoll<sup>2</sup>, J. M. Woo<sup>1</sup>, A. E. Kalkbrenner<sup>1</sup>;

<sup>1</sup>Zilber School of Public Health, University of Wisconsin - Milwaukee, Milwaukee, WI, <sup>2</sup>University of Wisconsin - Milwaukee, Milwaukee, WI.

Background: Cadmium is a toxic metal that has, in a sparse literature, been linked to age-related cognitive decline. We investigated cadmium exposure and cognitive function while considering confounding and modifying effects of tobacco use, given tobacco is a major source of cadmium exposure and is linked to cognitive decline.

Methods: We included 2,069 adults age 60 years and older from the National Health and Nutrition Examination Survey (NHANES), 2011-2014, after excluding 262 with missing data, classifying active smokers by self-report or serum cotinine levels >10ng/mL. Cadmium levels in whole blood likely reflected prolonged exposure due to persistence in human tissues: mean=0.52µg/L (standard deviation=0.45µg/L). Cognitive performance was assessed concurrently with blood testing, via four neuropsychological tests: tapping memory, executive function, sustained attention, and working memory, which were standardized and combined to form a composite cognitive z-score mean z=0 (stdev 0.75). We used linear models to estimate change in cognitive function per 1-unit µg/L increase in cadmium, incorporating the NHANES MEC sampling weights. Results: Initial observations of worse cognitive performance with higher cadmium from unadjusted models,  $\beta = -0.17$  (95% CI -0.24, -0.09), were highly attenuated after adjusting for gender, age, age<sup>2</sup>, race/ethnicity, marital status, education level, and poverty income ratio:  $\beta = -0.08$  (95% CI -0.14, -0.01). Additional adjustment for smoking status (active/former/never) and serum cotinine further attenuated this association:  $\beta = -0.05$  (95% CI -0.13, 0.03). The cadmium-cognition association was not modified by smoking status; the p value on a likelihood ratio test of cadmium\*smoking status=0.34.

Conclusion: In contrast to prior studies, our findings suggest that cadmium is not related to cognitive decline, although our design was limited to a single cognitive measure rather than a trajectory of cognitive decline and may have been impacted by missing data. Studies that fail to account for tobacco exposure may over-estimate the neurodegenerative impacts of cadmium.

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**P-0517**

### **The Effects of Alcohol Drinking and Environmental Cadmium Exposure on Hypertension in the Korean Adults: Data Analysis of the Korea National Health and Nutrition Examination Survey (KNHANES), 2008-2013**

**Presenter:** Yun-Hee Choi, Department of Health and Safety Convergence Science, Korea University, Seoul, Korea, Republic of

**Authors:** Y. Choi<sup>1</sup>, D. Huh<sup>2</sup>, J. Lee<sup>1</sup>, W. Chae<sup>1</sup>, J. Choi<sup>1</sup>, J. Lee<sup>1</sup>, K. Moon<sup>1</sup>;

<sup>1</sup>Department of Health and Safety Convergence Science, Korea University, Seoul, KOREA, REPUBLIC OF,

<sup>2</sup>Department of Health Science, Korea University, Seoul, KOREA, REPUBLIC OF.

**Background/Aim** Hypertension is a common disease found in one-third of Korean adults. Although previous studies have reported that high-risk drinking and cadmium exposure are risk factors for hypertension, most of these studies were limited to small populations or occupational workers exposed to a high concentration. Several studies that presented the joint effect of combined exposure of alcohol drinking and cadmium exposure on hypertension were also mainly conducted on animal experiments. This study will verify the individual effects of alcohol drinking and cadmium in the body and the joint effect of their co-exposure on hypertension in the general population.

**Methods** We analyzed data from 6,795 Korean adults who had been randomly assigned to the Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2013. Multiple linear and logistic regression analysis was conducted to estimate the association of alcohol drinking and blood cadmium concentration with blood pressure and odds ratio (OR) for hypertension. Results After adjusting for age, sex, smoking status, monthly income, education level, body mass index, stress level, physical activity, sodium intake, and the energy intake, ORs for hypertension comparing the group with high-risk alcohol drinking versus the group who did not was 1.67 (95% CI: 1.34, 2.06). In the same model, ORs for hypertension comparing the highest versus the lowest blood cadmium quartiles were 1.46 (95% CI: 1.15, 1.86), increasing significantly as cadmium concentration increased (p for trend <0.001). The results of logistic regression analysis for the additive scale of joint effects, ORs for interaction term was 0.64 (95% CI: 0.14, 1.14, p-value=0.011).

**Conclusions** This study supports the hypothesis that alcohol drinking and environmental cadmium exposures at levels currently observed in the Korea may increase the risk of hypertension. Our findings support efforts to reduce alcohol drinking and environmental cadmium exposure to prevent hypertension in the general population effectively.

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**P-0519**

### **Preliminary Data from the PROGRESS Cohort on Early Life Blood Lead Concentrations and Child MMR Vaccine Response**

**Presenter:** Marina Oktapodas Feiler, University of Rochester School of Medicine and Dentistry, Rochester, United States

**Authors:** M. Oktapodas Feiler<sup>1</sup>, S. A. Quataert<sup>1</sup>, Z. Quinones Tavarez<sup>1</sup>, K. Thevenet-Morrison<sup>1</sup>, M. M. Tellez-Rojo<sup>2</sup>, L. F. Bautista<sup>2</sup>, I. Pantic<sup>3</sup>, N. McRae<sup>4</sup>, S. W. Thurston<sup>1</sup>, B. P. Lawrence<sup>1</sup>, R. O. Wright<sup>4</sup>, T. A. Jusko<sup>1</sup>;  
<sup>1</sup>University of Rochester School of Medicine and Dentistry, Rochester, NY, <sup>2</sup>National Institute of Public Health, Morelos, MEXICO, <sup>3</sup>National Institute of Perinatology, Mexico City, MEXICO, <sup>4</sup>Icahn School of Medicine at Mt. Sinai, New York, NY.

**Background:** Despite convincing animal data, few human studies have examined potential immune dysregulation in relation to early life lead exposure. Furthermore, these studies often assess non-specific endpoints that limit causal and mechanistic inference. The present analysis addresses this, providing preliminary data on the association between early life blood lead levels (BLLs) and potential immunosuppression, using antigen-specific post-vaccination antibody levels to the measles, mumps, and rubella (MMR) vaccine. **Methods:** A subset of 43 mother-child pairs enrolled in the Programming Research in Obesity, Growth, Environment, and Social Stress (PROGRESS) study in Mexico City, from 2007-2011, who had complete information on BLLs, antibody responses to the MMR vaccine, and covariates of interest were included. BLLs were determined in mothers (second and third trimesters, and at delivery) and in offspring (age 48 months). Vaccine-specific immunoglobulin (IgG) levels were determined at 48 months, and dates of MMR vaccination were abstracted from health records. Regression models were fit to estimate the effects of BLLs on MMR-specific antibody levels, adjusting for child sex and socioeconomic status. **Results:** The median maternal BLL at delivery was 3.5 µg/dL (IQR: 0.8-5.5 µg/dL), and the three maternal BLLs were strongly correlated with each other ( $r > 0.8$ ). Median 48-month BLLs were 1.4 µg/dL (IQR: 1.0-2.3 µg/dL) and moderately correlated with maternal BLLs ( $0.5 < r < 0.6$ ). Each doubling of maternal delivery BLL was associated with a 15% lower anti-mumps IgG level (95% CI: -25.6, -3.3). Effect estimates were similar for second and third trimester lead measures. Anti-measles and anti-rubella antibodies were not associated with maternal BLLs. Child's 48-month BLL was not associated with any of the anti-MMR antibody levels. **Conclusions:** Higher prenatal BLLs were associated with lower anti-mumps antibody levels at 48 months of age. Future work will integrate other time points and antibody responses to additional vaccines to better understand exposure-, outcome-, and age-specific effects.

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**P-0520**

**Environmental metal exposures and kidney function of Guatemalan sugarcane workers**

**Presenter:** Jaime Butler-Dawson, University of Colorado, Aurora, United States

**Authors:** J. Butler-Dawson, K. James, L. Krisher, D. Jaramillo, M. Dally, L. Newman;  
University of Colorado, Aurora, CO.

**Background:** Exposure to environmental metals can cause nephrotoxicity. There is an international epidemic of chronic kidney disease of unknown cause (CKDu), referred to in Latin America as Mesoamerican Nephropathy (MeN). Whether metal exposures contribute to kidney dysfunction in populations at-risk for CKDu remains unresolved.

**Methods:** We examined the presence and concentrations of urinary heavy metals (arsenic, cadmium, and nickel) in 201 sugarcane cutters in Guatemala at three time points over one year. We explored relationships between urine metal concentrations and markers of kidney function by calculating  $\beta$  estimates and 95% confidence intervals of kidney function markers using multivariable linear mixed-effect models.

**Results:** Urine arsenic, cadmium, and nickel were detected in the majority of the 332 urine samples. After adjusting for age, systolic blood pressure, Hemoglobin A1c, body mass index, time of collection, and urine creatinine, higher urine cadmium was inversely associated with estimated glomerular filtration rate (eGFR) ( $\beta$ : -6.11, 95% Confidence Interval [CI]: -8.83, -3.39) and positively associated with neutrophil gelatinase-associated lipocalin (NGAL) ( $\beta$ : 2.73, 95% CI: 1.03, 4.43). Higher urine arsenic was inversely associated with eGFR ( $\beta$ : -4.55, 95% CI: -7.08, -2.01).

**Conclusions:** Our findings are suggestive of kidney toxicity due to metal exposure, as measured by urinary cadmium and arsenic.

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**P-0521**

**Comparing creatinine and osmolality for urine dilution adjustment in a case-cohort study of urine cadmium and risk of incident heart failure in the Danish Diet, Cancer, and Health Cohort**

**Presenter:** Clara Sears, Brown University School of Public Health, Department of Epidemiology, Providence, United States

**Authors:** C. G. Sears<sup>1</sup>, A. H. Poulsen<sup>2</sup>, J. Harrington<sup>3</sup>, C. Howe<sup>1</sup>, K. James<sup>4</sup>, G. A. Wellenius<sup>5</sup>, O. Raaschou-Nielsen<sup>6</sup>, J. Meliker<sup>7</sup>;

<sup>1</sup>Brown University, Providence, RI, <sup>2</sup>Danish Cancer Research Centre, Copenhagen, DENMARK, <sup>3</sup>Center for Analytical Science, RTI International, RTP, NC, <sup>4</sup>University of Colorado, Denver, CO, <sup>5</sup>Boston University, Boston, MA, <sup>6</sup>Danish Cancer Society Research Centre, Copenhagen, DENMARK, <sup>7</sup>Stony Brook University, Stony Brook, NY.

**Background/Aim:** Traditionally, analyses using urinary biomarkers adjusted for urine creatinine to account for differences in urine dilution. Urine creatinine, however, is associated with muscle mass, dietary intake of creatine, and meat intake; therefore consideration of other measures for urine dilution adjustment may be critical. We measured osmolality, in addition to creatinine, and compared epidemiologic associations of urine cadmium with heart failure across several strategies of urine dilution adjustment. **Methods:** In our case-cohort study of never smokers from the Danish Diet, Cancer, and Health cohort, we identified 958 cases of incident heart failure occurring between baseline (1993-1997) and 2015 using the Danish National Patient Registry and we randomly selected a sub-cohort of 600 males and 600 females for comparison. We quantified cadmium concentrations, creatinine, and osmolality in urine samples collected at baseline. Using an unweighted case-cohort approach we estimated adjusted hazard ratios for heart failure in Cox proportional hazards models with age as the time scale. **Results:** In our primary analysis using creatinine standardized cadmium levels ( $\mu\text{g Cd/g cr}$ ), we report  $\text{HR}=1.12$  per interquartile range difference (95%  $\text{CI}=1.02\text{-}1.22$ ) in models adjusted for gender, BMI, education, and urine cotinine. Findings were similar when other strategies for urine dilution adjustment were implemented: regression adjustment for creatinine ( $\text{HR}=1.15$ ; 95%  $\text{CI}=1.02\text{-}1.30$ ); standardization for covariate-adjusted creatinine ( $\text{HR}=1.17$ ; 95%  $\text{CI}=1.05\text{-}1.30$ ); osmolality standardized cadmium ( $\text{HR}=1.11$ ; 95%  $\text{CI}=1.01\text{-}1.22$ ); and regression adjustment for osmolality ( $\text{HR}=1.13$ ; 95%  $\text{CI}=1.02\text{-}1.26$ ). Results were also similar when we compared upper quartile with lower quartile exposure; additional case populations of stroke and acute myocardial infarction also showed similar results. **Conclusion:** In our case-cohort study of cadmium and heart failure among never-smokers, selection of urine dilution marker or adjustment strategy did not alter findings.

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**P-0522**

**Association between metal exposure and Follicle Stimulating Hormone (FSH) and thyroid hormone among women of reproductive age: Korean Nationwide Biomonitoring Studies**

**Presenter:** Aram Lee, Soonchunhyang university, Asan, Korea, Republic of

**Authors:** A. Lee, S. Choi, J. Park;  
Soonchunhyang university, Asan, KOREA, REPUBLIC OF.

**Background** Heavy metals including mercury, lead, and cadmium are known as endocrine disrupting chemicals. There are few epidemiological studies available to present the relationship between metal exposures and changes in hormones. Infertility, polycystic syndrome, and uterine myoma are quite prevalent among women, which are related to hormonal abnormalities. In this study, we analyzed measurement data from nationwide biomonitoring studies in Korea and examine the association between co-exposure to heavy metals and sex and thyroid hormone among women of reproductive age. **Methods** This study involved 3,088 women of reproductive age (15-49 years) included in the 2<sup>th</sup> Korean National Environmental Health Survey in 2012-2014 and the 6<sup>th</sup> Korea National Health and Nutrition Examination Survey in 2013. The concentrations of mercury, lead, and cadmium in either urine or blood, serum follicle-stimulating hormone (FSH), thyroid stimulating hormone (TSH), triiodothyronine (T3), tetraiodothyronine (T4), and free tetraiodothyronine (FT4) were analyzed using multiple regression analysis. Age, body mass index, smoking status, alcohol, income, and urinary creatinine were adjusted in the statistical model. The statistical analysis was performed using R (ver. 3.6.3). **Results** Mercury in urine was negatively associated with FSH [ $\beta$  (95% CI): -0.064 (-0.120, -0.008)]. Mercury in blood was positively associated with the FT4 [0.119 (0.030, 0.208)]. Lead in blood was positively associated with FSH [0.119 (0.030, 0.208)]. Cadmium had no significant association with any hormones. The results are comparable to other previous studies analyzing the association between single metal exposure and hormonal effects. Still, the effect ( $\beta$ ) of metals seems greater in co-exposure models. Many the previous studies of the single exposure to heavy metals have reported that exposure to lead and cadmium increases FSH. For thyroid hormones, significant hormones or directions were different from the previous findings. **Conclusions** FSH levels is related to infertility. Further studies of metals exposure are needed to protect the women of reproductive age.

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**P-0523**

**Prenatal chemical exposures associated with subsequent digital media use in adolescence**

**Presenter:** Jessica R Shoaff, Harvard T. H. Chan School of Public Health, Boston, United States

**Authors:** J. R. Shoaff, A. Oppenheimer, B. Coull, S. Korrick;  
Harvard T. H. Chan School of Public Health, Boston, MA.

**Background:** Use of digital media (computer, smart phones, social media, gaming, etc.) has increased drastically in the past decade, with 97% of US teens reporting use. While digital media can be a valuable educational and social tool, excessive use has been associated with adverse health including maladaptive behavior. Despite established associations between environmental chemical exposure and adverse neurobehavioral development, there are limited data on the role of these exposures as predictors of maladaptive digital media use.

**Methods:** Participants were a subset of the New Bedford Cohort (NBC), a birth cohort study of 788 children born 1993-1998 to mothers residing near the New Bedford Harbor Superfund site, Massachusetts. Biomarkers of prenatal chemical exposure to metals and organochlorines were measured from samples collected at delivery (cord blood) or approximately 10 days post-partum (maternal hair/nails) children. Digital media use was assessed via questionnaire from 528 NBC participants as adolescents (age ~15 yrs). We used multivariable negative binomial models to assess the association between a 2-fold increase in chemical biomarker concentrations and risk of high (>75<sup>th</sup>% of hrs/week) digital media use.

**Results:** In this racially diverse (31% non-white or Hispanic) and socioeconomically disadvantaged population of adolescents (e.g., at birth, 38% lived in low income households, and 58% of mothers had ≤ high school education), each doubling of peripartum maternal toenail arsenic was associated with a 1.34 increase in relative risk of high digital media use (95% CI: 1.06, 1.70), while each doubling of toenail cadmium was associated with a 1.26 increase (95% CI: 1.05, 1.50). We did not observe associations with organochlorines.

**Conclusion:** Our findings suggest that prenatal exposure to some metals may be associated with excessive digital media use in adolescence. Understanding environmental risk factors for maladaptive use is key to strategies for remediating digital media's potential adverse health impacts.

[Funding: NIEHS/NIH P42ES005947, R01ES014864; T32ES007069].

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**P-0524**

**Multi-pollutant effects of prenatal heavy metal exposure on atopic dermatitis in 6-month-old infants**

**Presenter:** Seulbi Lee, Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor, United States

**Authors:** S. Lee<sup>1</sup>, S. K. Park<sup>1</sup>, H. Park<sup>2</sup>, W. Lee<sup>3</sup>, J. Kwon<sup>4</sup>, Y. Hong<sup>5</sup>, M. Ha<sup>6</sup>, Y. Kim<sup>7</sup>, E. Ha<sup>8</sup>;  
<sup>1</sup>Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor, MI, <sup>2</sup>Department of Epidemiology, College of Medicine, Ewha Womans University, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Department of Statistics, Inha University, Incheon, KOREA, REPUBLIC OF, <sup>4</sup>Department of Pediatrics, College of Medicine, Korea University, Seoul, KOREA, REPUBLIC OF, <sup>5</sup>Department of Preventive Medicine, College of Medicine, Seoul National University, Seoul, KOREA, REPUBLIC OF, <sup>6</sup>Department of Preventive Medicine, College of Medicine, Dankook University, Cheonan, KOREA, REPUBLIC OF, <sup>7</sup>Department of Occupational and Environmental Medicine, Ulsan University Hospital, University of Ulsan College of Medicine, Ulsan, KOREA, REPUBLIC OF, <sup>8</sup>Occupational and Environmental Medicine, College of Medicine, Ewha Womans University, Seoul, KOREA, REPUBLIC OF.

**Background:** Prenatal exposures to endocrine-disrupting chemicals during critical developmental phases have been implicated in the development of the immune system and allergic phenotypes. However, there are few studies associating prenatal heavy metal exposure with atopic dermatitis (AD) in infants according to their sex. **Objective:** We aimed to examine prenatal exposure to multiple heavy metals with sex-specific AD incidence in 6-month-old infants using data from the Mothers and Children's Environmental Health (MOCEH), a prospective birth cohort study. **Methods:** We evaluated 738 mother-child pairs from the MOCEH study. Concentrations of three heavy metals (mercury, lead, and cadmium) in maternal blood samples were measured at early and late pregnancy. Each quantile of heavy metal concentration was used for capturing nonlinear association with AD. To account for selection bias caused by loss to follow-up, we generated an inverse probability of censoring weight (IPCW). Furthermore, the group Lasso model with IPCW was used to perform variable selection with categorized exposures and assess the effect of multiple pollutants with selected exposures, and its optimal lambda was estimated by 5-fold cross-validation. 95% confidence intervals (CIs) were estimated by bootstrap method. Exposures in early and late pregnancy were simultaneously included in the model to identify the susceptible window. **Results:** A total of 200 incident cases of AD were diagnosed in 6-month-old infants. In late pregnancy model of the boy group, lead and mercury exposures were selected, and adjusted odds ratios (ORs) comparing the second, third and fourth quartiles of lead exposure with the first quartile group were 1.155 (95% CI: 0.965, 5.619), 1.097 (0.924, 5.715), and 1.191 (1.138, 8.390), respectively. However, no significant associations were observed in the girl group. **Conclusion:** Our findings suggest that lead exposure in late pregnancy may be independently associated with a higher risk of AD in 6-month-old boys.

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**P-0525**

### **Study of metal exposures and amyotrophic lateral sclerosis in Denmark**

**Presenter:** Aisha S. Dickerson, Johns Hopkins Bloomberg School of Public Health, Baltimore, United States

**Authors:** A. S. Dickerson<sup>1</sup>, J. Hansen<sup>2</sup>, O. Gredal<sup>3</sup>, M. G. Weisskopf<sup>4</sup>;

<sup>1</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>2</sup>Danish Cancer Society Research Center, Copenhagen, DENMARK, <sup>3</sup>National Rehabilitation Center for Neuromuscular Disorders, Copenhagen, DENMARK, <sup>4</sup>Harvard T.H. Chan School of Public Health, Boston, MA.

**Background/Aim:** Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disease characterized by progressive loss of motor function. Although several studies have investigated exposures to known neurotoxic metals, including lead and aluminium, to our knowledge there have been no previous studies of chromium, nickel, or iron occupational exposures and risk of ALS.

**Methods:** We conducted a nested case-control study of occupational exposures to chromium, nickel, and iron and ALS diagnosis using population-based data from Denmark. We identified ALS cases from 1982-2013 and age- and sex-matched controls. Based on employment history and validated job exposure matrices (JEMs), we estimated cumulative exposures to these metals for 1639 ALS cases and 168,194 controls. We used sex-stratified unconditional logistic regression to obtain adjusted odds ratios (aOR) and 95% confidence intervals (CI) for quartile-categorized exposures, adjusting for residential location, socioeconomic status, and age. We also conducted multivariable models mutually adjusting for each metal.

**Results:** Cumulative occupational chromium, nickel, and iron exposures were not associated with ALS in men individually or mutually adjusted. Although chromium exposures in men showed higher adjusted odds for those with the 5-year lagged exposures in the third quartile (aOR=1.24; 95% CI 0.91, 1.69) and fourth quartile (aOR=1.19; 95% CI: 0.80, 1.76) compared to those with no exposure, differences did not reach statistical significance. We also observed higher odds of ALS in women with nickel exposures in the third quartile (aOR=2.21; 95% CI: 1.14, 4.28), but not for the fourth quartile (aOR=0.61; 95% CI: 0.23, 1.64). There were no other notable results in women.

**Conclusion:** Though previous studies have suggested that levels of chromium, iron, and nickel can contribute to pathogenesis of neurodegenerative diseases, our findings do not suggest associations between occupational exposures to these metals and ALS. However, unavoidable non-differential misclassification from the use of JEMs, may have masked truly increased risk.

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**P-0526**

**Sexual dysfunction and mining-related jobs: A cross-sectional study in the former Katanga Province, DR Congo**

**Presenter:** Paul Musa Obadia, University of Lubumbashi, Lubumbashi, Congo, Democratic Republic of the

**Authors:** P. Musa Obadia<sup>1</sup>, J. Pyana Kitenge<sup>1</sup>, C. Banza Lubaba Nkulu<sup>1</sup>, V. Haufröid<sup>2</sup>, G. Kalenga Ilunga<sup>1</sup>, T. Kayembe-Kitenge<sup>1</sup>, T. Carsi Kuhangana<sup>1</sup>, A. Mukalay wa Mukalay<sup>1</sup>, L. Ris<sup>3</sup>, P. Enzlin<sup>4</sup>, B. Nemery<sup>4</sup>;  
<sup>1</sup>University of Lubumbashi, Lubumbashi, CONGO, DEMOCRATIC REPUBLIC OF THE, <sup>2</sup>Université Catholique de Louvain, Bruxelles, BELGIUM, <sup>3</sup>Université de Mons, Mons, BELGIUM, <sup>4</sup>KU Leuven, Leuven, BELGIUM.

**Aim:** Based on a preliminary case-control study of erectile dysfunction among mineworkers in the former Katanga province of the DR Congo (Musa et al. *Occ Environ Med* 2020), we investigated the association between sexual dysfunction and metal exposure in mining-related-jobs. **Methods:** In a cross-sectional study, we included 138 miners and 140 bakers from Lubumbashi, Likasi, Kipushi and Kolwezi. Using questionnaires administered face-to-face, we obtained socio-demographic and occupational data and determined the International Index of Erectile Function (IIEF-15), a validated tool to evaluate five sexual domains (maximum score 75). We measured trace metals in blood and urine, and total + free testosterone and sex hormone binding globulin (SHBG) in serum. **Results:** Miners and bakers had similar median (IQR) age [35.6 y (30.6-40.0)]. For several trace metals, concentrations were higher in blood or urine among miners than bakers, this being most pronounced for lead. Thus, median blood lead ( $\mu\text{g/dl}$ ) was higher ( $p=0.002$ ) in miners [6.7 (4.5-16.7)] than in bakers [5.4 (4.1-7.5)]. Blood lead and free testosterone were inversely correlated (Spearman  $R=-0.25$ ,  $p=0.002$ ). The median IIEF-15 score was lower ( $p<0.001$ ) among miners [66 (49-73)] than among bakers [73 (66-74)]. Total testosterone (ng/dl) did not differ between miners [505 (453-651)] and bakers [541 (447-709)], but free testosterone (ng/dl) was lower among miners [8.1 (6.8-10.1)] than among bakers [9.3 (8.7-12.5)]; conversely, SBGH (nmol/l) was higher ( $p<0.001$ ) among miners [55 (44-65)] than among bakers [47 (33-52)]. **Conclusion:** We confirmed that miners had lower scores of erectile function than controls. Miners had lower free testosterone and higher SHBG than bakers, and evidence of higher exposure to trace metals, especially lead. The possible role of lead in sexual dysfunction needs to be clarified, especially as lead is not among the main ores mined in the region.

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**P-0527**

**Arsenic exposure and Measles Antibody Titers in the US Children: NHANES 2003-2004 and 2009-2010.**

**Presenter:** Taehyun Roh, Department of Epidemiology and Biostatistics, School of Public Health, Texas A&M University, College Station, United States

**Authors:** T. Roh<sup>1</sup>, N. C. Shah<sup>1</sup>, N. T. Hasan<sup>1</sup>, N. M. Johnson<sup>2</sup>, G. Carrillo<sup>2</sup>;

<sup>1</sup>Department of Epidemiology and Biostatistics, School of Public Health, Texas A&M University, College Station, TX, <sup>2</sup>Department of Environmental and Occupational Health, School of Public Health, Texas A&M University, College Station, TX.

**Background/Aim:** Exposure to arsenic during childhood is associated with adverse health problems including cancers and non-cancerous diseases. However, little is known about its effect on vaccine-related humoral immunity in children. In this study, we examined the association between arsenic exposure and measles antibody titers in US children. **Methods:** The association between urinary arsenic and serum measles antibody levels in the US children aged between 6 and 11 was investigated, based on the National Health and Nutrition Examination Survey (NHANES) 2003-2004 and 2009-2010. The total urinary arsenic level was calculated by summing inorganic arsenic and their metabolites (arsenite, arsenate, methylarsonic acid, and dimethylarsinic acid), and was divided by the level of urinary creatinine. The generalized linear regression was conducted to evaluate the association, adjusted for the cycle, age, race, undergrowth, secondhand smoking, and poverty index ratio. Stratified analyses were conducted by gender and serum folate levels using the median as cutoff (18.7 ng/mL). **Results:** The level of serum measles antibody titers decreased by 28.1% (95%CI: -44.2%, -12.0%) per tertile increase in the concentration of creatinine-adjusted urinary arsenic among boys with serum folate levels lower than 18.7 ng/ml. However, no associations were observed in boys with high serum folate levels and girls. **Conclusion:** Our stratified analysis showed the inverse association between arsenic exposure and measles antibody level among boys with lower folate intake. This study will provide the basis for an intervention strategy to protect children's health from arsenic exposure.

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**P-0528**

### **Effects of prenatal lead exposure on child's DNA methylation: methylation distribution-specific epigenome-wide association study (MDS-EWAS)**

**Presenter:** Yoon-Jung Choi, Department of Preventive Medicine, Seoul National University College of Medicine, Seoul, Korea, Republic of

**Authors:** Y. Choi<sup>1</sup>, J. Cho<sup>2</sup>, Y. Lim<sup>3</sup>, C. Shin<sup>4</sup>, Y. Lee<sup>4</sup>, B. Kim<sup>5</sup>, J. I. Kim<sup>6</sup>, Y. Hong<sup>1</sup>;

<sup>1</sup>Department of Preventive Medicine, Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Institute of Environmental Medicine, Seoul National University Medical Research Center, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Section of Environmental Epidemiology, Department of Public Health, University of Copenhagen, Copenhagen, DENMARK, <sup>4</sup>Department of Pediatrics, Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>5</sup>Division of Children and Adolescent Psychiatry, Department of Psychiatry, Seoul National University Hospital, Seoul, KOREA, REPUBLIC OF, <sup>6</sup>Department of Psychiatry, Hanyang University Medical Center, Seoul, KOREA, REPUBLIC OF.

**BACKGROUND:** Epigenome-wide association studies (EWAS) frequently use linear regression analysis assuming that methylation levels are continuous variables between 0 and 1 with a unimodal distribution. While 2~5% of CpG sites are known to have bimodal or trimodal (multimodal) distributions, such modality differences are seldom considered in previous EWAS. **OBJECTIVES:** We have developed a novel EWAS model which takes the distribution of methylation levels into account, namely "methylation distribution-specific (MDS)-EWAS". **METHODS:** Blood lead levels were measured from pregnant women at 2<sup>nd</sup> trimester in the Environment and Development in Children cohort. Methylation profiles were analyzed from sixty 2-year-old children's blood samples, using the Illumina Infinium HumanMethylation EPIC BeadChip providing 865,688 CpG probes. For conventional EWAS, linear regression was applied to investigate the association between prenatal lead exposure and DNA methylation status at age 2 with covariates adjusted. For MDS-EWAS, unimodal and multimodal CpG sites were classified by dip test. Then, linear regression was applied for unimodal CpG sites. Among multimodal CpG sites, methylation levels at bimodal and trimodal CpG sites were transformed into binary (0 or 1) and categorical (0, 1, or 2) variables, respectively, followed by logistic regression. **RESULTS:** Out of 865,688 CpG sites, 17,852 CpG sites (2.06%) showed multimodal distribution. After excluding single nucleotide polymorphism-associated CpG sites, conventional EWAS showed no significant results. MDS-EWAS, however, showed two multimodal CpG sites positively associated with prenatal lead level: cg08989084 (P2RX2 coding for ion channels in neuronal signaling)(estimate: 0.00101, p-value:  $3.52 \times 10^{-5}$ ) and cg23620282 (IRX4 reported to interact with vitamin D receptor in suppression of cancer)(estimate: 0.000133, p-value:  $4.17 \times 10^{-5}$ )(both FDR corrected p-value <0.05). **CONCLUSION:** MDS-EWAS may provide a more appropriate statistical model based on actual distributions of methylation status, and may be more sensitive in detecting CpG sites associated with environmental exposures.

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Theme: **Heavy metal health**

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**P-0529**

**Prenatal Exposure to Cadmium and Risk of Allergic Diseases in Pre-school Children**

**Presenter:** Tsung-Lin Tsai, National Health Research Institutes, Miaoli County, Taiwan

**Authors:** T. Tsai, C. Sun, S. Wang;  
National Health Research Institutes, Miaoli County, TAIWAN.

**Background/Aim:** The prevalence of child's allergic disease has been increased worldwide. Atopic dermatitis is considered to be the first clinical characteristic and the beginning of the atopic march that followed by asthma and allergic rhinitis during the first several years of life. Exposure to metals (such as chromium, cadmium and lead) was reported to associate with immune biomarkers and allergy. Our aim is to investigate the association between prenatal exposure to metals and allergic diseases in children. **Methods:** A total of 243 pairs of pregnant women and newborns were recruited in central Taiwan during 2012 to 2013, and the questionnaires and specimens were collected from pregnant women. Children were follow-up during 2016 to 2017 to identify their allergic disease by International Study of Asthma and Allergies in Childhood (ISAAC). Metal concentration (cadmium, Cd; lead, Pb) in maternal urine was measured by inductively coupled plasma mass spectrometry (ICP-MS), and child's blood IgE was quantified using ImmunoCAP total IgE assay system. A few cigarette smokers at pregnancy were excluded from the beginning. Child's sex, allergic status in parents, environmental tobacco smoke at pregnancy, and child's blood total IgE were adjusted in statistical model. **Results:** The mean age of children is 3.95 years (SD = 0.56), and approximate 60% is boy. In these children, 30.45% were identified with atopic dermatitis, 3.70% with asthma, and 20.99% with allergic rhinitis. Per doubling increase of prenatal Cd exposure was significantly associated with elevated risk of allergic rhinitis in children (OR = 1.59; 95% CI 1.07, 2.36) even Pb was included in full-adjusted model. **Conclusions:** Prenatal exposure to cadmium has increased risk of allergic rhinitis in early childhood. Therefore, it is suggested to identify pregnant women at risk of metal exposure and avoid the exposure sources thus might reduce the risk of allergic disease on their children.

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**P-0530**

**The application of statistical models to create meaningful psychological endpoints for environmental exposures: Generating forgetting functions in children exposed to lead**

**Presenter:** Katherine Svensson, Department of Health Sciences, Karlstad University, Karlstad, Sweden

**Authors:** K. Svensson<sup>1</sup>, J. Chelonis<sup>2</sup>, C. Gennings<sup>3</sup>, L. Schnaas<sup>4</sup>, I. Pantic<sup>4</sup>, M. Tellez-Rojo<sup>5</sup>, R. Wright<sup>3</sup>;  
<sup>1</sup>Department of Health Sciences, Karlstad University, Karlstad, SWEDEN, <sup>2</sup>National Center for Toxicological Research, Food and Drug Administration, Jefferson, AR, <sup>3</sup>Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>4</sup>Division of Research in Community Interventions, National Institute of Perinatology, Mexico City, MEXICO, <sup>5</sup>Center for Nutrition and Health Research, National Institute of Public Health, Cuernavaca, MEXICO.

**Background:** The delayed matching-to-sample test assesses short-term memory performance in a variety of species, including humans allowing for cross species translation. We tested a novel statistical model to evaluate the effect of prenatal and childhood lead exposure on children's rate of forgetting as an illustration. **Methods:** We analyzed data from 550 children participating in the PROGRESS study, a longitudinal birth cohort in Mexico. Children performed a delayed matching-to-sample tests at 6-8 years of age. Lighted shapes appear followed by a variable time delay from a few seconds up to 3 minutes, then the comparison stimuli appear as 3 choices, one of which is correct. Correct choices are rewarded with a coin. Blood lead was measured at 2<sup>nd</sup> trimester, and at 4-6 years of age. We used a nonlinear modified power function to predict the rates of forgetting at each time delay, and constructed separate models for prenatal and childhood blood lead. **Results:** Prenatal and childhood blood lead predicted increased rates of forgetting; indicating a faster forgetting as blood lead levels increased (prenatal:  $\beta = -0.02$ ; 95%CI: -0.05, -0.01, and childhood:  $\beta = -0.05$ ; 95%CI: -0.09, -0.01). In the prenatal lead model, higher maternal IQ and child's age were significantly associated with a slower rate of forgetting (Maternal IQ:  $\beta = 0.01$ ; 95%CI: 0.01, 0.02, and child's age:  $\beta = 0.01$ ; 95%CI: 0.01, 0.03). Similar results were found with childhood lead except children's age was not significant. Plots based on the model estimates showed that either high prenatal or high childhood blood lead (90<sup>th</sup> percentile) with low maternal IQ (10<sup>th</sup> percentile) had the greatest effect on increased rate of forgetting. **Conclusion:** We validated our novel power functions statistical for rates of forgetting using lead exposure, a paradigm neurotoxin. Future work will evaluate other environmental exposures on children's forgetting rates including mixed exposures.

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**P-0531**

**Environmental exposure to manganese in adults and cognitive and motor function. A systematic literature review and meta-analysis.**

**Presenter:** LAURA RUIZ-AZCONA, UNIVERSITY OF CANTABRIA, SANTANDER, Spain

**Authors:** L. RUIZ-AZCONA, B. MARKIV, A. EXPÓSITO, M. PAZ-ZULUETA, P. PARAS-BRAVO, C. SARABIA, I. FERNÁNDEZ-OLMO, M. SANTIBAÑEZ;  
UNIVERSITY OF CANTABRIA, SANTANDER, SPAIN.

Background/Aim. Whether environmental exposure to Mn in adults is associated with poorer results in cognitive and motor function is unclear. We aimed to determine these associations through a meta-analysis of published studies. Methods: A systematic review was conducted to identify environmental Mn epidemiologic studies in  $\geq 18$  years old, and in which results on a specific test to evaluate cognitive or motor function were reported. Medline through PubMed, ISI Web of Knowledge and SCOPUS databases were consulted. A manual search in the references of retrieved studies and systematic reviews found that addressed the topic was also conducted. Data were pooled in meta-analysis using the method of random effects or fixed effects, as convenient, after examination of statistical heterogeneity. Results. Seventeen studies fulfill inclusion criteria. Among them, 13 studies reported data susceptible of meta-analysis through a pooled correlation or a Standardized Means Difference (SMD) approach between exposed and non-exposed. Regarding cognitive function, the results of the studies showed heterogeneity among them ( $I^2=76.49\%$ ,  $p<0.001$ ). The overall effect was a statistically significant negative correlation in the random effects model (pooled  $r=-0.165$ ; 95%CI: -0.214 to -0.116;  $p<0.001$ ). In terms of SMD, results showed also moderate heterogeneity but did not reach statistical significance under the random effects model (SMD=-0.049; 95%CI: -0.124 to 0.026;  $p=0.203$ ). Regarding motor function, heterogeneity ( $I^2=75\%$ ) was also observed in the correlation approach with a pooled  $r$  (random effect model)=-0.150; 95%CI: -0.219 to -0.079. Moderate heterogeneity was observed according to SMD approach ( $I^2=51.81\%$ ), with a pooled SMD=-0.136; 95%CI: -0.188 to -0.084;  $p<0.001$ , indicating worse motor function in exposed. Conclusions: Correlation approach results support a negative effect on cognitive and motor function (the higher the Mn levels, the poorer scores). Regarding SMD approach, results also support a worse cognitive and motor function in exposed, although only for motor function statistical significance was obtained.

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**P-0532**

**Folate and the association between maternal arsenic exposure and birth outcomes in the Biomarkers of Exposure to ARsenic (BEAR) cohort**

**Presenter:** Jeliyah Clark, UNC Gillings School of Global Public Health, Chapel Hill, United States

**Authors:** J. Clark<sup>1</sup>, P. Bommarito<sup>1</sup>, J. Laine<sup>2</sup>, M. Stýblo<sup>1</sup>, M. Rubio-Andrade<sup>3</sup>, G. García-Vargas<sup>3</sup>, M. Gamble<sup>4</sup>, R. C. Fry<sup>1</sup>;

<sup>1</sup>UNC Gillings School of Global Public Health, Chapel Hill, NC, <sup>2</sup>Imperial College London, London, UNITED KINGDOM, <sup>3</sup>Universidad Juarez del Estado de Durango, Gómez Palacio, MEXICO, <sup>4</sup>Columbia Mailman School of Public Health, New York City, NY.

Inorganic arsenic (iAs) is a ubiquitous metalloid, carcinogen, and reproductive toxicant commonly found in drinking water at levels exceeding the World Health Organization's (WHO) recommended limit of 10 ppb. Upon ingestion, iAs is biotransformed to monomethylated (MMA) and dimethylated (DMA) arsenic through the addition of methyl groups. As a methyl-donor nutrient, folate contributes to the methylation process, and folic acid supplementation among adults exposed to iAs has been shown to improve methylation efficiency. Since maternal iAs exposure has been linked to adverse birth outcomes, we sought to evaluate whether serum folate concentrations modified the relationship between maternal iAs exposure and various birth outcomes in a cross-sectional cohort of 193 women residing in Gómez Palacio, State of Durango, Mexico between 2011 and 2012. Folate intake was measured in maternal serum, and indicators of arsenic exposure were evaluated in drinking water and maternal urine samples. In evaluating effect modification by folate, likelihood ratio tests were implemented to evaluate the goodness-of-fit of interaction models as compared to main effects models. The prevalence of folate deficiency, defined as < 9 nM, was minimal, still effect modification by folate was significant ( $p < 0.1$ ) on the additive scale for associations between several indicators of maternal iAs exposures and birth outcomes, namely birth weight and head circumference. In many cases, increased serum folate concentrations attenuated or changed the direction of associations. This cross-sectional study suggests that higher serum folate concentrations attenuate the negative association between maternal iAs exposure and anthropometric measures at birth.

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**P-0533**

**Child Health Cohort Study. “Bruminha project”.**

**Presenter:** Aline de Souza Espindola Santos, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

**Authors:** A. d. Santos, R. Duarte, N. D. Figueiredo, C. I. Asmus;  
Federal University of Rio de Janeiro, Rio de Janeiro, BRAZIL.

Background: After the breakdown of the metal residue dam in Brumadinho - Minas Gerais State, Brazil, one of the main concerns is possible impacts these residues on the health of children living in the affected areas. We will investigate metal concentrations and their effects on immunologic and neurological development, growth and respiratory health of children from 0 to 4 years old living in areas affected by the disaster. Methods: A prospective cohort study, whose study population comprises 200 children aged 0 - 4 years old living in the struck areas, and a control group, living in a non-affected area. Questionnaires, clinical evaluations, and metal assessments in biological samples (urine and blood) will be carried out each year over 4 years. Results: The investigation and identification of possible metal exposure effects on child health will be applied to public health action settlements.

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**P-0534**

### **Urinary Metal Mixtures and Longitudinal Changes in Insulin Resistance and $\beta$ -cell Function: The Study of Women's Health Across the Nation (SWAN)**

**Presenter:** Xin Wang, University of Michigan School of Public Health, Ann Arbor, United States

**Authors:** X. Wang<sup>1</sup>, B. Mukherjee<sup>1</sup>, C. Karvonen-Gutierrez<sup>1</sup>, W. Herman<sup>2</sup>, S. Batterman<sup>1</sup>, S. Harlow<sup>1</sup>, S. K. Park<sup>1</sup>;

<sup>1</sup>University of Michigan School of Public Health, Ann Arbor, MI, <sup>2</sup>University of Michigan Medical School, Ann Arbor, MI.

**Background:** Epidemiologic studies on associations between metals and insulin resistance and  $\beta$ -cell dysfunction have been cross-sectional and focused on individual metals. We assessed the association between exposure to metal mixtures as a set of 15 urinary metals and longitudinal changes in homeostatic model assessments for insulin resistance (HOMA-IR) and  $\beta$ -cell function (HOMA- $\beta$ ). **Methods:** We examined 1,262 women, aged 45-56 years at baseline (1999-2000), who were followed through 2015-2016, from the Study of Women's Health Across the Nation. Urinary concentrations of 15 metals (arsenic, barium, cadmium, cobalt, cesium, copper, mercury, manganese, molybdenum, nickel, lead, antimony, tin, thallium, and zinc) were determined at baseline. HOMA-IR and HOMA- $\beta$  were repeatedly measured over 16 years of follow-up. The adaptive elastic-net (AENET) models were fitted to identify important components of metal mixtures associated with longitudinal changes in HOMA-IR and HOMA- $\beta$ . **Results:** In multivariable adjusted AENET models, urinary copper, lead, and zinc were associated with higher HOMA-IR at baseline, whereas molybdenum was associated with lower HOMA-IR at baseline. The estimated changes in baseline HOMA-IR for one-standard deviation increase in log-transformed urinary metal concentrations were 1.57% (-1.09%, 4.29%) for copper, 0.70% (-1.59%, 3.05%) for lead, 5.76% (3.05%, 8.55%) for zinc, and -3.25% (-5.45%, -1.00%) for molybdenum, respectively. Urinary zinc was also associated with a faster rate of increase in HOMA-IR. Urinary arsenic and zinc were associated with lower baseline HOMA- $\beta$ , whereas cobalt was associated with higher baseline HOMA- $\beta$ . Arsenic was also associated with a faster rate of decline in HOMA- $\beta$ . **Conclusions:** Our study suggests that exposure to metal mixtures may be exerting effects on insulin resistance and  $\beta$ -cell dysfunction, which might be mechanisms by which metal exposures may lead to elevated diabetes risks.

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**P-0535**

**Lead-related dietary pattern is inversely associated with cognitive functioning in school children**

**Presenter:** Jianghong Liu, University of Pennsylvania School of Nursing, Philadelphia, United States

**Authors:** J. Liu<sup>1</sup>, A. Mizrahi<sup>2</sup>, J. Wang<sup>2</sup>, Z. Shi<sup>3</sup>;

<sup>1</sup>University of Pennsylvania School of Nursing, Philadelphia, PA, <sup>2</sup>University of Pennsylvania, Philadelphia, PA, <sup>3</sup>Qatar University College of Health Sciences, Doha, QATAR.

**Background:** The role of diet has been documented to be linked with blood lead levels (BLL). While it is well known that blood lead levels are inversely related to children's cognitive functioning, few studies have assessed lead-related dietary patterns (LDP) in association with children's cognitive functioning. **Methods:** This cross-sectional study is part of the China Jintan cohort study. Participants included 617 children (53.5% boys) with mean age of  $13.0 \pm 0.9$  years old. Dietary pattern was assessed with a self-administrated food frequency questionnaire that asked children to recall what they had eaten during past three months. Blood lead level was measured using a graphite furnace atomic absorption spectrophotometer. Reduced rank regression was used to construct LDP with blood lead level as a response variable. Cognition was assessed with the Chinese version of the WISC, with full scale IQ (FIQ) composed of verbal (VIQ) and performance (PIQ) IQ. LDP score was recoded into tertiles. Multivariable linear regression was used in the analyses. **Results:** The LDP explained 5.2% of the blood lead variation and was characterized by high intake of soft drinks, both caffeinated and non-caffeinated, and juice but low intake of fruit, yoghurt and fish. LDP was inversely associated with verbal IQ. Comparing extreme tertiles of the dietary pattern, the regression coefficient for verbal IQ was -4.73 (-7.07--2.38) after adjusting for age and gender. Further adjusting for father's education slightly attenuated the association. A trend of inverse association between LDP and FIQ was found. However, no association between LDP and PIQ was found. **Conclusion:** Lead-related dietary pattern is associated with children's poor cognitive functioning, partly due to high consumption of soft drinks and juice, while consumption of fruit, yogurt, and fish is associated with improved cognition scores.

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**P-0536**

**Placental cadmium, genetic variations, and birth size**

**Presenter:** Michael Hussey, University of Washington, Seattle, United States

**Authors:** M. Hussey, D. Enquobahrie;  
University of Washington, Seattle, WA.

Background: While maternal cadmium (Cd) burden has been associated with fetal growth markers (including birth weight and head circumference), associations of placental Cd with birth size is less clear. Further, the role of genetics in these associations has not been examined. We investigated associations of placental Cd with birth size and the role of placental genotypes in this relationship. Methods: Participants were 527 mother-child pairs from the OMEGA and Placental Microarray studies. Placental Cd was measured using Agilent 7500 ICP-MS. Placental single nucleotide polymorphisms (13 SNPs) related to metal transport, growth regulation, endocrine response, and cell signaling were genotyped. Multivariable linear regression models were used to examine associations of placental Cd (quartiles) with birth weight, ponderal index and head circumference, adjusted for maternal covariates. Potential effect modification by infant sex or placental SNPs were examined using interaction terms and stratified analyses. Results: The mean maternal age and pre-pregnancy BMI were 33.7 years (SD=4.4) and 23.9 (SD=0.04) respectively. The mean Cd level in placenta was 0.0039 ng/mg tissue (SD=0.0027 ng/mg tissue). Placental Cd was not associated with birth weight ( $\beta=7.579$ , 95%CI: -38.597, 53.755), ponderal index ( $\beta=-0.015$ , 95%CI: -2.385, 2.355) or head circumference ( $\beta=-0.095$ , 95%CI: -0.503, 0.313). SNPs were also not associated with placental Cd and interaction terms with infant sex or SNPs were not significant. Conclusions: In the current study, placental Cd was not associated with birth size or placental genotypes.

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**P-0537**

### **Arsenic and Immune Response to Influenza Vaccination in Pregnant Women and Newborns**

**Presenter:** Christopher D Heaney, Department of Environmental Health & Engineering, Johns Hopkins Bloomberg School of Public Health, Baltimore, United States

**Authors:** C. D. Heaney<sup>1</sup>, T. J. Smith<sup>1</sup>, H. Ali<sup>2</sup>, K. Alland<sup>3</sup>, L. N. Avolio<sup>1</sup>, R. Haque<sup>2</sup>, N. Pisanic<sup>1</sup>, S. Shaikh<sup>2</sup>, K. P. West, Jr.<sup>3</sup>, A. B. Labrique<sup>3</sup>;

<sup>1</sup>Department of Environmental Health & Engineering, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>2</sup>The JiVitA Maternal and Child Health and Nutrition Research Project, Gaibandha, BANGLADESH, <sup>3</sup>Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD.

#### Background/Aims

There is a gap in understanding of whether arsenic exposure during pregnancy alters the maternal immune response and antibody transfer to the infant. We aimed to establish a birth cohort in a region with low-moderate drinking water arsenic concentrations to investigate the relationship between arsenic exposure and immunogenicity of a seasonal quadrivalent inactivated influenza vaccine (IIV) in pregnant women and infants.

#### Methods

We established a birth cohort (NCT03930017) at the JiVitA Maternal and Child Health and Nutrition Research Project site, which covers ~650,000 people over 500 km<sup>2</sup> in rural northern Bangladesh. We planned to enroll 850 pregnancies to achieve a desired sample size of 400 mother-infant pairs at three-months postpartum, based on minimum detectable differences in geometric mean hemagglutination inhibition antibody titers for seasonal quadrivalent IIV antigens when comparing the highest and lowest quartiles of arsenic exposure. From July 2018 to June 2019, we screened women of reproductive age to identify incident pregnancies. Multiparous pregnant women were enrolled in gestational weeks (GW) 13-16. At enrollment, we collected drinking water, urine, blood, and saliva, and administered IIV.

#### Results

We screened 52,000 women to identify 2,623 incident pregnancies in multiparous women. Of these, 1,338 were identified prior to GW 16, 846 consented, and 784 enrolled. We followed 567 mother-infant pairs to three-months postpartum. At enrollment, all participants contributed drinking water, urine, blood (processed as plasma, serum, and peripheral blood mononuclear cells), and saliva. An analysis of 40 drinking water samples selected at random found that arsenic concentrations were comparable to arsenic-endemic regions of the U.S. (geometric mean: 3.03 µg/L, geometric standard deviation: 9.54 µg/L, range: 0.05 to 96.83 µg/L).

#### Conclusions

The number of pregnancies enrolled in our cohort yielded the sample size needed to investigate prespecified aims related to low-moderate arsenic exposure and altered maternal and child immune response.

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**P-0538**

**Trace Element Exposures and Blood Pressure along the Interoceanic Highway, Madre de Dios, Peru**

**Presenter:** Stacy M Pettigrew, Albany College of Pharmacy and Health Sciences, ALBANY, United States

**Authors:** S. M. Pettigrew<sup>1</sup>, J. Bobb<sup>2</sup>, W. Pan<sup>3</sup>, D. Strogatz<sup>4</sup>, E. M. Bell<sup>5</sup>, A. Berky<sup>3</sup>, B. J. Feingold<sup>5</sup>;  
<sup>1</sup>Albany College of Pharmacy and Health Sciences, ALBANY, NY, <sup>2</sup>Kaiser Permanente Washington Health Research Institute, Seattle, WA, <sup>3</sup>Duke University, Durham, NC, <sup>4</sup>Basset Research Institute, Cooperstown, NY, <sup>5</sup>State University of New York at Albany, ALBANY, NY.

Urbanization and economic development in lower and middle income nations (LMICs) have facilitated epidemiologic and nutritional transitions. Cardiovascular disease is the leading cause of death worldwide and prevalence of hypertension, a main risk factor, is projected to grow 80% by 2025 in LMICs. The completion of the Interoceanic Highway in 2011 in the Amazonian Department of Madre de Dios (MDD), Peru spurred rapid development, leading to population health concerns over environmental contamination due to gold mining. In addition to lifestyle exposures, elevated levels of lead, mercury, cadmium, and arsenic have been associated with hypertension in both animal studies and epidemiological analyses, although some population-based studies have failed to measure a statistically significant association. The essential element selenium potentially exerts a protective influence on hypertension. To gain insight into these potentially complex relationships, we analyzed joint arsenic, cadmium, mercury, lead, and selenium exposures in nails and systolic and diastolic blood pressure (SBP, DBP) of 389 adults in the Investigacion de Migracion, Ambiente, y Salud (IMAS) (Migration, Environment, and Health Study) conducted in MDD. Relationships were analyzed using linear mixed models with a household random intercept, and Bayesian kernel machine regressions (BKMR) to capture potential interactive and non-linear effects with trace elements. Visual inspection of the exposure-response surface estimated under BKMR, and estimation of parameters quantifying potential interaction, did not reveal evidence of interactive effects. In the linear mixed model, SBP was significantly associated with age ( $B=0.19$ ,  $SE=0.06$ ,  $p=.0025$ ), female sex ( $B=-14.08$ ,  $SE=4.2$ ,  $p=.0011$ ) and BMI ( $B=.48$ ,  $SE=0.15$ ,  $p=.0017$ ). Positive associations were observed between DBP and BMI ( $B=0.34$ ,  $SE=0.10$ ,  $p=.0010$ ) and log mercury (ng/g) ( $B=1.08$ ,  $SE=0.56$ ,  $p=.0586$ ). When stratified by sex there were additional suggested inverse associations between SPB and Western diet and selenium among men. The prevalence of artisanal gold mining and resultant mercury contamination in the region warrants further investigation.

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**P-0539**

### **Low-dose Vitamin E Supplementation Associated with Lower Risk of Diabetes Mellitus in South Asian Population Exposed to Arsenic: Results from a Randomized Clinical Trial**

**Presenter:** Mohammad H Shahriar, Department of Public Health Sciences, University of Chicago, CHICAGO, United States

**Authors:** M. H. Shahriar<sup>1</sup>, M. Argos<sup>2</sup>, L. Tong<sup>1</sup>, M. Rahman<sup>3</sup>, F. Parvez<sup>4</sup>, J. J. Dignam<sup>1</sup>, T. Islam<sup>3</sup>, I. Quasem<sup>3</sup>, S. K. Hore<sup>5</sup>, A. T. Haider<sup>3</sup>, Z. Hossain<sup>5</sup>, T. I. Patwary<sup>3</sup>, M. Rakibuz-Zaman<sup>3</sup>, T. Islam<sup>3</sup>, G. Sarwar<sup>3</sup>, J. Harjes<sup>6</sup>, M. G. Kibriya<sup>1</sup>, F. Jasmine<sup>1</sup>, R. Khan<sup>7</sup>, M. Kamal<sup>8</sup>, C. R. Shea<sup>9</sup>, M. Yunus<sup>5</sup>, J. A. Baron<sup>10</sup>, H. Ahsan<sup>1</sup>;

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**Background:** Considerable data have emerged showing an increased risk of diabetes mellitus (T2DM) with higher arsenic or selenium exposure. Limited data suggest a potentially reduced risk in relation to higher vitamin E exposure. **Methods:** The Bangladesh Vitamin E and Selenium Trial (BEST) is a 2x2 factorial double-blind RCT that aimed to evaluate the effect of daily vitamin E (100 mg) and selenium (200 µg) supplementation on the incidence of non-melanoma skin cancer (primary outcome) and T2DM (secondary outcome). There were 715 cases of T2DM (out of 7,000 participants randomized) identified at the end of 6 years intervention period based on Hemoglobin A1c (HbA1c) and oral glucose tolerance test (OGTT). **Results:** Of the 715 cases of T2DM (HbA1c ≥ 6.5% or positive OGTT), 187 developed in the placebo group, 207 in the selenium group, 160 in the vitamin E group, and 161 in the group receiving both vitamin E and selenium (incidence rates of 20.1, 22.1, 20.1, and 17.2 per 1,000 person-years, respectively). A statistically significant protective effect of vitamin E on T2DM (RR=0.78; 95% CI=0.66-0.92) was observed in marginal analyses (vitamin E alone + vitamin E and selenium versus selenium alone + placebo). The protective effects were stronger among men (RR=0.68; 95% CI=0.52-0.90), individuals with lower baseline selenium (RR=0.75; 95% CI=0.59-0.95), lower baseline α-tocopherol (RR=0.47, 95% CI=0.28-0.80), lower baseline γ-tocopherol (RR=0.50, 95% CI=0.30-0.82), higher baseline BMI (RR=0.74; 95% CI=0.60-0.92), and less severe arsenical skin lesion (RR=0.75; 95% CI=0.57-0.97). There was no association of prediabetes (HbA1c 5.7-6.4) in relation to vitamin E and no association of prediabetes or T2DM in relation to selenium supplementation. **Conclusion:** This large RCT found that 6-year supplementation with low dose vitamin E (100 mg daily) is associated with a lower risk of T2DM in a South Asian population exposed to arsenic from drinking water.

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## ABSTRACT E-BOOK

Theme: **Heavy metal health**

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**P-0540**

**Association between blood lead, high sensitivity C-reactive protein and metabolic syndrome**

**Presenter:** Won-Jun CHOI, Gachon University College of Medicine, Gil Medical Center, Incheon, Korea, Republic of

**Authors:** W. CHOI;  
Gachon University College of Medicine, Gil Medical Center, Incheon, KOREA, REPUBLIC OF.

**Background:** Environmental exposure to toxic heavy metal such as lead and systemic inflammation have been suggested as risk factors for cardiovascular disease. However, little is known about the association between environmental lead exposure, elevated inflammation marker and metabolic syndrome. The aim of this study was to investigate the association between blood lead, high sensitivity C-reactive protein (hsCRP) and metabolic syndrome.

**Methods:** Data used in this study was from the Korea National Health and Nutrition Examination Survey (KNHANES) in 2016 and 2017. Among them, 5,258 subjects who were tested for blood lead hsCRP were included in the analysis. Logistic regression analyses were performed to calculate odds ratios (OR) of blood lead level and hsCRP level for having metabolic syndrome.

**Results:** There were 1,290 subjects (24.5%) who were met the criteria of metabolic syndrome. The median of blood lead was 1.603  $\mu\text{g/dL}$  (IQR 1.199 ~ 2.145  $\mu\text{g/dL}$ ). Mean values of hsCRP and blood lead were statistically significantly higher in those who had metabolic syndrome ( $p < 0.001$ , respectively). Blood lead level was statistically significantly associated with metabolic syndrome. Compared to the lowest quartile of blood level ( $< 1.199 \mu\text{g/dL}$ ), OR of the highest quartile of blood level ( $> 2.145 \mu\text{g/dL}$ ) was 1.548 (95% CI 1.168~2.051), after adjusting for age and sex. hsCRP level was also statistically significantly associated with metabolic syndrome. Compared to the lowest level of hsCRP ( $< 1 \text{ mg/dL}$ ), OR of the highest level of hsCRP ( $> 3 \text{ mg/dL}$ ) was 2.988 (95% CI 2.275~3.926), after adjusting for age and sex. These association was not significantly changed after adjusting for blood lead level and hsCRP simultaneously.

**Conclusions:** Elevated blood lead may be a potential risk factor for metabolic syndrome. It is worth to emphasize that efforts are needed to reduce exposure to lead.

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## ABSTRACT E-BOOK

Theme: **Heavy metal health**

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**P-0543**

**Lead exposure and cognitive impairment in older people living in communities located near mine tailing dumps in Johannesburg**

**Presenter:** Nisha Naicker, National Institute for Occupational Health, Johannesburg, South Africa

**Authors:** N. Naicker<sup>1</sup>, V. Nkosi<sup>2</sup>, A. Todd<sup>3</sup>, K. Schneider<sup>3</sup>, A. Mathee<sup>2</sup>;

<sup>1</sup>National Institute for Occupational Health, Johannesburg, SOUTH AFRICA, <sup>2</sup>South African Medical Research Council, Johannesburg, SOUTH AFRICA, <sup>3</sup>Mount Sinai, New York, NY.

Background: Mild cognitive impairment (MCI) is a chronic health disease that is growing globally. It has been associated with modifiable risk factors such as environmental exposure to lead. One of the main causes of environmental contamination with lead is from the gold mining industry and mine tailings. The aim of this study was to determine if long-term exposure (bone lead) to environmental lead is associated with decrements in cognitive ability in older individuals residing near mine tailing dumps or gold mining activities. Methods: A random sample of 139 participants aged 60 to 75 years was selected from state owned old age/retirement homes. Participants were interviewed with a structured questionnaire assessing socio-demographic status, occupational and medical history. Cumulative lead exposure will be measured in the tibia using a KXRF bone lead measurement. The early dementia questionnaire (EDQ) and the CANTAB battery of cognitive assessments was performed on touch screen monitors to assess for MCI. Results: The mean age of participants was 69.9 years' age. Males consisted of 54% of the sample with 48% having secondary education. Only 9% of the participants had a previous job in a mining or lead manufacturing sector and the majority resided in gold mining areas. The median bone lead measurement was 7.85. The EDQ results showed that 52% had screen positive for mild cognitive decline. Preliminary bivariate linear regression results showed a significant association between bone lead levels and a positive EDQ score for MCI. The CANTAB results for MCI and the multivariate analyses assessing factors associated with MCI is currently being conducted. Conclusion: Cumulative environmental lead exposure may lead to MCI which has serious consequences for quality of life of the individual and places an additional burden on the health care and social system of the country.

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**P-0544**

**Low-level maternal exposure to cadmium, lead, and methylmercury and birth outcomes in a Swedish prospective birth-cohort**

**Presenter:** Klara Gustin, Karolinska Institutet, Stockholm, Sweden

**Authors:** K. Gustin<sup>1</sup>, M. Barman<sup>2</sup>, M. Stråvik<sup>2</sup>, M. Levi<sup>1</sup>, L. Englund-Ögge<sup>3</sup>, F. Murray<sup>4</sup>, B. Jacobsson<sup>5</sup>, A. Sandberg<sup>2</sup>, A. Sandin<sup>4</sup>, A. E. Wold<sup>5</sup>, M. Vahter<sup>1</sup>, M. Kippler<sup>1</sup>;

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<sup>3</sup>Sahlgrenska University Hospital, Gothenburg, SWEDEN, <sup>4</sup>Umeå University, Umeå, SWEDEN, <sup>5</sup>University of Gothenburg, Gothenburg, SWEDEN.

Background: Observational studies have indicated that low-to-moderate exposure to cadmium (Cd), lead (Pb), and methylmercury (MeHg) adversely affects birth anthropometry, but results are inconclusive. Objective: To assess the exposure to Cd, Pb, and MeHg in pregnant women, identify the main dietary sources, and elucidate potential impact on birth anthropometry. Methods: In the NICE (Nutritional impact on Immunological maturation during Childhood in relation to the Environment) birth-cohort in northern Sweden, blood and urine were collected from pregnant women in early third trimester. Cd, Pb and Hg were measured in erythrocytes (n=584), Cd also in urine (n=581), by inductively coupled plasma mass spectrometry. Dietary data were collected through a semi-quantitative food frequency questionnaire administered in mid third trimester. Birth anthropometry data were extracted from hospital records. Results: Bivariate associations appeared non-linear (inverted U-shape). In multivariable-adjusted spline regression models, a doubling of maternal erythrocyte Cd above 0.50 µg/kg (median: 0.29 µg/kg) was significantly associated with reduced birth weight by almost 200 g, and length by 0.7 cm. The association with birth weight remained when the analysis was restricted to never-smokers. Likewise, a doubling of erythrocyte Hg above 1.0 µg/L (median 1.5 µg/kg, mainly MeHg), was significantly associated with 60 g lighter and 30 cm shorter newborns. Maternal Pb (median 11 µg/kg) was unrelated to birth weight and length. Erythrocyte Cd was primarily associated with intake of grains, rice and root vegetables, Pb with tea, coffee and game meat, and Hg with intake of fish. Conclusion: The results showed that low-level maternal Cd and MeHg exposure during pregnancy was associated with poorer birth anthropometry. The indicated positive associations at very low exposure levels, likely reflected food benefits. Further prospective studies in low-level exposed populations are warranted.

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**P-0546**

**Gene-Environment interactions on Children's neurocognitive function in a prospective cohort study**

**Presenter:** Youn-Hee Lim, Seoul National University Medical Research Center, Seoul, Korea, Republic of

**Authors:** Y. Lim<sup>1</sup>, B. Kim<sup>2</sup>, J. I. Kim<sup>3</sup>, Y. Lee<sup>4</sup>, C. Shin<sup>4</sup>, Y. Hong<sup>5</sup>;

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Background: Exposure to endocrine-disrupting chemicals (EDC) may affect neurocognitive development in exposed individuals and/or offspring. Objectives: We aimed to investigate the gene-environment interactions on the associations between prenatal and postnatal exposure to EDC and children's neurocognitive development in a prospective cohort study. Methods: We recruited midterm pregnant women between 2008 and 2011 and followed-up their children in 2012-2019 (n=574 mother-child pairs). We measured mothers' and their children's Bisphenol A (BPA), 3-Phenoxybenzoic acid (3-PBA), phthalates, heavy metal levels at ages 6 and 8 years, and assessed mother's and children's intelligence quotient (IQ) and children's attention-deficit/hyperactivity disorder (ADHD) using the Wechsler Intelligence Scale and the Korean version of the ADHD rating scale (K-ARS), respectively. In a Genome-wide association study, we derived generic risk scores (GRS) from single nucleotide polymorphisms (SNPs) showing significant associations with children's IQ and ADHD. We compared the associations of IQ and ADHD with EDC levels among children with low or high GRS. Results: We identified 8, 18, and 22 SNPs associated with IQ and ADHD at 6 and 8 years of age, respectively. We observed a decrease in IQ related to interquartile range increase in maternal lead and cadmium concentrations among the children with high genetic profiles: 3.0 (95% Confidence intervals [CI]: -6.0, -0.1) and 3.7 (95% CI: -6.9, -0.4). However, we did not observe significant associations between IQ and maternal exposure to EDC among children with low GRS. In addition, the associations between children's exposure to EDC and neurocognitive functions were not modified by GRS. Discussion: The study supports that children's genetic profiles modified the association between prenatal exposure to EDC and children's neurocognitive development.

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## ABSTRACT E-BOOK

Theme: **Heavy metal health**

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**P-0547**

### **The Effects of the Exposure to Neurotoxic Elements on Italian Schoolchildren Behavior**

**Presenter:** Stefano Renzetti, Università degli Studi di Brescia, Brescia, Italy

**Authors:** S. Renzetti<sup>1</sup>, G. Cagna<sup>1</sup>, S. Calza<sup>1</sup>, M. Conversano<sup>2</sup>, C. Fedrighi<sup>1</sup>, G. Forte<sup>3</sup>, A. Giorgino<sup>2</sup>, S. Guazzetti<sup>1</sup>, R. G. Lucchini<sup>1</sup>, C. Majorani<sup>3</sup>, M. Peli<sup>1</sup>, F. Petrucci<sup>3</sup>, A. Pino<sup>3</sup>, D. Placidi<sup>1</sup>, O. Senofonte<sup>3</sup>, S. Zoni<sup>1</sup>, A. Alimonti<sup>3</sup>;

<sup>1</sup>Università degli Studi di Brescia, Brescia, ITALY, <sup>2</sup>ASL, Taranto, ITALY, <sup>3</sup>Italian National Institute of Health, Rome, ITALY.

Background/Aim: Neurodevelopmental disorders are constantly increasing on a global scale. Some elements are known to be neurotoxic being able to interfere with neurons. In this study we assessed the neurobehavioral effect of the exposure to trace elements including lead, mercury, cadmium, manganese, arsenic and selenium among 6-12 years old children residing in Taranto area in Italy. Methods: A total of 299 children from 6 to 11 years were enrolled in the 12 primary schools located in the 5 sub-areas. Whole blood, urine and hair were collected while The Child Behavior Checklist (CBCL) and the Social Responsiveness Scale (SRS), administered to the main teacher and to the mother were considered to identify problem behavior in children. The relationship between metal exposures and neurobehavioral outcomes was tested through linear mixed effects model and tobit regressions. Results: Blood lead mainly influenced social problems (beta 0.7; 95% CI 0.1, 1.4), aggressive behaviour (beta 0.9; 95% CI 0.2, 1.6), externalizing (beta 1.8; 95% CI 0.1, 3.5) and total problems (beta 1.9; 95% CI 0.2, 3.7). Urinary arsenic showed to have an impact on anxiety and depression (beta 0.4; 95% CI 0.1, 0.8), somatic problems (beta 0.6; 95% CI 0.1, 1.1), attention problems (beta 0.4; 95% CI 0.1, 0.7) and rule breaking behaviour (beta 0.4; 95% CI 0.1, 0.7). Conclusions: Overall, we were able to test that higher blood lead or urinary arsenic concentrations increase the risk of neurobehavioral problems. This is in line with the U.S. Environmental Protection Agency's (EPA) priority list of hazardous substances where arsenic and lead are ranked as first and second respectively. No other studied elements appeared to have a statistically significant effect on children neurobehavior.

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## ABSTRACT E-BOOK

Theme: **Heavy metal health**

**P-0548**

**Manganese and lead exposure and thyroid hormones during pregnancy in the Infants' Environmental Health Study (ISA) in Costa Rica**

**Presenter:** Andrea Corrales Vargas, Universidad Nacional de Costa Rica (National University of Costa Rica). P.O. Box 86-3000, Heredia, Costa Rica

**Authors:** A. Corrales Vargas<sup>1</sup>, J. Peñaloza Castañeda<sup>2</sup>, E. Rietz Liljedahl<sup>3</sup>, A. Mora<sup>4</sup>, J. Menezes-Filho<sup>5</sup>, D. Smith<sup>6</sup>, D. Mergler<sup>7</sup>, C. Lindh<sup>3</sup>, B. van Wendel de Joode<sup>1</sup>;

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**Background:** Metals may disrupt thyroid hormones (TH) like thyroid stimulating hormone (TSH), thyroxine (T4) and triiodothyronine (T3). We examined whether hair (MnH) and blood manganese (MnB), and blood lead (PbB) concentrations explained serum TH concentrations in pregnant women from the ISA birth cohort in Costa Rica. **Methods:** Using the first sample of each woman (n=384), we ran separate multivariate linear regression models and General Additive Models (GAMs) adjusting for gestational age, maternal age, cotinine, prepregnancy Body Mass Index and severe vomiting. We also ran stratified analysis by trimester of pregnancy. **Results:** Median (p25-75) TSH, FT3, FT4 concentrations were: 1.47 (1.06-2.08) mIU/L, 4.60 (4.29-5.06) pmol/L, and 14.09 (13.00-15.65) pmol/L, respectively. Median (p25-75) MnH, MnB and PbB were 1.62 (0.86-3.49) µg/g, 23.44 (19.36-27.43), 6.66 (5.17-9.08) µg/L, respectively. Increased MnH was associated with increased TSH (% of change = 13,24, 95%CI -1,95, 30,79 for each 1% increase in MnH) during the second trimester of pregnancy. In addition, MnH showed a non-linear association with FT4 during the third trimester of pregnancy (GAM estimated degrees of freedom >2 with p<0.05). Overall, higher MnB concentrations were associated with increased FT4,  $\beta=0,04$  (95%CI 0, 0,07). Associations were strongest during the first trimester  $\beta=0,13$  95% CI: 0,05, 0,21). MnB also showed a non-linear association with FT3 during the first trimester. Finally, increased PbB concentrations were associated with higher FT4 [ $\beta=0.07$  (95% CI: 0.00, 0.13)], particularly during the second trimester of pregnancy [ $\beta=0.10$  (95% CI: 0.02, 0.19)]. **Conclusion:** Our findings show that both manganese and lead explain TH concentrations during pregnancy. For Mn, being an essential element, this may reflect normal physiological functioning. Nevertheless, increased MnH is likely to reflect excess Mn and associations may also reflect endocrine disrupting effects. For lead, results show even very low concentrations might affect TH and possibly cause endocrine disrupting effects.



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Theme: **Heavy metal health**

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**P-0549**

**CONAMAD: Birth cohort to quantify the effects of in-utero metals exposure on child development in an artisanal and small-scale gold mining region of the Amazon**

**Presenter:** William Pan, Duke University, Durham, United States

**Authors:** W. Pan<sup>1</sup>, H. Hsu-Kim<sup>1</sup>, C. Weinhouse<sup>2</sup>, E. Ortiz<sup>1</sup>, A. Berky<sup>1</sup>, E. Fixsen<sup>3</sup>, A. Mallipudi<sup>4</sup>, N. Rivera<sup>1</sup>, B. Feingold<sup>5</sup>, J. Miranda<sup>6</sup>;

<sup>1</sup>Duke University, Durham, NC, <sup>2</sup>Oregon Health and Sciences University, Portland, OR, <sup>3</sup>University of Hawaii, Honolulu, HI, <sup>4</sup>New York University, Longone Bellevue Hospital, New York, NY, <sup>5</sup>State University of New York, Albany School of Public Health, Albany, NY, <sup>6</sup>Universidad Peruana Cayetano-Heredia, Lima, PERU.

Research quantifying in-utero trace metals exposure and health effects have been conducted primarily in developed regions. Given the global increase of artisanal scale gold mining (ASGM), there is a critical need to quantify in-utero exposure to trace metals and related health risks in populations living in ASGM environments, characterized by high prevalence of malnutrition, infectious disease, and poverty. We describe the design and initial results of CONAMAD, a birth cohort of multiparous women (18 and over) living in an ASGM region of Madre de Dios (MDD), Peru, whose long-term goal is to quantify in-utero toxic metals exposures and subsequent child health effects during the first two years of life. 270 mothers were enrolled during pregnancy across four zones representing differential economic and development activities in MDD. At enrollment, women averaged 28 years of age, 20 weeks gestational age, and 17% were of short stature (<1.45m). Half of all mothers lived near a major road and ~20% lived near mining or a gold shop, which varied by location ( $p < 0.001$ ). We obtained biomarkers from 215 mothers and their newborns at birth, including maternal and cord blood, hair samples, and placenta for exposure assessment. The median levels of mercury and lead in cord blood were 5.8  $\mu\text{g/L}$  and 10.0  $\mu\text{g/L}$ , respectively, while median levels in maternal blood were 3.4  $\mu\text{g/L}$  and 13.3  $\mu\text{g/L}$ , respectively (USEPA BMDL is 5.8  $\mu\text{g/L}$  for blood Hg, 5  $\mu\text{g/dL}$  for lead). USEPA assumes cord:maternal blood mercury ratio (Hgc:Hgm) to be equal when estimating reference doses for risk quantification; however, we find higher median Hgc:Hgm of 1.67 (10<sup>th</sup> to 90<sup>th</sup> percentile: 1.13-2.42) with 93% of cord blood Hg samples exceeding maternal blood levels. Results indicate that the developing fetus may have increased health risks if standard public health recommendations are followed by pregnant women in ASGM regions.

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Theme: **Heavy metal health**

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**P-0552**

**Social adversity, blood lead level, and behavior problems in young US adolescents**

**Presenter:** Jianghong Liu, University of Pennsylvania School of Nursing, Philadelphia, United States

**Authors:** J. Liu<sup>1</sup>, C. Tai<sup>2</sup>, A. Raine<sup>2</sup>, T. Richmond<sup>1</sup>;

<sup>1</sup>University of Pennsylvania School of Nursing, Philadelphia, PA, <sup>2</sup>University of Pennsylvania, Philadelphia, PA.

**Background:** To investigate the associations among social adversity, very low blood lead levels (BLL; <2.5 ug/g), and behavioral problems in young adolescents from the Philadelphia community, and explore the mediating/moderating roles of lead exposure among the relationships. **Methods:** This cross-sectional study included 141 young adolescents aged 11 to 12 years from Philadelphia. BLLs were assessed using a graphite furnace atomic absorption spectrophotometer, and social adversity was measured using the Social Adversity Index with 18 indicators. Behavior problems, including internalizing and externalizing, were assessed with the self-reported Aggression Questionnaire, the parent-reported Conduct and Oppositional Defiant Disorder (CODD), and the parent-reported Child Behavior Checklist (CBCL). **Results:** The mean (SD) BLL was 2.14 (4.98) µg/dL. For externalizing behavior, BLLs were positively associated with physical aggression ( $r = .247, p < .01$ ), anger ( $r = .257, p < .01$ ), and total aggression score ( $r = .178, p < .05$ ) from the Aggression Questionnaire after controlling for gender and ethnicity, as well as the Conduct Disorder subscale ( $r = .224, p < .01$ ) and total score of Conduct and Defiant disorder ( $r = .184, p < .05$ ) from the CODD Questionnaire. BLLs partially mediated the social adversity-externalizing behavior relationship, explaining 9.0, 10.1, and 17.7 percent of the effect of social adversity on physical aggression, anger, and total aggression score, respectively. For internalizing behavior, BLLs were positively related to CBCL traumatic stress ( $r = .179, p < .05$ ). Social adversity moderated the lead-behavior relationship, explaining 11.1 percent of the effect of BLLs on children's affective problems. **Conclusion:** Social adversity is implicated in the relationship between BLLs and behavior problems, which highlights the importance of social determinants of health. As such, early mitigation of adverse social indicators and close monitoring of BLLs may help reduce the likelihood of externalizing behavioral problems, a risk factor for future violence.

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## ABSTRACT E-BOOK

Theme: **Heavy metal health**

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**P-0553**

**Early life lead exposure and behavioral problems among children in the HOME Study**

**Presenter:** Clara G Sears, Brown University, Providence, United States

**Authors:** C. G. Sears<sup>1</sup>, B. P. Lanphear<sup>2</sup>, D. E. Jacobs<sup>3</sup>, S. Dixon<sup>3</sup>, J. Wilson<sup>3</sup>, Y. Xu<sup>4</sup>, A. Chen<sup>5</sup>, K. Yolton<sup>6</sup>, J. M. Braun<sup>1</sup>;

<sup>1</sup>Brown University, Providence, RI, <sup>2</sup>Simon Fraser University, Burnaby, BC, CANADA, <sup>3</sup>National Center for Healthy Housing, Columbia, MD, <sup>4</sup>Cincinnati Children's Hospital, Cincinnati, OH, <sup>5</sup>University of Cincinnati College of Medicine, Cincinnati, OH, <sup>6</sup>Cincinnati Children's Hospital, University of Cincinnati College of Medicine, Cincinnati, OH.

Background: Lead exposure is associated with behavioral problems in children, but the ages when children are most susceptible to lead toxicity are unclear. Our objective was to evaluate the association of repeated blood lead concentrations with parent-reported behaviors and identify periods of heightened susceptibility. Methods: Between 2003-2006, we recruited pregnant women (n=389) living in homes built pre-1978 from Cincinnati, Ohio (HOME Study) and followed their children until age 8 years. We quantified lead in whole blood samples collected from children at ages 1, 2, 3, 4, 5, and 8 years. We assessed parent-reported child behavior using the Behavioral Assessment System for Children-2 (BASC-2) when children were ages 2, 3, 4, 5, and 8 years. Using linear regression with generalized estimating equations adjusted for covariates, we estimated associations of time-varying blood lead concentrations (ln-transformed, g/L) with behavioral profiles using the BASC-2 composite scales. We used multiple informant models to assess heterogeneity in these associations across exposure periods (n=241). Results: The median blood lead concentration peaked at 15 g/L around age 2 years (25<sup>th</sup>, 75<sup>th</sup>=10, 22 g/L) and gradually decreased to 6 g/L around age 8 years (25<sup>th</sup>, 75<sup>th</sup>=4, 9) g/L. Higher time-varying blood lead concentrations were associated with more externalizing problems ( $\beta$ :1.8-point; 95% CI= 0.3, 3.2). The association between blood lead levels and externalizing problems varied by exposure timing (lead x period interaction p-value=0.11), with heightened susceptibility around ages 3 ( $\beta$ :2.1-point; 95% CI= 0.6, 3.6) and 8 ( $\beta$ :3.5-point; 95% CI= 1.2, 5.7) years compared with other ages. Conclusion: Children with higher blood lead levels had more parent-reported hyperactive and aggressive behaviors. Future research could investigate if the periods of heightened susceptibility around ages 3 and 8 years are due to unique neurodevelopmental processes.

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Theme: **Heavy metal health**

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**P-0554**

**Exposure to heavy metals in utero and autism spectrum disorder at age 3**

**Presenter:** John Dou, University of Michigan, Ann Arbor, United States

**Authors:** J. Dou<sup>1</sup>, K. M. Bakulski<sup>1</sup>, R. J. Schmidt<sup>2</sup>, H. Volk<sup>3</sup>, J. I. Feinberg<sup>3</sup>, I. Hertz-Picciotto<sup>2</sup>, L. Croen<sup>4</sup>, C. Newschaffer<sup>5</sup>, M. D. Fallin<sup>3</sup>;

<sup>1</sup>University of Michigan, Ann Arbor, MI, <sup>2</sup>University of California Davis, Davis, CA, <sup>3</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>4</sup>Kaiser Permanente Division of Research, Oakland, CA, <sup>5</sup>Penn State University, State College, PA.

**Background:** Autism spectrum disorder is a prevalent and heterogeneous neurodevelopmental disorder. Risk is attributed to genetic and prenatal environmental factors, though the environmental agents are incompletely characterized.

**Methods:** In the Early Autism Risk Longitudinal Investigation (EARLI), an enriched-risk pregnancy cohort, maternal urinary metals concentrations at two time points during pregnancy were measured using inductively coupled plasma mass spectrometry. At age three, clinicians assessed autism spectrum disorder with DSM-5 criteria. Using multivariable logistic regression, we tested each metal for association with autism spectrum disorder status, adjusting for gestational age, child sex, and maternal education.

**Results:** In this enriched-risk study sample (n=167), 18.6% of children were diagnosed with autism spectrum disorder, 31.1% were non-neurotypical, and 50.9% were males. Mothers averaged 34 years old and 57.5% had greater than high school education. Median urinary metals concentrations were 0.04 ppb antimony, 6.8 ppb arsenic, 1.8 ppb barium, 0.12 ppb cadmium, 3.9 ppb cesium, 0.66 ppb cobalt, 8.5 ppb copper, 0.26 ppb lead, 0.26 ppb manganese, 0.22 ppb mercury, 51.8 ppb molybdenum, 3.5 ppb nickel, 39 ppb selenium, 0.14 ppb thallium, 0.37 ppb tin, and 245 ppb zinc. In early pregnancy, an interquartile range increase in barium concentration was associated with 2.33 (1.13, 4.82) higher odds of autism spectrum disorder, an interquartile range increase of cesium with 2.65 (1.37, 5.13) higher odds, and an interquartile range increase in zinc with 2.11 (1.21, 3.69) higher odds. Having cadmium concentration over the level of detection was associated with 2.78 (1.02, 7.59) higher odds of autism spectrum disorder. Longitudinal analyses and mixtures analyses will be presented.

**Conclusion:** Exposure in utero to elevated metals levels (barium, cesium, cadmium, zinc), as measured via maternal urine, was associated with increased odds of developing autism spectrum disorder. Prenatal timing of exposure and longitudinal clinical evaluations are critical.

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**P-0555**

**Mechanistic insight on the effects of metals and metalloids to neurodevelopment**

**Presenter:** Nafsika Papaioannou, HERACLES Research Center on the Exposome and Health, Center for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki, Thessaloniki, Greece

**Authors:** N. Papaioannou<sup>1</sup>, C. Gabriel<sup>1</sup>, V. Jejeja<sup>1</sup>, I. Petridis<sup>1</sup>, O. Anesti<sup>2</sup>, M. Fafouti<sup>1</sup>, M. Dickinson<sup>3</sup>, J. Snoj Tratnik<sup>4</sup>, S. Karakitsios<sup>1</sup>, M. Horvat<sup>4</sup>, D. Sarigiannis<sup>1</sup>;

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<sup>3</sup>Fera Science, York, UNITED KINGDOM, <sup>4</sup>Jožef Stefan Institute, Ljubljana, SLOVENIA.

The neurodevelopmental exposome paradigm was applied on a cohort of mother-infant pairs (n=178). Prenatal exposure to metals and metalloids was determined by measuring mercury in hair samples selected at birth, while cord blood and breast milk samples were analysed for mercury, cadmium, lead, and arsenic, as well as for essential elements (selenium, zinc, copper). Cognitive function, language, and motor development were assessed in children at the age of 18 months by the Bayley Scale for Infant Development (Bayley-III) development tool. The individual-level biological profiles were characterized using both nuclear magnetic resonance (NMR) spectroscopy and ultra-high-performance liquid chromatography-high resolution mass spectrometry (UPLC-HRMS) for the untargeted urinary and plasma metabolomics analysis. LC-HRMS metabolites were assigned using the xcms and CAMERA R packages. In this study Human Metabolome DataBase (HMDB), Metlin, and LipidMaps databases were used for annotations, considering the calculated mass error in ppm, the isotope patterns, and the MS spectra. NMR spectra were preprocessed with MestreNova v.11.04 and ChenomX 8.03. Integrated pathway analysis and exposome-wide association algorithms were used for the evaluation of the associations between in utero exposure to metals and metabolic pathway dysregulation, as well as between metabolic pathway perturbations and neurodevelopment. NMR and UPLC-HRMS analysis of plasma samples, as well as the analysis of urine samples pointed out the presence of oxoglutaric acid, oxalosuccinic acid, succinate, 2-oxoglutarate, formate, isocitrate, oxoglutaric acid, glycerol, L-carnitine, glutathione, methionine, cysteine, pyruvate, N-acetylglutamic acid,  $\beta$ -alanine, serine, and arginine. Therefore, pathway analysis revealed that the most perturbed metabolic pathways from exposure to heavy metals were related to TCA cycle, purine, pyrimidine, phospholipids and carnitine metabolism, and glycolysis. The aforementioned results suggested major disturbances to cell biochemistry, which resulted in the impairment of antioxidant defense mechanisms leading to the clinically observed results in linguistic, motor development and cognitive capacity.

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**P-0557**

### **Aortic Strain -Threshold Analysis of Non-Cancer Outcome from Arsenic Exposure**

**Presenter:** Steven H Lamm, CEOH, Washington, United States

**Authors:** J. Ahn<sup>1</sup>, S. H. Lamm<sup>2</sup>, H. Ferdosi<sup>2</sup>, I. J. Boroje<sup>2</sup>;

<sup>1</sup>Georgetown University, Washington, DC, <sup>2</sup>CEOH, Washington, DC.

**Background:** While arsenic has been shown in many studies to behave as a threshold carcinogen, analyses of non-cancer outcomes (e.g., cardiovascular) have generally been presented only using linear models. Alternative models have received little consideration. We choose here to examine aortic strain data, a known risk factor for hypertension and cardiovascular disease, on arsenic-exposed workers with alternative analytic modeling.

**Method:** A previously published study (Karakulak et al., 2016) of aortic strain measurements in arsenic-exposed workers had demonstrated that aortic strain was markedly reduced among workers with high levels of arsenic exposure (urinary arsenic in ug/L). The original analysis was limited to a linear model without model validation. We have analyzed the data using alternative models.

**Results:** Examination of the linear analysis and its residuals demonstrated significant heteroscedascity with unequal variances, particularly at urinary levels of > 160 ug arsenic per liter (ug/L). The test of equal variances from samples with >160 and samples <= 160 demonstrated inequality ( $p < 0.0001$ ). The better alternative model was a step-function with a mean aortic strain of 11.3% for those with urinary arsenic <= 160 ug/L and with a mean aortic strain of 5.3% for those with urinary arsenic > 160 ug/L. A further stratified analysis with bins of 40 ug/L showed no effect on aortic strain for the urinary arsenic range of <= 160 ug/L and, separately, no effect for the urinary arsenic range of > 160 ug/L.

**Conclusion:** Aortic elasticity parameters show an adverse effect from arsenic exposure only at urinary exposure levels of > 160 ug/L and not below, indicating a step-function rather than a linear function. Restriction of analyses to a linear no-threshold model may have blinded the finding of a more useful demonstration of a dose-response pattern that may offer different toxicological interpretations.

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**P-0559**

**Blood cadmium is not a predictor of carotid intima-media thickness in young adults from Padang, Indonesia**

**Presenter:** Cimi Ilmiawati, Universitas Andalas, Padang, Indonesia

**Authors:** C. Ilmiawati, M. Reza, M. Yanni, D. Rusjdi;  
Universitas Andalas, Padang, INDONESIA.

Background: Cd exposure is a non-traditional risk factor of cardiovascular disease and mortality by promoting the development of atherosclerosis. There are many studies showing that environmental Cd exposure is associated with atherosclerosis in developed countries, however, there are still limited studies in developing countries. The development of atherosclerosis can be monitored non-invasively by measuring carotid intima-media thickness (CIMT). This study aimed to measure the level of blood Cd and other factors known to be associated with CIMT, measured at the segment of the common and the internal carotid artery (CCA and ICA, respectively), in young adults from Padang, West Sumatera, Indonesia, and we analyzed whether blood Cd is a predictor of CIMT. Methods: The participants were 156 young adults, aged 18-24. Blood Cd was analyzed by using inductively coupled plasma-mass spectrometry (ICP-MS). CIMT was measured by ultrasonography of the left and right carotid artery. Multiple regression analyses were performed to identify predictors of CIMT. Results: The median blood Cd level was 0.61  $\mu\text{g/L}$  (range 0.01-5.96  $\mu\text{g/L}$ ), with no difference in male compared to female subjects (Mann-Whitney U test,  $p=0.60$ ). To identify factors associated with CIMT, we performed a multivariable model including all relevant variables. Our model predicted 21.9% variation in CCA IMT, with sex as the best predictor ( $\beta=-0.438$  [95% confidence interval (CI): -0.009 - -0.003];  $p<0.001$ ). The model for predicting ICA IMT, where 16.5% variation was accounted for, showed that sex was the best predictor ( $\beta=-0.529$  [95% CI: -0.010 - -0.004];  $p<0.001$ ). Blood Cd was not a predictor of CCA IMT (adjusted  $R^2=0.219$ ;  $\beta=-0.101$  [95% CI: -0.001-0.000];  $p=0.203$ ) and ICA IMT (adjusted  $R^2=0.165$ ;  $\beta=-0.055$  [95% CI: -0.001-0.001];  $p=0.503$ ). Conclusion: Blood Cd level is not a predictor of CIMT in young adults from Padang, Indonesia.

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Theme: **Heavy metal health**

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**P-0560**

**A common adverse outcome pathway for toxic metals inducing nephrotoxicity to aid human health risk assessment of chemical mixtures**

**Presenter:** Tessa Schillemans, Karolinska Institutet, Stockholm, Sweden

**Authors:** T. Schillemans<sup>1</sup>, A. Åkesson<sup>1</sup>, M. Mengelers<sup>2</sup>, M. Luijten<sup>2</sup>;  
<sup>1</sup>Karolinska Institutet, Stockholm, SWEDEN, <sup>2</sup>National Institute for Public Health and the Environment (RIVM), Bilthoven, NETHERLANDS.

**Background:** There is evidence that chronic exposure to certain metals may induce nephrotoxicity in humans, even at relatively low doses. However, there is no consensus on the biological processes involved and the human health risk assessment is complicated by frequently occurring combined exposure to metal mixtures. We aimed to address these issues by developing a common Adverse Outcome Pathway (AOP) for toxic metals and nephrotoxicity.

**Methods:** We focused on four toxic metals, i.e. arsenic, cadmium, lead and mercury, prioritized in the context of the Horizon2020 project on Human Biomonitoring in Europe and labelled as substances of high concern by the World Health Organization. First, renal dysfunction due to proximal tubular damage was identified as their common adverse outcome using available risk assessment reports. Subsequently, the AOP was developed by collecting evidence from experimental studies.

**Results:** We identified the following common pathway via which these metals most likely induce nephrotoxicity: thiol binding induces oxidative stress and mitochondrial dysfunction, which results in cytochrome c release followed by apoptosis in the proximal tubuli of the kidney. Evaluation of the weight-of-evidence using modified Bradford-Hill criteria, including assessment of the relevance of doses tested in experimental studies, revealed a high confidence in this AOP.

**Conclusions:** The developed AOP enhances mechanistic understanding of metal-induced nephrotoxicity and provides scientific evidence for a causal relationship between the adverse effect and effect biomarkers. Furthermore, it can be a useful tool to facilitate and improve risk assessment of combined exposure to different metals, because it enables determination of key events that are most perturbed by the studied metals and that could be used for bioassays in the future.

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**P-0561**

**Adherence of healthcare providers to WHO management guidelines for malaria in Ijebu Ode, Nigeria**

**Presenter:** Owolabi Emmanuel Sokefun, Covenant University, Ota, Nigeria

**Authors:** O. E. Sokefun<sup>1</sup>, F. T. Afuye<sup>2</sup>, O. A. Onileere<sup>1</sup>, O. A. Folarin<sup>2</sup>;

<sup>1</sup>Covenant University, Ota, NIGERIA, <sup>2</sup>Redeemer's University, Ede, NIGERIA.

**Introduction:** Adherence to malaria treatment guidelines is pivotal to the management and control, and ultimately the actualisation of the eradication agenda in Africa. This study assessed malaria management practices among health care givers in Ijebu Ode community in Ogun State, Nigeria. **Methodology:** Structured questionnaires measuring treatment practices were administered to consenting health care givers in the study area. Responses were scored and compared to national and WHO guidelines for malaria management to measure practice. **Results:** A total of 46 health care givers made up of mostly doctors (54.3%) were enrolled into the study. Presumptive diagnosis (90.5%) was the most reported form of diagnosis while Artemether-Lumefantrine (91.0%) was the most prescribed drug for treating uncomplicated malaria. Sulphadoxine-Pyrimethamine (85.0%) was mostly recommended to pregnant women for intermittent preventive therapy (IPT). Standard dose of SP is given at least twice during the pregnancy. The lack of necessary equipment was reported by 70% respondents as the reason for current management practices. Mean practice score in the study was  $5.28 \pm 1.8$  out of a total obtainable score of 8. Only 59% of study respondents had good practice based on our set threshold of 6 practice points. **Conclusion:** This study has shown fair practice among healthcare officers in the study area but also reveals that 41% of the healthcare providers are yet to meet up with the minimum standard practice for the management of malaria. This therefore necessitates the need for renewed efforts such as education of health care givers to ensure better compliance with guidelines. **Key Words:** Malaria, Malaria Management & Control, Malaria Treatment, World Health Organisation.

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Theme: **Infection microbes immunity**

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**P-0562**

**Temperature and hand, foot and mouth disease in California, 2005-2013, an exploratory analysis**

**Presenter:** Dharshani L. Pearson, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Oakland, United States

**Authors:** D. L. Pearson, R. Basu, X. Wu, K. Ebisu;  
Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Oakland, CA.

Background: Researchers have found that temperature has been associated with hand, foot and mouth disease (HFMD) in Asia. However, few have explored the relationship in the United States, particularly California where HFMD cases have increased recently. Methods: We collected weekly counts of HFMD emergency department (ED) visits in California from 2005 to 2013 and calculated weekly temperature for each of the state's sixteen climate zones using an inverse distance-weighting method for weekly lags 0 to 2. For each season, we conducted a time-series analysis using Poisson regression, adjusting for weekly average relative humidity, average number of HFMD cases in previous weeks and long-term temporal trends. We combined season-specific climate zone estimates to produce an overall estimate for California. Results: We found an increased risk of ED visits for HFMD per 1°F increase in temperature during the same week by 2.00% (95% confidence intervals: 1.15, 2.86) and 2.35% (1.38, 3.33) during the warm and cold season, respectively. The coastal region showed a higher association during the cold season [3.18% (1.99, 4.39)] than the warm season [1.64% (0.47, 2.82)] for weekly lag 0, which may be attributed to the relatively mild winter in the coastal region. Additionally, during the warm season, only weekly lag 0 showed a positive association while weekly lags 0, 1 and 2 remained elevated during the cold season in the all California analysis. Conclusions: Our findings indicated an association between temperature and ED visits for HFMD in California, which varied both seasonally and regionally. The elevated associations for later lags observed in the cold season could indicate a more favorable environment for HFMD pathogens to survive on surfaces and in the air. Because HFMD is a disease that mainly affects children, a group that is already vulnerable to higher temperature, health care providers should be especially aware.

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**P-0564**

**Relationships between meteorological factors and mumps in Jinan, China**

**Presenter:** Ying Zhang, School of Public Health, Faculty of Medicine and Health, University of Sydney, Camperdown, NSW, Australia

**Authors:** S. Lin<sup>1</sup>, S. Ruan<sup>1</sup>, X. Geng<sup>1</sup>, K. Song<sup>1</sup>, L. Cui<sup>1</sup>, X. Liu<sup>1</sup>, Y. Zhang<sup>1</sup>, M. Cao<sup>1</sup>, Y. Zhang<sup>2</sup>;  
<sup>1</sup>Jinan Municipal Center for Disease Control and Prevention, Jinan, CHINA, <sup>2</sup>School of Public Health, Faculty of Medicine and Health, University of Sydney, Camperdown, NSW, AUSTRALIA.

**Background/Aim:** Although vaccination is available, mumps remains a public health concern in many countries including China, where had approximately 260,000 notified cases in 2018. Previous studies have indicated the impact of meteorological factors and mumps, but findings vary across different regions, with limited evidence to inform local public health responses. We aim to examine the impacts of meteorological variables and mumps in Jinan, a temperate city of China.

**Methods:** Weekly meteorological data and notified cases of mumps in Jinan were collected for 2014-2018. Descriptive, correlation and regression analyses using the generalized additive model were performed with considerations of multicollinearity, lag effects, long-term trend and seasonality.

**Results:** A total of 4,141 mumps cases were notified in Jinan during the study period, with peaks in May and June. We found a nonlinear relationship between weekly mean temperature and the number of cases. Between 1.2°C and 24.5°C, the Excess Risk (ER) of mumps for a 1°C increase in weekly mean temperature was 3.39% (95%CI: 1.63% to 5.17%) at 0-week lag. The lagged effects could last for 3 weeks. When relative humidity was above 55%, the ER of mumps for 1% increase in humidity was -1.03% (95%CI: -1.76% to -0.30%) at 0-week lag. We did not find significant impact of wind speed on the risk of mumps.

**Conclusions:** There are non-linear relationships between temperature and relative humidity and mumps in the temperate city of China. Findings could be integrated into current early warning systems for mumps in order to protect people's health from the risks of changing climate.

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**P-0565**

### **A Case-Control Analysis of Traceback Investigations for *Vibrio parahaemolyticus* Infections (Vibriosis) and Pre-harvest Environmental Conditions in Washington State, 2013-2018**

**Presenter:** Benjamin Davis, Exponent, Inc., Washington, United States

**Authors:** B. Davis<sup>1</sup>, Z. Sun<sup>2</sup>, A. E. Corrigan<sup>2</sup>, E. Atherly<sup>3</sup>, A. DePaola<sup>4</sup>, F. C. Curriero<sup>2</sup>;

<sup>1</sup>Exponent, Inc., Washington, DC, <sup>2</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD,

<sup>3</sup>Washington State Department of Health, Olympia, WA, <sup>4</sup>Angelo DePaola Consulting, Coden, AL.

**Background/Aim:** *Vibrio parahaemolyticus* is a major cause of seafood-borne illness. It is naturally prevalent in brackish waters and accumulates in shellfish. Vibriosis cases are rising globally, likely due to warming temperatures. We aimed to identify pre-harvest risk factors of vibriosis in Washington State using environmental and genetic variables sampled from shellfish. **Methods:** Successful traceback investigations of vibriosis were spatiotemporally matched to routine intertidal oyster (*Crassostrea gigas*) sampling events, which included measurements of temperature, salinity, and *V. parahaemolyticus* genetic targets. Remaining sampling events were treated as controls. Ecological variable importance was assessed using logistic regression models. **Results:** Systematic differences were observed across Washington harvesting zones. These included positive associations between the odds of vibriosis and genetic targets in South Puget Sound, with a particularly high odds ratio (OR) = 13.0 (95% CI: 1.5, 115.0) for a 1- $\log_{10}$  increase in the *tdh* pathogenic marker when total bacterium abundance was low ( $<1 \log_{10}$ ). A positive association also occurred for a 1°C increase in tissue temperature OR=1.20 (95% CI: 1.10, 1.30) while a negative association occurred for a similar increase in water temperature OR= 0.70 (95% CI: 0.59, 0.81). The coastal bays displayed positive associations for water temperature OR= 2.16 (95% CI: 1.15, 4.05), and for a 1- $\log_{10}$  increase in the *tdh:trh* pathogenic marker ratio OR= 5.85 (95% CI: 1.06, 32.26). **Conclusions:** The zonal variation in associations indicates unique pathogenic strain prominence, suggesting *tdh+/trh+* strains in South Puget Sound, such as the O4:K12 serotype, and *tdh+/trh-* strains in the coastal bays. The temperature discrepancy between water and oyster tissue suggests that South Puget Sound pathogenic strains flourish with exposure to relatively warm air during low tide. These findings identify new ecological risk factors for vibriosis in Washington State that can be used in future prevention efforts.

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**P-0566**

### **Exposure to Environmental Chemical Mixtures is Associated with Nasal Colonization by Staphylococcus aureus: NHANES 2001-2004**

**Presenter:** Shoshannah Eggers, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** S. Eggers<sup>1</sup>, C. Gennings<sup>1</sup>, K. M. Malecki<sup>2</sup>, N. Safdar<sup>2</sup>, M. Arora<sup>1</sup>;

<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>University of Wisconsin School of Medicine and Public Health, Madison, WI.

**Background:** Understanding the health effects of exposure to chemical mixtures is critical given the broad range of concurrent exposures throughout the life-course. While investigations of environmental chemicals and components of the human microbiome are becoming more common, few have examined associations with chemical mixtures. This study assesses the association between exposure to mixtures of 66 different environmental chemicals and nasal colonization of Staphylococcus aureus (SA) and methicillin resistant SA (MRSA).

**Methods:** Data came from the National Health and Nutrition Examination Survey (NHANES) 2001-2004. The analytical sample consists of 10,312 participants, subdivided into 8 different chemical mixture groups. Within each of 6 chemical classes (metals, phthalates, polycyclic aromatic hydrocarbons (PAHs), polybrominated diphenyl ethers (PBDEs), polyfluorochemicals (PFCs), and phenols), weighted quantile sum (WQS) regression was used to analyze the joint association of the component compounds and nasal SA colonization. WQS was also used to assess the joint association of 3 chemical mixtures (metals, metal and PAHs, and metal and triclosan) and nasal MRSA colonization. All regression models were adjusted for confounders. **Results:** The analytical sample was between ages 6-85, slightly more female, and predominantly non-smokers. Prevalence of SA carriage was 29.2%, and MRSA colonization prevalence was 1.2%. Within each chemical class, odds of SA colonization increased significantly with exposure to mixtures of metals (OR = 1.11, 95% CI = 1.02-1.20), phthalates (OR = 1.09, 95% CI = 1.04-1.14), and phenols (OR = 1.08, 95% CI = 1.01-1.15). Exposure to a mixture of metals combined with PAHs was also associated with increased odds of MRSA carriage (OR=1.38, 95% CI = 1.02-1.86).

**Conclusion:** Results indicate an association between multiple environmental chemical mixtures and SA colonization, including MRSA. These findings support the need for further analysis of associations between chemical mixtures and SA colonization, as well as other components of the human microbiome.

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**P-0567**

**Awareness of Dengue hemorrhagic fever and Dengue shock syndrome: A cross-sectional survey**

**Presenter:** Welera Haissou Elodie, Southern Medical University, Nanfang Hospital, Guangzhou, China

**Authors:** W. Elodie, F. Zhi;  
Southern Medical University, Nanfang Hospital, Guangzhou, CHINA.

**Abstract Objectives:** Dengue Shock Syndrome (DSS) is known as the final stage of the critical episode of Dengue Hemorrhagic Fever (DHF). That probability of getting DHF, which can progress into DSS, is very higher for patients who contracted dengue more than once. The lack of public awareness can lead to the complications of the disease. We conducted a public survey to assess the awareness of the disease in the foreigners residing in Guangzhou, China. **Methods:** In October/November 2019, we conducted a cross-sectional survey with structured questionnaires in 987 foreigners residing in Guangzhou aged 18 and over 40 years old regarding their understanding of DHF and DSS. **Results:** DHF and DSS were never heard in 81% and 85% (group A), respectively, whereas 16% and 15% had already heard about the disease (group B). Only 3% and 0% of the participants dealt with DHF and DSS, respectively (group C). Among provided options of the potential form of disease transmission, participants of group C associated DHF and DSS with the mosquito bite in 96% and 89%, respectively. Of 987 participants, 52% and 45% for DHF and DSS respectively don't know the form of disease transmission. Overall, 19% and 15% of the participants affirmed to be familiarized on DHF and DSS and correctly associated these diseases with a mosquito bite. **Conclusions:** The aforementioned denotes the first study on public awareness of the Dengue Shock Syndrome and Dengue Hemorrhagic Fever regarding foreigners living in Guangzhou. We believe that the lack of knowledge caused by language barriers concerning these diseases may considerably impact the outcome and health economic consequences of Dengue fever. **Key words:** Dengue, Dengue hemorrhagic fever, Dengue shock syndrome, Awareness, Guangzhou, Severe abdominal pain, Painful muscles and joints.

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**P-0568**

**Benzophenone-3 and prevalence of antinuclear antibodies in adolescents and adults ages 12-39 in the U.S. population**

**Presenter:** Christine G Parks, NIEHS, Durham, United States

**Authors:** C. G. Parks<sup>1</sup>, H. C. Meier<sup>2</sup>, F. W. Miller<sup>1</sup>, D. P. Sandler<sup>1</sup>;

<sup>1</sup>NIEHS, Durham, NC, <sup>2</sup>Joseph J Zilber School of Public Health, University of Wisconsin, Milwaukee, NC.

Background: Prevalence of antinuclear antibodies (ANA), a marker of systemic autoimmunity, is increasing in the general population, especially among adolescents and non-Hispanic whites. A female predominance of ANA and autoimmunity suggests a role for hormonal exposures. Benzophenone-3 (BP3) is an endocrine disruptor found in sunscreen and personal care products, with widespread exposures, especially in whites and females. We examined the association of ANA with BP3 in a national sample of U.S. adolescents and young adults. Methods: In 1,941 participants ages 12-39 in the National Health and Nutrition Examination Survey (NHANES; 2003-4, 2011-12), including 214 ANA-positive individuals, we conducted cross-sectional analyses of ANA in relation to urinary BP3 (detected in >98.5% of the sample). Prevalence Odds Ratios (OR) and 95% Confidence Intervals (CI) were calculated by logistic regression, adjusting for sampling variables, urinary creatinine, age, sex, race/ethnicity, body mass index, smoking, and education. Models were stratified by season because NHANES data collection varies geographically by season and sunscreen is often seasonally applied. Results: ANA prevalence was higher in females but did not vary by age, race/ethnicity, season, or serum vitamin D3 levels. In models of log-transformed BP3, an association with ANA was seen in the winter (Oct-April OR 1.58; 95%CI 1.14-2.17) but not the summer (OR 0.87; 95%CI 0.58, 1.30), a multiplicative interaction ( $p=0.038$ ). The association of BP3 with ANA in the winter was most apparent in females (OR 1.78; 95%CI 1.23, 2.59), but did not appear to vary by race/ethnicity. Conclusions: Individuals with elevated BP3 levels in the winter had greater odds of being ANA positive, but a similar pattern was not seen in the summer. These differences warrant further exploration, also considering potential indicators of longer term BP3 exposure (e.g., sunscreen use) and related factors such as other sun exposure and protective behaviors, measured phenols and parabens.

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**P-0569**

**Yellow fever outbreak investigation in Mgbakwu, Awka North Local Government Area (LGA), Anambra State, Southeast Nigeria - Entomological perspective.**

**Presenter:** Samuel Amifofum Owoicho, NFELTP, Abuja, Nigeria

**Authors:** S. A. Owoicho;  
NFELTP, Abuja, NIGERIA.

Background: Nigeria has reported cases of Yellow fever (YF) since 2017. Cases have been confirmed in at least 18 states, including the capital, Abuja. The disease is mostly transmitted by mosquitoes of the *Aedes* genus. We determined the risk of transmission of YF in Dunokofia, Awka-North and Awka-South Local Government Areas. Method: We conducted a baseline study to establish presence of the vectors and risk of the disease transmission in one community each of the three LGAs (Dunokofia, AwkaNorth and Awka-South) of Anambra State. We used major mosquito sampling methods – ovitrapping, larval survey, human landing catch and light trapping – to ascertain the biting and breeding behavior of the vector. We collected samples day and night. We identified adult collections right in the field using standard identification keys, while immature stages were reared to adults for proper identification. Results: A total of 1,014 mosquitoes were collected in the study. Of these, 72 (7.1%) were YF non-related vectors while *Aedes* species (*Ae. aegypti*, *Ae. albopictus*, *Ae. circumluteolus* and *Ae. simpsoni* complex) accounted for 942 (92.9%). *Aedes albopictus*, 478 (50.7%) and *Aedes aegypti*, 461 (49%) were predominant across all locations surveyed. The House Index ranged from 60-80% while the Breteau Index ranged from 75-131, across all sites. No *Aedes* mosquito was collected indoors. Conclusion: The high larval indices, abundance and diversity of the vectors across the study locations make them high-risk areas for transmission of the disease. This is underscored by the YF outbreak in Awka-North LGA and the large number of primates in the study area. There was Immediate reactive mass vaccination in the affected State. Residual treatment of discarded containers, as well as massive community sensitization and mobilization on larval source reduction, to reduce vector density in the study area were recommended and initiated.

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**P-0570**

**Identification of Ross River virus hot spots along urban fringes of South East Queensland, Australia**

**Presenter:** Amanda K. Murphy, QIMR Berghofer Medical Research Institute, Brisbane, Queensland, Australia

**Authors:** A. K. Murphy<sup>1</sup>, J. A. Clennon<sup>2</sup>, G. Vazquez-Prokopec<sup>2</sup>, C. C. Jansen<sup>3</sup>, F. D. Frentiu<sup>4</sup>, L. M. Hafner<sup>4</sup>, W. Hu<sup>4</sup>, G. J. Devine<sup>1</sup>;

<sup>1</sup>QIMR Berghofer Medical Research Institute, Brisbane, Queensland, AUSTRALIA, <sup>2</sup>Emory University, Atlanta, GA, <sup>3</sup>Communicable Diseases Branch, Queensland Health, Brisbane, Queensland, AUSTRALIA,

<sup>4</sup>Queensland University of Technology, Brisbane, Queensland, AUSTRALIA.

Background/Aim: Ross River virus (RRV) is responsible for the most common vector-borne disease of humans reported in Australia. The virus circulates in enzootic cycles between multiple species of mosquitoes, wildlife reservoir hosts and humans. Despite regular outbreaks, ongoing morbidity and substantial economic costs, the underlying determinants of epidemics remain unclear. Public health concern about RRV has recently increased due to rising incidence rates in Australian urban centres, along with increased circulation in Pacific Island countries. We aimed to provide a detailed analysis of disease trends and explore potential links between disease patterns and transmission pathways of RRV. Methods: We assessed the spatial and temporal distribution of notified RRV cases, and associated epidemiological features in south east Queensland, Australia, from 2001-2016. This included fine-scale analysis of disease patterns across the suburbs of the endemic capital city of Brisbane, and those of 8 adjacent Local Government Areas. Results: The mean annual incidence rate for the region was 41/100,000 with a consistent seasonal peak between February and May. The highest RRV incidence was in adults aged from 30-64 years (mean incidence rate: 59/100,000), and females had higher incidence rates than males (mean incidence rates: 44/100,000 and 34/100,000, respectively). Spatial patterns of disease were heterogeneous between years, and there was a wide distribution of disease across both urban and rural areas of SEQ. Overall, the highest incidence rates were reported from predominantly rural suburbs to the north of Brisbane City, with significant hot spots located in peri-urban suburbs where residential, agricultural and conserved natural land use types intersect. Conclusions: Although RRV is endemic across all of SEQ, transmission is most concentrated in areas where urban and peri-urban environments intersect. The drivers of RRV transmission across rural-urban landscapes should be prioritised for further investigation, including identification of specific vectors and hosts that mediate human spillover.

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**P-0571**

**changes of diarrhea in rural areas of huaihe river basin**

**Presenter:** Han Zhang, Chinese Research Academy of Environmental Sciences, Beijing, China

**Authors:** H. Zhang, Z. Lv, J. Zhang;  
Chinese Research Academy of Environmental Sciences, Beijing, CHINA.

Background/Aim diarrhea is a group of digestive tract diseases caused by multiple pathogens and multiple factors. it has the characteristics of rapid transmission and wide epidemic range, and causes a heavy disease burden worldwide every year. the huaihe river basin has the highest population density of all the major rivers. in order to investigate the epidemic situation, related risk factors and changes of diarrhea among rural residents, scientific basis was provided for the prevention and control of diarrhea. Methods a diarrhea study was conducted with 13484 subjects from 2007 to 2008 and from 2015 to 2018, using the same questionnaire. Results the incidence of diarrhea in rural areas of huaihe river basin was 0.765 episodes per person-year from 2007 to 2008, which increased by 0.505 times per person per year from 2015 to 2018. the incidence of diarrhea was influenced by the highest temperature and precipitation at 20-20 hours. the risk factors included not washing hands before meal, having mouldy food, drinking no-tap-water, and water jar use in 2007~2008. the risk factors included having mouldy food and drinking no-boiled-water in 2015~2018. in multivariate analysis, having fresh staples, having tap water, and no water jar use were associated with lower diarrhea risk significantly in 2007~2008. in multivariate analysis, having mouldy fruits and vegetables and drinking unboiled water were associated with diarrhea risk significantly in 2015~2018. Conclusions the incidence of diarrhea is increasing in rural areas of huaihe river basin compared with ten years ago. the hazard factors changed and varied in each district and county. the eating and drinking habits play an important in the process of the onset of diarrhea. the rural water supply project should be centralized in order to ensure the safety of rural drinking water, while strengthening the health education and promoting the sanitation of household water use.

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**P-0572**

**Microorganisms as Biocontrol Agents: A Panacea to Chemically Polluted Environment**

**Presenter:** Bukola Temitope Fabunmi, Achievers University Owo, Ondo State, Nigeria

**Authors:** B. T. Fabunmi<sup>1</sup>, G. O. Ambrose<sup>2</sup>;

<sup>1</sup>Achievers University Owo, Ondo State, NIGERIA, <sup>2</sup>University of Ilorin, Kwara State, NIGERIA.

Abstract Microorganisms are the occupants and architect of the biosphere maintaining metabolic cycles essential for life processes. They are the oldest and most abundant natural resource of important products to man. The aim of the study was to explore bacteria groups associated with agricultural plantation and waste as biocontrol agents. Bacteria were isolated following standard procedures from kolanut plantation soil and kolanut waste. The isolates were identified using molecular techniques and Sanger sequencing was employed to detect labeled chain-terminating nucleotides that are incorporated by DNA polymerase during replication of the templates. The pathogenicity of the isolates was determined according to laid down methods. The genera of bacteria identified include; Bacillus, Enterobacter, Citrobacter, Klebsiella, Pseudomonas, Marinobacter, Staphylococcus, Lysinibacillus and Providencia. Although some of the isolated microbes are pathogens, most of them are harmless and even beneficial as biocontrol agents. There is a strong correlation between the environment and the human health. It is thus paramount to exploit microbes as biocontrol agents in place of synthetic chemical products used by farmers, which is detrimental to man's health and the entire ecosystem at large. **KEY WORDS:** Biocontrol agents, Kolanut, Synthetic chemicals, Environment, Microorganisms

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**P-0573**

**Tracking the epidemiology of Parasitic Diseases Research in Palestine: Challenges and Limitations**

**Presenter:** Adnan I Alhindi, Islamic University of Gaza, Gaza, Palestinian Territory

**Authors:** A. I. Alhindi;  
Islamic University of Gaza, Gaza, PALESTINIAN TERRITORY.

**Title:** Tracking the epidemiology of Parasitic Diseases Research in Palestine: Challenges and Limitations  
**Background:** Doing scientific/epidemiological research in Palestine is so difficult due to the un-stable conditions especially in Gaza Strip where it is under siege. Parasitic diseases are one of the health problems in Gaza Strip especially Intestinal parasites which is endemic in the area. **Objectives:** The study aimed to track the epidemiology of Parasitic Diseases Research in Palestine, to determine the gaps in this area and determine the challenges and limitations facing this type of research. **Methods:** We tracked the publications/studies carried out in Palestine using the databases (PubMed, Medline) and using focusing groups of experts. **Results:** The results of the study indicated that the epidemiology of parasitic diseases focuses on the prevalence, diagnostic techniques, association with environment, malnutrition, drinking water but no systematic reviews regarding this branch of research. **Key words:** Epidemiology, Environmental, research, challenges, Palestine, Gaza West Bank.

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**P-0574**

**Geographic variation in the oral microbiome of NIH-AARP Diet and Health Study Participants**

**Presenter:** Ian D Buller, National Cancer Institute, Rockville, United States

**Authors:** I. D. Buller, E. Vogtmann, M. H. Ward, C. Abnet, R. Sinha, L. Liao, Y. Wan, M. H. Gail, R. R. Jones;  
National Cancer Institute, Rockville, MD.

Background Geographic location of individuals may partially explain heterogeneity in the composition of their microbiota, but studies are limited. Methods We evaluated the spatial variation of oral microbial communities in a subset of participants in the NIH-AARP Diet and Health Study, a cohort of men and women aged 50-71 years. Geocoded addresses were available and buccal cell specimens collected 2005-2006 were analyzed using 16S rRNA gene sequencing. We compared richness of observed species (rarefaction: 20,000 reads) within and between six states (California, Florida, Pennsylvania, New Jersey, North Carolina, Louisiana; n=2,119) and 16 metropolitan areas (Atlanta, Charlotte, Detroit, Fort Lauderdale, Jacksonville, Los Angeles, New Brunswick, New Orleans, Orlando, Philadelphia, Pittsburgh, Raleigh, Sacramento, San Diego, San Francisco, Tampa; n=1,817) in which participants resided. We evaluated differences using intraclass correlation coefficients (ICC), a measure of spatial clustering (Moran's I), and non-spatial linear models including age, sex, and smoking status as covariates. We also evaluated the relationship of Euclidean distance between participants and beta diversity using an index of overall community composition (a Bray-Curtis dissimilarity matrix; BCD; rarefaction: 20,000 reads) with the Mantel statistic (999 simulations) based on Pearson's correlation (r). Results Species richness varied more within than between states (ICC=0.016; 95% CI:-0.01-0.041), but no spatial autocorrelation was observed at the state level. Species richness varied more within than between cities (ICC=0.015; 95% CI:-0.003-0.033) with positive spatial autocorrelation observed within Sacramento (I=0.044; p=0.042; n=93) and negative within Philadelphia (I=-0.031; p=0.022; n=238). Residuals were spatially autocorrelated in Philadelphia (p=0.025), suggesting variation was best explained by a spatial model. BCD was significantly correlated within Charlotte (r=0.184; p=0.016; n=35) and New Orleans (r=0.266; p=0.019; n=29). Conclusions We demonstrated spatial variation in the oral microbiota of NIH-AARP participants within U.S. cities but not states, suggesting the importance of spatial scale for future analyses.

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## ABSTRACT E-BOOK

Theme: **Infection microbes immunity**

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**P-0575**

**Intestinal Parasitism and Associated Risks in a University Dining Hall Food Handlers**

**Presenter:** Wondwossen Birke, Jimma University, Jimma, Ethiopia

**Authors:** W. Desalegn, W. Birke, T. Teshome, K. Bacha;  
Jimma University, Jimma, ETHIOPIA.

### Background

Various studies have addressed the relationship between intestinal parasitism and associated risk factors in food handlers. Very few studies have done in Ethiopia in general and none exist in Wachemo town, Southern Ethiopia. The present study aimed to investigate intestinal parasitic infections and related risks among food handlers of Wachemo University students' cafeteria.

### Methods

Institution-based cross-sectional study was conducted on 212 randomly selected food handlers from February-March, 2019. Structured and pre-tested questionnaire was used to collect data on socio-demographic and related risk factors. Standard laboratory procedures were employed to collect stool and finger specimens and analyzed for intestinal parasites using standard methods. The data were entered into a computer, edited and analyzed using SPSS for windows version 20.0. Stepwise logistic regression model was used to calculate the Odds ratios and 95% confidence interval for the different risk factors.

### Results

From 212, the majority 63.7 % were females and 48.1% attended grades 9-10. Of the stool and finger nail specimens examined, about 29.7 % and 5.6% were positive for different parasites, respectively. The most prevalent parasite is *Ascaris lumbricoides* (12.7%) followed by Hookworms (6.6%), *Giardia lamblia* (4.7%), *Taenia saginata* (2.4%), and Mixed infection (3.3%). Although several factors showed significant association with intestinal parasitism on bivariate analysis, sex, education, finger nail status and hand washing with soap and water after toilet use were the only significant variables on multivariate analysis ( $P < 0.05$ ).

### Conclusions

Though prevalence of intestinal parasites among food handlers is moderate, still appropriate intervention programmes need to be formulated focused on identified risk factors to avoid further infection transmission to students and the general population.

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**P-0577**

**Risk Factors associated with Dengue Fever Outbreak in Dire Dawa Administration City, Ethiopia, October, 2015**

**Presenter:** Luna Habtamu Degife, Ethiopian Public Health Institute, Addis Ababa, Ethiopia

**Authors:** L. H. Degife<sup>1</sup>, Y. Worku<sup>2</sup>, D. Belay<sup>1</sup>, A. Bekele<sup>1</sup>, Z. Hailemariam<sup>3</sup>;

<sup>1</sup>Ethiopian Public Health Institute, Addis Ababa, ETHIOPIA, <sup>2</sup>Saint Paul's Millennium Medical College, Addis Ababa, ETHIOPIA, <sup>3</sup>Ethiopian Field Epidemiology and Laboratory Program, Addis Ababa, ETHIOPIA.

Background: Dengue Fever is under recognized mosquito borne viral disease prevalent in tropical and subtropical regions. In 2013, Ethiopia reported the first Dengue outbreak in Dire Dawa city which affected 11,409 people. On October 3/2015, five suspected serum samples from Dire Dawa were confirmed positive for Dengue at national laboratory. We investigated to determine associated risk factors and implement control measures. Methods: We conducted a 1:2 un-matched case control study from October 7-15/2015. Case was any person with fever of 2-7 days and more than two symptoms: headache, arthralgia, myalgia, rash, or bleeding from any part of the body. We recruited participants using purposive sampling from health facilities in Dire Dawa and used structured questionnaire to collect data. Multivariable logistic regression analysis was conducted to identify risk factors. Sixty-nine serum-samples were tested by Enzyme-Linked Immunosorbent Assay (ELISA). Results: We enrolled 210 participants (70 cases and 140 controls) in the study. Females accounted for 51.4% of cases and 57.1% of controls. The mean age was 23.7±9.5 standard deviation (SD) for cases and 31.2±13 SD for controls. Close contact with Dengue patient (Adjusted odds ratio (AOR) =5.36, 95% confidence interval (CI): 2.75-10.44), nonuse of bed-nets (AOR=2.74, 95% CI: 1.06-7.08) and stagnant water around the village (AOR=3.61, 95% CI: 1.31-9.93) were independent risk factors. From the samples tested, 42 were confirmed positive. Conclusions: Individuals who live with Dengue Fever patient, around stagnant water and do not use bed nets are at high risk of contracting the disease. Health education on Dengue prevention was given and mosquito breeding sites were drained. Strong vector prevention strategies are recommended by enhancing the existing malaria prevention and control program. Key Words: Dengue Fever, Dire Dawa, Outbreak, Risk factors.

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**P-0578**

### **Applying NASA Satellite Data to Examine Emerging One Health Threats: Going Beyond Traditional Epidemiologic Methods**

**Presenter:** Helena J Chapman, NASA Headquarters, Washington, United States

**Authors:** H. J. Chapman<sup>1</sup>, S. M. Estes<sup>2</sup>, J. A. Haynes<sup>1</sup>;

<sup>1</sup>NASA Headquarters, Washington, DC, <sup>2</sup>University of Alabama in Huntsville, Huntsville, AL.

Emerging environmental health threats, such as exposure to air pollutants, extreme temperatures, and infectious pathogens, directly affect human and animal health. These exposures can affect morbidity and mortality rates as a result of increased risk of developing acute or chronic illnesses. The World Health Organization has quantified the direct human impact of these environmental risks, including living or working in unhealthy environments (12.6 million deaths), vector-borne disease transmission (700,000 deaths), and ambient and household air pollution (6.5 million deaths). In order to advance future environmental health research applications and field interventions, traditional epidemiologic methods must be integrated with innovative approaches that encourage cross-cutting One Health topics and foster transdisciplinary collaborations. One innovative approach highlights the value of integrating NASA Earth-observing satellite data (e.g. chlorophyll, nitrogen dioxide, surface temperature, vegetation) into traditional research methods. Scientists and stakeholders can analyze these data of public health importance and examine associations between variables, identify disease or vector hotspots, and forecast real-time environmental exposure levels. These efforts can alert health authorities and inform their health decision-making for policy and public health recommendations. In this paper, we will define the One Health concept as a holistic view of environmental health research applications, as they relate to aquatic, atmospheric, and terrestrial ecosystems. We will describe the need to integrate innovative approaches to traditional epidemiologic methods and practices, focusing on the value of satellite data to closely examine the impact of an array of environmental exposures. We will present three examples that exemplify how satellite data can advance scientific knowledge, strengthen communication with stakeholders and decision-makers, and support policy decision-making and practice guidelines. These novel approaches have the potential to strengthen global health systems, foster innovation in environmental health research applications, and reinforce capacity building for the global health workforce.

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**P-0579**

### **Onchocerciasis Transmission and Prevention Knowledge, Attitude and Practices among Rural Ethiopian Families**

**Presenter:** Wondwossen Birke, Jimma University, Jimma, Ethiopia

**Authors:** D. Kebede, S. Assegid, A. Atomsa, W. Birke;  
Jimma University, Jimma, ETHIOPIA.

#### Background

Currently about 10 million Ethiopians are at risk of onchocerciasis and 3 million are infected. The disease burden is still expand and treatment coverage is widely different from district to district, in which disparities directly linked with the community knowledge, attitude, and practice (KAP) about the disease. This study is aimed to assess KAP of families on onchocerciasis transmission & prevention in Gambella district, Gambella region, Southwest Ethiopia.

#### Methods

A community based cross-sectional survey supported by in-depth interview and health facility assessment was conducted in 13 kebeles/sites of the district from February-March, 2018. Data were gathered using structured and standardized questionnaires. EPI DATA and SPSS software's version 20 were used for data entry and analysis, respectively. Qualitative data had been transcribed and summarized manually.

#### Results

A total of 692 families were participated in the study. Majority 92.8% of them heard about the disease. Only 5.1% knew causative agent and 4% correctly responded to the disease outcome. However, 76.8% respondents were confident that the disease is preventable of which 72.2% stressed the use of preventive drugs. Finally, 40.4%, 58.8%, 0.8% participants were categorized as poor, fair, good with regard to their knowledge. About 56.9% participants had fair attitude and 43.1% had favorable (good) attitude, and 17.2%, 71.1%, 11.7% categorized as poor, moderate and good practices, respectively.

#### Conclusions

KAP on the correct causative agent, mode of transmission, potential sign/symptoms, possible outcomes and prevention of onchocerciasis were still far from sufficient level which were mixed with conspicuous misconceptions in all issues. Hence health education, administrative and financial shortcomings need to be solved and maintained by relevant local authorities.

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**P-0580**

**Cow Stables Accommodate More Diverse Airborne Bacterial Communities Than Pig Stables.**

**Presenter:** Hesham Amin Abouelhana, University of Bergen, Bergen, Norway

**Authors:** H. Amin Abouelhana<sup>1</sup>, I. Marshall<sup>2</sup>, V. Schlünssen<sup>2</sup>, T. Sigsgaard<sup>2</sup>, R. J Bertelsen<sup>1</sup>, K. Finster<sup>2</sup>, G. Holst<sup>2</sup>, T. Santl-temkiv<sup>2</sup>, D. V. Vestergaard<sup>2</sup>;

<sup>1</sup>University of Bergen, Bergen, NORWAY, <sup>2</sup>Aarhus University, Aarhus, DENMARK.

**Background** A considerable number of research publications indicate that growing up on a farm and possibly also farm exposure in adulthood reduces the risk of asthma and allergies. Contact with livestock, mostly cow and pigs, and increased airborne microbial exposure has been suggested to play a role in this association. **Aim** This study aims at determining the differences in the composition of the indoor airborne bacterial communities between cow and pig stables as well as between farmers' and suburban homes. **Methods** We sampled settled airborne dust using electrostatic dust collectors from Danish cow stables, pig stables, associated farmers' homes, and from suburban homes and carried out MiSeq sequencing of the V3-V4 region of bacterial 16S rRNA genes isolated from these samples. **Results** In terms of richness, cow farmer's homes had the highest bacterial richness followed by cow stables and pig farmers' homes. All these differences in richness were significant ( $P < 0.001$ ). Family-level classification showed Staphylococcaceae abundant in cow stables and cow farmer's homes. Furthermore, specific bacterial taxa that have previously been suggested to contribute asthma protective effects such as Firmicutes and Lactobacillus were more abundant in livestock stables and farmers' homes than suburban homes. **Conclusion** People living on farms are exposed to a wider range of microbes and this exposure might contribute to explain the inverse relationship between farm living and asthma risk. Moreover, cow stables harbor a wider range of microbes than pig stables which might provide higher protection towards asthma and atopy. Our finding is in the line with previous epidemiological studies showing that growing up in cattle farms reduces the risk of asthma, hay fever, and atopic sensitization more so than living on the pig farms.

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**P-0581**

**Factors influencing hand-foot-mouth disease across 13 provinces of the Mekong Delta region, Vietnam**

**Presenter:** Nguyen Xuan Huong, Da Nang University of Medical Technology and Pharmacy, Da Nang, Viet Nam

**Authors:** N. X. Huong<sup>1</sup>, P. T. Dung<sup>2</sup>, N. T. Huong<sup>3</sup>, C. Chu<sup>2</sup>;

<sup>1</sup>Da Nang University of Medical Technology and Pharmacy, Da Nang, VIET NAM, <sup>2</sup>Griffith University, Brisbane, AUSTRALIA, <sup>3</sup>Health Environment Management Agency, Ministry of Health, Vietnam, Ha Noi, VIET NAM.

Background: Hand-foot-mouth disease (HFMD) is an emerging infectious disease spreading rapidly in the Western Pacific Region, including Vietnam. However, few studies have focused on identifying factors influencing HFMD, which is necessary for prevention and control. This study aims to examine the potential factors influencing HFMD in Vietnam. Methods: Weekly reported cases of HFMD and hydro-meteorological data were collected from 13 provinces of the Mekong Delta Region (MDR), Vietnam, from 2013 to 2016. Ten socio-economic and health-related factors were extracted from the Statistics Yearbook of Vietnam in 2014. First, generalised linear models were used to analyse the influences of climatic factors on HFMD in each province. Second, random-effect meta-analysis was used to analyse the estimated effects of these climate factors for the whole MDR. Third, spatial autoregressive models were used to examine the effects of the ten influencing factors on HFMD. Results: There were 102,567 HFMD cases reported from 2013 to 2016 in the MDR. Temperature and humidity were statistically positively associated with HFMD at all 3 weeks lag, whereas, rainfall was only statistically positively associated with HFMD at the same week. Two out of ten socio-economic and health-related factors were identified as having the most influence on HFMD: percentage of children under 1 year old having full immunisation, and percentage of houses with access to clean water. The modification effects of these two factors on the climate-HFMD associations were found to be contrary. Significant differences in higher/lower groups for the temperature/humidity-HFMD associations were found, while the rainfall-HFMD associations were only slightly different between the high and low provinces for these two modifying factors. Conclusions: Three climate factors and two socio-economic and health-related factors were found to influence HFMD in Vietnam. These findings are useful for public health in the efforts to improve HFMD prevention and control in a changing climate.

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## ABSTRACT E-BOOK

Theme: **Infection microbes immunity**

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**P-0582**

**2019 Dengue epidemic in Côte d'Ivoire**

**Presenter:** AMA KOUNANGUI MARIE NOELLE ANO, NATIONAL INSTITUT OF PUBLIC HEALTH, ABIDJAN, Côte D'Ivoire

**Authors:** A. ANO, J. Bénie, D. Coulibaly, K. Ekra, B. Akani, E. Ahoussou, I. Tiembré, N. Dagnan, M. Dosso; NATIONAL INSTITUT OF PUBLIC HEALTH, ABIDJAN, CÔTE D'IVOIRE.

**Context**Dengue fever represents a public health problem. Côte d'Ivoire has experienced recurrent epidemics of dengue fever over the past three decades.  
**Goal**Describe the dengue epidemic that occurred in Côte d'Ivoire in 2019.  
**Method**This is a retrospective study, going from January to December 2019, on all cases meeting the case definition of dengue having been collected and sent to the reference laboratory Pacteur Institut of Côte d'Ivoire (IPCI).  
**Results**A total of 3265 new suspected cases were declared, including 291 confirmed cases with the DEN 1, 3 serotypes which were represented.All health districts in Abidjan have reported suspected and confirmed cases, and Cocody-Bingerville was the epicenter of the epidemic. The epidemic began during the dry season (S 9) with major outbreaks during the rainy season (S 29). All suspected suspected cases were sampled and sent to the reference laboratory (IPCI) for confirmation. And 25% of the cases were children from 1 to 14 years old with a sex ratio of two women to one man. The mono-specific batches formed for viral research have confirmed the presence of *Aedes aegypti* in the majority of cases present in used tires and abandoned vehicles. With a statistically significant link between the presence of these deposits and the reservoir.  
**Conclusion**The dengue epidemic that occurred in Côte d'Ivoire in 2019 concerned the DEN type serotype (1 and 3) and the number of cases increased during the rainy season and sporadic cases during the dry season and the *Aedes aegypti* was represented in the majority of cases.

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**P-0584**

### **Occurrence of Multidrug Resistant Escherichia coli O157: H7 from Human and Raw Bovine Meat Sources in Southern Nigeria and its Public Health Implications**

**Presenter:** Rine Christopher Reuben, Jashore University of Science and Technology, Jashore, Bangladesh

**Authors:** J. F. Nfongeh<sup>1</sup>, R. C. Reuben<sup>2</sup>;

<sup>1</sup>Federal University Lafia, Lafia, NIGERIA, <sup>2</sup>Jashore University of Science and Technology, Jashore, BANGLADESH.

**Background/Aim:** Escherichia coli O157: H7 remains a major foodborne pathogen of immense public health concern in most countries of the world. It is easily transmitted to humans through the consumption of contaminated bovine meats and meat products. This cross-sectional study aimed at evaluating the risk factors and antibiogram profiles of E. coli O157: H7 from human and bovine meat from selected households in southern Nigeria.

**Methods:** A total of 360 and 366 fresh household bovine meat and stools (diarrheal and non-diarrheal) samples respectively were collected. E. coli O157: H7 was isolated, identified and evaluated for antimicrobial resistance using standard microbiological methods.

**Results:** From bovine meat, E. coli O157: H7 was detected in 21.11% (76/360) of the samples examined while 19.13% (70/366) and 1.37% (5/366) of diarrhea and non-diarrheic stool samples were also positive for E. coli O157: H7. There was a significant difference ( $P < 0.05$ ) between the prevalence E. coli O157: H7 among diarrhea and non-diarrhea stool samples. Risk factors such as age range, parents/guardian occupation, and domestic water source were observed to significantly ( $P < 0.05$ ) determine the prevalence of the pathogen in children. All the E. coli O157: H7 isolates were resistant to multiple antibiotics with 88.6% and 77.1% to tetracycline and cotrimoxazole from diarrhoeal isolates and 77.64 and 7.58% to tetracycline and cotrimoxazole from bovine meat isolates.

**Conclusion:** Bovine meat and some human and environmental factors play a vital role in the establishment of E. coli O157: H7 infection in humans, hence the need for continuous surveillance of this pathogen and implementation of legislation against the indiscriminate use of antibiotics.

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**P-0585**

**Open-defecation and Attainment of SDG Six - Evidence from Kintampo Health and Demographic Surveillance System in Ghana**

**Presenter:** Sulemana W Abubakari, Kintampo Health Research Centre, Kintampo, Ghana

**Authors:** S. W. Abubakari;  
Kintampo Health Research Centre, Kintampo, GHANA.

**Background**The Sustainable Development Goal (SDG) six partly targets at ending open defecation (OD) by 2030. It is essential to assess progress towards this target in sub-Saharan Africa (SSA) where the sanitation target of the Millennium Development Goal (MDG) was largely not achieved. About 215 million people are involved in OD in SSA. In Ghana, it is estimated that three out of five Ghanaians practice OD. This study examined whether the OD free target is achievable by 2030.**Method**This study used longitudinal health and demographic surveillance data from two districts in Kintampo. Data were collected from household heads or their representatives over a 12-year period. In an exploratory analysis, the correlation between total number of households, year, and total number of OD households was obtained. The average percentage yearly increase in OD was computed and used to project the percentage of OD for the years 2020, 2025 and 2030. In addition, geo-spatial technology was used to visualize variability in OD across the twelve sub-Districts.**Results**The results showed that the OD free target is not achievable in 2030 or even after if the current trend continues. In 2016, more than two out of five households defecate openly. In six out of the 12 sub-Districts, more than half of the households openly defecated. Four out of these six sub-Districts were in the Kintampo North Municipality.**Conclusion**The 2030 OD free target is not achievable in the Kintampo districts of Ghana.

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**P-0587**

### **Effects of Triclosan Exposure on the Gut Microbiome in Zebrafish**

**Presenter:** Fengxiu Ouyang, Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

**Authors:** F. Ouyang, N. Tang, P. Fan, X. Yu, W. Wang;  
Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, CHINA.

**Background/Aim** Triclosan (TCS) is a widely used antibacterial agent in personal care products and ubiquitous in environment. As gut microbiota is known important for health, it is unclear whether TCS exposure may affect gut microbiota. This study aimed to examine the effects of early life long-term exposure to TCS and concurrent short-term exposure on gut microbiota in zebrafish. **Methods** Zebrafish fertilized eggs were cultured in TCS concentrations of 0 (Dimethyl Sulphoxide, DMSO control), 0.03, 0.3, 3, 30, 100, and 300 ng/mL from 0 to 120 days post fertilization (dpf) to examine its early life exposure effect. At 120 dpf, intestine samples were collected for analysis of gut microbiota based on the V3-V4 hypervariable regions of the 16S ribosomal RNA gene. We also exposed adult zebrafishes to TCS for 7 days to examine its short-term effect on gut microbiota of adult zebrafish. **Results** In exposure to TCS for 0-120 dpf, compared with those in DMSO control group, gut microbiota of zebrafish at TCS 300 ng/mL had 54.5 lower mean number of operational taxonomic units (OTUs) (mean  $\pm$  SE,  $71.29 \pm 11.22$  vs.  $125.75 \pm 2.39$ ,  $p = 0.003$ ), 41.40 lower Chao index ( $p = 0.03$ ), and 34.10 lower ace index ( $p = 0.006$ ), with lower relative abundance in Proteobacteria, Planctomycetes and Cyanobacteria and CKC4, but higher abundance in Bacteroidetes, at phylum level, and lower relative abundance in Acinetobacter, Cyanobacteria\_norank, Hyphomicrobium, Methylobacterium, Sphingomonas, but higher abundance in CKC4\_norank, Aeromonas, Staphylococcus, Prevotella and Bacteroides, at genus level. The short-term 7-day TCS exposure was not associated with the alpha or beta diversity of gut microbiota in adult zebrafish. **Conclusions** Early life exposure to high TCS concentration may lower diversity and richness of gut microbiota, and altered its composition in zebrafish. Such effect was not observed for short-term TCS exposure in adult zebrafish.

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**P-0588**

**Determinants of uptake of PMTCT services by HIV positive mothers accessing care in Akure, Ondo State, Nigeria**

**Presenter:** ADEWALE KAYODE OJOGBEDE, Nigerian Institute of Medical Research, Lagos, Nigeria

**Authors:** A. K. OJOGBEDE<sup>1</sup>, O. A. Esimai<sup>2</sup>;

<sup>1</sup>Nigerian Institute of Medical Research, Lagos, NIGERIA, <sup>2</sup>Obafemi Awolowo University, Ile-Ife, NIGERIA.

**BACKGROUND:** Mother-to-child transmission (MTCT) of HIV remains a major public health challenge which account for substantial proportion of new HIV infections among children. Global interventional programme such as Prevention of mother to child transmission (PMTCT) of HIV has been initiated to protect children from the scourge of HIV pandemics. However, it is faced by multiple challenges in Africa. This study assessed the influencers of PMTCT services uptake among HIV-positive mothers in Akure. **METHODS:** A cross-sectional descriptive survey was employed using quantitative and qualitative design among 300 HIV positive pregnant and lactating mothers. Information on knowledge, awareness, and factors influencing uptake of PMTCT were collected using semi structured questionnaire. Data was analysed using SPSS v.20. **RESULT:** The average age of the respondents was 31.07 ±5.0 years with 77% being married. Majority (83%) were aware of PMTCT. The uptake level of PMTCT services was 89%. Knowledge on PMTCT ( $\chi^2 = 9.3$ , P value 0.002), Partner Support ( $\chi^2 = 5.09$ , p=0.024), Religion (Christianity) ( $\chi^2 = 7.264$ , p=0.007), Occupation (unskilled) ( $\chi^2 = 12.6$ , p=0.002) were factors found to be significantly associated with the uptake of PMTCT services among HIV positive mothers. **CONCLUSION:** The uptake of PMTCT services among HIV positive mothers was high in Akure. Knowledge of the respondent on PMTCT, Partner Support, Religion and occupation were factors that influenced level of uptake of PMTCT service. Health workers should intensify quality counselling and health talks by taking time to explain extensively in English and their mother tongues

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**P-0589**

**Use of weekly mobile phone call-unit to screen pregnant women and their newborns for acute respiratory and gastrointestinal illness symptoms in rural Bangladesh**

**Presenter:** Lindsay N. Avolio, Johns Hopkins Bloomberg School of Public Health, Baltimore, United States

**Authors:** L. N. Avolio<sup>1</sup>, N. Pisanic<sup>1</sup>, A. Navas-Acien<sup>2</sup>, K. Alland<sup>1</sup>, M. S. Flora<sup>3</sup>, R. Haque<sup>4</sup>, A. Khancon<sup>3</sup>, A. Lambrou<sup>1</sup>, L. S. Wu<sup>1</sup>, A. B. Labrique<sup>1</sup>, C. D. Heaney<sup>1</sup>;

<sup>1</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>2</sup>Columbia Mailman School of Public Health, New York, NY, <sup>3</sup>Institute of Epidemiology, Disease Control and Research (IEDCR), Dhaka, BANGLADESH, <sup>4</sup>The JiVitA Project, Gaibandha, BANGLADESH.

**Background/Aims** Acute respiratory and gastrointestinal illnesses are major contributors to morbidity and mortality worldwide, particularly in vulnerable populations of pregnant women and infants. It is critical to understand the burden of these illnesses in low-resource settings where infectious, nutritional, and immunotoxicological risk factors overlap and access to medical care may be limited.

**Methods** We established a birth cohort (NCT03930017) at the JiVitA Maternal and Child Health and Nutrition Research Project site in rural Bangladesh enrolling pregnant women during gestational weeks 13-16. In collaboration with the Government of Bangladesh Institute of Epidemiology, Disease Control and Research (IEDCR), we established a mobile phone-based research support system call-center to ascertain acute respiratory and gastrointestinal symptoms in the cohort of pregnant women and their newborns at weekly intervals from study enrollment to 3-months postpartum. Further, if a participant reported acute respiratory illness or influenza-like illness (ILI) symptoms a confirmatory nasal swab specimen was collected, and real time qPCR analysis and subtyping was conducted for influenza types A and B.

**Results** From October 2018 to January 2020, IEDCR completed 24,915 weekly mobile phone call-based interviews with 765 mothers (94% completion rate) and 11,230 weekly call-based interviews with caretakers who described morbidity for 638 infants (93% completion rate). Incident cases of ILI were recorded at a rate of 3.2 per 100 interviews among mothers and 7.7 per 100 interviews for infants. We also observed 1.6 and 1.8 incident cases of diarrhea per 100 interviews among mothers and infants, respectively. 850 nasal swabs were collected for confirmatory RT-qPCR analysis.

**Conclusions** A mobile phone call-unit was established and produced high degree of data completeness in a pregnancy and birth cohort in rural Bangladesh. These longitudinal acute respiratory and gastrointestinal morbidity symptom data can support future planned analyses of associations with biomarkers of co-infections, micronutrient deficiency, and immunotoxicant exposure.

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## ABSTRACT E-BOOK

Theme: **Infection microbes immunity**

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**P-0590**

**Health Risks of Intestinal Parasitism in a Military Dinning Hall Food Handlers**

**Presenter:** Wondwossen Birke, Jimma University, Jimma, Ethiopia

**Authors:** G. Desta, W. Birke;  
Jimma University, Jimma, ETHIOPIA.

### Background

Several studies assessed health risks of intestinal parasitic infections of food handlers in the home, community and institutional settings in different parts of the world including Ethiopia. However, there is a paucity of research in the military food service setting in general and particularly in Ethiopia. This study aimed to investigate intestinal parasitic infections of food handlers and possible health risks in defense north command center food service milieu of Ethiopia.

### Methods

A cross-sectional survey of all food handlers (N=57) was carried out from October-December, 2018. Standardized and structured questionnaires were used to gather data on socio-demographic and potential risk factors. Intestinal parasitic infections were assessed following standard parasitological methods. Data entry and analysis were done using SPSS-20 and frequency of various parameters was determined..

### Results

Of all examined 70.2% had one or two intestinal parasite infections. Out of total positive 75% had single infection. The leading parasite detected was *Entamoeba histolytica* (27.5%) followed by *Giardia lamblia* (12.5%) and *Schistosoma mansoni* (7.5%). The survey identified several possible risk factors for intestinal parasite infections transmission. These included lack of food safety training and medical checkup; poor finger nail status and hand washing practice after toilet; preparing food when suffering from diseases, inadequate kitchen facilities, unsanitary use of cutting boards, inefficient sanitizing of utensils and food contact surfaces, and using common knife for cutting raw and cooked foods were the most frequent indications for possible transmission

### Conclusions

Routine parasitological tests and treatment of cases, and hygiene and environmental sanitation improvement are recommended to control possible infection transmission to the military force and others.

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**P-0591**

**Climatic factors and rotavirus infections among children under five years old in Bangladesh: time-series analysis**

**Presenter:** Rezanur Rahaman, The University of Adelaide, Adelaide, SA, Australia

**Authors:** M. R. Rahaman<sup>1</sup>, A. Milazzo<sup>1</sup>, H. Marshall<sup>1</sup>, S. M. Satter<sup>2</sup>, M. Rahman<sup>2</sup>, P. Bi<sup>1</sup>;

<sup>1</sup>The University of Adelaide, Adelaide, SA, AUSTRALIA, <sup>2</sup>International Centre for Diarrhoeal Disease Research, Bangladesh, Dhaka, BANGLADESH.

### Background

Diarrhoeal disease is a significant public health challenge in Bangladesh and the association between climate and gastroenteritis is unknown. This study aimed to investigate the effects of climate conditions on rotavirus incidence among children under five years of age using countrywide rotavirus surveillance and climate data to inform public health policy concerning prediction and management of future infections.

### Methods

Time-series regression analysis was conducted on weekly rotavirus notifications, maximum temperature, relative humidity and rainfall between July 2012 and June 2017. A Poisson regression model with distributed lag linear terms were used to examine the association between climate factors and rotavirus notifications, adjusted for the presence of long-term and seasonal trends using flexible spline functions, over 0-8 week time-lags.

### Results

Unadjusted analysis - each 1°C increase in maximum temperature was associated with lower incidence of rotavirus infection (IRR 0.870, 95% CI 0.851-0.890). Adjusted analysis - the direction of the association reverses (IRR 1.046, 95% CI 1.012-1.081) with the number of rotavirus notifications increasing by 4.6% [1.2-8.1] for each 1°C rise in maximum temperature at lag 0 week. Analysis further adjusted for relative humidity (allowing for expected non-linearity) - the association persists (IRR 1.046, 95% CI 1.004-1.089).

### Conclusions

Variations in temperature and rotavirus infection may be confounded by seasonality and long-term trends. Our results are consistent with previous studies suggesting that higher temperatures are associated with increased risk of rotavirus infections. However, the magnitude of this effect may be smaller than previously estimated, particularly when intra-country geographical variations are taken into account. Considering the high prevalence of rotavirus infection in children under five years, understanding the role of climatic variables in disease incidence may inform targeted rotavirus prevention strategies, given the expected rises in annual temperature associated with climate change.

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**P-0592**

### **Bacterial Recontamination of Student Hands after Handwashing in a University Dining Halls**

**Presenter:** Wondwossen Birke, Jimma University, Jimma, Ethiopia

**Authors:** M. Hussien, W. Birke, A. Ambelu;  
Jimma University, Jimma, ETHIOPIA.

#### Background

In public universities of Ethiopia, students' identity cards (ID-cards) are commonly used as one card system for multipurposes including meal cards. However, there is little information on the potential of ID-cards that may readily recontaminate washed hands. Hence this study tried to assess the problem of recontamination of student hands after they wash and tick/show their ID-cards by determining the bacteriological loads on their hands.

#### Methods

Experimental analysis was conducted from January to June 2018 in Jimma University main campus, Southwest Ethiopia, by using checklists and taking swabs from hands of students. Students in two dining halls gave informed consent prior to participation. A total of 60 (30 females and 30 males) participated in the study.

#### Results

The mean bacteriological counts was 1.58 and 1.47 mean  $\log_{10}$  CFU counts per hand after hand washing, and after checkpoint, respectively. The post hoc analyses showed that the bacterial load before hand washing was significantly higher than after hand washing ( $p < 0.01$ ). Showing an ID card at the check point resulted recontamination of the hand and the bacterial load was significantly higher ( $p < 0.03$ ) than after hand washing.

#### Conclusions

The study showed that high amount of bacteria recovery after hand washing, while students show their ID-cards at check point. The Jimma university student dean alerted to take the necessary steps on the hand washing facility arrangement, as well as the students should give care for hands after washing.

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**P-0593**

**Risk assessment of infectious diseases in rural population associated with chronic exposure to sub-therapeutic concentrations of antibiotics in environment.**

**Presenter:** Abid Ali, PMAS Arid Agriculture University Rawalpindi Pakistan., Rawalpindi, Pakistan

**Authors:** A. Ali<sup>1</sup>, M. Khalid<sup>2</sup>, A. Rashid<sup>3</sup>;

<sup>1</sup>PMAS Arid Agriculture University Rawalpindi Pakistan., Rawalpindi, PAKISTAN, <sup>2</sup>Model Child Welfare Center Hummak., Islamabad, PAKISTAN, <sup>3</sup>Department of Botany, University of Gujrat, Gujrat, PAKISTAN.

Background: Various antibiotics are being continuously added in different environmental compartments from point and non-point sources. The rural settings are more vulnerable to this addition. Since, antibiotics are very sensitive compound which are also degraded in natural environment spontaneously as well as by means of microbial activity. Therefore, the concentrations of antibiotics reported in these compartments are perhaps below WHO regulatory limits but chronic exposure to these sub-therapeutic concentrations may cause antimicrobial resistance (AMR). The resistant microorganisms are potential threat in rural population that cause various infectious diseases in them. Aims: This study aimed to (i) assess the indirect exposure of rural population to antibiotics, (ii) assess the effect of exposure on human gut microbiome, and (iii) assess the risk of infectious diseases in exposed rural population. Method: Agricultural soil, sewage water, livestock waste, poultry waste and human feces samples in triplicate were collected fortnightly for three months and analyzed for ciprofloxacin and Co-amoxiclav (target antibiotics) through HPLC. Population exposure to antibiotics in rural population was characterized using self-structured questionnaire included livestock handlers, poultry workers, agricultural farmers, female households and children (n=300). Human fecal samples were also collected to assess the AMR in their gut microbiome against the target antibiotics. Results: Ciprofloxacin and Co-amoxiclav were estimated at concentration ranging between 0.90 and 3.88 ng/L in sewage water, 0.6 and 2.68 µg/kg in Agricultural soil, 1.12 and 3.82 µg/kg in livestock waste, 0.92 and 3.51 µg/kg in poultry waste and 0.65 and 1.41 µg/kg in human feces. Conclusion: Based upon antibiotic resistance percentages against target antibiotics, low risk of E.coli related infections in households and children, moderate risk in agricultural farmers and high risk in poultry workers and livestock handlers were concluded.

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**P-0594**

### Identification of Host-Specific Gene Elements in *E. coli*

**Presenter:** Naga Betrapally, George Washington University, Washington DC, United States

**Authors:** N. Betrapally, M. Aziz, C. Liu, D. Park, L. Price;  
George Washington University, Washington DC, DC.

Extra intestinal pathogenic *E. coli* causes a public health burden by causing infections which can lead to deaths by sepsis. These are commonly found to colonize food animals and are present in retail meat as a contaminant. There is an urgent need to study these zoonotic transmissions to determine precise proportions of human extraintestinal *E. coli* infections. We aim to use host-specific accessory elements in conjunction with core-genome phylogenetics to understand transmission routes and host-switch events. Here, we present the results from our host element discovery workflow. We performed a pan-genome analysis on a set of inhouse *E. coli* genomes isolated from human urinary tract infections (N=1,188) and retail meat [chicken (N=1,156), turkey (N=473) and pork samples (N=310)]. We searched for host-specific genes by characterizing their co-occurrence using the Sørensen-Dice method resulting in multiple gene clusters associated with poultry, pork and human clinical UTI infections. The gene clusters were mapped to closed and assembled genomes from our collection to characterize the genetic context of the elements that resulted in a total of 366 genes. Based on the physical location and statistical associations, the individual genes were grouped into 52 multigene elements consisting between 2 and 42 genes (6.75 average). These multigene elements were used along with Bayesian latent class models to estimate the putative host jumps by *E. coli* of food animal origin.

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**P-0595**

### **The reproducibility and stability of stool microbiota during collection and transport of stool specimen**

**Presenter:** Maria Nikodemova, University of Wisconsin, Madison, United States

**Authors:** M. Nikodemova, E. Holzhausen, C. Deblois, G. Suen, P. E. Peppard, A. K. Sethi, K. M. Malecki; University of Wisconsin, Madison, WI.

Background/Aim: The role of gut microbiome in epidemiologic research is increasingly recognized and with it the number of studies analyzing stool specimen is rapidly expanding. However, currently there are no standardized protocols for collecting, transporting and storing stool specimen in population-based environmental research covering a large geographic area. For home data collection, it takes between 12-100 hours from stool collection to time of sample processing in the lab. The aim of the study is to test the stability and reproducibility of stool microbiota during the transit period and provide guidance on collecting stool in population-based studies. Methods: Fresh stool was collected from 12 volunteers. Samples were aliquoted into cryovials within 30 min of collection. Three aliquots from each sample were frozen immediately (time 0) and remaining aliquots were kept at 4°C for 6, 24, 48, 72 and 96 hours followed by storage at -80°C. Three aliquots per sample were analyzed for each time point to assess reproducibility. The composition of stool microbiota was assessed by DNA sequencing of 16s rRNA V4 region. Results: The intraclass correlation coefficient (ICC) for repeated measures was between 0.6-1.0 for  $\alpha$ -diversity measures ACE, Chao1, Shannon, and Inverse Simpson. The ICC for relative abundance of four major phyla (Bacteroidetes, Firmicutes, Proteobacteria and Actinobacteria) between time 0 and 6 hours at 4°C was 0.9-1.0. The correlation remained excellent (0.9-1.0) for Proteobacteria and Actinobacteria, but was moderate (ICC from 0.6 to 0.7) for Bacteroidetes and Firmicutes between 24-96 hours at 4°C. Conclusions: Results suggest that a) the moderate correlation of repeated assessments from some of the samples suggests that stool specimen should be homogenized before taking aliquots, and b) stool microbiota is relatively stable at 4°C for up to 96 hours. However, some bacterial taxa had altered relative abundance suggesting they are more sensitive to storage conditions.

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**P-0596**

**Community Mapping and Engagement to co-create a One Health under-5 (U5) infection in urban slums conceptual diagram: Childhood Infection and Pollution (CHIP) Consortium**

**Presenter:** Yebeen Ysabelle Boo, Aceso Global Health Consultants Limited, London, United Kingdom

**Authors:** L. Manikam<sup>1</sup>, Y. Boo<sup>1</sup>, Y. Bou Karim<sup>1</sup>, C. Mayadewi<sup>2</sup>, D. Aisyah<sup>2</sup>, R. Sharma<sup>3</sup>, H. Altamirano-Medina<sup>4</sup>, H. Chaturvedi<sup>1</sup>, R. Prasad<sup>5</sup>, P. Factor-Litvak<sup>6</sup>, M. Lakhanpaul<sup>7</sup>;

<sup>1</sup>Aceso Global Health Consultants Limited, London, UNITED KINGDOM, <sup>2</sup>Indonesia One Health University Network (INDOHUN), Jakarta, INDONESIA, <sup>3</sup>Jeevan Ashram Sanstha, Jaipur, INDIA, <sup>4</sup>UCL Bartlett School of Environment Energy and Resources, London, UNITED KINGDOM, <sup>5</sup>Independent Researcher, Kathmandu, NEPAL, <sup>6</sup>Mailman School of Public Health Columbia University, New York, NY, <sup>7</sup>UCL Great Ormond Street Institute of Child Health, London, UNITED KINGDOM.

Infections are a leading cause of mortality in children Under-5 (U5s) and morbidity due to these infections are exacerbated by increasing antimicrobial resistance (AMR) from poor antibiotic governance. The Childhood Infection and Pollution (CHIP) Consortium aims to utilise novel approaches to use; a One Health framework to identify infection determinants and technology-enabled citizen science to work with slum-dwelling communities to change their environments sustainably and employing novel public health surveillance. Between September-December 2019, we undertook transect walks, social mapping and 1:1 interview with mothers and key informants in Jaipur, Jakarta and Antofagasta. We utilised a geo-tagged action camera in transect walks to extensively observe potential infection pathways. Social mapping with slum-dwellers then produced detailed slum level drawings of households, general resource access and One Health infection determinants. Lastly, 1:1 interview explored the community's understanding of infections and pathways, whilst assessing mobile phone penetrance, and the feasibility of collecting biological and non-biological samples. In consenting slum dwellers, pictures and geographical data were noted and preserved into Cloud Storage to be developed as a platform of citizen science software. With safeguards, high acceptability of invasive procedures was observed across the 3 countries. The detailed conceptual map of potential One Health factors associated with infections and AMR in U5s living in urban slums were created from the collected data. The infection pathways involve a complex network of multiple One Health, including environmental, factors and AMR. Therefore, co-designing interventions addressing this are critical; research involving policy and the private sector is necessary to address the upstream factors needed for meaningful changes of slum-dwellers' health. The slum-dwellers will participate throughout the complex intervention design of CHIP via a novel opportunity that continuously enables communities to record data. This includes participatory Geographic Information Systems using mobiles/sensors to detect and/or track diseases, pollution, mould and temperature.

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## ABSTRACT E-BOOK

Theme: **Infection microbes immunity**

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**P-0599**

**Understanding Dengue Dynamic and Risk Factors in Abidjan for Relevant Coping Strategies.**

**Presenter:** Brama KONE, Centre Suisse de Recherches Scientifiques & University Peleforo Gon Coulibaly of Korhogo, Abidjan, Côte D'Ivoire

**Authors:** B. KONE<sup>1</sup>, A. ANO<sup>2</sup>, D. FOFANA<sup>2</sup>, G. CISSE<sup>3</sup>, K. EBI<sup>4</sup>;

<sup>1</sup>Centre Suisse de Recherches Scientifiques & University Peleforo Gon Coulibaly of Korhogo, Abidjan, CÔTE D'IVOIRE, <sup>2</sup>Institut National d'Hygiène Publique, Abidjan, CÔTE D'IVOIRE, <sup>3</sup>Swiss Tropical and Public Health Institute, University of Basel, Basel, SWITZERLAND, <sup>4</sup>University of Washington, Seattle, WA.

**Background:** In 2017 Côte d'Ivoire experienced its first dengue fever (DF) epidemic, centered on Abidjan. Since that period, the city still experiencing dengue cases and a new pic was observed in 2019. There is concern that DF will become endemic and spread throughout the region driven by climate variability and change and rapid urbanization. In order to set up appropriate coping strategies, socio-environmental risk factors for DF in Abidjan were assessed.

**Methods:** Dengue suspected cases were collected by the National Institute for Public Hygiene from January to December 2019 in health centres. Cases were confirmed by the Pasteur Institute of Abidjan. Larvae were collected in the surrounding of households with confirmed DF cases. Larvae were raised in laboratory to obtain adult mosquitoes. Breeding site were characterized and their productivity assessed. Monthly rainfall and temperature for 2019 were collected and analysed.

**Results:** A total of 2,858 suspected and 256 confirmed cases of DF were collected from January to December 2019. The month of May, June and July, corresponding to the heavy rainy season were the most affected with 78% of suspected cases and 67% of confirmed cases. Among the 11 districts of Abidjan, one of them (Cocody-Bingerville) had alone 62% of all suspected cases and represent the epicenter of the epidemic. Larvae of Aedes, Anopheles and Culex were collected. Breeding sites observed were mainly household water storage containers (36% positive), used tires (30%) and abandoned containers (27%). Among them, used tires were the most productive (44%), followed by water storage container (29%) and abandoned containers (18%). Higher larval density was observed in sanitary facilities, followed by used tires, flowerpots, water containers and abandoned containers.

**Conclusion:** The results are being used to raised awareness among populations about the recognition and destruction of breeding sites and for health surveillance and actions.

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Theme: **Infection microbes immunity**

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**P-0600**

**Bayesian latent class analysis of mobile genetic elements for identification of zoonotic spillover and host switch events**

**Presenter:** Daniel Park, The George Washington University, Washington, United States

**Authors:** D. Park<sup>1</sup>, C. Liu<sup>1</sup>, M. Aziz<sup>1</sup>, N. Betrapally<sup>1</sup>, L. Price<sup>1</sup>, Z. Wu<sup>2</sup>;

<sup>1</sup>The George Washington University, Washington, DC, <sup>2</sup>University of Michigan, Ann Arbor, MI.

Background: Extraintestinal pathogenic *Escherichia coli* causes millions of urinary tract infections and nearly 40,000 sepsis deaths each year in the United States. Accessory genetic elements may provide information regarding host origin of *E. coli* isolates. Mobile genetic elements, or clusters of genes, are labile and are preserved at differential rates between hosts. Detection of mobile genetic elements in conjunction with core-genome phylogenetics may identify zoonotic spillover and host switch events. A hierarchical Bayesian latent class model (HBLCM) is proposed to systematically integrate multiple accessory elements for probabilistic assignment of host-origins. Methods: The HBLCM assumes the host-origin for each isolate is in an unobserved class of human, turkey, pork and chicken, with further stratification into three major clades based on core phylogeny. HBLCM uses multivariate binary responses that indicate presence or absence of 18 host-associated accessory elements, identified previously, to infer the latent host-origins. The latent classes and model parameters can be learned in an unsupervised fashion or using a training set. Markov chain Monte Carlo algorithms are used to iteratively produce samples from the posterior distribution of the unobserved host-origins, based on which we calculate posterior probabilities of host-origins for each isolate. *E. coli* isolates (n=3,128) derived from human clinical isolates and turkey, chicken, and pork meat samples was randomly split 75/25 into training and validation sets. Results: HBLCM results matched human vs. meat host origins in 94.0% of isolates, and 74.7% of isolates from specific meat types in the validation set (n=782). Eight potential spillover events were identified a priori from phylogenetic trees built using the core genome. HBLCM results confirmed four as potential host switches, with three others demonstrating uncertainty. Conclusions: Mobile genetic elements and HBLCM constitute a principled approach for estimating probabilities of zoonotic spillover and host switch events and may inform policy and treatment recommendations.

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## ABSTRACT E-BOOK

Theme: **Infection microbes immunity**

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**P-0601**

**In utero arsenic exposure modulates children's immune function**

**Presenter:** Molly L Kile, Oregon State University, Corvallis, United States

**Authors:** M. L. Kile<sup>1</sup>, S. M. Ahmed<sup>2</sup>, B. Welch<sup>3</sup>, A. Branscum<sup>1</sup>, S. J. Afroz<sup>4</sup>, O. S. Ibn Hasan<sup>4</sup>, M. Golam<sup>4</sup>, Q. Quamruzzaman<sup>4</sup>, D. Christiani<sup>5</sup>;

<sup>1</sup>Oregon State University, Corvallis, OR, <sup>2</sup>University of Utah, Salt Lake City, UT, <sup>3</sup>NIEHS, Research Triangle, NC, <sup>4</sup>Dhaka Community Hospital Trust, Dhaka, BANGLADESH, <sup>5</sup>Harvard TH Chan School of Public Health, Boston, MA.

**Title:** In utero arsenic exposure modulates children's immune function  
**Background.** Arsenic exposure occurs globally, and it is immunotoxic.  
**Objective.** We examined the association between drinking water arsenic exposure and immunological outcomes in a prospective cohort recruited in Bangladesh (2008-2018).  
**Methods.** Linear and Poisson regression models were used to evaluate the association between arsenic exposure and serum antibody (N=502) and infectious diseases (N=989) in children aged 5.  
**Results.** Median water arsenic (W-As) was 4.6µg/L in pregnancy. Comparing highest to lowest tertile of W-As, children aged 5 had a greater odds of clinically insufficient concentrations of diphtheria antibody (OR:1.91, 95%CI: 1.03, 3.56) after adjusting for income, maternal education, breastfeeding, birth, gender, age, and BMI. No association was observed with diphtheria or measles antibody levels. The incident rate ratios for each doubling of W-As were 1.10 (95% confidence interval [CI] = 1.00, 1.22) and 0.93 (95% CI = 0.82, 1.05) for respiratory and febrile illness, respectively, after adjusting for covariates.  
**Conclusion.** This study provides epidemiological evidence that chronic low level arsenic exposure from drinking water during pregnancy modulates children's immunological functioning and increases their susceptibility to infectious respiratory diseases.

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Theme: **Ionizing Radiation**

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**P-0602**

### **Temporal effect modifiers of the radon-associated excess relative rate of lung cancer in the Pooled Uranium Miners Analysis (PUMA) study**

**Presenter:** Kaitlin Kelly-Reif, National Institute for Occupational Safety and Health, Cincinnati, United States

**Authors:** K. Kelly-Reif<sup>1</sup>, S. Bertke<sup>1</sup>, E. Rage<sup>2</sup>, P. A. Demers<sup>3</sup>, M. T. Do<sup>3</sup>, N. DeBono<sup>3</sup>, N. Fenske<sup>4</sup>, M. Kreuzer<sup>4</sup>, J. Samet<sup>5</sup>, C. Wiggins<sup>6</sup>, M. K. Schubauer-Berigan<sup>7</sup>, L. Tomasek<sup>8</sup>, L. B. Zablotska<sup>9</sup>, D. Laurier<sup>2</sup>, D. B. Richardson<sup>10</sup>;

<sup>1</sup>National Institute for Occupational Safety and Health, Cincinnati, OH, <sup>2</sup>Institute for Radiological Protection and Nuclear Safety, Fontenay-aux-Roses, FRANCE, <sup>3</sup>Occupational Cancer Research Centre, Toronto, ON, CANADA, <sup>4</sup>Federal Office for Radiation Protection, Neuherberg, GERMANY, <sup>5</sup>Colorado School of Public Health, Aurora, CO, <sup>6</sup>University of New Mexico, Albuquerque, NM, <sup>7</sup>International Agency for Research on Cancer, Lyon, FRANCE, <sup>8</sup>Radiation Protection Institute, Prague, CZECH REPUBLIC, <sup>9</sup>University of California, San Francisco, San Francisco, CA, <sup>10</sup>University of North Carolina, Chapel Hill, Chapel Hill, NC.

**Aim:** The Pooled Uranium Miners Analysis (PUMA) is the largest pooled study of uranium miners to date. Here we report initial observations on temporal patterns of variation in the association between cumulative exposure to radon decay products and lung cancer mortality in this large multinational pooled study. **Methods:** PUMA combines cohorts of uranium miners from Canada, the Czech Republic, France, Germany, and the United States. PUMA includes approximately 120,000 males followed for lung cancer deaths between 1946 and 2014. Associations between occupational radon progeny exposure and lung cancer mortality were estimated using internal Poisson regression with background stratification by cohort, attained age, calendar period, and race. This analysis focuses on windows of age at exposure and time since exposure modeled simultaneously and separately as modifiers. **Results:** In this study with 7,774 lung cancer deaths and 4.4 million person-years, there was statistically significant evidence of a positive association between cumulative exposure to radon decay products, under a 5-year lag assumption, and lung cancer mortality. There was statistically significant evidence of variation by age at exposure in the association between cumulative exposure to radon decay products, under a 5-year lag assumption, and lung cancer mortality. There also was statistically significant evidence of variation in the association between cumulative exposure to radon decay products and lung cancer mortality with time since exposure; the estimated excess relative rate (ERR) per working level month (WLM) tended to diminish across windows defined by increasing time since exposure; however, estimated ERR per WLM remained above the null even 35+ years after exposure. **Conclusion:** Preliminary analyses yield estimates with substantial statistical precision of the radon-lung cancer association and its variation with age at exposure and time since exposure. Further analyses will investigate additional effect modification by exposure rate and heterogeneity between individual studies.

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Theme: **Ionizing Radiation**

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**P-0604**

**Increased cancer risk in male hunters in Northern Sweden after the Chernobyl Nuclear Power Plant accident?**

**Presenter:** Martin Tondel, Occupational and Environmental Medicine, Uppsala University, Uppsala, Sweden

**Authors:** M. Tondel<sup>1</sup>, T. Nordquist<sup>2</sup>, M. Isaksson<sup>3</sup>, C. Rääf<sup>4</sup>, R. Wålinder<sup>1</sup>;

<sup>1</sup>Occupational and Environmental Medicine, Uppsala University, Uppsala, SWEDEN, <sup>2</sup>Occupational and Environmental Medicine, Uppsala University Hospital, Uppsala, SWEDEN, <sup>3</sup>Department of Radiation Physics, University of Gothenburg, Gothenburg, SWEDEN, <sup>4</sup>Medical Radiation Physics, Lund University, Malmö, SWEDEN.

Background: Hunters have higher internal radiation exposure due to consumption of game in Swedish counties with high fallout of <sup>137</sup>Cs after the Chernobyl accident compared with the general population. Methods: Cancer incidence was studied in nine counties with three deposition categories of <sup>137</sup>Cs fallout after the Chernobyl accident in 1986. A total of 9,267 cancer cases occurred in male hunters and 138,909 cancer cases in male non-hunters to 31 December 2015. Directly age standardized cancer incidence and Incidence Rate Ratios (IRR) with 95% Confidence Intervals (CI) were calculated for total cancer and radiation associated cancers, respectively. IRR was calculated between hunters, using the lowest deposition counties as reference, and within counties using non-hunters as reference. Hence, cancer risks of internal radiation exposure and the hunting lifestyle, respectively, could be studied. Results: An increasing trend in total cancer incidence was seen in non-hunters. For hunters this trend was significantly lower up to 2001 when the total cancer incidence crossed over the weaker non-hunter trend and remained higher the following 15 years. A weak exposure response trend for radiation associated cancers was found both within hunter and non-hunter category, respectively. No clear exposure response pattern was seen in IRRs for total cancer in hunters versus non-hunters between counties with increasing <sup>137</sup>Cs deposition. IRRs for hunters compared with non-hunters were higher regardless of rural/non-rural status with slightly higher risk estimates in rural areas. The overall IRR for hunters was 1.06 (95% CI 1.04 - 1.08) 1986 - 2015, representing an excess of 531 cancer cases in hunters. No confounding effect from tobacco smoking or education level could be identified. Conclusion: Total cancer incidence was increased for hunters versus non-hunters. However, exposure classification was too crude to exclude an association between cancer and <sup>137</sup>Cs. Detailed dosimetry is needed to analyse and interpret any trend.

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**P-0605**

**Mobile apps for environmental and health monitoring after a nuclear accident: Towards a better resilience with involvement of citizen science and general public**

**Presenter:** Liudmila Liutsko, ISGlobal, Barcelona, Spain

**Authors:** L. Liutsko<sup>1</sup>, P. Fattibene<sup>2</sup>, S. Della Monaca<sup>2</sup>, C. De Angelis<sup>2</sup>, S. Brescianini<sup>2</sup>, C. Nuccetelli<sup>2</sup>, T. Ohba<sup>3</sup>, A. Goto<sup>4</sup>, Y. Lyamzina<sup>5</sup>, A. Sarukhan<sup>1</sup>, K. Tanigawa<sup>6</sup>, D. Deborah Oughton<sup>7</sup>, Y. Tomkiv<sup>7</sup>, D. Laurier<sup>8</sup>, J. Bottolier-Depois<sup>8</sup>, S. Charron<sup>8</sup>, P. Croüail<sup>9</sup>, T. Shneider<sup>9</sup>, M. Maître<sup>9</sup>, P. Pirard<sup>10</sup>, A. Van Nieuwenhuyse<sup>11</sup>, N. Novikava<sup>12</sup>, V. Chumak<sup>13</sup>, J. Barquinero<sup>14</sup>, E. Cardis<sup>1</sup>;

<sup>1</sup>ISGlobal, Barcelona, SPAIN, <sup>2</sup>ISS, Rome, ITALY, <sup>3</sup>FMU, Fukushima, JAPAN, <sup>4</sup>FMU, Fukushima, ITALY, <sup>5</sup>FMU, Rome, ITALY, <sup>6</sup>FMC, Fukushima, JAPAN, <sup>7</sup>NMBU, As, NORWAY, <sup>8</sup>IRSN, Fontenay-aux-Roses, FRANCE, <sup>9</sup>CEPN, Fontenay-aux-Roses, FRANCE, <sup>10</sup>Santé Publique France, Saint-Maurice, FRANCE, <sup>11</sup>LSN, Dudelange, LUXEMBOURG, <sup>12</sup>ISEI-BSU, Minsk, BELARUS, <sup>13</sup>NRCRM, Kyiv, UKRAINE, <sup>14</sup>UAB, Barcelona, SPAIN.

**Abstract Background/Aim:** One of the lessons learned from nuclear accidents is the need to increase stakeholder engagement in accident preparedness and response, including data collection by citizens (and citizen scientists). In particular, the use of personal dosimeters, including sensors connected to mobile phones, was widely used after the Fukushima accident, leading to the collection and sharing of many ambient radioactivity measurements, dedicated web-platforms for exchanging questions and advice, as well as attempts to initiate participative epidemiological studies. **Methods:** The SHAMISEN-SINGS European project combined 3 approaches: 1) review and testing of existing mobile apps for dose measurements; 2) review of relevant mobile apps on health & welfare that could be used after a nuclear accident, and 3) on-line anonymous survey & group discussions on awareness, experiences and willingness to use mobile apps for dose and health monitoring. **Results:** A Tool-kit for using apps for dose measurements has been developed, summarised in infographics for the general public, and described together with recommendations on developing and use of mobile apps for health monitoring in a booklet. A brief cost-benefit analysis based on data collected by citizens was performed to complement those existing from official sources. A data management plan was proposed, in which data from the apps can be used with benefits at the individual and societal level. Ethical issues related to apps development, data collection and sharing were explored. **Conclusions:** The Recommendations and Tool-kits for use and development of mobile apps for dose and health monitoring after a nuclear accident, as developed by the SHAMISEN SINGS project, are directed toward the general public, apps developers and relevant professional stakeholders. If implemented in collaboration with stakeholders and citizen scientists, they should provide individual and societal benefits, and may contribute to national and regional monitoring networks for radiation and health surveillance programs in post-accidental situations.

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Theme: **Ionizing Radiation**

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**P-0606**

**Radon R<sup>222</sup> flux associations with standardized mortality rates of lung cancer in men and women in Spain**

**Presenter:** Liudmila Liutsko, ISGlobal, Barcelona, Spain

**Authors:** C. Grossi<sup>1</sup>, O. Puig<sup>2</sup>, J. Ferrer<sup>2</sup>, S. Paredes<sup>2</sup>, E. Cardis<sup>3</sup>, L. Liutsko<sup>3</sup>;

<sup>1</sup>UPC, Barcelona, SPAIN, <sup>2</sup>INS Menéndez y Pelayo, Barcelona, SPAIN, <sup>3</sup>ISGlobal, Barcelona, SPAIN.

Background/Aim: López-Abente et al. (2017) found a linear significant relationship between residential concentration of radon and mortality for lung, stomach and brain cancer in women in Galicia (Spain). Karsten et al. (2015) presented a method applied for developing a high-resolution <sup>222</sup>Rn flux map for Europe, based on a parameterization of gas production depending on soil properties, uranium content, moisture and transport in the soil. Aim of our exploratory study was to check association between <sup>222</sup>Rn flux values and standardised mortality rates (SMR) of lung cancer in men and women in 48 regions of Spain. Methods: <sup>222</sup>Rn flux data were calculated as per Karsten et al. (2015) methods. The epidemiological data on lung cancer mortality in men and women by region were taken from free available source (Carlos III Institute). Paired t-differences were used to observe the statistically significant differences in seasonal variations of <sup>222</sup>Rn flux. Regression analysis was performed to observe the relationship of epidemiological data with <sup>222</sup>Rn flux. Results: Statistically significant differences were found between seasonal variations: winter / spring vs. summer / autumn (but not between winter and spring or summer and autumn) in <sup>222</sup>Rn flux parameters. The higher values were related to summer and autumn period (by a factor 1.4 in average). Regression analyses revealed statistically significant associations between SMR of lung cancer in men and Rn flux in summer/autumn: R<sup>2</sup>=0.15, p=0.007), winter/spring: R<sup>2</sup>=0.10, p=0.002). No any significant relationship was found for women in this study. Conclusions: In spite of study limitations (not availability of epidemiological data for the periods posteriors to measurements to perform time series analyses with associations related on time lags); <sup>222</sup>Rn flux data could be used as proxies comparable to <sup>222</sup>Rn concentrations. Further comparative studies with similar data on indoor concentration vs. flux are to be performed and analyses with corresponding epidemiological data.

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Theme: **Ionizing Radiation**

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**P-0607**

**Utility gains from reducing lung cancer morbidity and mortality from residential radon interventions in Canada**

**Presenter:** Janet Gaskin, Health Canada, Ottawa, Canada

**Authors:** J. Gaskin<sup>1</sup>, J. Whyte<sup>2</sup>, D. Coyle<sup>3</sup>;

<sup>1</sup>Health Canada, Ottawa, ON, CANADA, <sup>2</sup>National Research Council of Canada, Ottawa, ON, CANADA,

<sup>3</sup>University of Ottawa, Ottawa, ON, CANADA.

### Abstract

Background/Aim: Lung cancer is the leading cause of cancer mortality in Canada, and radon is the second most important cause of lung cancer. The goal is to estimate the utility gains from radon interventions in new housing, and in existing housing built without preventive measures, to reduce the burden from radon attributable lung cancer morbidity and mortality in Canada. Methods: A lifetable analysis is conducted using the 2016 population data, including mortality and smoking prevalence, the recent Canadian Cancer Registry data on lung cancer stage at diagnosis, and the results of the 2009-2011 national radon survey. Markov modelling of lung cancer incidence and survival time is conducted for small cell and non-small cell lung cancer, over a lifetime horizon and using a discount rate of 1.5%. Years lived with lung cancer morbidity are evaluated using quality of life decrements reported for local, regional and distant stages of lung cancer. Results: Installing passive preventive radon measures in new housing over a 100 years is estimated to result in an average annual increase of 5,612 discounted quality-adjusted life years, preventing an average of 2,336 lung cancer cases and 1,286 lung cancer deaths annually. Based on a radon action level of 200 (100) Bq/m<sup>3</sup>, testing and mitigation of existing housing at current rates over a 100 years is estimated to result in an average annual increase of 150 (410) discounted quality-adjusted life years, preventing an average of 35 (102) lung cancer cases and 19 (57) lung cancer deaths annually. Conclusions: Including the reduced lung cancer morbidity in addition to mortality results in larger utility gains from interventions in new and in existing housing in Canada. Future inclusion of costs of radon interventions and health care use in this lung cancer model would refine cost-effectiveness estimates of residential radon interventions in Canada.

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**P-0608**

### **Development of a Sensitive Radon in Breath Analyzer for Exposure Assessment to Uranium Ore Constituents**

**Presenter:** Doug Brugge, University of Connecticut, Farmington, United States

**Authors:** D. Brugge<sup>1</sup>, A. Nidecker<sup>2</sup>, G. Vandrish<sup>3</sup>;

<sup>1</sup>University of Connecticut, Farmington, CT, <sup>2</sup>International Physicians for Prevention of Nuclear War, Basel, SWITZERLAND, <sup>3</sup>Independent consultant, Gatineau, QC, CANADA.

Currently only imprecise metrics are available to assign lifetime exposure to uranium ore constituents, such as living in proximity to sources of exposure. The purpose of this project is to develop a radon in breath analyzer sensitive enough to measure radon in the breath of people exposed to uranium ore. Radon is exhaled from decaying radium stored in the bones. We are exploring the use of traditional Lucas cells as the radon detection method. To date, background levels in the range of 0.02 to 0.05 CPM have been achieved through careful choice of the ZnS(Ag) scintillator, the method of deposition and an optimized detector operating point. We are also using liquid nitrogen to collect and focus small amounts of radon from large volumes of breath (50 L). To do this, radon samples are passed through a processing system consisting of a CO<sub>2</sub> trap, a water trap employing dry ice/acetone, and a liquid nitrogen trap where the radon is collected. To date, approximately 75% of the radon in the initial sample is collected and transferred to the Lucas cell for analysis. Assuming a breath sample of liters (10 minutes breathing for a measurement), a 75% collection and transfer efficiency to the Lucas cell, and a background level of 0.02 to 0.05 CPM in the Lucas cell, the projected sensitivity of the instrument will be 0.00005 to 0.0005 pCi/l. This level of sensitivity was targeted to provide exposure assessment for people exposed to lower levels than historical underground uranium miners. If this instrument has necessary detection limit and is feasible in the field, future epidemiology studies can assign historical exposure with much greater accuracy. The instrument may also be useful for screening people for clinical purposes to assess their health risk.

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**P-0609**

**Estimation of internal radiation exposure during 9 years after Fukushima nuclear accident using National food-monitoring data in Japan**

**Presenter:** Ichiro Yamaguchi, National Institute of Public Health, Wako city, Saitama, Japan

**Authors:** I. Yamaguchi, H. Terada, T. Shimura;  
National Institute of Public Health, Wako city, Saitama, JAPAN.

**Purpose:** To clarify public health mitigations to reduce ingestion dose after the nuclear accident by demonstrating the trends in official radiological food monitoring data from the national food surveillance program during the first nine years after the Fukushima nuclear accident. **Methods:** 2,524,369 food samples have been officially submitted to the Ministry of Health, Labour and Welfare for monitoring during the first nine years after the Fukushima Nuclear Accident as of 25 December 2019 since March 2011. Among them exceeded samples were 6,577. Radiation doses were estimated using ingestion rates based on the Japanese National Food Consumption Survey dataset (N = 6,962) using a Monte Carlo method. **Results:** Assuming that food restrictions were fully implemented and using the national mean food consumption data, the 95 percentile of the effective doses to adult males from dietary exposures was 110  $\mu$ Sv reducing 108  $\mu$ Sv in 2011 and 36  $\mu$ Sv reducing 1  $\mu$ Sv in 2019. The 99.99 percentile of the effective doses to adult males from dietary exposures was 943  $\mu$ Sv reducing 3,608  $\mu$ Sv in 2011 and 206  $\mu$ Sv reducing 54  $\mu$ Sv in 2018. **Discussion:** The effect of public health mitigation on radiation food safety has been changing during the first nine years after the Fukushima accident. The 99.99 percentile of the effective doses was below the standard limit even if the regulation was not applied in 2019. **Conclusions:** We confirmed the improving internal radiation dose trend with the official national food surveillance system data from the first nine years after the Fukushima nuclear accident. We expect that the food contamination levels will continue to decrease over time.

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**P-0611**

**Association between ambient beta particle radioactivity and lower hemoglobin concentrations in a cohort of elderly men**

**Presenter:** Carolina Leticia Zilli Vieira, Harvard School of Public Health, Boston, United States

**Authors:** C. Zilli Vieira<sup>1</sup>, E. Garshick<sup>2</sup>, J. Schwartz<sup>1</sup>, S. Huang<sup>1</sup>, D. Gold<sup>1</sup>, V. Pantel<sup>3</sup>, P. Koutrakis<sup>1</sup>;  
<sup>1</sup>Harvard School of Public Health, Boston, MA, <sup>2</sup>Pulmonary, Allergy, Sleep and Critical Care Medicine Section, VA Boston Healthcare System, Boston, MA, <sup>3</sup>VA Normative Aging Study, VA Boston Healthcare System, Boston, MA.

Although ionizing radiation is known to have detrimental effects on red blood cells, the effect of environmental radioactivity associated with ambient particulate matter (PM) is unknown. We hypothesized that exposure to ambient PM-associated beta particle radioactivity ( $PR_{\beta}$ ) would be associated with a lower hemoglobin concentration. We studied 1,704 participants from the Normative Aging Study (NAS) over 36 years (1981-2017) who lived in Eastern, MA and the surrounding area. Exposures to  $PR_{\beta}$  was assessed using USEPA's RadNet monitoring network that measures gross beta radiation associated with ambient PM. Mixed effect models with a random intercept adjusting for potential confounders was used, including ambient black carbon (BC) and particulate matter  $\leq 2.5 \mu\text{m}$  ( $PM_{2.5}$ ) concentrations. Greater cumulative  $PR_{\beta}$  activities at 7-, 14-, 21- and 28-days before the hemoglobin determination were associated with lower hemoglobin concentrations. The greatest effect was for a 28-day moving average. An IQR of  $0.83 \times 10^{-4} \text{Bq/m}^3$  of ambient  $PR_{\beta}$  was associated with a 0.12 g/dL decrease in hemoglobin concentration (95%CI: -0.18 to -0.05). The effects of  $PR_{\beta}$  were similar when the models were adjusted for ambient BC or  $PM_{2.5}$ . This is the first study to demonstrate an association between environmental ionizing radiation released from particulate matter with a lower hemoglobin concentration, suggesting that ambient radiation may contribute to the development of anemia.

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## ABSTRACT E-BOOK

Theme: **Ionizing Radiation**

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**P-0612**

**Levels of Polonium-210 in brain and pulmonary tissues: Preliminary study in autopsies conducted in the city of Sao Paulo, Brazil**

**Presenter:** Carolina Leticia Zilli Vieira, Harvard School of Public Health, Cambridge, United States

**Authors:** N. Villa dos Santos<sup>1</sup>, C. Zilli Vieira<sup>2</sup>, P. H. Saldiva<sup>1</sup>, B. P. Mazzilli<sup>3</sup>, M. Saiki<sup>3</sup>, C. Saldiva de Andre<sup>4</sup>, C. Saueia<sup>3</sup>, M. Bessa Nisti<sup>3</sup>, P. Koutrakis<sup>2</sup>;

<sup>1</sup>Laboratory of Experimental Air Pollution, Department of Pathology, University of Sao Paulo School of Medicine, Sao Paulo, BRAZIL, <sup>2</sup>Harvard School of Public Health, Cambridge, MA, <sup>3</sup>Nuclear and Energy Research Institute, IPEN-CNEN, Sao Paulo, BRAZIL, <sup>4</sup>Institute of Mathematics and Statistics, University of Sao Paulo, Sao Paulo, BRAZIL.

The accumulation of detectable amounts of radon progeny in human tissues may be a risk factor for development and progression of chronic diseases. In this study, we analyzed the levels of alpha-emitting radon progeny 210-Polonium (<sup>210</sup>Po) in the olfactory epithelium, olfactory bulb, frontal lobe, and lung tissues in cadavers from the city of Sao Paulo, SP, Brazil. We investigated the association between <sup>210</sup>Po levels with the traffic-related pleural anthracosis index, smoking habits and socioeconomic index. Our findings show that olfactory bulb presented higher concentrations of <sup>210</sup>Po in comparison with other tissues among all ages and gender. Women, smokers and elderly presented higher <sup>210</sup>Po levels in some tissues, especially in lungs. We found statistically significant association between <sup>210</sup>Po levels and anthracosis in lungs of non-smokers and lower socioeconomic index. The presence of high concentrations of <sup>210</sup>Po in olfactory bulb may indicate the main pathway for transfer of radon progeny from nasal tissues to the central nervous system. Our findings suggest that radon progeny in human tissues may contribute to the development of chronic diseases in urban areas, including neurodegenerative diseases.

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## ABSTRACT E-BOOK

Theme: **Ionizing Radiation**

**P-0613**

### **Indoor PM<sub>2.5</sub> Alpha-Radioactivity is Associated with Biomarkers of Oxidative Stress in COPD Patients**

**Presenter:** Eric Garshick, VA Boston Healthcare System and Harvard Medical School, West Roxbury, United States

**Authors:** E. Garshick<sup>1</sup>, M. Liu<sup>2</sup>, C. Kang<sup>3</sup>, S. Grady<sup>4</sup>, C. Collins<sup>1</sup>, J. Hart<sup>5</sup>, E. Maher<sup>3</sup>, J. Zhang<sup>6</sup>, P. Koutrakis<sup>3</sup>;

<sup>1</sup>VA Boston Healthcare System and Harvard Medical School, West Roxbury, MA, <sup>2</sup>Harvard T.H. Chan School of Public Health Boston, Boston, MA, <sup>3</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>4</sup>VA Boston Healthcare System, West Roxbury, MA, <sup>5</sup>Brigham and Women's Hospital and Harvard Medical School, Boston, MA, <sup>6</sup>Nicholas School of the Environment, Duke University, Durham, NC.

**Introduction:** Radon decays into progeny that attach to indoor air pollution particles and form unattached clusters. After inhalation, we hypothesize that these serve as vectors for radioisotopes that emit radiation (including  $\alpha$ -radioactivity) that promote oxidative damage in patients with COPD. **Methods:** We recruited 140 patients (97% men, mean (SD) age 72.8 (8.3)) with COPD at VA Boston 5/2013-3/2017 who ran a micro-environmental PM<sub>2.5</sub> sampler in their home for 1 week up to 4 times a year (n=414 samples). Samples were analyzed for PM<sub>2.5</sub> and black carbon (BC). In 2019,  $\alpha$ -radioactivity was measured on each PM<sub>2.5</sub> filter. Since <sup>210</sup>Pb (t<sub>1/2</sub>=22 years), a Rn progeny, is a parent of <sup>210</sup>Po (t<sub>1/2</sub>=138 days,  $\alpha$ -radiation emitter),  $\alpha$ -radioactivity reflects formation of <sup>210</sup>Po from <sup>210</sup>Pb. Based on the <sup>210</sup>Pb decay constant and sampled air volume,  $\alpha$ -radioactivity during sampling was estimated. Urinary concentrations of oxidative stress biomarkers, 8-hydroxy-2'-deoxyguanosine (8-OHdG) and malondialdehyde (MDA) were assessed. Mixed effects models with a random intercept for each subject were used to examine associations adjusting for age, race, season, urine collection time, BMI, creatinine, diabetes, heart disease, ambient temperature, humidity, and indoor BC and PM<sub>2.5</sub>. **Results:** Median (IQR) PM<sub>2.5</sub>  $\alpha$ -radioactivity=1.5 (0.64) mBq/m<sup>3</sup> (equivalent to 0.056 (0.024) pCi/L); PM<sub>2.5</sub>=6.9 (5.7)  $\mu$ g/m<sup>3</sup>; BC=0.58 (0.27)  $\mu$ g/m<sup>3</sup>. There was a positive association between natural log ( $\alpha$ -radioactivity) and 8-OHdG [5.2% increase (95% CI: 0.9-9.7%) per IQR] and MDA [2.0% increase (95% CI: -2.6-6.8%) per IQR]. Results for 8-OHdG were similar adjusting for PM<sub>2.5</sub> (5.4%; 95% CI: 1.1-10.0%) and BC (4.6%; 95% CI: 0.1-9.2%). Results for MDA were similar adjusting for PM<sub>2.5</sub> (1.9%; 95% CI: -2.8-6.8%) and were reduced adjusting for BC [0.5%; 95% CI: -4.2-5.4%]. **Conclusions:** Indoor PM<sub>2.5</sub>  $\alpha$ -radioactivity reflecting <sup>210</sup>Pb was positively associated with increased DNA oxidation (8-OHdG) and lipid peroxidation (MDA) in participants with COPD. **Funding:** ES029637, ES019853, USEPA grant RD-835872

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## ABSTRACT E-BOOK

Theme: **Mixtures and models**

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**P-0614**

### **Non-steroidal anti-inflammatory drugs (NSAIDs) impact on soil microbiota: consequences on soil functioning**

**Presenter:** Dalma Eموke Kovacs, Research Institute for Analytical Instrumentation, INCDO INOE 2000, Cluj Napoca, Romania

**Authors:** D. Kovacs;  
Research Institute for Analytical Instrumentation, INCDO INOE 2000, Cluj Napoca, ROMANIA.

Background: NSAIDs are commonly used pharmaceuticals at worldwide level. Their wide consumption and limited removal through current practices of wastewater treatment plants has made them to easily reach environment. Concerns regarding their occurrence in water and soil environment is given by their potential ecotoxicological effects on living organisms at different trophic levels. Aims: The objective of this study was to assess the impact of common NSAIDs as ibuprofen, ketoprofen and diclofenac on soil microbiota (structure, abundance, metabolic activity) and related functions (enzymatic activity) in soil ecosystem services provision. Methods: Ibuprofen, ketoprofen and diclofenac were analyzed on GC-MS after derivatization with BSTFA and 1 % TMCS. Artificial exposure experiments with single and mixtures of Ibuprofen, ketoprofen and diclofenac, at different exposure concentrations (0.5 – 5 mg/kg), were performed with agricultural soils collected from Cluj county, Romania. Microbiota structure and abundance analysis was performed applying PLFA techniques. Microbiota metabolic activity was assessed with 31 sole carbon sources on 96-well Ecoplates. Results: Exposure of soil microbiota at 0.5 and 1 mg/kg at single NSAIDs for a period of 30 days has shown no changes in both structure and abundance. When soil samples were contaminated with mixture (1:1) of studied NSAIDs at the same concentration gram negative bacteria has inhibited development with 42 %, thus reducing it from 61.6 nmol/kg to approximately 25 nmol/kg. In experiments with exposure at higher doses (> 2.5 mg/kg) the average total bacteria abundance increased from 184.3 mg/kg at 236.4 mg/kg suggesting that microbiologically decomposed NSAIDs could serve as C source for some microorganism. Extracellular enzymatic activities as dehydrogenase activity decreased in all exposure experiments with about 6.2 % regardless of exposure dose, while acid-phosphatase increased with more than 28 %. Conclusions: Cumulative exposure of soil microbiota at mixture of NSAIDs changes their abundance and structure, influencing therefore soil functions.

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## ABSTRACT E-BOOK

Theme: **Mixtures and models**

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**P-0615**

**Knowledge, practices, and environmental health risks associated with electronic waste recycling in Cotonou, Benin**

**Presenter:** Karel Mahoutondji HOUSSIONON, Regional Institute of Public Health, Ouidah, Benin

**Authors:** K. M. HOUSSIONON<sup>1</sup>, N. BASU<sup>2</sup>, C. BOULAND<sup>3</sup>, E. D. OUENDO<sup>1</sup>, B. FAYOMI<sup>4</sup>, J. FOBIL<sup>5</sup>;  
<sup>1</sup>Regional Institute of Public Health, Ouidah, BENIN, <sup>2</sup>Department of Natural Resource Sciences, McGill University, Montreal, QC, CANADA, <sup>3</sup>School of Public Health, Université Libre de Brussels, Bruxelles, BELGIUM, <sup>4</sup>Occupational Health and Environment Research Unit, University of Abomey-Calavi, Cotonou, BENIN, <sup>5</sup>School of Public Health, University of Ghana, Accra, GHANA.

The recycling of e-waste is increasing rapidly worldwide and there remain outstanding environmental health concerns. However, most studies are localized to few countries (e.g., China, Ghana). This study analyzes the knowledge and practices of e-waste recyclers in Cotonou from which a deeper understanding of environmental health risks could be determined. A descriptive, cross-sectional study was conducted in September 2018. All e-waste recyclers working in Cotonou, having given their consent and available during the investigation period were interviewed individually. Survey data was collected from 45 recyclers concern their professional profile, knowledge of the risks of their activities on health and environment and their daily recycling practices. The data analysis was done under the SPSS software and the graphs were generated under Microsoft Excel. All of the 45 people were male. The average age is  $24 \pm 6$  years old and 53.3% of recyclers have at least 3 years of seniority. Recyclers dismantle (97.8%), sort (91.1%) and incinerate (88.9%) e-waste. Only 44.2% of recyclers wear at least one piece of personal protective equipment and 48.8% do not wash their hands before eating at recycling sites. More than 90% noted that their residues are abandoned in nature and 46.7% think that e-waste can pollute water against 71.1% for air and soil. Regarding the diseases that can be linked to their activity, recyclers self-recognize respiratory diseases 67.4%, heart diseases 62.8%, eye diseases 65.1%, kidney diseases 41.9% and cancers 30.2%. Note that the number of e-waste dismantled per month is significantly associated with the symptoms experienced: blood in the urine and stool, wounds, dizziness, itchy skin. The number of hours of work per day is associated with: blood in the urine, dizziness, itchy skin and airway obstruction. It becomes important to raise awareness of e-waste workers about the dangers of their activities and encourage prevention.

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Theme: **Mixtures and models**

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**P-0616**

### **Exposure to Phenols and Incident Diabetes in Midlife Women: The Study of Women's Health Across the Nation (SWAN)**

**Presenter:** Seulbi Lee, Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor, United States

**Authors:** S. Lee<sup>1</sup>, B. Mukherjee<sup>2</sup>, W. H. Herman<sup>3</sup>, S. D. Harlow<sup>1</sup>, S. K. Park<sup>1</sup>;

<sup>1</sup>Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor, MI, <sup>2</sup>Department of Biostatistics, School of Public Health, University of Michigan, Ann Arbor, MI, <sup>3</sup>Department of Internal Medicine, School of Medicine, University of Michigan, Ann Arbor, MI.

**Background:** Although environmental phenols have been suggested to be diabetogenic chemicals, few epidemiologic studies have investigated associations between phenols (except bisphenol-A [BPA]) and diabetes. Furthermore, most previous studies have been cross-sectional, raising concerns related to reverse causality. **Objective:** We examined the associations between urinary concentrations of phenols, assessed at two time points, and incident diabetes in the Study of Women's Health Across the Nation (SWAN), a multi-site, multi-ethnic prospective cohort of midlife women. **Methods:** We analyzed data of 1315 white, black, Chinese, and Japanese women aged 45-56 years who were diabetes-free at the baseline of the SWAN Multi-Pollutant Study (MPS) (1999–2000) and were followed up over 17 years. Twelve phenols (BPA, bisphenol-S, bisphenol-F, triclosan, triclocarban, 2,4-dichlorophenol, 2,5-dichlorophenol, benzophenone-3, ethylparaben, methylparaben, butylparaben, propylparaben) were measured in urine samples collected at baseline and three years after the baseline (2002–2003). We generated inverse probability weights (IPW) to account for potential selection bias into the MPS and selective attrition during follow-up. The association of phenol to incident diabetes was examined using time-varying Cox proportional hazards models with IPW adjusted for potential confounders. **Results:** During follow-up (median =16 years), 184 incident cases were identified (incidence rate=9.96 per 1000 person-years (95% CI: 8.60,11.49). Compared with the first quartile, hazard ratios (HRs) for the second, third, and fourth quartiles of BPA were 2.86 (95% CI: 1.66, 4.94), 1.82 (0.97, 3.42), and 2.48 (1.39, 4.42). Conversely, HRs comparing the third and fourth quartiles of benzophenone-3 with the first quartile were 0.43 (0.27, 0.70) and 0.43 (0.26, 0.72). There were no statistically significant associations between other chemicals and incident diabetes. **Conclusions:** This prospective cohort study of midlife women suggests that BPA exposure may be associated with a higher risk of diabetes, while benzophenone-3 exposure may be associated with a lower risk.

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Theme: **Mixtures and models**

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**P-0617**

### **PROTECTIVE EFFECT OF VITAMIN C ON LEACHATE INDUCED GENOTOXICITY AND OXIDATIVE STRESS IN THE LIVER AND OVARY OF RAT**

**Presenter:** OLUWATOSIN ADETOLA AROJOJOYE, LEAD CITY UNIVERSITY, IBADAN, Nigeria

**Authors:** O. A. AROJOJOYE, O. O. NWAECHEFU, A. M. ADEOSUN, A. A. ALIM; LEAD CITY UNIVERSITY, IBADAN, NIGERIA.

**Introduction** This study investigated the protective effect of vitamin C on leachate induced genotoxicity and oxidative stress in the liver and ovary of rats exposed to Ajakanga landfill leachate. **Methods** Sixty female rats (150-200g) were equally divided into ten groups (A-I). Group A animals (control) were given distilled water, groups B – E animals were given 12.5%, 25%, 50%, and 100% leachate respectively via drinking water for twenty-eight days. Animals in group F were given distilled water plus 100mg/kg vitamin C while groups G – I animals were given 100mg/kg vitamin C plus 12.5%, 25%, 50%, and 100% leachate respectively. Activities of alanine amino transferase (ALT), aspartate aminotransferase (AST) and Gamma-glutamyltransferase (GGT) were determined in the serum of rats using enzyme kits. Oxidative stress markers were determined in the liver and ovary of the rats by spectrophotometry. Genotoxicity study was carried out using micronucleus assay. **Results** There was increase in the activities of ALT, AST and GGT in serum of rats exposed to leachate compared with control but ALT and AST activity decreased in rats treated with vitamin C. There was increase in malondialdehyde concentration (index of lipid peroxidation) in the liver (102.3-302.7mol/mg protein) and ovary (1.1-2.1mol/mg protein) of rats exposed to leachate compared with control (72.6mol/mg protein; 0.7mol/mg protein) but there was a significant decrease in animals treated with vitamin C. There was decrease in the levels of reduced glutathione and super oxide dismutase in the ovary of rats in groups B-E, but vitamin C treatment increased the levels of these antioxidants. A significant increase in micronucleated polychromatic erythrocytes (MPCE) was observed in bone marrow of rats exposed to leachate (74.7-113 MPCE/1000PCE) but there was a decrease in MPCEs in rats treated with vitamin C (66.8-78.8 MPCE/1000PCE). **Conclusion** Vitamin C has a protective effect on leachate induced genotoxicity and oxidative stress in the liver and ovary of the rats.

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Theme: **Mixtures and models**

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**P-0618**

### **Predictors of residential location change in the ARIC Study**

**Presenter:** Erin E Bennett, The George Washington University Milken Institute School of Public Health, Washington, United States

**Authors:** E. E. Bennett<sup>1</sup>, X. Xu<sup>2</sup>, E. Park<sup>2</sup>, Q. Ying<sup>2</sup>, J. Wei<sup>1</sup>, R. Smith<sup>3</sup>, J. Stewart<sup>3</sup>, E. A. Whitsel<sup>3</sup>, M. C. Power<sup>1</sup>;

<sup>1</sup>The George Washington University Milken Institute School of Public Health, Washington, DC, <sup>2</sup>Texas A&M University, College Station, TX, <sup>3</sup>University of North Carolina Gillings School of Global Public Health, Chapel Hill, NC.

**Background:** Relatively little work has described predictors of moving residence in the context of epidemiological studies, though residential mobility could lead to selection bias and misclassification of contextual exposures. Our goal was to explore predictors of moving among participants in the Atherosclerosis Risk in Communities (ARIC) Study. **Methods:** We used data from ARIC visits 1 (1987-1989), 2 (1990-1992), and 3 (1993-1995). Movers were identified by a change in geocoded address coordinates between visits 2 and 3 and further defined as within-county and out-of-county moves. We further characterized moves by distance, either greater or less than the median moving distance. We compared Visit 2 sociodemographic, cognitive, psychosocial, and health-related characteristics of within and out-of-county movers to non-movers and used logistic regressions to identify independent predictors of moving within-county and out-of-county. **Results:** Of 12,834 participants included in analyses, we identified 390 out-of-county moves and 1,046 within-county moves. Out-of-county movers had higher cognitive test scores, were more educated, and had better self-rated health compared to non-movers (all  $p < 0.001$ ). Within-county movers were more likely to live alone and had worse self-rated health compared to non-movers (all  $p < 0.001$ ). Independent predictors of out-of-county moves included concurrent change in employment status or cohabitation status, better cognitive performance on a test of verbal fluency, higher depressive symptom burden, and fewer years living in one's community. Independent predictors of within-county moves included younger age, being unmarried, lower income, prevalent coronary heart disease, concurrent change in cohabitation status, and fewer years living in one's community. **Conclusions:** Life events, demographics, and health-related characteristics are independently associated with within-county and out-of-county moves. Understanding these associations can help explain trends in residential mobility. Our results have implications for epidemiological studies of the impact of contextual factors and the potential for selection bias due to moves outside of the study catchment area.

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## ABSTRACT E-BOOK

Theme: **Mixtures and models**

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**P-0619**

### **Pharmacokinetics of Bisphenol A in Humans Following Dermal Administration**

**Presenter:** Rebecca Nachman, U.S. Environmental Protection Agency, Washington, United States

**Authors:** A. Sasso<sup>1</sup>, R. Pirow<sup>2</sup>, S. Andra<sup>3</sup>, R. Church<sup>4</sup>, R. Nachman<sup>1</sup>, S. Linke<sup>2</sup>, D. Kapraun<sup>1</sup>, S. Schurman<sup>4</sup>, M. Arora<sup>3</sup>, K. Thayer<sup>1</sup>, J. Bucher<sup>4</sup>, L. Birnbaum<sup>5</sup>;

<sup>1</sup>U.S. Environmental Protection Agency, Washington, DC, <sup>2</sup>German Federal Institute for Risk Assessment (BfR), Berlin, GERMANY, <sup>3</sup>Senator Frank R. Lautenberg Environmental Health Sciences Laboratory, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>4</sup>National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health (NIH), Department of Health and Human Services (DHHS), Research Triangle Park, NC, <sup>5</sup>Scientist Emeritus, NIEHS, NIH, DHHS, Research Triangle Park, NC.

Background Human exposures to bisphenol A (BPA) are widespread. Sources include food packaging and cash register receipts. Assessments of human health risk from BPA exposure rely on pharmacokinetic data for estimation of internal dose following human exposure. We addressed uncertainties regarding human pharmacokinetics of BPA following dermal exposure through an examination of absorption, distribution, metabolism and excretion in humans following dermal administration. Methods We dermally administered deuterated BPA (d6-BPA) to 10 subjects (6 men, 4 women) at a dose of 100 µg/kg over a 12-hour period and collected blood and urine samples over a follow-up period of three or six days. Using total and unconjugated (“free”) d6-BPA concentrations in serum, we calculated the elimination half-life and area under the curve. Results Detectable serum levels of total d6-BPA and unconjugated BPA were observed at 1.4 hours and 2.8 hours, respectively, after start of dermal administration, with maximum serum concentrations ( $C_{max}$ ) of 3.26 nM and 0.272 nM, respectively. Beginning at approximately seven hours and continuing to 12 hours, the rate of increase in free and total serum d6-BPA slowed. The elimination half-lives of total d6-BPA and free d6-BPA were  $17.9 \pm 4.88$  h and  $14.8 \pm 4.06$  h, respectively. Unconjugated d6-BPA was a greater percentage of the area under the curve of total serum BPA (8.95%) compared to 0.56% in our previously published oral study. Recovery of total administered d6-BPA in urine was ~1% of the applied dose after three days. Analysis of the area under the curve for dermal and oral administration revealed 2.3% of the dermal dose became systemically available. Conclusions These data confirm predictions that pharmacokinetics of BPA differ following oral and dermal exposure. Dermal exposure resulted in a longer apparent serum elimination half-life and higher free:total d6-BPA ratio compared to oral. This abstract does not represent EPA policy.

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**P-0620**

### **Cumulative Environmental Exposures and Accelerated Biological Aging**

**Presenter:** Kristen Malecki, University of Wisconsin Madison, Madison, United States

**Authors:** K. Malecki, M. Nikodemova, A. Spicer, A. Schultz, M. Engelman;  
University of Wisconsin Madison, Madison, WI.

Background: New methods for understanding biological pathways by which social and physical environments intersect to exacerbate disease processes and contribute to health disparities are needed. Epigenetic clocks derived from DNA methylation patterns are a novel tool to measure biological aging in comparison to chronological age. We used two different epigenetic clocks (Horvath and Levine) to determine the impact of chemical and social exposures on accelerated biological aging. Methods: Data from 620 Survey of the Health of Wisconsin participants were analyzed to examine associations between self-reported neighborhood-related stress, ambient air pollution, lead exposure, and smoking status and accelerated biological aging. The “Horvath clock” includes 351 CpGs that are highly correlated with chronological age and is the most commonly-used biological aging measure. The DNA Phenotypic Age or “Levine clock” includes 513 CpGs correlated with several blood biomarkers predictive of premature mortality. Only 41 CpG sites are included in both clocks. DNA methylation was measured using the Illumina 850K EPIC chip array. Accelerated aging was calculated via the residuals produced by regressing each biological age metric on chronological age. Results: After adjustment for gender, BMI, education and income, self-reported stress from living in a neighborhood ( $\beta = .54$ ,  $p < .04$ ) and smoking ( $\beta = 1.59$ ,  $p < .000$ ) were both associated with accelerated biological aging using the Levine clock. Only smoking ( $\beta = .50$ ,  $p < .04$ ) was associated with the Horvath clock. Adjustments for physical activity reduced associations with neighborhood stress. Conclusions: Epigenetic clocks may capture accelerated biological aging associated with social stress and smoking but not environmental exposures at or below background population levels. Findings suggest that the Levine clock may be more sensitive to measuring the impact of social factors on aging. Epigenome-wide associations studies are needed to identify specific functional pathways and CpG sites that better epigenetic indicators more reflective of both chemical and social impacts on health and aging.

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Theme: **Mixtures and models**

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**P-0621**

**The perception and disposal practices on unused and expired medications in an urban municipality, southwest Nigeria**

**Presenter:** Olufemi T Aluko, Obafemi Awolowo University, Ile Ife, Nigeria

**Authors:** O. O. Aluko, G. T. Imbianozor, C. O. Jideama, O. V. Ogundele, T. E. Fapetu;  
Obafemi Awolowo University, Ile Ife, NIGERIA.

Background: A drug is any formulation used in the prevention and treatment of a disease or condition. Pharmaceutical wastes results from the unused drugs posing a disposal challenge for the pharmacy and users. Studies have shown that drugs disposed of in the environment have health consequences and multiplier environmental risks. This study aims to determine and compare the management of Unused and Expired Medications (UEM) by households in a heterogeneous municipality in southwest Nigeria. Methods: The study comparative cross-sectional in nature, and multi-stage sampling technique identified the study population, who are women in households, assumed to be experienced in the handling and safekeeping of medications. The minimum sample size was 382 and recorded 97.4% response rate. Data management was achieved using the IBM-SPSS version 20. Continuous and categorical variables were presented in tables as mean ( $\pm$ SD), and proportions (percentages) with bar charts to highlight salient findings. Results: 72.9% and 66.7% of residents in the low-density (LD) and high-density (HD) settlements disposed of household unused solid medications in the trash-bin. Likewise, 47.9% and 55.6% of respondents in the LD and HD areas, respectively disposed of their unused liquid medications in the trash-bin, respectively while 34.9% and 16.7% disposed of their unused liquid medications in the toilet/sink, respectively. Most respondents had good knowledge and had poor practice. However, there were significant differences in disposal methods used by households in LD and HD settlements for solid ( $p=0.0001$ ) and liquid medications ( $p=0.0001$ ), respectively. Conclusions: Respondents good knowledge and positive attitudes contrasted to poor practice on disposal of UEMs. There were disparities in the disposal of solid and liquid medications, respectively in LD and HD settlements. Appropriate legislation, and compliance monitoring and enforcement and are drivers to a formal, incentive driven recovery systems for UEMs and alleviate the consequences of current disposal practices in Nigeria.

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## ABSTRACT E-BOOK

Theme: **Mixtures and models**

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**P-0622**

### Comparing Performance between Models Assessing the Additive Effects of Exposure Mixtures

**Presenter:** Drew B Day, Seattle Children's Research Institute, Seattle, United States

**Authors:** D. B. Day<sup>1</sup>, S. Sathyanarayana<sup>2</sup>, K. Z. LeWinn<sup>3</sup>, N. R. Bush<sup>3</sup>, C. J. Karr<sup>4</sup>, A. A. Szpiro<sup>4</sup>;

<sup>1</sup>Seattle Children's Research Institute, Seattle, WA, <sup>2</sup>Seattle Children's Research Institute & University of Washington, Seattle, WA, <sup>3</sup>University of California, San Francisco, San Francisco, CA, <sup>4</sup>University of Washington, Seattle, WA.

**Background/Aim:** Multiple methods have been proposed to assess the relationship between mixtures of environmental exposures and health outcomes. However, few simulation experiments have been performed to compare statistical properties. **Methods:** We simulated data to compare the performance of additive mixture models in inferring associations with continuous outcomes. We tested weighted quantile sum (WQS) regressions run using either a bootstrap or random subset algorithm to determine mixture weights. Each of these was tested without splitting the data into training and validation datasets, splitting the data once, or repeatedly splitting the data. In addition, we tested a novel WQS regression permutation test designed to maintain statistical power with nominal false positive rate (FPR) by not requiring splitting the data. We also tested quantile g-computation regression and novel Bayesian formulations of WQS and quantile g-computation regressions. Simulations modeled a positive or null association between the outcome and a mixture with individual components having contributions in the same direction and varying weights. We also applied these methods to assess the association between prenatal phthalate exposure and early childhood full scale intelligence quotient (FSIQ) in the CANDLE cohort. **Results:** The random subset WQS regressions without splitting the data into training and validation datasets coupled with the permutation test had the best balance of accuracy, specificity, and sensitivity for mixture coefficients and weights (Power=0.86-0.92, FPR=0.05), compared to splitting the data once (Power=0.57-0.69, FPR=0.03-0.06), multiple times (Power=0.88-0.94, FPR=0.07-0.11), or not at all (Power=0.93-0.97, FPR=0.05-0.18). Quantile g-computation performed similarly though with increased weight estimate error. Associations with FSIQ varied substantially across analytic methods. **Conclusions:** WQS methods perform best when paired with a permutation test and when using a random subset algorithm, even with relatively few mixture components. Variation in model results with the real data highlights the importance of evaluating the relative performance of these models.

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**P-0623**

**Genotoxicity of bisphenol A and bisphenol analogues using human breast cancer (MCF-7) mutants**

**Presenter:** Jiyun Lee, Korea University, Seoul, Korea, Republic of

**Authors:** J. Lee<sup>1</sup>, S. Akter<sup>2</sup>, R. Akagawa<sup>2</sup>, S. Takeda<sup>2</sup>, K. Ji<sup>3</sup>;

<sup>1</sup>Korea University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Kyoto University, Kyoto, JAPAN, <sup>3</sup>Yongin University, Yongin, KOREA, REPUBLIC OF.

In response to the restriction of bisphenol A (BPA), bisphenol analogues (BPs) have been often used as alternative compounds for the production of polycarbonate plastics. However, limited information is available on their genotoxic effects. In this study, the genotoxic effects and underlying mechanisms of BPs were investigated using human breast cancer (MCF-7) mutants that were deficient in major DNA repair pathway. We assessed whether tyrosyl-DNA phosphodiesterase 2 (TDP2) contributed to the repair of BPs-induced double strand breaks (DSBs) in MCF-7 cell line. MCF-7 TDP2<sup>-/-</sup> mutant cells were generated by CRISPR/Cas9 gene targeting with a guide RNA designed and cloned into pX459. After pulse exposure (2 hr) of MCF-7 TDP2<sup>-/-</sup> mutants to DMSO (as solvent control), estradiol (as positive control), and seven BPs (BPA, BPAF, BPAP, BPC, BPF, BPS, and BPSIP 20 ppm), immunostaining of tumor suppressor p53-binding protein 1 (53BP1) foci was performed. To exclude the effects of DNA replication and homology-directed repair, we enriched G1-phase cells by serum starvation using serum-free medium for 24 hr before chemicals treatment. The average number of 53BP1 foci was significantly increased in MCF-7 TDP2<sup>-/-</sup> mutant cells exposed to BPA and its analogues compared to the solvent control. The extent of increase in foci number was greater in BPAF, BPSIP, and BPS-treated groups than in BPA or E2 exposure group. These results suggest that BPs could induce DSBs repaired through TDP2 pathway, and BPAF, BPSIP, and BPS appeared to have more profound effects on genotoxicity than BPA did. The present study indicated that BPs have a genotoxicity similar or greater than the compound that they were intended to replace, i.e., BPA. Acknowledgement: This study was supported by the National Research Foundation of Korea (Project NRF-2019R1A2C1002712).

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**P-0624**

**Characterizing multipollutant exposure profiles among a cohort of pregnant women via self-organizing maps**

**Presenter:** Brett T Doherty, Dartmouth College, Lebanon, United States

**Authors:** B. T. Doherty<sup>1</sup>, M. E. Romano<sup>1</sup>, J. L. Pearce<sup>2</sup>, M. R. Karagas<sup>1</sup>;

<sup>1</sup>Dartmouth College, Lebanon, NH, <sup>2</sup>Medical University of South Carolina, Charleston, SC.

Exposure to pollutants during pregnancy can adversely impact fetal development during the sensitive prenatal period. Such exposures do not occur in isolation, and pregnant women are exposed to multipollutant mixtures, which poses challenges for the investigation of risks of harm of environmental pollutants. One approach to investigate health effects of multipollutant mixtures is to derive exposure profiles from multipollutant exposure data, which obviates the challenging parameterization of multipollutant exposures and enable contrasts of health outcomes across exposure profiles. A promising method for exposure profile discovery and characterization is the self-organizing map (SOM). SOMs are similar to the k-means clustering algorithm, with the added utility of a spatially correlated topology among clusters that enhances understanding of between-cluster relationships. SOMs were used to characterize multipollutant exposure profiles among pregnant women from the New Hampshire Birth Cohort Study (n=337). Multipollutant exposures were assessed via silicone wristband passive monitors, worn for 7±1 days at 15±6 gestational weeks. Wristbands were analyzed for concentrations of 1530 organic pollutants via gas chromatography. Of 200 chemicals detected in at least one wristband, 18 were detected in ≥60% of wristbands. These 18 chemicals included five phthalates, six pesticides, and several chemicals used in consumer products and personal care products. A rectangular SOM of dimensions 7x2 was fit to these frequently detected chemicals. The 14 SOM profiles reflected unique combinations of these chemicals and ranged in size from 180 to 1 participants per profile. The largest profile was characterized by low to moderate exposures to most pollutants, whereas other profiles had exceptionally high or low exposure to a subset of pollutants. Certain covariates varied across SOM profiles, including BMI, educational attainment, race/ethnicity, and season of wear. This work demonstrates the utility of SOMs for discovering and characterizing exposure profiles from multifaceted exposure data.

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**P-0626**

### **Testing the Utility of Electronic Health Records and Health Information Network Data to Determine Potential Health Impacts Associated with Opportunities for Exposure to Environmental Contaminants**

**Presenter:** Suzanne Kathryn Condon, US Centers for Disease Control and Prevention, Atlanta, United States

**Authors:** S. K. Condon, G. Namulanda;  
US Centers for Disease Control and Prevention, Atlanta, GA.

It was hypothesized that health care claims (HCC) and electronic health records (EHRs) might provide the opportunity to access more timely and geographically refined data, and more information than is typically available from traditional public health surveillance systems; for example, measurements of risk factors (such as high cholesterol), co-diagnosis, medication prescription information and laboratory test results. We designed a pilot study in the state of Delaware (DE) to explore the utility of these data as a surveillance tool. The city of New Castle, DE was selected because: (1) it had levels of contaminants in drinking water that exceeded federal advisory levels and (2) it has universal claims and access to EHR data through the Delaware Health Information Network (DHIN). We included residents who lived in New Castle City during the period 2013 to 2018. We selected the following outcomes to focus on based on the contaminants of interest: cardiovascular disease; thyroid disease; kidney cancer; and testicular cancer. We are in the process of defining the inclusion and exclusion criteria for de identified laboratory and clinical diagnosis data on these outcomes, to identify HCC and EHR datasets for analysis. We will analyze the data by zip code and census tract, and include demographic information (age, race/ethnicity, and gender) for each outcome of interest. We will also compare rates of health outcomes obtained using HCC data to those obtained using EHR data. The overall goal is to determine the value of conducting ecologic analyses using HCC and EHR data to inform the design of larger, long term epidemiological studies evaluating exposure to environmental contaminants and potential health impacts. The need to identify such surveillance tools is critical as existing disease registries are often not timely enough due to reporting requirements and disease latency and/or are limited by small numbers of events.

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**P-0627**

### **A Hierarchical Model for Estimating Exposure-Response Curves from Multiple Studies of Household Air Pollution**

**Presenter:** Joshua P. Keller, Colorado State University, Fort Collins, United States

**Authors:** J. P. Keller<sup>1</sup>, J. Katz<sup>2</sup>, A. K. Pokhrel<sup>3</sup>, M. N. Bates<sup>3</sup>, J. Tielsch<sup>4</sup>, S. L. Zeger<sup>2</sup>;  
<sup>1</sup>Colorado State University, Fort Collins, CO, <sup>2</sup>Johns Hopkins University, Baltimore, MD, <sup>3</sup>University of California, Berkeley, Berkeley, CA, <sup>4</sup>George Washington University, Washington, DC.

Estimating flexible exposure-response curves is critical for quantifying the impacts of environmental exposures on health. In intervention trials targeting household air pollution, the limited range of concentrations and small sample sizes of individual studies are important factors that may be limiting their statistical power. Pooling data from multiple studies provides an opportunity to increase power for estimating the exposure-response relationship.

We present hierarchical approaches to modeling exposure concentrations and combining data from multiple studies to estimate a common exposure-response curve. The models are designed to accommodate features relevant to many environmental epidemiology studies: exposure measurements and outcome ascertainment that are irregularly spaced across time, clustered by individual and groups of individuals, and impacted by seasonal trends. The exposure concentration model additionally incorporates shrinkage to reduce error from high-variance observations. The exposure-response curve model provides a flexible, semi-parametric estimate of the joint exposure-response relationship across multiple studies from different times and contexts. We demonstrate this modeling approach using data from three studies of cookstoves and acute lower respiratory infections in children in Nepal.

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**P-0628**

**Benefits and challenges of combining data from the CHEAR consortia**

**Presenter:** Stefanie A Busgang, HHEAR Data Center, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** S. A. Busgang<sup>1</sup>, E. Colicino<sup>1</sup>, M. J. Mazzella<sup>1</sup>, M. Hauptman<sup>2</sup>, A. M. Schiltz<sup>3</sup>, K. L. Hamlington<sup>4</sup>, S. S. Andra<sup>5</sup>, R. O. Wright<sup>5</sup>, D. Boyd Barr<sup>6</sup>, P. Panuwet<sup>6</sup>, W. Phipatanakul<sup>2</sup>, A. H. Liu<sup>3</sup>, S. Teitelbaum<sup>1</sup>, C. Gennings<sup>1</sup>;

<sup>1</sup>HHEAR Data Center, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Boston Children's Hospital, Boston, MA, <sup>3</sup>Children's Hospital Colorado, University of Colorado School of Medicine, National Jewish Health, Denver, CO, <sup>4</sup>Pediatric Pulmonary and Sleep Medicine, University of Colorado School of Medicine at Children's Hospital Colorado, Aurora, CO, <sup>5</sup>Department of Environmental Medicine and Public Health, Mount Sinai School of Medicine, New York, NY, <sup>6</sup>Laboratory of Exposure Assessment and Development for Environmental Research (LEADER), Gangarosa Department of Environmental Health, Rollins School of Public Health, Emory University, Atlanta, GA.

**Background/Aim:** The constraints of sample size in environmental epidemiology studies can limit the detection of meaningful associations. Additionally, study-specific biases may arise from differences in data collection methods, exposure and outcome definitions, and confounder selection. Pooling individual level data across studies may reduce implicit study bias. **Methods:** Using the Children's Health Exposure Analysis Resource (CHEAR), we assessed the benefits and potential challenges of pooling data by combining study participants (206 children ages 4-16 years) from the School Inner-City Asthma Intervention Study and the Denver Asthma Panel Study who submitted urine samples to CHEAR laboratories for phthalate metabolite measurement. Composite Asthma Severity Index (CASI) score was used to assess the relationship of phthalates, singularly and as a mixture, on asthma severity in each cohort and combined. All models controlled for age, sex, race, income, body mass index percentile, and creatinine with a random effect for study when appropriate to account for intra-study correlation. **Results:** For individual log<sub>2</sub> transformed phthalate analyses conducted for each study alone, no significant associations with CASI score were observed after applying a false discovery rate (FDR) p-value. However, when the studies were combined, four phthalate metabolites had significant associations with CASI after FDR adjustment. One challenge of pooling data was the need to harmonize covariates - for example, income definition: yearly income compared to last month's income. An additional challenge was the range in exposure distributions across cohorts. We utilized CHEAR quality control samples to evaluate potential systematic lab differences versus study-specific differences. **Conclusion:** Although pooling data poses several challenges, we were able to overcome some of them and identified associations in the pooled data that were null in the individual cohorts. The increased sample size may be more suitable for studying potential effect modifiers, such as sex, that could not be found in one cohort alone.

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**P-0629**

**Effects of land use and vegetation on nighttime air temperature in heat vulnerable neighborhoods in New York City**

**Presenter:** Lauren Smalls-Mantey, NYC Department of Health, New York, United States

**Authors:** L. Smalls-Mantey<sup>1</sup>, S. Johnson<sup>1</sup>, B. Gunther<sup>2</sup>, K. Charles-Guzman<sup>3</sup>, K. Ito<sup>1</sup>;

<sup>1</sup>NYC Department of Health, New York, NY, <sup>2</sup>NYC Department of Parks and Recreation, New York, NY,

<sup>3</sup>NYC Mayor's Office of Resiliency, New York, NY.

Background: Climate change is projected to increase the frequency and duration of extreme heat days in New York City (NYC), increasing heat risks among vulnerable populations. A Heat Vulnerability Index (HVI) previously developed in NYC based on epidemiological analysis, facilitated the City's heat mitigation initiatives (i.e. planting street trees in high heat-vulnerable neighborhoods). The initiative also allowed an assessment of the role of land-use and vegetation on air temperature variations within these neighborhoods. Methods: Nearly 500 temperature sensors were installed on street trees and light poles in 16 medium to high HVI neighborhoods, with approximately 35 sensors within each neighborhood of size up to 1 km<sup>2</sup>, during the summer of 2018. The average nighttime air temperatures (3 to 5 am) at these locations were modeled as a function of buffer-based (along street blocks) tree canopy, grass/shrubs, impervious surfaces, and buildings, allowing for non-linear relationships in a land-use regression model, adjusting for inter-neighborhood variations as a smooth function of XY coordinates. Results: With all predictors, the model R-squared was 71%. Street block level grass/shrub density was negatively associated with nighttime air temperature, with a ~0.8 degrees °C reduction within its range (0-25% cover). Street block level tree-canopy was also negatively associated with nighttime temperature, though it was strongly modified by street orientation: a ~0.4 degrees °C reduction for east-west streets over its range 0-60% cover, but null for north-south streets, likely influenced by both sunlight duration and wind patterns. Street block level impervious surface was positively associated with nighttime temperature, with ~0.2 degrees °C increase over its range of 5 to 50% coverage. Conclusions: In this high density, hyper-local temperature data measured in heat vulnerable neighborhoods, vegetative covers were associated with reductions in nighttime air temperatures. Parameters obtained from this study will be incorporated into modeling and projections for future heat mitigation planning.

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**P-0630**

**Evaluation of confounding by socioeconomic status (SES) on the association between PM<sub>2.5</sub> and mortality in the U.S Medicare population**

**Presenter:** Chloe S Kim, Electric Power Research Institute, Palo Alto, United States

**Authors:** C. S. Kim, A. C. Rohr;  
Electric Power Research Institute, Palo Alto, CA.

**Background/Aim:** Socioeconomic status (SES) is a complex construct that is influenced by many individual- and area-level factors encompassing material, human, and social capital. SES has been suggested to be an important confounder to consider in environmental epidemiological studies. However, many previous studies were limited in their ability to adequately capture the complexity of SES and likely have resulted in residual confounding. The objective of our study was to assess the potential for utilizing publicly available SES data to more accurately describe confounding by SES on the association between PM<sub>2.5</sub> and mortality in the Medicare population in the U.S. **Methods:** Monthly mortality counts and PM<sub>2.5</sub> concentrations in the contiguous U.S. for 2000-2012 were obtained at the ZIP code level. We also searched for publicly available SES data beyond what is typically used (such as income, education, and race). The base model was only adjusted for age and sex, while the multivariable models were adjusted for multiple SES indicators by controlling for individual SES variables as well as using Principal Component Analysis (PCA) approach. **Results:** 29 publicly available SES data were collected from the Census Bureau and the Internal Revenue Service (IRS). Some examples of the SES indicators used in our study include income inequality (Gini index), non-salary wealth, % occupation in management/business/science, % moved from abroad, and % household with > 1 person/room. We found that the increased risks of mortality associated with PM<sub>2.5</sub> in our Medicare population were slightly confounded by SES with different methods of controlling for SES resulting in different magnitudes of confounding effect. **Conclusion:** These results warrant further investigation examining the best approach for using multiple SES data to accurately capture the confounding effect of SES. In addition, our study demonstrated the possibility of utilizing publicly available data to examine the complex confounding effect of SES in environmental epidemiological studies.

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**P-0631**

### **Biochemical Studies Reveal Remarkable Influence of Bioremediation Treatments on Health Status of Crude Oil Polluted Soil and Oxidative Stress in Selected Plants**

**Presenter:** Folasade M. Olajuyigbe, Federal University of Technology Akure, Akure, Nigeria

**Authors:** F. M. Olajuyigbe, F. O. Fasimoye;  
Federal University of Technology Akure, Akure, NIGERIA.

Oil spillage is a challenging global problem which requires urgent search for effective clean-up strategies to conserve the ecosystem. In this study, effects of crude oil pollution and bioremediation treatments on soil health and plant growth were investigated. Agricultural soil was polluted with crude oil ranging from 5.0 to 25.0 mL per kg soil. Three food crops, maize (*Zea mays*), soybean (*Glycine max*) and amaranth (*Amaranthus cruentus*) were planted and grown in three groups; Group I comprised plants on polluted soils without any treatment. Group II were plants on polluted soils exposed to bioremediation treatments using biostimulation and bioaugmentation methods. Group III comprised plants on clean soil which served as control. Experiments were carried out in triplicates. Soil enzyme activities and physicochemical parameters were determined using standard assay and evaluation procedures. Growth parameters, proximate composition and oxidative stress indicators of maize, soybean and amaranth plants were monitored over 120 d experimental period. Results indicated significant inhibition ( $p < 0.05$ ) of activity of soil enzymes (dehydrogenase,  $\beta$ -glucosidase, acid phosphatase, arylsulphatase, amidase and protease) by crude oil pollution. The trend was significantly reversed in bioremediated soils with significant enhancement of enzyme activity. Height of plant and number of leaves significantly decreased ( $p < 0.05$ ) with increasing concentration of crude oil polluted soil. Improvement in plant growth parameters was recorded in soils bioremediated with inorganic and organic fertilizers. Levels of oxidative stress indicators (superoxide dismutase, catalase and peroxidase) and malondialdehyde from stem of plants grown on bioremediated soils significantly reduced compared with polluted soil. GC-MS analysis revealed more significant level of crude oil degradation in soil bioremediated with inorganic fertilizer (NPK). Results established the efficacy of bioremediation treatments in alleviating toxicity of crude oil pollution in agricultural soils and revealed biostimulation using NPK and cow dung (organic fertilizer) as a more effective strategy.

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**P-0633**

**High spatial and temporal resolution estimates of air pollutants from the TEMPO satellite:  
Methodological opportunities and challenges for environmental epidemiology studies**

**Presenter:** Daniel Carrión, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** D. Carrión<sup>1</sup>, S. Alexander<sup>2</sup>, A. Naeger<sup>3</sup>, M. Newchurch<sup>2</sup>, K. Chance<sup>4</sup>, A. C. Just<sup>1</sup>;

<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>University of Alabama at Huntsville, Huntsville, AL, <sup>3</sup>NASA Short-term Prediction Research and Transition Center, Huntsville, AL, <sup>4</sup>Harvard & Smithsonian Center for Astrophysics, Cambridge, MA.

The NASA Tropospheric Emissions: Monitoring of Pollution (TEMPO) mission is scheduled to launch its satellite in 2022. This satellite is specifically designed to provide some of the finest spatial (2.1 km\*4.7 km) and temporal (hourly) resolution estimates of gaseous and particulate air pollutants across North America, including ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), and formaldehyde (H<sub>2</sub>CO). Given its geostationary orbit, it will have repeated daytime measurements of each pollutant. These data will provide new opportunities and challenges for exposure science and environmental epidemiology. Within-day measurements allows for epidemiologic analyses of how within-day variability (and peak exposures) of air pollutants effects human health. Simultaneous measurement of multiple pollutants allows for mixtures modeling rather than traditional single pollutant approaches. Finally, increased resolution of measurements can improve understanding of environmental justice and both exposure and health disparities. Potential challenges include identification and use of health datasets matching the fine-scale resolution of exposure, and the management of large exposure and health datasets. Furthermore, careful exposure science will be required to translate satellite estimates (which are integrated over an atmospheric column) into ground-level estimates most relevant to human exposure. Our session will discuss the TEMPO satellite, the epidemiological basis for studying peak exposures rather than daily averages, and the methodological opportunities and challenges that these efforts represent.

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**P-0634**

**Exposure patterns among Coast Guard responders to the Deepwater Horizon Oil Spill: a latent class analysis**

**Presenter:** Matthew O Gribble, Emory University, Atlanta, United States

**Authors:** M. O. Gribble<sup>1</sup>, T. Keshav<sup>2</sup>, L. S. Engel<sup>3</sup>, H. Denic-Roberts<sup>2</sup>, M. Stenzel<sup>4</sup>, D. L. Thomas<sup>5</sup>, J. A. Rusiecki<sup>2</sup>;

<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Uniformed Services University, Bethesda, MD, <sup>3</sup>University of North Carolina, Chapel Hill, Chapel Hill, NC, <sup>4</sup>Exposure Assessment Applications, LLC., Arlington, VA, <sup>5</sup>United States Coast Guard, Directorate of Health, Safety and Work Life, Washington, D.C., DC.

Disclaimer: The contents, views or opinions expressed in this presentation are those of the author(s) and do not necessarily reflect official policy or position of Uniformed Services University of the Health Sciences, the Department of Defense (DoD), or the United States Coast Guard. Background: The Deepwater Horizon Oil Spill was an environmental crisis for which multiple groups, including the United States Coast Guard (USCG), provided emergency response services. A cohort of 5,665 USCG oil spill responders completed post-deployment surveys on a number of topics, including oil spill-related exposures and experiences. Methods: This secondary data analysis of survey responses used latent class analysis (LCA) methods to determine the most common exposure patterns in this population of responders. Our LCA model was based on six indicator variables assumed to be independent of each other within latent classes. The indicator variables reflected different aspects of the responders' experiences: exposure to oil, exposure to engine exhaust fumes, hand sanitizer use, sunblock use, mosquito bites, and level of anxiety. To assess the convergent construct validity of these models, we considered the relationship of the latent classes to indicators not used in the latent class models. We also considered the relationship to the types of missions reported by cohort participants. Results: The data were consistent with four exposure profiles, which we interpreted as "low exposure", "higher environmental hazard exposure and moderate time outdoors", "moderate environmental hazard exposure and more time outdoors", and "high exposure to both environmental hazards and time outdoors". The tests for convergent construct validity supported this interpretation of the latent classes. For example, participants in administrative roles were most likely to be in the low-exposure latent class. Conclusions: The exposure pattern variables resulting from this analysis can help inform future studies of the health impacts of exposure mixtures among oil spill responders.

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**P-0635**

**Aggregate exposure assessment using cosmetic co-use scenarios**

**Presenter:** Miyoung Lim, Institute of Health and Environment, Seoul National University, Seoul, Korea, Republic of

**Authors:** M. Lim<sup>1</sup>, K. Lee<sup>2</sup>;

<sup>1</sup>Institute of Health and Environment, Seoul National University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Graduate School of Public Health, Seoul National University, Seoul, KOREA, REPUBLIC OF.

The “co-use” patterns of cosmetics would be critical for accurate aggregate exposure assessment. We proposed cosmetic co-use scenarios by analyzing the co-use patterns of Koreans. We conducted aggregate exposure assessments using the co-use scenarios and validated the new methodology by comparing the results to those of a receptor-based aggregate exposure assessment. The Korean national representative exposure factor database, which includes simultaneous usage patterns of 31 cosmetics by 1,001 subjects, was used to analyze the co-use patterns by Koreans. Frequent pattern mining was performed using the eclat algorithm. The number of cosmetics used and co-use pattern were influenced by gender and age of the population. The co-use patterns exhibited an additive property in that new cosmetics were added to previous cosmetic combinations. A co-use scenario was proposed using the rank of occurrence frequency in co-use patterns and percentile values of the number of cosmetics used. The 16 co-use scenarios represented to the 25th, 50th, 75th, and 95th percentiles of the co-use patterns for four gender-age groups. The aggregate exposures of di(2-ethylhexyl)phthalate (DEHP), di-n-butyl phthalate (DnBP) and diethyl phthalate (DEP) in cosmetics were estimated by co-use scenarios for cosmetics. The co-use scenario-based AED increased with the number of cosmetics in the co-use scenarios, and was higher in female and younger groups. The major contributors were body lotion for DEHP, nail polish for DnBP, and hair styling product in males and shower cologne in females for DEP. The distribution of the co-use scenario based AEDs displayed a similar trend to that of the receptor-based AEDs, with the 95th percentiles of the AED slightly underestimated in the co-use scenario. The aggregate exposure assessment methodology using co-use scenario could provide reasonable aggregate exposures with relatively few resources required.

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**P-0637**

**Disentangling multiple environmental stressors in relation to incident cardiovascular disease in UK Biobank: a sparse principal component analysis**

**Presenter:** Yutong Cai, University of Oxford, Oxford, United Kingdom

**Authors:** Y. Zhu<sup>1</sup>, A. Hong<sup>1</sup>, R. Ramakrishnan<sup>1</sup>, M. Nazarzadeh<sup>1</sup>, P. Song<sup>2</sup>, D. Canoy<sup>1</sup>, Y. Cai<sup>1</sup>, K. Rahimi<sup>1</sup>;  
<sup>1</sup>University of Oxford, Oxford, UNITED KINGDOM, <sup>2</sup>Imperial College London, London, UNITED KINGDOM.

**Background:** Multicollinearity is a common challenge in environmental epidemiology research. However, existing methods are mostly difficult to implement or produce results that are not readily interpretable. **Objectives:** Our aim is to use sparse principal component analysis (SPCA) to address the multicollinearity issue and improve interpretability of the prospective association between environmental exposures and risk of incident cardiovascular disease (CVD) using data from a large population-based cohort. **Methods:** We derived principal components using SPCA techniques on 24 different environmental exposures from the UK Biobank (405,583 participants) and built Cox regression models to estimate the hazard ratio (HR) for incident cardiovascular disease (CVD) associated with each component. We then back-calculated the hazard ratio (HR) to each individual environmental exposure from the coefficients derived from the SPCA Cox model and loading scores using a commonly adopted method for instrumental variable analysis. **Results:** During an average follow-up of 9.7 years, 25,655 participants developed CVD. Components characterised by higher exposure to traffic intensity on the nearest major road or traffic-related air pollutants (NO<sub>2</sub>, NO<sub>x</sub> and PM<sub>2.5</sub>) were significantly associated with incident CVD risk, as identified by the SPCA Cox model. For each 1-SD (1.05 ug/m<sup>3</sup>) higher PM<sub>2.5</sub>, the HR was 1.09 (95% confidence interval 1.06-1.12); risk estimates were similar in magnitude for NO<sub>2</sub> or NO<sub>x</sub>. Results for other exposures were variable and inconsistent. **Conclusion:** Using SPCA, our study consistently identified traffic-related air pollution as an important risk factor of CVD. SPCA offers a potential solution to address multicollinearity and the advantage for to identify relatively more important environmental exposures in relation to incident CVD outcome.

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## ABSTRACT E-BOOK

Theme: **Mixtures and models**

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**P-0638**

### **Evaluating commercially generated residential address histories in an aging population: the Ginkgo Evaluation of Memory Study**

**Presenter:** Cindy S Leary, University of Montana, Missoula, United States

**Authors:** C. S. Leary<sup>1</sup>, A. Hajat<sup>2</sup>, J. D. Kaufman<sup>2</sup>, A. Fitzpatrick<sup>2</sup>, C. Park<sup>2</sup>, E. O. Semmens<sup>1</sup>;  
<sup>1</sup>University of Montana, Missoula, MT, <sup>2</sup>University of Washington, Seattle, WA.

Background: Epidemiological studies of spatially varying exposures benefit from accurate long-term comprehensive residential address histories of study participants in order to accurately link locations to spatially and temporally resolved exposure information. Commercially available residential address history databases might help researchers establish historical address data retrospective to study onset. The Ginkgo Evaluation of Memory Study (GEMS) was a randomized trial in four US sites (Hagerstown MD, Pittsburgh PA, Sacramento CA, and Winston-Salem NC) from 2000-2008. We aimed to assess the accuracy and historical reach of LexisNexis residential histories for the 3,069 GEMS participants from 1980 to 2008. Methods: We submitted to LexisNexis a list of 3069 participant names and 4050 known addresses and dates of residency from 2000-2008. The query returned 10,966 addresses. We developed a set of specific rules along with a fuzzy matching algorithm, to establish a sequence of probable residential histories. The average length of histories per participant were then evaluated and compared across gender, study site, and age. Results: Almost all (97.8%) GEMS participants had at least a partial address history returned by LexisNexis for years prior to 2000. The earliest historical addresses had a median year of 1983 and 35.2% of participants had their earliest historical address going back to at least 1980. The biggest differences in average historical lengths were between study sites. Participants from Hagerstown had an average of between 2.9 and 6.0 fewer years of residential history than the other three sites. Additionally, males had between .56 and 1.23 more years on average than females. Conclusions: Commercial residential address systems have the potential to enhance health studies that require historical residential information. As these types of databases grow in accessibility and accuracy, historical databases can be a key tool of environmental epidemiologists. Demographics and geographic locations, however, could impact accuracy and address length.

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**P-0639**

### **Health impact of teargas and other crowd control weapons: early findings from a panel study of journalists in Hong Kong**

**Presenter:** Crystal Y Chan, JC School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, Hong Kong

**Authors:** C. Chan<sup>1</sup>, D. Lui<sup>2</sup>, J. Lau<sup>2</sup>, K. Lui<sup>1</sup>, P. Lee<sup>3</sup>, J. Chan<sup>2</sup>, S. Ng<sup>4</sup>, K. Yiu<sup>4</sup>, D. Hui<sup>4</sup>;

<sup>1</sup>JC School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, HONG KONG, <sup>2</sup>Public Health Research Collaborative, Hong Kong, HONG KONG, <sup>3</sup>Faculty of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, UNITED KINGDOM, <sup>4</sup>Division of Respiratory Medicine, The Chinese University of Hong Kong, Hong Kong, HONG KONG.

**Background:** In 2019, there has been a large number of sustained street protests against government policies worldwide, with many involved extensive use of crowd control weapons (CCWs) such as teargas by law enforcement forces against civilians. Previous studies on the health impact of CCWs are sparse, and little evidence exists on the consequences of repeated, intensive exposure, especially in densely-populated cities like Hong Kong, where large-scale protests have been ongoing since June 2019.

**Methods:** During October-November 2019, we recruited 230 journalists in Hong Kong, for a baseline survey to assess their past exposure to CCWs (e.g. teargas, kinetic impact projectiles [KIPs]), symptoms and injuries experienced, use of protective equipment, and mental health condition (using the Depression Anxiety Stress Scale-21). Subsequent resurveys were conducted one, three and six months after the baseline to capture the temporal variations in exposure and health outcomes.

**Results:** Of the 230 journalists (57% female; mean [SD] age = 21.9 [15.5] years), 94% have been exposed to any CCWs before the baseline survey, with two-third exposed  $\geq$ once/ week since June 2019. About 95% participants had been exposed to teargas; ~50% had been exposed to pepper spray and water cannon; and ~40% had been exposed to at least one type of KIPs, including 43 and 35 being shot by teargas canisters and rubber bullets, respectively. Most (>80%) participants used respirators with chemical filters, but respiratory symptoms (e.g. cough, burning throat, breathing difficulties) remained common (20-30%). There were also surprisingly high prevalences of gastrointestinal (diarrhoea [27%], vomit [6%], dysentery [3%]), mental (moderate or severe depression [47%] and anxiety [23%]), and female reproductive (23% disrupted menstrual cycle) problems.

**Discussion:** Despite the independent role of journalists in mass protests, the sample had frequent exposure to CCWs and experienced a wide range of health problems across multiple body systems.

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Theme: **Mixtures and models**

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**P-0640**

**Combined effect of multiple exposure to low-level organic solvents on hepatotoxicity**

**Presenter:** Shinhee Ye, Occupational Safety and Health Research Institute, Korea Occupational Safety and Health Agency, Incheon, Korea, Republic of

**Authors:** S. Ye<sup>1</sup>, J. Sung<sup>1</sup>, M. Shin<sup>2</sup>, S. Lee<sup>3</sup>, J. Lee<sup>1</sup>;

<sup>1</sup>Occupational Safety and Health Research Institute, Korea Occupational Safety and Health Agency, Incheon, KOREA, REPUBLIC OF, <sup>2</sup>Occupational Safety and Health Research Institute, Korea Occupational Safety and Health Agency, Ulsan, KOREA, REPUBLIC OF, <sup>3</sup>University of Michigan School of Public Health, Ann Arbor, MI.

**Background/Aim** Exposure to organic solvents is one of the most common health hazard in workplaces. We aimed to find an association of multiple exposure to low-level organic solvents with hepatotoxicity by Bayesian kernel machine regression(BKMR). **Methods** Korean special health screening data of 2013 was used. We used hippuric acid(g/g crea.), methyl hippuric acid(g/g crea.), and N-dimethylformamide(mg/L) concentrations for exposure variable and aspartate aminotransferase(AST, IU/L), alanine transaminase(ALT, IU/L), and gamma-glutamyltransferase(GGT, IU/L) for outcome variable. For statistical analysis, participants with the exposure concentration above the exposure limits of the Korea special health screening were excluded, and those with missing data were excluded. All exposure variables were log transformed and standardized prior to the analysis. We examined the association between single exposure and each outcome using multivariate linear regression. In addition, we estimated combined hepatotoxicity of three exposure variables using BKMR. All analyses were adjusted for age, sex, body mass index, smoking status, alcohol drinking habits, and physical activity. **Results** 615 workers' data were included in the analysis. In the single exposure model, N-dimethylformamide concentrations were positively associated with AST ( $\beta=0.92$ ,  $SE=0.35$ ). In the BKMR analysis, increase of AST level was significantly associated with increase of combined three exposures. Posterior inclusion probabilities of the hippuric acid, methyl hippuric acid, and N-dimethylformamide were 0.148, 0.382, and 0.950, respectively. In addition, the results of BKMR represented the interactions among the three exposures and nonlinearity of each exposure. **Conclusions** The study found that simultaneous exposure to low-level organic solvents resulted in hepatotoxicity, and among the three exposures, N-dimethylformamide had the highest hepatotoxicity. BKMR can show combined effect, contribution of each exposure on the combined effect, nonlinear relationship, and interactions between exposures. Therefore, we should try to use this approach on occupational health study to obtain additional information not available from classical statistics.

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**P-0641**

**Indirect adjustment for unmeasured confounders in the association between long-term PM<sub>10</sub> exposure and mortality in South Korea**

**Presenter:** Garam Byun, BK21PLUS Program in 'Embodiment: Health-Society Interaction', Department of Public Health Sciences, Graduate School, Korea University, Seoul, Korea, Republic of

**Authors:** G. Byun<sup>1</sup>, J. Lee<sup>2</sup>;

<sup>1</sup>BK21PLUS Program in 'Embodiment: Health-Society Interaction', Department of Public Health Sciences, Graduate School, Korea University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>School of Health Policy and Management, College of Health Science, Korea University, Seoul, KOREA, REPUBLIC OF.

Background: Cohorts based on administrative data often lack information on socio-economic status or lifestyle, which could be potential confounders in the association between air pollution and health outcomes. Indirect adjustment via partitioned regression adopts an ancillary dataset to control for unmeasured confounders. We aimed to evaluate the bias correction of the indirect adjustment for individual-level variables in PM<sub>10</sub> mortality estimates in South Korea. Methods: The Korea National Health and Nutrition Examination Survey (2007-2015)-mortality linked cohort was used as a primary and ancillary dataset simultaneously to produce an adjusted mortality risk estimate of PM<sub>10</sub>. A total of 26,752 subjects (146,905 person-years), aged over 30 and resided in 122 districts of South Korea at baseline were included in the analyses. The district-level long-term PM<sub>10</sub> exposures (2007-2016 average concentrations) were assigned to individuals based on the residential address. A cox-proportional hazard regression model was used to estimate the effects of PM<sub>10</sub> on all-cause mortality. The effect estimate was indirectly and directly adjusted for smoking, physical activity, education, and occupation. Results: During the follow up by 2016, a total of 890 deaths were identified. PM<sub>10</sub> concentrations were higher in those who are smokers, less educated, do not participate in physical activity, and who are non-manual workers. The unadjusted hazard ratio for an increase of 10 µg/m<sup>3</sup> in PM<sub>10</sub> was 1.11 (95% CI: 1.00, 1.24). The indirectly adjusted hazard ratio was 1.03 (95% CI: 0.93, 1.16), and direct adjustment yielded a hazard ratio of 1.07 (95% CI: 0.95, 1.19). Conclusions: Individual socioeconomic and lifestyle factors might confound the association between long-term PM<sub>10</sub> exposure and mortality, and the effects of PM<sub>10</sub> can be over-estimated if no correction is made for these variables. Part of the difference in estimates between direct and indirect adjustment may be due to a high censoring rate.

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**P-0643**

**Multinomial logistic model for prediction of epidemiological indicators among urban dwellers exposed to outdoor air pollution**

**Presenter:** Audil Rashid, University of Gujrat, Gujrat, Pakistan

**Authors:** A. Rashid<sup>1</sup>, M. U. Ali<sup>2</sup>;

<sup>1</sup>University of Gujrat, Gujrat, PAKISTAN, <sup>2</sup>PMAS Arid Agriculture University, Rawalpindi, PAKISTAN.

Human exposure to environmental contaminants is unprecedented. World Health Organization has highlighted environmental disease burden a major health risk for developing countries. In the successive years (2012-14), two major hospitals in Rawalpindi city have witnessed rapid increase in air borne health anomalies among population such as upper respiratory tract infections, chest congestion, allergic response etc. Human exposure to air pollutants in urban environment cause considerable disease burden however, a scientific assessment is necessary to attribute health risks. Based on this premise, this study was conducted in urban area of Rawalpindi city with an aim to analyze population exposure to dust and particulate matter (PM) in relation to their vulnerability for disease susceptibility. Data from hospital records as well as through questionnaire-based survey was collected about exposure estimates, work environment, disease history, socio-demographic aspects and health risk type. The observed population (males=452 and females=128) of adult ages had numerous exposure durations ranging from 4 to 12 h day<sup>-1</sup>. Chi square test revealed 'age' and 'occupation' significant but 'gender' inconsistent with respiratory symptoms. A Cronbach's alpha value of 0.74 was maintained for reliability of health variables. Multinomial logistic-regression model showed 'shortness of breath' ( $\beta = 2.62$ ; odds ratio=13.8; 95% CI = 3.63-52.41) has highest risk factor followed by 'eye redness' ( $\beta = 1.14$ ; odds ratio=3.1; 95% CI =1.55-6.30). Overall a direct relationship between exposure to dust and PM with population illness was observed especially during construction of Rawalpindi Metro Bus Project in 2014. We conclude that degradation of environmental health has strong negative impact on general urban population that has not only lowered their functional capacity but also placed them at higher risk category. To overcome this challenge, prevention of human exposure to air pollution can be an effective intervention measure especially for people who are more vulnerable.

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Theme: **Mixtures and models**

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**P-0644**

### Identifying Multiple Exposure Burden with National Biomonitoring Data

**Presenter:** Jueun Lee, National Institute of Environmental Research, Incheon, Korea, Republic of

**Authors:** J. Lee<sup>1</sup>, J. Yoo<sup>1</sup>, E. Ha<sup>2</sup>, C. Lee<sup>1</sup>, S. Song<sup>1</sup>;

<sup>1</sup>National Institute of Environmental Research, Incheon, KOREA, REPUBLIC OF, <sup>2</sup>Ewha Womans University, College of Medicine, Seoul, KOREA, REPUBLIC OF.

**Background** The main impetus for the current assessment and management of hazardous chemicals is on its doses and health effect, but fewer studies have evaluated types of chemical mixtures, number of exposed chemicals and the vulnerable groups in general public. This study investigated exposure load through national biomonitoring program to pursue the exposure complexity over general population and to assess multipollutant exposure burden. **Methods** We obtained data from the Korean National Environmental Health Survey (2015-2017) and 6,167 participants were recruited including 571 preschoolers(3 to 5), 887 school-aged children(6 to 11) , 922 adolescent(12 to 18) and 3,787 adults(19 and older). All subjects were sampled for urinary levels of mercury, cadmium, polycyclic aromatic hydrocarbon(PAH) metabolites, volatile organic compound(VOC) metabolites, phthalate metabolites, parabens, environmental phenols, pyrethroid metabolite and cotinine. Additionally, blood lead and blood mercury levels were measured for ages 12 and older. In total, 26 chemicals were included in the analysis. We conducted several exposure load calculations with binary values for each individual analyte with different age groups and thresholds(limit of detection(LOD), 50<sup>th</sup>, 75<sup>th</sup>, 95<sup>th</sup>). **Results** Using LOD as exposure thresholds, 20% of all participants(age 3 to 86) were exposed to more than 25 chemicals. With 50<sup>th</sup>, 75<sup>th</sup>, 95<sup>th</sup> percentile thresholds, 20% of each population were exposed to more than 18, 11 and 2 chemicals, respectively. For participants who had the highest exposure to each chemical(95<sup>th</sup> percentile) cadmium was the most frequent chemical and 17.2% of all population had more than one heavy metal(mercury, lead, cadmium) exposure. For each age group, the most frequent chemical differed; cadmium for adults, bisphenol F and A for adolescent, monobenzyl phthalate for school-aged children, and 1-hydroxyphenanthrene for preschoolers. **Conclusions** These results can improve multipollutant exposure burden assessment, especially for the highly susceptible population and can strengthen national chemical management practice.

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Theme: **Mixtures and models**

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**P-0645**

**Development of informatics techniques for studying the exposome in large population scale studies**

**Presenter:** Krystal Godri Pollitt, Yale University, New Haven, United States

**Authors:** J. P. Koelme<sup>1</sup>, A. Chen<sup>1</sup>, A. Aksenov<sup>2</sup>, J. He<sup>1</sup>, E. Z. Lin<sup>1</sup>, S. Tang<sup>3</sup>, X. Shi<sup>3</sup>, K. Godri Pollitt<sup>1</sup>;

<sup>1</sup>Yale University, New Haven, CT, <sup>2</sup>University of California San Diego, San Diego, CA, <sup>3</sup>National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, Beijing, CHINA.

Environmental stressors, including air pollution, are attributable to disease globally. Technologies to comprehensively measure personal exposures to environmental contaminants are essential to link exposures to health outcomes and develop interventions. Most samplers are costly, impracticable for vulnerable populations, and only target a select number of contaminants. We developed wearable air pollutant samplers (clip and wristband form factor) that contain PDMS sorbent bars which are used to passive sample airborne environmental contaminants. These PDMS sorbent bars are analyzed following the exposure assessment period using gas chromatography high resolution mass spectrometry to assess personal time averaged exposures for thousands of compounds simultaneously. Samplers were deployed with 76 participants (aged 60-69 years) for 3-days every month for five consecutive months as part of the China BAPE (Biomarkers of Air Pollutants Exposure) study. MSHub and GNPS were used for deconvolution and alignment of peaks with neural networks, showing better reproducibility and lower RSD than vendor software, and spectral similarity networks. Suspect screening was performed using the Thermo Deconvolution plugin and stringent filtering parameters and appended to MSHub results. Annotations were automatically classified by source/use using our in-house ChemCat software and the EPA CPCat/CPDat databases. Predicted toxicities, exposure levels in general populations, and fate, transport, and biological half-lives were also determined using ChemCat and DSSTox databases. Using our unique workflow, we determined a number of xenobiotic compounds of concern and associated them with lifestyle choices, temporal changes in the environment, and indicators of health. Of most concern was the identification of dichlorvos in most participants passive samplers, a neurotoxin used for pest control in household as well as agricultural use.

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**P-0646**

### **Identifying patterns in environmental mixtures: a Bayesian approach and application to endocrine disrupting chemicals**

**Presenter:** Elizabeth A Gibson, Environmental Health Science Department, Mailman School of Public Health, Columbia University, New York, United States

**Authors:** E. A. Gibson<sup>1</sup>, J. Goldsmith<sup>2</sup>, F. Perera<sup>1</sup>, P. Factor-Litvak<sup>3</sup>, J. Paisley<sup>4</sup>, J. B. Herbstman<sup>1</sup>, M. Kioumourtzoglou<sup>1</sup>;

<sup>1</sup>Environmental Health Science Department, Mailman School of Public Health, Columbia University, New York, NY, <sup>2</sup>Biostatistics Department, Mailman School of Public Health, Columbia University, New York, NY, <sup>3</sup>Epidemiology Department, Mailman School of Public Health, Columbia University, New York, NY, <sup>4</sup>Electrical Engineering Department, Data Science Institute, Columbia University, New York, NY.

Environmental health researchers may aim to identify sources (i.e., patterns), such as product use or behaviors, that give rise to mixtures of potentially harmful environmental exposures such as endocrine disrupting chemicals (EDCs). Existing methods are limited by user-specified number and interpretability of patterns in terms of human understanding. We adapted a non-parametric Bayesian Non-negative Matrix Factorization (npBNMF) to identify patterns of chemical exposures when the number of patterns is not known a priori. We placed strictly positive continuous priors on pattern loadings and individual scores, making both interpretable as concentrations, and used a non-parametric prior to estimate the pattern number. To validate this method, we simulated 300 datasets with increasing levels of complexity: (1) distinct underlying patterns, (2) overlapping patterns, and (3) overlapping patterns and correlated scores. We compared npBNMF performance with non-negative matrix factorization (NMF), principal component analysis (PCA), and factor analysis (FA). After validation, we applied npBNMF to 51 EDCs in 569 pregnant mothers in the Columbia Center for Children's Environmental Health "Mothers and Newborns Cohort."

In simulations, npBNMF out-performed traditional methods and estimated the true number of patterns in 98% of runs, something no other known method can do. npBNMF and NMF provided non-negative scores and loadings with no orthogonality constraint, thus providing more interpretable results than PCA, whose mutually uncorrelated patterns are implausible in environmental health, or FA, whose negative scores and loadings are incomprehensible as concentrations.

We identified three patterns of EDC exposure in pregnant mothers, corresponding well with known EDC classes. Additionally, we observed pattern associations with measured behaviors, such as personal care product use.

npBNMF successfully identified EDC patterns that correspond well with current understanding of EDC sources. In future research, we will examine associations between patterns and health outcomes to inform interventions. npBNMF may be used to identify patterns in environmental mixtures.

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## ABSTRACT E-BOOK

Theme: **Mixtures and models**

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**P-0647**

**Application of time-activity estimates in a representative population to a cohort study: the ELSA cohort**

**Presenter:** Dylan Wood, King's College London, London, United Kingdom

**Authors:** D. Wood<sup>1</sup>, J. Smith<sup>1</sup>, D. Evangelopoulos<sup>1</sup>, S. Beevers<sup>1</sup>, K. Katsouyanni<sup>2</sup>;

<sup>1</sup>King's College London, London, UNITED KINGDOM, <sup>2</sup>National and Kapodistrian University of Athens, Athens, GREECE.

### Background/Aim

Application of modelled air pollution exposure estimates to cohort study respondents most often rely on the assumption that the individual remains outside (at their residential address) and static throughout the exposure period. This method likely leads to overestimation of exposure to outdoor air pollution. A lack of information on time-activity patterns and movement of a population throughout a study area therefore has the potential to limit heterogeneity in exposure estimates applied to cohort respondents in epidemiological study. In the present study, the London Travel Demand Survey (LTDS) and London Hybrid Exposure Model (LHEM) incorporate time-activity information of London residents alongside air pollution model estimates applied to respondents of the English Longitudinal Study of Ageing (ELSA).

### Methods

Annual average CMAQ-urban (Community Multiscale Air Quality) dispersion model estimates were applied to the residential address of ELSA respondents. LTDS data for ~75,000 London residents were incorporated into the LHEM in order to calculate average time-activity patterns stratified by age and location. Estimates of exposure to NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> for ELSA respondents were then calculated as a reflection of both CMAQ-urban and LTDS/LHEM adjustments.

### Results

Time-activity patterns were shown to be significantly different between age groups, as well as by location across London. At recruitment to the ELSA study, London-based respondents (n = 1,037) showed a 62.9% reduction in modelled NO<sub>2</sub> exposure when representative time-activity estimates were incorporated. A reduction of 67.7% and 38.3% were observed for PM<sub>10</sub> and PM<sub>2.5</sub>, respectively.

### Conclusions

A framework through which estimates of time-activity patterns in representative populations are calculated will likely improve the accuracy of modelled outdoor air pollution estimates when both are applied to respondents of cohorts in epidemiological study. The framework described here will be utilised in a study assessing the true association of air pollution on cognition in the elderly respondents of ELSA.

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**P-0648**

**A Self-Controlled Approach to Survival Analysis, with application to Air Pollution and Mortality**

**Presenter:** Joel Schwartz, Harvard TH Chan School of Public Health, Boston, United States

**Authors:** J. Schwartz, M. Yitshak-Sade, Q. Di, P. Koutrakis, F. Dominici, M. Mittleman;  
Harvard TH Chan School of Public Health, Boston, MA.

Background: Many studies reported that long-term exposure to air pollution is associated with increased mortality rates. These studies have been critiqued for failure to control for omitted, generally personal, confounders. Studies robust to such confounders can address this issue. Methods: We used a self-controlled design for survival analysis. We stratified on each person in the Medicare cohort between 2000 and 2015 who died and examined whether exposure predicted in which follow-up period the death occurred. We controlled for nonlinear terms in calendar year and age. Slowly varying covariates such as smoking history, BMI, diabetes, usual diet and alcohol consumption, sex, race, socioeconomic status, and green space were controlled by matching. Analyses were restricted to persons entering the study at age 65. We used machine learning models of PM<sub>2.5</sub>, NO<sub>2</sub>, and O<sub>3</sub> that predict exposure on a 1km grid for the entire U.S. Results: There were 6,452,618 deaths in the study population. In multipollutant models we observed a 5.37% increase in the mortality rate (95% CI 4.67%, 6.08%) for every 5 µg/m<sup>3</sup> increase in PM<sub>2.5</sub>, a 2.10% decrease in mortality rate (95% CI -1.88%, -2.33%) for each 5ppb increase in NO<sub>2</sub>, and a 1.98% increase in mortality rate (95% CI 1.61%, 2.36%) for each 5ppb increase in O<sub>3</sub>. When restricted to people whose PM<sub>2.5</sub> exposure never exceeded 12 µg/m<sup>3</sup> the effect size increased for PM<sub>2.5</sub>, became positive and significant for NO<sub>2</sub>, and disappeared for O<sub>3</sub>. Conclusion: There is strong evidence that the association between PM<sub>2.5</sub> and mortality is not confounded by individual or neighborhood covariates, which were controlled by matching. The effects of NO<sub>2</sub> and O<sub>3</sub> were more ambiguous and may reflect differential confounding by each other in different atmospheric conditions.

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**P-0650**

**Machine Learning to Identify Metabolic Effects of Chlorine Gas Exposure**

**Presenter:** Yuri Levin-Schwartz, Icahn School Of Medicine, New York, United States

**Authors:** Y. Levin-Schwartz<sup>1</sup>, A. Rappold<sup>2</sup>, R. O. Wright<sup>1</sup>, D. P. Jones<sup>3</sup>, R. Devlin<sup>2</sup>, D. I. Walker<sup>1</sup>;  
<sup>1</sup>Icahn School Of Medicine, New York, NY, <sup>2</sup>Office of Research and Development, United States Environmental Protection Agency, Research Triangle Park, NC, <sup>3</sup>Emory University School of Medicine, Atlanta, GA.

**Background/Aim:** Untargeted metabolomics enable the exploration of pathways that are affected by environmental respiratory exposures. However, traditional analyses of such data analyze each feature separately, ignoring interactions between features and reducing power. Independent component analysis (ICA) is a machine learning method that uncovers hidden patterns in data and has found widespread application in the analysis of medical imaging, video surveillance, and financial data. We propose that applying ICA to untargeted metabolomics data can alleviate the limitations of traditional feature-by-feature analyses. **Methods:** We applied ICA to approximately 25,000 untargeted metabolomic features measured in brachial lavage fluid (BALF) collected from 15 healthy participants who experienced separate exposures to Cl<sub>2</sub> gas and clean air. We estimated a total of 7 components using ICA. We compared our results to traditional feature-by-feature analyses. **Results:** In the traditional analyses, no features remained significant after a false discovery rate (FDR) correction. Of the 7 ICA components, 3 showed statistically significant differences, assessed using paired t-tests, in expression between the two conditions (Cl vs. clean air). These three components (t-statistics: 2.4, 7.2, and 12.2) remain significant after FDR correction. Annotation of detected metabolites in these components suggests variations in oxidative stress-related metabolites, including methionine (an important anti-oxidant) and oxidized fatty acids in the Cl<sub>2</sub> exposure compared with the clean air exposure. Other features in these components showed a negative mass defect, which is consistent with the presence of halogenated compounds that may form through chlorine nucleophilic substitution. These ICA components were not associated with the age or sex of the participants. **Conclusions:** Our results suggest Cl<sub>2</sub> exposure influences the lung metabolome and demonstrate the value of using machine learning methods to uncover biological response to respiratory exposures. **Disclaimer:** The views in this abstract belong to the authors and are not necessarily those of the U.S. Environmental Protection Agency.

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**P-0651**

**Modelling seasonal adaptation to temperature in UK with nonlinear functional regression models**

**Presenter:** Pierre Masselot, London School of Hygiene & Tropical Medicine, London, United Kingdom

**Authors:** P. Masselot, F. Sera, A. Gasparrini;  
London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM.

**Background/Aim:** Several studies have investigated associations between non-optimal temperature and mortality, with now established analytical methods. However, important aspects of these associations, such as the substantial geographical and temporal variability, still need to be elucidated. For instance, limited evidence exists on how risks changes within a season due to acclimatization and adaptive behaviours. In this contribution, we apply novel methods based on functional data analysis to study the evolution of temperature-mortality risks during the year.

**Methods:** FDA models consider data as continuous curves instead of scalar variables, thus offering a flexible and elegant framework to depict multi-dimensional changes in complex exposure-response relationships along time. Here we demonstrate the use of FDA models to estimate the association between heat and cold with mortality risk using data from 70 cities in UK in the years 1990-2016. Specifically, we apply nonlinear additive functional regression models, a flexible FDA extension that allows for a nonlinear associations as well as a historical effect, i.e. lags. In addition, the association is allowed to evolve across the time domain of the curve, in this case the season.

**Results:** Preliminary results show that susceptibility to non-optimal temperature diminishes during the season, both heat in the summer and, equivalently, cold in the winter. In parallel, changes also affect the lag structure, with sharper variations in risk early in the season compared to later periods, both for summer and winter.

**Conclusion:** This case study demonstrates that FDA models can be applied to study complex aspects of health associations with environmental risk factors, with increased flexibility when compared to more traditional regression methods. These methods can represent a powerful and complementary tool in the set of methodologies developed for environmental epidemiology, with a number of potential application in various areas.

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**P-0652**

**Effects of personal air pollution exposure on inflammatory responses: potential mediation by endogenous melatonin**

**Presenter:** Linchen He, Duke University, DURHAM, United States

**Authors:** L. He<sup>1</sup>, X. Hu<sup>2</sup>, J. Gong<sup>2</sup>, D. Day<sup>3</sup>, J. Xiang<sup>4</sup>, Y. Zhang<sup>5</sup>, J. Zhang<sup>1</sup>;

<sup>1</sup>Duke University, DURHAM, NC, <sup>2</sup>Peking University, Beijing, CHINA, <sup>3</sup>Seattle Children's Research Institute, Seattle, WA, <sup>4</sup>University of Washington, Seattle, WA, <sup>5</sup>Tsinghua University, Beijing, CHINA.

**Background/Aim:** Melatonin is a free radical scavenger and an anti-inflammatory molecule. Air pollution exposure has been associated with increased inflammatory responses. We hypothesize that endogenous melatonin plays a role in inflammatory responses to air pollution exposure. **Methods:** We tested this hypothesis in a cohort of 53 healthy adults (22-52 years old, 16 women), none of whom were on melatonin supplementation. Early morning urine and blood were collected from each participant for up to three times. We analyzed urinary 6-sulfatoxymelatonin (aMT6s), as a surrogate of circulating melatonin, and pro- and anti-inflammatory cytokines in plasma. Indoor and outdoor air pollutants were measured and combined with participants' time-activity pattern to calculate personal exposure to O<sub>3</sub>, PM<sub>2.5</sub>, NO<sub>2</sub>, and SO<sub>2</sub> averaged over 12-hour, 24-hour, 1-week, and 2-week prior to biospecimen collection, respectively. Linear mixed effects models were used to examine the relationships of urinary aMT6s with personal pollution exposure and plasma cytokines controlling for covariates including temperature, humidity, sex, age, and respiratory infection & smoking status. Mediation analysis was conducted to test whether aMT6s is a mediator for the relationships between pollution exposure and inflammatory cytokines. **Results:** A one interquartile range (4.2 ppb) increase in 2-week O<sub>3</sub> exposure was associated with a -29.4% (95% CI: -50.0%, -0.50%) decrease in aMT6s, while the relationships of aMT6s with other pollutant exposures were nonsignificant. Within the range of endogenous aMT6s concentration (0.5-53.0 ng/ng creatinine), increasing aMT6s level was associated with decreasing levels of pro-inflammatory cytokines, including IL-1 $\beta$ , IL-6, IL-8, IL-17A, IFN- $\gamma$ , and TNF- $\alpha$ . The mediation analysis showed that 5.2%, 7.7%, 8.2%, 10.5%, 16.1%, and 8.3% of the total effects of 2-week O<sub>3</sub> exposure on IL-1 $\beta$ , IL-6, IL-8, IL-17A, IFN- $\gamma$ , and TNF- $\alpha$  were mediated by urinary aMT6s, respectively. **Conclusions:** Our findings suggest that air pollution exposure may decrease endogenous melatonin, which may further contribute to enhanced pro-inflammatory responses.

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**P-0654**

**Exposure Health Informatics Methods for Environment Epidemiological Research**

**Presenter:** Ram Gouripeddi, University of Utah, Salt Lake City, United States

**Authors:** R. Gouripeddi, N. Riches, J. Kitt, K. Sward, J. Facelli;  
University of Utah, Salt Lake City, UT.

Traditional environmental epidemiology has relied on assessing individual exposures and their effects. Exposure science methods provides opportunities to advance epidemiological studies considering multiple and consequent exposures and over extended periods of time. Materializing the exposome concept requires methods to collect, integrate and assimilate data from multiple exposures including at personal levels, genomics, personal activities, locations, socio-behaviors, biomarkers of exposures, physiological effects, and health outcomes - all with appropriate spatiotemporal descriptions and associated uncertainties in measurements. Such an exposome requires integration of data from wearable and stationary sensors, environmental monitors, physiology, medication use and other clinical data. In addition, such an integration needs to have a high spatial-temporal resolution for correlating times and location of exposures to occurrences of conditions and their severities. This would require filling any gaps in the measured data with modeled data along with characterization of any uncertainties. Informatics is the scientific field that deals with biomedical information, data, and knowledge - their storage, retrieval, and optimal use for problem solving and decision-making. Recently, informatics methods are being developed, evaluated and utilized in sphere of environmental epidemiological and the exposome. In this symposium, we define the novel informatics sub-field, Exposure Health Informatics, and discuss challenges that require development of informatics methods. We then formally describe informatics methods that address these challenges, and their implementation as a scalable computation infrastructure, the Exposure Health Informatics Ecosystem (EHIE). EHIE is a comprehensive, standards-based, open-source informatics platform that provides semantically consistent, metadata-driven, event-based management of exposomic data consisting of sensor data acquisition pipelines, participant and researcher facing tools, computational modeling, and big data integration platform. Finally, with PRISMS pediatric asthma, Environmental Children's Health Outcomes, diabetes and molecular epidemiological studies as exemplars, we discuss the generalizability of these multi-scale and multi-omics informatics methods for providing epidemiological researchers with robust reproducible pipelines.

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**P-0655**

### **Implementation of an Air Quality Forecasting Operating System for Health Surveillance and Sustainability in the Salvador Metropolitan Region, Brazil**

**Presenter:** Nelzair Araujo Vianna, Oswaldo Cruz Foundation, Salvador, Brazil

**Authors:** N. A. Vianna<sup>1</sup>, A. Fraga<sup>2</sup>, L. Zanutto<sup>3</sup>, F. Velay-Lasry<sup>4</sup>, S. Pinheiro<sup>3</sup>;

<sup>1</sup>Oswaldo Cruz Foundation, Salvador, BRAZIL, <sup>2</sup>Secretary of Sustainability, Innovation and Resilience, Salvador, BRAZIL, <sup>3</sup>ARIA, Rio de Janeiro, BRAZIL, <sup>4</sup>ARIA, Salvador, FRANCE.

Air pollution is a threat to public health in the 21st century. In Latin America, more than 100 million people are exposed to air pollution. There is a gap in air quality monitoring in cities around the world. Environmental risk factor monitoring and forecasting systems are strategic for the adoption of preventive measures and health surveillance alerts. The engagement of stakeholders is crucial to develop strategies to control air pollution. Objective: To define air quality and health risk indicators relevant to health surveillance and civil defense, allowing the mapping of areas of higher risk and vulnerability for the population. Methodology: The SOPRAR project was built through an articulated intersectoral mobilization, scientific institutions, private and public sector. The project includes the configuration of emission, chemical, and transportation models to represent the local conditions. The system operates based on CHIMERE model runs (48h forecast) forced by weather forecast simulations (WRF) performed by the local civil defense, integrating a updated emissions inventory. Model results, pollutants concentration maps and air quality index, will be available by WEB service. A tailored health risk indicator will be developed to make the SOPRAR system. The project is committed with the technology and know-how transfer to local actors. Results: The emission inventory was updated based on available local data regarding traffic, road network, industries processes and land use. Total emissions in the Salvador Metropolitan Region corresponds to 3327.03 tons/year of Particulate Matter, 14964.32 tons/year of Sulfur Dioxide, 75572.28 tons/year of Carbon Monoxide, 24756.30 tons/year of Nitrogen Oxides and 21756.64 tons/year of Volatile Organic. Considerations: The system is as an innovative management tool based on urban environment air quality modeling and will provide support for the activation of air quality protection and communication service protocols for use in research, public policies for primary care and health surveillance.

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**P-0656**

**On adjustment for seasonality and time trend when estimating linear associations between long-term exposure and health outcomes in time-series studies**

**Presenter:** Honghyok Kim, Yale University, New Haven, United States

**Authors:** H. Kim, M. L. Bell;  
Yale University, New Haven, CT.

Associations between exposure to air pollution and health outcomes are usually investigated through three types of epidemiologic study designs: time-series designs, case-crossover designs, and cohort designs. The first two types can be applied with case-only data, which has great potential when cohort data is limited. Associations between short-term exposure and health outcomes are investigated via these two types. However, associations between long-term exposure and health outcomes are hardly investigated. One of the reasons is that when controlling for seasonality and long-term time trend, estimates of coefficients of lagged variables or moving averages that exceed roughly two months can become unusual, making it difficult to make inferences. Our preliminary results show that this problem is at least partially related to model specifications of adjusting for seasonality and time-trend. We argue that time-series designs may be used to estimate linear associations between long-term exposure and health outcomes, although exposure measurement error remains an issue to solve.

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**P-0657**

### **Comparison of emerging dried capillary blood collection devices for untargeted metabolomics in epidemiological studies**

**Presenter:** Georgia Dolios, Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** G. Dolios<sup>1</sup>, P. Tu<sup>1</sup>, M. Yu<sup>1</sup>, L. Petrick<sup>2</sup>;

<sup>1</sup>Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Department of Environmental Medicine and Public Health, Institute of Exposomics Research, Icahn School of Medicine at Mount Sinai, New York, NY.

**Background:** Capillary blood collection is minimally invasive, easy to perform, and when dried, is more stable at higher temperatures than liquid blood, making dried capillary blood microsamplers a promising alternative to venous blood for epidemiological research, particularly for vulnerable populations. Newly developed micro sampler technologies are making headway as replacements to venous blood sampling in nonclinical pharmaceutical research, suggesting their potential for use in epidemiological research. However, their compatibility with untargeted metabolomics assays has not been fully evaluated. **Methods:** Using commercially purchased whole blood, we performed untargeted metabolomics profiling of 5-mm Guthrie card punches (~8-10  $\mu$ L of whole blood), Volumetric Absorptive Microsampling (VAMS®) tips (10  $\mu$ L of whole blood), HemaXis™ whole spots (10  $\mu$ L of whole blood), and a Noviplex™ plasma discs (2.74  $\mu$ L of plasma). Samples were analyzed using Liquid Chromatography-High Resolution Mass Spectrometry (LC-HRMS) for measurement of polar compounds (ZHP) and semi- and non-polar compounds (RPN). Molecular features with a fold-change > 3, compared to equivalent matrix blank were retained for analysis. **Results:** Endogenous and exogenous metabolites, environmental chemicals, and contaminants were measured in all four samplers. 4690 and 1605 peaks were measured in all four methods for ZHP and RPN analysis, respectively. An additional 3669 and 1848 peaks were shared by VAMS, Guthrie and HemaXis, but not found in Noviplex for ZPH and RPN analysis, respectively. Coefficients of variation calculated in replicate samples indicated higher reproducibility in VAMS and Guthrie card punches, than from HemaXis™ and Noviplex™. Furthermore, Noviplex™ extracts contained large contamination peaks not found in other devices. **Conclusions:** While we found that all microsamplers were amenable to untargeted metabolomics, differences were observed in the total number of metabolites measured, reproducibility of features, and background contamination levels. VAMS and Guthrie cards are the most promising devices for further untargeted metabolomics development for use in epidemiological research.

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**P-0658**

**Environmental Chemicals and Red Blood Cell Folate levels in the U.S. Population, NHANES**

**Presenter:** Michael T Mascari, University of Massachusetts Amherst, Amherst, United States

**Authors:** M. T. Mascari<sup>1</sup>, B. Lanphear<sup>2</sup>, J. Braun<sup>3</sup>, N. Fields<sup>1</sup>, Y. Oulhote<sup>1</sup>;

<sup>1</sup>University of Massachusetts Amherst, Amherst, MA, <sup>2</sup>Simon Fraser University, Burnaby, BC, CANADA,

<sup>3</sup>Brown University, Providence, RI.

**Background/Aim:** Inadequate folate during pregnancy has been associated with congenital birth deficits and adverse neurodevelopmental outcomes, including autism spectrum disorders. Recent studies show that folic acid supplementation may protect against the potential adverse effects of gestational chemical exposures on neurodevelopment. However, it is unclear whether these chemicals impact folate metabolism. Therefore, we investigated the relationship between environmental chemicals and red blood cell (RBC) folate concentrations. **Methods:** We assessed associations of 41 chemical biomarkers including metals, phthalate metabolites, per- and polyfluoroalkyl substances (PFAS), parabens, and polycyclic aromatic hydrocarbons with RBC folate concentrations in 41,433 participants ages 1-80 from the U.S. National Health and Nutrition Examination Survey (2007-2016). We triangulated evidence from three statistical methods developed to examine chemical mixtures: Exposome Wide Association (ExWAS), Bayesian Kernel Regression (BKMR), and SuperLearner with G-computation. We examined the individual and joint associations of these chemicals with RBC folate concentrations, while adjusting for confounders. **Results:** The geometric mean RBC folate was 463 ng/mL (Interquartile range: 361 - 587.2 ng/mL). Some metals, PFAS, phthalates, and cotinine were consistently associated with lower RBC folate concentrations. Using BKMR, an interquartile range increase in perfluorononanoic acid (PFNA), cotinine, mono-ethyl phthalate, and lead was associated with a -0.15 standard deviation (SD) (95% confidence interval (CI): -0.23, -0.07), -0.11 SD (95% CI: -0.17, -0.03), -0.03 SD (95% CI: -0.07, 0.02), and -0.18 SD (95% CI: -0.25, -0.10) decrease in RBC folate concentrations, respectively. Estimates differed slightly between methods, but these findings remained robust. **Conclusion:** This study, which is the first to examine an association between a mixture of environmental chemicals and RBC folate concentrations in a nationally representative sample, may help enhance our understanding of the interplay between environmental chemicals, folate, and adverse health outcomes.

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**P-0659**

### **Sensitivity Analysis and Epidemiologic Triangulation**

**Presenter:** Brian Knaeble, Utah Valley University, Orem, United States

**Authors:** B. Knaeble<sup>1</sup>, R. Gouripeddi<sup>2</sup>;

<sup>1</sup>Utah Valley University, Orem, UT, <sup>2</sup>University of Utah, Salt Lake City, UT.

Epidemiologic triangulation integrates evidence from a variety of studies that have unrelated sources of bias. Sensitivity analysis assesses how a conclusion would change if assumptions were relaxed. Causal interpretations of associations between measures of health and air quality require a non-confounding assumption. Exposures are not randomly assigned nor selected, but with integrated sensor monitoring systems and annotation a key confounding parameter can be estimated. This talk introduces a novel statistical methodology for causal inference based on data transport and collaboration between exposure scientists and environmental epidemiologists.

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**P-0660**

### **Developing Literature Search Strategies and Strings to Identify Fate, Exposure and Physical-Chemical Property References**

**Presenter:** Amina Wilkins, U.S. Environmental Protection Agency, Washington, United States

**Authors:** A. Wilkins;  
U.S. Environmental Protection Agency, Washington, DC.

While the process for developing search strings for physical-chemical properties is relatively straight-forward due to availability of existing data presented in a controlled manner, identifying published fate and human environmental chemical exposure-related studies is difficult. Challenges also exist for identifying health-related studies, but controlled vocabularies for indexing and PubMed Medical Subject Headings (MeSH) help to identify such studies, while relatively fewer developed vocabularies exist for identifying fate and exposure studies. In addition, the scope of 'exposure' is broad and comprises several sub-categories. Provision of these search strings will facilitate and standardize the approach for systematic review of scientific evidence needed for transparent chemical assessment. To develop the search strings, a team of topic-specific experts and librarians was assembled and developed keyword lists. To create the physical-chemical string, librarians used the keyword list and a series of iterative exchanges with the expert to draft, and revise strings based on performance. For fate strings, librarians drafted strings utilizing the keyword list and analysis tools such as the Keyword Analysis Tool (KAT) and SWIFT-Review's fingerprinting feature, and on-topic reference lists to determine performance; exposure strings will be developed in a similar manner. The quality of all test strings will be further evaluated by human manual screening of on- and off-topic search string generated results. This presentation overviews various approaches taken to develop the fate, chemical-physical property and exposure literature search strings, including development and testing of broad versus minimal search strings (where we identify terms that are unambiguous and/or necessary to retrieve the greatest number of on-topic references while minimizing retrieval of off-topic references); discusses the organization of keywords and search strings into main and subcategory headings; and outlines the process for incorporating keyword analysis tools. The recall and precision performance results of the broad versus minimal search strings are also presented.

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**P-0661**

### **A National Spatiotemporal Model for Ambient Ozone Concentration in the United States Using Universal Kriging and Land-use Regression: 2005-2014**

**Presenter:** Michael Young, University of Washington, Seattle, United States

**Authors:** M. Young<sup>1</sup>, M. Wang<sup>2</sup>, A. Szpiro<sup>1</sup>, J. D. Kaufman<sup>1</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>University at Buffalo, Buffalo, NY.

Accurate prediction models for ambient air pollution concentrations are a key component of modern air pollution epidemiology, and epidemiological studies regarding long-term effects of ozone are urgently needed. Large-scale models are necessary for cohort studies with national recruitment, and models are also needed to accurately characterize fine-scale spatial gradients in a region. We applied a spatiotemporal modeling approach, previously used in individual cities for ozone and nationally for other pollutants, to predict weekly ambient ozone concentration over the contiguous United States for the period from 2005 through 2014. **Methods:** Using long-term regulatory ozone monitoring data collected daily (n=669 sites) and short-term spatially-rich cohort-specific data collected as two-week time integrated averages (n=1958 sites) divided into nine regions across the country, we fit a regionalized likelihood-based spatiotemporal model using land-use regression on dimension reduced land-use covariates combined with universal kriging. Ten-fold cross-validated predictions, leaving out sites, were used to compute  $R^2$  (from root mean-squared error) in three different ways: spatial  $R^2$  to assess accuracy in predicting long-term average exposures at locations without data, temporal  $R^2$  to assess accuracy in predicting the time series of weekly exposures at locations without data, and spatiotemporal  $R^2$  to assess overall prediction accuracy. **Results:** Overall cross-validated performance was high. Spatial  $R^2$  was 0.69, spatiotemporal  $R^2$  was 0.78, and median site-specific temporal  $R^2$  was 0.80. Spatial performance varied by modeling region and season. **Conclusion:** We report a novel, successful national-scale spatiotemporal model for outdoor ozone concentrations for the contiguous U.S. Strengths of this model include its national scale and its ability to make accurate fine-scale predictions spatially at all arbitrary points and temporally at one-week intervals, suggesting future usefulness to a wide variety of epidemiological studies.

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**P-0662**

### **Outdoor Light at Night and Diabetes Incidence in the Danish Nurse Cohort Study**

**Presenter:** Heresh Amini, University of Copenhagen, Copenhagen, Denmark

**Authors:** H. Amini<sup>1</sup>, J. T. Jørgensen<sup>1</sup>, J. Cramer<sup>1</sup>, P. James<sup>2</sup>, T. Cole-Hunter<sup>1</sup>, A. Mehta<sup>1</sup>, R. Westendorp<sup>1</sup>, L. H. Mortensen<sup>1</sup>, S. Loft<sup>1</sup>, J. Brandt<sup>3</sup>, O. Hertel<sup>3</sup>, C. Backalarz<sup>4</sup>, Z. J. Andersen<sup>1</sup>, Y. Lim<sup>1</sup>;  
<sup>1</sup>University of Copenhagen, Copenhagen, DENMARK, <sup>2</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>3</sup>Aarhus University, Aarhus, DENMARK, <sup>4</sup>DELTA Acoustics, Hørsholm, DENMARK.

Background/Aim: Recent animal studies suggested that light-at-night (LAN) may impair glucose tolerance in rats and disturb glucose homeostasis. We aimed to evaluate the association between exposure to residential outdoor LAN and diabetes incidence in Denmark. Methods: In the nationwide Danish Nurse Cohort consisting of 23,797 nurses, recruited in 1993 or 1999, we identified 1,065 diabetes incident cases through National Diabetes Register up to 2012. The LAN data was estimated using Global Radiance Calibrated products of the Defense Meteorological Satellite Program (DMSP) for 1996, 1999, 2000, 2002, 2004, 2005, and 2010. The full residential address histories were obtained and the LAN exposure was assigned based on the 1996 data for addresses before 1997, and based on the most recent measure for addresses after 1997. Time-varying Cox regression models were used to estimate hazard ratios (HR) (95% confidence intervals (CI)) for the associations of LAN and diabetes incidence, adjusting for individual anthropometric, lifestyle and environmental covariates, such as residential air pollution (PM<sub>2.5</sub> and NO<sub>2</sub>), and night-time road traffic noise determined by validated models. Results: The estimated HR based on a fully adjusted model for incident diabetes with an interquartile range (IQR) (75.6 nW/cm<sup>2</sup>/sr) increase in cumulative average outdoor LAN was 1.13 (95% CI: 1.05, 1.21). Based on the fully adjusted model of LAN exposure divided into quintiles, where LAN quintile 1 was reference, we found an increase in diabetes incidence at higher LAN levels: LAN quintile 2: HR: 1.04 (95% CI: 0.86-1.27, p = 0.66), LAN quintile 3: HR: 1.04 (95% CI: 0.85-1.26, p = 0.71), LAN quintile 4: HR: 0.99 (0.81-1.20, p = 0.91), and LAN quintile 5: HR: 1.21 (95% CI: 1.0-1.46, p = 0.053). Conclusion: We found suggestive evidence that outdoor LAN exposure may be associated with diabetes incidence, independent of air pollution and road traffic noise.

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**P-0663**

**Insights into human behavior to inform exposure assessment using a low-cost, time-resolved location and activity monitoring system: a case study from a Ghanaian household energy study**

**Presenter:** Megan Benka-Coker, Gettysburg College, Gettysburg, United States

**Authors:** E. Coffey<sup>1</sup>, M. Benka-Coker<sup>2</sup>, M. Dalaba<sup>3</sup>, D. Agao<sup>3</sup>, R. Alirigia<sup>1</sup>, A. Moro<sup>3</sup>, J. Awaregya<sup>4</sup>, J. Bosco Aburiya<sup>4</sup>, Z. Brown<sup>5</sup>, A. Oduro<sup>3</sup>, M. Hannigan<sup>1</sup>, K. Dickinson<sup>6</sup>;

<sup>1</sup>University of Colorado Boulder, Boulder, CO, <sup>2</sup>Gettysburg College, Gettysburg, PA, <sup>3</sup>Navrongo Health Research Center, Navrongo, GHANA, <sup>4</sup>Organization for Indigenous Initiatives Ghana, Navrongo, GHANA,

<sup>5</sup>North Carolina State University, Raleigh, NC, <sup>6</sup>Colorado School of Public Health, Aurora, CO.

Background: Human behaviors play a key role in determining patterns of exposure to environmental pollution. A better understanding of where and how people are spending their time can generate insights into ways to reduce overall exposure and associated health burdens. We develop a low-cost location and activity monitoring system designed for use in a household energy study, but with widespread applicability across the exposure sciences. Methods: The study sample includes 41 rural and 45 urban households in Northern Ghana enrolled in the Prices, Peers, and Perceptions (P3) cookstove study. To measure minute-to-minute variation in participants' proximity to pollution sources at home and beyond the household, primary cooks were outfitted with wireless Bluetooth proximity monitors, GPS logging devices, and accelerometers (to measure instrument compliance) for multiple 2-day deployments. Minute-level location data were categorized into distinct classifications of 'at home' or 'away' and discrete zones of proximity to stoves. We examine compliance patterns, and then focus on days with high compliance (>30% of 24hr period) to explore and model the variability of participant location among stove groups, hour of day, and urban vs. rural location. Results: Compliance is variable and low overall; we observe strong diurnal trends peaking at late morning and decreasing to lows around midnight. Focusing on a subset of 36 high-compliance deployment days, we find that location patterns can vary substantially within and between unique 24hr periods and across repeat visits. Participants are seldom compliant and away from home (<5%). While at home, participants are closest to their stoves during dinner hours (14:00-19:00) and half of that time is spent within 5 meters of stoves. Conclusions: A low-cost sensor system can provide valuable behavioral information to inform exposure assessments. Understanding how to increase compliance with these systems could unlock the potential to provide actionable information for researchers and practitioners.

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**ISEE  
2020**  
August 24-27, 2020

## ABSTRACT E-BOOK

Theme: **Mixtures and models**

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**P-0664**

**Novel study designs and data technologies for environmental epidemiology**

**Presenter:** Antonio Gasparinni, London School of Hygiene & Tropical Medicine, London, United Kingdom

**Authors:** A. Gasparinni<sup>1</sup>, I. Koolhof<sup>2</sup>, P. Jones<sup>2</sup>, F. Johnston<sup>2</sup>;

<sup>1</sup>London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM, <sup>2</sup>University of Tasmania, Hobart, AUSTRALIA.

**Introduction.** Availability of modern data technologies, such as wearables, remote sensors in satellites, and re-analysis modelling provide exceptional opportunities for environmental research. These tools allow the longitudinal collection of individual-level information, and the linkage with finely reconstructed spatio-temporal exposure maps. However, traditional analytical methods are not well suited in this complex data setting. In this contribution we illustrate the application of a new study design called case time series to analyse short-term association between environmental exposures and allergic symptoms in a smartphone study. **Methods.** Data were collected within AirRater, an integrated online platform operating in Tasmania. Daily events of allergic symptoms were collected from 1,601 subjects in 2015-2018 through a smartphone app. Geolocation allowed the linkage with spatio-temporal measures of pollen (grains/m<sup>3</sup>), fine particulate matter (PM<sub>2.5</sub>, µg/m<sup>3</sup>), and temperature (Celsius) from ground stations and re-analysis models. Individual outcome and exposure series were analysed with a case time series design, fitting conditional Poisson models with distributed lag models to estimate dependencies while enforcing a strict temporal control through subject/month strata intercepts, natural splines of time, and indicators of day of the week. **Results.** We found increased risk of allergic symptoms associated independently with all the three environmental factors. Pollen shows a step increase in risk that flattens out at high exposures, and a lagged effect up to two days. Risks of PM<sub>2.5</sub>, is linear and mostly limited to the same-day exposure. Temperature displays non-linear associations, with increases in allergic symptoms beyond daily averages of 15°C. **Discussion.** The combination of novel study designs and modern data technologies allows investigation of complex epidemiological relationships using individual-level longitudinal data and ensuring strict control for time-invariant and time-varying factors. This flexible modelling framework can be adapted to various contexts and research areas.

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## ABSTRACT E-BOOK

Theme: **Mixtures and models**

**P-0665**

### **Biomarkers of kidney injury among Deepwater Horizon oil spill workers**

**Presenter:** Lawrence S Engel, Epidemiology Branch, National Institute of Environmental Health Sciences, Research Triangle Park, United States

**Authors:** L. S. Engel<sup>1</sup>, W. B. Jackson II<sup>2</sup>, M. Bodkin<sup>2</sup>, R. Church<sup>3</sup>, A. Blair<sup>4</sup>, A. Miller<sup>5</sup>, M. D. Curry<sup>2</sup>, P. Stewart<sup>6</sup>, M. Stenzel<sup>7</sup>, R. K. Kwok<sup>1</sup>, D. P. Sandler<sup>1</sup>;

<sup>1</sup>Epidemiology Branch, National Institute of Environmental Health Sciences, Research Triangle Park, NC, <sup>2</sup>Social & Scientific Systems, Inc., Durham, NC, <sup>3</sup>Eshelman School of Pharmacy, University of North Carolina, Chapel Hill, NC, <sup>4</sup>Division of Cancer Epidemiology and Genetics, National Cancer Institute, Rockville, MD, <sup>5</sup>Office of the Director, National Institute of Environmental Health Sciences, Bethesda, MD, <sup>6</sup>Stewart Exposure Assessments, LLC, Arlington, VA, <sup>7</sup>Exposure Assessment Applications, LLC, Arlington, VA.

**Background:** Individuals who participated in oil spill response and cleanup following the 2010 Deepwater Horizon (DWH) disaster were exposed to a range of chemicals from fresh and burning oil. These included benzene, toluene, ethylbenzene, and xylenes (BTEX), which have shown nephrotoxicity in animal and/or human studies. We examined biomarkers of kidney injury among participants in the GuLF Study, a prospective study of health effects among DWH oil spill workers.

**Methods:** We analyzed data and biospecimens collected at baseline (1-3 years after the spill) from 924 male workers randomly sampled on the basis of exposures estimated in the GuLF Study using detailed DWH work histories collected at baseline and extensive air monitoring data collected during the spill response. Fourteen urinary biomarkers of kidney injury were measured via multiplex immunoassay. We used linear regression to examine both maximum and cumulative exposures to BTEX and hexane in relation to creatinine-adjusted biomarker concentrations, adjusting for age, race, BMI, smoking status, binge drinking, and pre-spill physician-diagnosed diabetes.

**Results:** Maximum exposures to benzene, toluene, xylene, and hexane were associated with higher levels of GST- $\alpha$ , a marker of proximal tubule damage, and osteoactivin, a marker of distal tubule damage. Cumulative exposures to benzene, toluene, and ethylbenzene were associated with higher levels of osteoactivin, while cumulative exposures to toluene and xylene were associated with higher levels of EGF, another marker of proximal tubule damage. Results were similar among never smokers, non-binge drinkers, and individuals without pre-spill diabetes.

**Conclusions:** Exposure to BTEX and hexane among oil spill workers is associated with elevated levels of urinary biomarkers of kidney injury, including of the proximal and distal tubules. Mixtures analysis will allow us to tease apart the relative contributions of these correlated exposures and follow-up of the cohort will shed light on whether these exposures are also associated with kidney disease.

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Theme: **Mixtures and models**

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**P-0666**

**Estimation of a buffering window in functional linear cox regression models for spatially-defined environmental exposure**

**Presenter:** Jooyoung Lee, Harvard T.H. Chan School of Public Health, Boston, United States

**Authors:** J. Lee<sup>1</sup>, D. Spiegelman<sup>2</sup>, M. Wang<sup>1</sup>, J. Hart<sup>1</sup>, P. James<sup>1</sup>, F. Laden<sup>1</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>2</sup>Yale School of Public Health, New Haven, CT.

In environmental health research, it is of interest to understand the effect of the neighborhood environment on health. Typically, neighborhood environmental exposures are measured within radial buffer zones from a residential address and identification of a buffer window within which the environmental exposure is associated with the health outcome is of importance; this is the so called “uncertain geographic context” problem. We propose to address geographic uncertainty through developing statistical methods for estimating the buffering window in a penalized functional linear Cox proportional hazard model. The theoretical properties of our proposed method are studied and simulation studies are conducted. The method is illustrated in a study of the effect of greenness on depression in the Nurses’ Health Study.

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## ABSTRACT E-BOOK

Theme: **Mixtures and models**

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**P-0668**

### **Comparison of Hospitalization and Mortality Associated with Short-term Exposure to Ambient Ozone and PM<sub>2.5</sub> in Canada**

**Presenter:** Rajendra P Parajuli, University of Montreal, Montreal, Canada

**Authors:** H. Shin<sup>1</sup>, P. Gogna<sup>2</sup>, A. Maquiling<sup>3</sup>, L. Haque<sup>3</sup>, B. Burr<sup>4</sup>, R. P. Parajuli<sup>5</sup>;

<sup>1</sup>Environmental Health Science and Research Bureau, Health Canada & Department of Mathematics and Statistics, Queen's University, Ottawa, ON, CANADA, <sup>2</sup>Department of Public Health Sciences, Queen's University, Kingston, ON, CANADA, <sup>3</sup>Environmental Health Science and Research Bureau, Health Canada, Ottawa, ON, CANADA, <sup>4</sup>Department of Mathematics and Statistics, Carleton University, Ottawa, ON, CANADA, <sup>5</sup>University of Montreal, Montreal, QC, CANADA.

**Background:** Hospitalization and mortality (H-M) have been linked to air pollution separately. However, previous studies have not adequately compared whether air pollution is a stronger risk factor for hospitalization or mortality. This study aimed to investigate differences in H-M risk from exposure to ozone and PM<sub>2.5</sub>, and determine whether these differences are modified by season, age, and sex. **Methods:** Daily ozone, PM<sub>2.5</sub>, temperature, and all-cause H-M counts (ICD-10, A00-R99) were collected for 22-24 urban cities for up to 29 years. Generalized additive Poisson models were employed to estimate overall associations between single pollutant and health outcome, which were compared across season (warm, cold, or year-round), age (all ages or seniors>65), and sex. A Bayesian hierarchical model was applied to pool city-specific estimates to represent national associations. **Results:** Overall, both ozone and PM<sub>2.5</sub> exposures showed season-specific higher risk of mortality than hospitalization: warm-season ozone, 0.54% (0.20, 0.85) vs. 0.14% (0.02, 0.27) per 10 ppb; and year-round PM<sub>2.5</sub>, 0.90% (0.33, 1.41) vs. 0.29% (0.03, 0.56) per 10 µg/m<sup>3</sup>. While age showed little H-M difference, sex appeared to be a modifier of H-M difference. While females had higher mortality risk, males had higher hospitalization risk: for females, ozone 0.87% (0.36, 1.35) vs. -0.03% (-0.18, 0.11) and PM<sub>2.5</sub> 1.19% (0.40, 1.90) vs. 0.19% (-0.10, 0.47); and for males ozone 0.20% (-0.28, 0.65) vs. 0.35% (0.18, 0.51). **Conclusion:** This study found H-M differences attributable to both ozone and PM<sub>2.5</sub>, suggesting that both are stronger risk factors for mortality than hospitalization. In addition, there were clear H-M differences when stratifying by sex: specifically, females showed higher mortality risk and males showed higher hospitalization risk in relation to air pollution. It is unclear whether biological sex-specific or gender-related differences in exposure drive these effects. Further studies are warranted to identify biological and/or socioeconomic factors underlying the H-M differences.

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## ABSTRACT E-BOOK

Theme: **Mixtures and models**

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**P-0669**

**Associations of residential and occupational history with the distribution of mixtures of persistent pollutants in adipose tissue**

**Presenter:** Ruth Echeverría, University of Granada, Granada, Spain

**Authors:** R. Echeverría<sup>1</sup>, F. M. Pérez-Carrascosa<sup>2</sup>, C. Gómez-Peña<sup>3</sup>, I. Salcedo-Bellido<sup>1</sup>, R. Barrios-Rodríguez<sup>1</sup>, P. Requena-Méndez<sup>1</sup>, P. Vrhovnik<sup>4</sup>, J. P. Arrebola<sup>1</sup>;

<sup>1</sup>University of Granada, Granada, SPAIN, <sup>2</sup>Instituto de Investigación Biosanitaria de Granada, Granada, SPAIN, <sup>3</sup>Hospital Universitario San Cecilio, Granada, SPAIN, <sup>4</sup>Slovenian National Building and Civil Engineering Institute (ZAG), Ljubjana, SLOVENIA.

### Background

This research aims to explore patterns of distribution of 15 persistent pollutants in the adipose tissue of 227 individuals of an adult cohort from Granada, Southern Spain.

### Methods

Information about lifetime residential and occupational history was gathered by means of validated questionnaires. Clusters of pollutants in the study population were identified by Principal Component Analyses (PCA). The first 3 components were mainly represented by 3 major groups of pollutants: PC1: a group of metals, namely aluminium, arsenic, chromium, nickel and lead; PC2: predominantly by Organochlorine Pesticides (OCPs); PC3: mainly by a mixture of Polychlorinated Biphenyls (PCB-138, PCB-153 and PCB-180) and metals (cadmium, cobalt and chromium). The patterns of distribution of individual pollutants and their mixtures were explored through Geographic Information Systems and Generalized Linear Models.

### Results

Current and lifetime residence history in rural areas was associated with decreased levels of the mixture of "PCBs and metals/metalloids", as well as of the combination of OCPs. Current residents in Granada Metropolitan Area showed the highest levels in the "metals/metalloids" component. Occupational history related to agriculture/food industry was associated with the highest levels of the mixture of "metals/metalloids", whereas those involved in motor and industrial activities showed increased levels of the combination of OCPs. Participants working in motor/industry at recruitment showed the highest levels in the "PCBs and metals/metalloids" component.

### Conclusions

Our results revealed interesting clusters of exposure, and emphasized the need for further epidemiological studies to address the effect of environmental pollutants from a mixture perspective. Our results also highlight the potential of adipose tissue as a matrix for exposure assessment to combinations of different families of contaminants, that will definitely shed light on their potential effects.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0670**

**Heterogenous air pollution exposure effects on the dynamic association between depressive symptoms and episodic memory in women aged 80 and older**

**Presenter:** Andrew John Petkus, University of Southern California, LOS ANGELES, United States

**Authors:** A. J. Petkus<sup>1</sup>, X. Wang<sup>1</sup>, D. Younan<sup>1</sup>, D. P. Beavers<sup>2</sup>, H. C. Chui<sup>1</sup>, M. A. Espeland<sup>2</sup>, M. Gatz<sup>1</sup>, T. Gruenewald<sup>3</sup>, J. D. Kaufman<sup>4</sup>, J. E. Manson<sup>5</sup>, S. M. Resnick<sup>6</sup>, G. A. Wellenius<sup>7</sup>, E. A. Whitsel<sup>8</sup>, J. Chen<sup>1</sup>;  
<sup>1</sup>University of Southern California, LOS ANGELES, CA, <sup>2</sup>Wake Forest School of Medicine, Winston-Salem, NC, <sup>3</sup>Chapman University, Orange, CA, <sup>4</sup>University of Washington, Seattle, WA, <sup>5</sup>Harvard Medical School, Boston, MA, <sup>6</sup>National Institute on Aging, Baltimor, MD, <sup>7</sup>Boston University, Boston, MA, <sup>8</sup>University of North Carolina, Chapel Hill, NC.

**Background/aim:** Elucidating how exposure influences interrelationships between episodic memory (EM) and depressive symptoms (DS) helps understand air pollution neurotoxicity on aging brain. Previously, in women primarily aged 70-years old (PMID:31881430), we showed PM<sub>2.5</sub> (particulate matter <2.5 μm) may indirectly contribute to increased DS mediated by EM declines, but no indirect associations between exposure and decreased EM mediated by increased DS were found. How exposure was associated with such longitudinal interrelationship has not been examined in women aged ≥ 80, despite observed increased incidence with possibly different etiologies of these syndromes. **Methods:** Women aged ≥80 years at study baseline (N=1,430; age=83.80± 2.74 years), enrolled in the Women's Health Initiative Memory Study-Epidemiology of Cognitive Health Outcomes, completed up to 5-annual assessments of EM (latent composite of East Boston Memory Test and Telephone Interview for Cognitive Status) and DS (15-item Geriatric Depression Scale). We estimated 3-year average exposures to regional PM<sub>2.5</sub> and NO<sub>2</sub> (proxy of traffic pollutants) both at baseline and during the remote period 10 years earlier, using regionalized national universal kriging. Latent-change structural equation models examined how exposures were associated with the interrelationship of annual changes in T-score standardized EM and DS while adjusting for covariates. **Results:** A statistically significant indirect effect of remote (p<0.05), but not recent (p>0.05), NO<sub>2</sub> exposure on EM decline (β=-0.042, per interquartile=9.32ppb) mediated by increased DS was present. Remote NO<sub>2</sub> was associated with increased DS (β=.270) which was associated with EM decline (β=-.155). PM<sub>2.5</sub> exposure, remote or recent, was not indirectly associated with declines in EM. Regardless of exposure time period, no significant indirect effects of PM<sub>2.5</sub> or NO<sub>2</sub> on increases in DS mediated by EM were found. **Conclusions:** The adverse effect air pollution on the interplay between DS and EM of older women is heterogenous, likely varying by pollutants, exposure time period, and age.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0671**

### **Evaluation of Mental Health and Welfare Aspects of Workers in an Environmental Sanitation Company. Use of a Questionnaire**

**Presenter:** TELMA NERY, INCOR FMUSP, São Paulo, Brazil

**Authors:** T. NERY<sup>1</sup>, M. Tononi<sup>2</sup>, E. HARA<sup>2</sup>, F. Viana<sup>2</sup>, R. Prestes<sup>2</sup>, C. Feijo<sup>2</sup>, M. Augusto<sup>3</sup>;

<sup>1</sup>INCOR FMUSP, São Paulo, BRAZIL, <sup>2</sup>CeAC – Collaborator Service Center - Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, São Paulo, BRAZIL, <sup>3</sup>Companhia de Saneamento Basico do Estado de SP, São Paulo, BRAZIL.

Aspects related to work organization can cause mental wear, mental disorders and illnesses to workers. According PAHO, an environment that respects and protects basic civil, political, socioeconomic and cultural rights is fundamental for the promotion of mental health. Brazil (2016) registered 199 thousand workers, and in 2017 mental and behavioral disorders were responsible for the leave of 178.268 workers. According to legislation, part of workers' illness is linked to the environment and work methodologies adopted by the company. In this context, there is a marked growth of methods aimed at evaluating aspects related to work organization and their repercussions on workers' health. Therefore, addressing workers' quality of life in today's world context becomes important, the assessment of the psychosocial work environment through a voluntary questionnaire is an important determinant of the mental health status of workers. To present the predominant aspects of the mental health of the employees of a sanitation company through a worker health and welfare evaluation questionnaire. Application of the Brazilian version of the Self-Reporting Questionnaire (SRQ-20), anonymous, volunteer, completed by employees before consultation with the occupational physician from May to December/2019 at the medical ambulatory of an environmental sanitation company in the SP Brasil. Evaluated data: Job sector, sex, function (operational and administrative positions) and the answers. Excel 2013 and SPSS were used. 100 questionnaires completed. 39 women, 61 men (33 administrative and 28 operational positions). 24% of the answers presented cutoff score for psycho-emotional disorders (equal to or greater than 7). Of these, 42% (10) were men (2 administrative and 8 operational positions) and 58% (14) were women, all in administrative positions. 67% were administrative. Discussions about the profile were held and used to adapt preventive measures. The use of SRQ-20 contributed to the tracking of mental health in the occupational context enabling specific health actions.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0672**

**Associations between community based mental health status and long-term exposure of particulate matters in a highly urbanized city: A cross-sectional study**

**Presenter:** Jayeun Kim, Institute of Health and Environment, Seoul, Korea, Republic of

**Authors:** J. Kim<sup>1</sup>, H. Kim<sup>2</sup>;

<sup>1</sup>Institute of Health and Environment, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Graduate School of Public Health, Seoul National University, Seoul, KOREA, REPUBLIC OF.

Particulate matters (PM) is one of relevant environmental factors associated with mental health among community dwelling populations. We aimed to verify the association between mental health status and long-term level of PM<sub>10</sub> and PM<sub>2.5</sub> with community based approach. Community health survey data (CHS) was obtained for 25 communities in Seoul, in 2017. Using a cross-sectional study design, we applied survey logistic regression analysis to assess the associations between mental health and community level environments were, adjusting for individual's demographic conditions. Mental health outcomes; experience of depressive symptoms (DS) and self-rated stress levels (SRS) were analyzed using CHS data. Community based long-term level of PM<sub>10</sub> and PM<sub>2.5</sub> were aggregated through 2002-2016 and 2015-2016 respectively. Individual's long-term PM levels were assigned according to the period of residency in a current community and association was estimated between varied community levels of PM and mental health status. Total participants were 22,955 [men 10,278 men (44.8%)] and age groups were 19–39 [7,506 (32.7%)], 40–59 [8,716 (38.0%)], 60–74 [4,902 (21.4%)], and 75+ [1,831 (8.0%)]. Residency periods in a current community were 5–10 years [2,544 (11.4%)], 10–15 years [2,476 (10.8%)], and 15–20 years [1,950 (8.5%)]. Participants with lower mental health conditions were DS [1,600 (7.0%)], SRS [5,939 (25.9%)], and low HI [8,355 (36.4%)]. Among the varied residency period in a current community, increased associations were observed in SRS [1.22, 95% CI 1.03–1.45] in greater than median of 15-year PM<sub>10</sub> level among 10–15 years consistent residency and DS [1.48, 95% CI 1.04–2.10] in greater than median of 15-year PM<sub>10</sub> level among 15–20 years consistent residency respectively. Increased relationships were detected between SRS/ DS and community based long-term PM<sub>10</sub> levels. This finding suggests that differentiated community level of air pollution should be considered to understand mental health conditions among the general populations.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0673**

**Association of long-term air pollution with cognitive decline in the Heinz Nixdorf Recall Study**

**Presenter:** Vanessa Jana Soppa, Heinrich Heine University of Düsseldorf, Institute for Occupational, Social and Environmental Medicine, Düsseldorf, Germany

**Authors:** V. J. Soppa<sup>1</sup>, L. Glaubitz<sup>1</sup>, M. Jokisch<sup>2</sup>, C. Weimar<sup>2</sup>, S. Sanchez Hoffmann<sup>2</sup>, D. Müller-Gerards<sup>2</sup>, A. Winkler<sup>2</sup>, S. Moebus<sup>3</sup>, K. Jöckel<sup>3</sup>, B. Hoffmann<sup>1</sup>;

<sup>1</sup>Heinrich Heine University of Düsseldorf, Institute for Occupational, Social and Environmental Medicine, Düsseldorf, GERMANY, <sup>2</sup>University medical center Essen, Department of Neurology, Essen, GERMANY,

<sup>3</sup>Institute of Medical Informatics, Biometry and Epidemiology (IMIBE), University Hospital Essen, University of Duisburg-Essen, Essen, GERMANY.

Background: Few studies have examined whether an association exists between long-term exposure to air pollution (AP) and neuropsychological function and cognitive decline in the elderly population, even though sustained neurocognitive function at older age is a prominent element of ageing and will be one of the main challenges in an ageing society. Methods: We analyzed data from the German population-based Heinz Nixdorf Recall Study (baseline examination 2000-2003, N=4814). Participants carried out five cognitive tests: Verbal Memory Test (immediate and delayed recall), Clock Drawing Test, Labyrinth Test, and a Verbal Fluency Test at the first ( $t_1=2006-2008$ ) and second ( $t_2=2011-2013$ ) follow-up examination. Individual test scores and a global score were transformed into z-scores (difference between the measured and the predicted cognitive test score for each time point divided by the standard deviation of the predicted test score at  $t_1$ ) and z-score differences for each test. We estimated long-term air pollution ( $PM_{10}$ ,  $PM_{coarse}$ ,  $PM_{2.5}$ ,  $PM_{2.5\text{absorbance}}$ , PNC, noise and a traffic indicator) at the participants' residences using the land use regression model. To evaluate the association of AP and cognitive decline we performed linear regression analyses adjusting for sex, SES and lifestyle variables. Results: Overall, 2716 participants (48.9% men) with a mean age of 63.3 (7.2) years were included in this analysis. Interquartile range (IQR) increases in long-term AP exposure showed weak, negative associations with immediate verbal memory (IQR: 3.66) of -0.15 (98%-CI: -0.29; -0.02) for  $PM_{2.5}$  and -0.15 (98%-CI: -0.25; -0.04) for  $PM_{10}$ . Associations for all other air pollutants, noise and traffic indicator were null. Conclusions: Our results indicate that long-term exposure to particles of small sizes in the elderly population may be associated with a decline in short-term memory, a hallmark of early stages of Alzheimer's Disease.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0674**

**Exposure to household air pollution and cognitive function in older Chinese adults**

**Presenter:** Tzu-Wei Joy Tseng, McGill University, Montreal, Canada

**Authors:** T. Tseng<sup>1</sup>, E. Carter<sup>2</sup>, L. Yan<sup>3</sup>, Q. Chan<sup>4</sup>, L. Zhao<sup>5</sup>, P. Elliott<sup>4</sup>, Y. Wu<sup>6</sup>, X. Yang<sup>7</sup>, M. Ezzati<sup>4</sup>, F. J. Kelly<sup>4</sup>, J. Baumgartner<sup>1</sup>;

<sup>1</sup>McGill University, Montreal, QC, CANADA, <sup>2</sup>Colorado State University, Fort Collins, CO, <sup>3</sup>Kings College London, London, UNITED KINGDOM, <sup>4</sup>Imperial College London, London, UNITED KINGDOM, <sup>5</sup>Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, CHINA, <sup>6</sup>Peking University Clinical Research Institute, Beijing, CHINA, <sup>7</sup>Tsinghua University, Beijing, CHINA.

**Background:** Exposure to air pollution from traffic and industry is associated with accelerated cognitive decline in older adults. The effects of exposure to air pollution from household solid fuel (coal/biomass) stoves (HAP) on adult cognitive function have not been investigated. **Methods:** Among 402 peri-urban adults in northern China (mean age=62.5 y), we assessed exposure to HAP by (1) measuring personal exposures to fine particulate matter (PM<sub>2.5</sub>) and black carbon (BC) for 2 days in the heating and non-heating seasons, and (2) collecting information on current and historical fuel use for cooking and heating. We evaluated cognitive function using the Montreal Cognitive Assessment that consists of seven domains and a total score. Cubic spline and linear regression models were used to investigate associations between HAP and cognitive function, adjusting for key sociodemographic, behavioral, and environmental confounders.

**Results:** Participants' average 24-h exposures ranged from 17-907 µg/m<sup>3</sup> (mean=104) for PM<sub>2.5</sub> and from 0.1-8.5 µg/m<sup>3</sup> (mean=1.6) for BC. Thirty-six percent and ten percent of participants exclusively used clean (electricity/gas) fuels for cooking and for both cooking and heating, respectively, while the remaining participants used solid fuel. Participants' total cognitive scores ranged from 2-30 points (mean=20.5). We observed linear inverse associations between air pollution and cognitive scores. Personal exposures to PM<sub>2.5</sub> and BC were associated with lower total cognitive score [per 100 µg/m<sup>3</sup> increase: -0.78 (95% confidence interval (CI): -1.49,-0.07); per 1 µg/m<sup>3</sup> increase: -0.58 (95%CI: -1.09,-0.07), respectively] in fully-adjusted models that included outdoor pollution level. BC was also associated with lower attention score [-0.17 (95%CI: -0.32,-0.02)]. Compared with exclusive and long-term (15-20 years) users of clean fuel, sold fuel users had lower scores in multiple cognitive domains: visuospatial/executive (-0.52, 95%CI: -1.02,-0.03), abstraction (-0.19, 95%CI: -0.37,-0.01) and orientation (-0.38, 95%CI: -0.66,-0.10). **Conclusions:** Exposure to HAP may be associated with lower cognitive function in older adults.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0675**

**Early life exposure to tetrachloroethylene (PCE) and misuse of prescription drugs: a retrospective cohort study in Cape Cod, MA**

**Presenter:** Alexa Friedman, Boston University School of Public Health, Boston, United States

**Authors:** A. Friedman, M. Winter, A. Aschengrau;  
Boston University School of Public Health, Boston, MA.

**Background/Aims:** Between 1968 and 1983, public drinking water supplies of Cape Cod, Massachusetts were contaminated with tetrachloroethylene (PCE), an established neurotoxicant. We previously found an affinity for risk-taking behaviors, including the use of illicit drugs, following early-life exposure to PCE. Using newly collected data, we investigated the risk of misusing prescription drugs following early life PCE exposure. **Methods:** Participants were identified from a retrospective cohort study ("Cape Cod Health Study") via cross-matching birth certificates and water system data. The original self-administered questionnaire gathered data on demographics, work and medical history, and alcohol and illicit drug use from 615 individuals (361 with early-life exposure and 254 unexposed). The follow-up survey added questions on misuse of prescription pain relievers, tranquilizers, stimulants and sedatives. A validated leaching and transport model was used to estimate exposure to PCE exposure in drinking water. **Results:** One hundred and thirty-four (19.3%) participants misused at least one type of prescription drug. Pain relievers were the most commonly misused prescription drug (14.3%). Compared to unexposed subjects, individuals with early-life exposure to PCE were 93% more likely to misuse prescription drugs (Adjusted relative risk (RR) 1.93, 95% CI: 1.31, 2.83), after adjusting for maternal education, father occupation and participant age. Similar increases in risk were seen for pain relievers, tranquilizers and stimulants (Adjusted RRs: 1.82-2.17) and for misusing only 1 or 2 or more prescription drugs [Adjusted RRs 1.97 and 2.12, respectively]. Participants exposed to PCE levels  $\geq$  median had a slightly higher risk of misusing prescription drugs than those exposed to levels  $<$  median [Adjusted RRs: 2.06 (95% CI: 1.34, 3.17) and 1.83 (95% CI: 1.20, 2.79), respectively]. **Conclusions:** Results suggest early life exposure to PCE increases the risk of misusing several types of prescription drugs.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0677**

### **Associations between Oil Spill Response Work and Acute Mental Health Symptoms among U.S. Coast Guard Responders to the Deepwater Horizon Oil Spill**

**Presenter:** Jeanny Wang, Department of Preventive Medicine and Biostatistics, Uniformed Services University, Bethesda, United States

**Authors:** J. Wang<sup>1</sup>, H. Denic-Roberts<sup>2</sup>, L. S. Engel<sup>3</sup>, D. L. Thomas<sup>4</sup>, J. Rusiecki<sup>1</sup>;

<sup>1</sup>Department of Preventive Medicine and Biostatistics, Uniformed Services University, Bethesda, MD,

<sup>2</sup>Department of Preventive Medicine and Biostatistics, Uniformed Services University (USU); Oak Ridge Institute for Science and Education (ORISE), Bethesda, MD, <sup>3</sup>Department of Epidemiology, Gillings School of Public Health, Chapel Hill, NC, <sup>4</sup>United States Coast Guard Headquarters, Directorate of Health, Safety, and Work Life,, Washington, DC.

**Background/Aim:** The 2010 Deepwater Horizon (DWH) Oil Spill was the largest marine oil spill in U.S. history. Over 8,500 U.S. Coast Guard (USCG) members were deployed to carry out a wide range of response and clean-up activities. Measures of oil spill response work, such as deployment length, timing, and oil exposure, may have an acute mental health impact. This population of USCG responders, many of whom are young, healthy, and have equal access to healthcare, has the unique potential to address challenges in understanding mental health impacts of disaster response work.

**Methods:** In this cross-sectional study of 4,855 USCG responders, deployment-related exposures, health symptoms, and lifestyle factors were ascertained via post-deployment surveys. An oil exposure index (OEI), which incorporated duration/timing of response and self-reported crude oil exposure, was developed to semi-quantitatively estimate crude oil exposure (none; medium/low; high). To investigate associations with self-reported anxiety and depression, we used adjusted log-binomial regressions to calculate prevalence ratios (PRs) and 95% confidence intervals (CI).

**Results:** Deployment duration of >30 days (versus <30 days) was significantly associated with increased prevalence of anxiety (PR=1.55, 95% CI: 1.19-2.05). Higher levels of OEI (versus none) were associated with anxiety (PR<sub>medium/low</sub>=1.52, 95%CI= 1.26-1.83; PR<sub>high</sub>=1.70, 95% CI:1.44-2.03) and depression (PR<sub>medium/low</sub>=1.72, 95%CI= 1.32-2.26; PR<sub>high</sub>=1.89, 95% CI: 1.47-2.42); p-trend<0.0001 for both.

**Conclusions:** Our study found cross-sectional associations between oil spill response work and self-reported mental health symptoms among USCG responders. These findings may help inform disaster planners in implementing interventions to mitigate adverse health effects among response workers in future disasters.

**Disclaimer:** The contents, views or opinions expressed in this presentation are those of the authors and do not necessarily reflect official policy or position of USU, the Department of Defense, or the USCG.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

**P-0678**

### **Increased Neuroanatomic Risk for Alzheimer's Disease: Exploring the Interaction of Fine Particle Exposure and Long-Chain Omega-3 Polyunsaturated Fatty Acids**

**Presenter:** Diana Younan, University of Southern California, Los Angeles, United States

**Authors:** D. Younan<sup>1</sup>, R. Casanova<sup>2</sup>, C. Chen<sup>3</sup>, K. He<sup>3</sup>, W. Harris<sup>4</sup>, X. Wang<sup>1</sup>, A. J. Petkus<sup>1</sup>, T. L. Gruenewald<sup>5</sup>, D. P. Beavers<sup>2</sup>, M. Braskie<sup>1</sup>, R. Wallace<sup>6</sup>, S. M. Resnick<sup>7</sup>, J. E. Manson<sup>8</sup>, M. Gatz<sup>1</sup>, H. C. Chui<sup>1</sup>, M. A. Espeland<sup>2</sup>, J. Chen<sup>1</sup>;

<sup>1</sup>University of Southern California, Los Angeles, CA, <sup>2</sup>Wake Forest School of Medicine, Winston-Salem, NC, <sup>3</sup>Columbia University, New York, NY, <sup>4</sup>Sanford School of Medicine at the University of South Dakota, Sioux Falls, SD, <sup>5</sup>Chapman University, Orange, CA, <sup>6</sup>University of Iowa, Iowa City, IA, <sup>7</sup>National Institute on Aging, Baltimore, MD, <sup>8</sup>Brigham and Women's Hospital, Harvard Medical School, Boston, MA.

**Background/Aim:** Ambient fine particulate matter (PM<sub>2.5</sub>) may increase Alzheimer's disease (AD) risk. Although epidemiologic and experimental studies have shown neurotrophic effects of long-chain omega-3 polyunsaturated fatty acids (LCn3FAs), no studies have investigated whether LCn3FAs modify the neurotoxic effect of PM<sub>2.5</sub> on neuroanatomic risk for AD. **Methods:** Community-dwelling older women (aged 71-89) from the Women's Health Initiative Memory Study of MRI completed two structural brain scans (MRI-1: 2005-6; MRI-2: 2010-11). The AD pattern similarity (AD-PS) score, developed by supervised machine learning and validated with AD Neuroimaging Initiative data, was used to measure neuroanatomic risk determined by the degree of high-dimensional gray matter atrophy in brain areas vulnerable to AD. Residential three-year average PM<sub>2.5</sub> exposure preceding MRI-1 was aggregated from daily estimates, based on nationwide spatiotemporal modeling. Red blood cell fatty acid composition was analyzed using gas chromatography, with the omega-3 index defined as the sum of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). We examined whether omega-3 index, EPA, and DHA modified the association between PM<sub>2.5</sub> and AD-PS scores (5-year standardized difference) using generalized linear models, adjusting for geographic region, sociodemographics, lifestyle factors, clinical characteristics, intracranial volume, and total energy intake. **Results:** Among 627 women, PM<sub>2.5</sub> (per 2.82- $\mu\text{g}/\text{m}^3$ ) was significantly associated with increased AD-PS scores ( $\beta=0.026$ ;  $p=0.003$ ; equivalent to a 24% increase in AD risk) over 5 years. This association with PM<sub>2.5</sub> was greater among women with lower ( $\beta=0.042$ ;  $p=0.001$ ) vs. higher ( $\beta=0.006$ ;  $p=0.660$ ) omega-3 index (median=0.050-g/1,000-kcal;  $p_{\text{interaction}}=0.056$ ) and among women with lower ( $\beta=0.042$ ;  $p=0.001$ ) vs. higher ( $\beta=0.007$ ;  $p=0.577$ ) DHA (median=0.044-g/1,000-kcal;  $p_{\text{interaction}}=0.064$ ). There was no evidence that EPA modified the association ( $p_{\text{interaction}}=0.340$ ). **Conclusions:** Our findings support potential interactions between PM<sub>2.5</sub> neurotoxicity and neurotrophic effects of LCn3FAs, though tests of interactions did not reach statistical significance. Higher LCn3FAs, achievable by dietary intervention, may reduce the AD risk associated with long-term PM<sub>2.5</sub> exposure.

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Theme: **Neurologic**

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**P-0679**

**Environmental and occupational risk factors for early onset dementia in an Italian community**

**Presenter:** Giorgia Adani, University of Modena and Reggio Emilia, Modena, Italy

**Authors:** G. Adani<sup>1</sup>, T. Filippini<sup>1</sup>, C. Garuti<sup>1</sup>, M. Malavolti<sup>1</sup>, G. Vinceti<sup>2</sup>, G. Zamboni<sup>3</sup>, M. Tondelli<sup>4</sup>, C. Galli<sup>5</sup>, M. Costa<sup>6</sup>, M. Vinceti<sup>7</sup>, A. Chiari<sup>1</sup>;

<sup>1</sup>University of Modena and Reggio Emilia, Modena, ITALY, <sup>2</sup>University of Modena and Reggio Emilia. Modena-Policlinico University Hospital, Modena, ITALY, <sup>3</sup>University of Oxford, UK. University of Modena and Reggio Emilia. Modena-Policlinico University Hospital, Modena, ITALY, <sup>4</sup>Modena Policlinico-University Hospital. Primary care Department, Modena Local Health Authority, Modena, ITALY, <sup>5</sup>Modena Policlinico-University Hospital. University of Florence. Neurology Unit of Carpi Hospital, Modena Local Health Authority, Modena, ITALY, <sup>6</sup>Neurology Unit of Carpi Hospital, Modena Local Health Authority, Modena, ITALY, <sup>7</sup>Boston University School of Public Health, Boston, Massachusetts. University of Modena and Reggio Emilia, Modena, ITALY.

**Background:** Early onset dementia (EOD) is defined as dementia with symptoms onset before 65 years. Little is known about the etiological role of environmental and occupational risk factors. We aimed at assessing the role of these factors in disease etiology. **Methods:** Using a case-control design, we recruited all EOD cases resident in Modena province from October, 2016 to October, 2019, as well as a referent population drawn from patients' care-givers. We investigated residential history of study participants, and their occupational and environmental exposures to pesticides, solvents and metals through a self-administered questionnaire. We computed the odds ratios (ORs) of disease risk, and the corresponding 95% confidence intervals (CIs), according to exposure to the investigated risk factors, using an unconditional logistic regression model adjusted for sex, age, and education. **Results:** Fifty-eight EOD cases and fifty-four controls agreed to participate. Among occupational factors, disease risk was associated with exposure to aluminum (OR 2.6, 95% CI 0.4-15.7), pesticides (OR 2.3, 95% CI 0.7-7.8) particularly from agricultural occupational exposure (OR 3.1, 95% CI 0.7-13.3) and dyes, paints or thinners (OR 1.7, 95% CI 0.6-5.0). Among lifestyles factors, smoking (OR 1.3, 95% CI 0.6-2.9) and playing football (OR 2.2, 95% CI 0.5-9.3) or cycling (OR 2.3, 95% CI 0.4-13.4) were associated with higher EOD risk, although overall sports practice appeared to be protective factor (OR 0.4, 95% CI 0.2-0.9). Risk was also positively associated with history of head trauma (OR 1.2, 95% CI 0.3-4.1) and particularly upper arm trauma (OR 2.2, 95% CI 0.7-7.5), but not overall trauma. No association emerged for exposure to electromagnetic fields. **Conclusions:** Despite the study limitations, our results appear to support a role of environmental risk factors in EOD etiology, particularly of some chemical exposures and professional sports, while overall sports practice may have a beneficial effect.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0682**

### **Common Mental Health Disorders among Informal Waste Pickers in Johannesburg, South Africa 2018—A Cross-Sectional Study**

**Presenter:** Matimba Joelander Makhubele, National Institute of Occupational Health, Johannesburg, South Africa

**Authors:** M. J. Makhubele;  
National Institute of Occupational Health, Johannesburg, SOUTH AFRICA.

Background: Waste-picking is an income generating opportunity for many living in poverty and a great contributor to environmental stability. Waste pickers have most of the risk factors associated with common mental disorders (CMD), such as poverty, work related stress and poor living conditions. The aim of this study was to determine the prevalence and associated risk factors of CMD among waste pickers. Method: A cross-sectional study analysed secondary data of 365 waste pickers. A validated Self-Reporting Questionnaire (SRQ-20) was used to assess CMD. Multivariable logistic regression was fitted to identify factors associated with CMD. Results: The overall prevalence of CMD among waste pickers was 37.3%. The odds of having CMD were 2.5 and 3.2 higher in female waste pickers and cigarette smokers, respectively ( $p = 0.019$  and  $p = 0.003$ ). Life enjoyment (Adjusted odds ratio [aOR] 0.54,  $p = 0.02$ ) and a good quality of life (aOR 0.34,  $p \leq 0.001$ ) were associated with lower odds of CMD. Conclusion: The high prevalence of CMD among waste pickers was significantly associated with cigarette smoking, being female, not enjoying life, and a poor quality of life. Mental health awareness of CMD will assist with the prevention, early detection, and comprehensive management of CMD among waste pickers.

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**P-0683**

**Exposure to particulate matter and risk of conversion from mild cognitive impairment to dementia: a cohort study in a Northern Italy population**

**Presenter:** Marco Vinceti, University of Modena and Reggio Emilia, Modena, Italy

**Authors:** M. Vinceti<sup>1</sup>, T. Filippini<sup>1</sup>, C. Malagoli<sup>1</sup>, A. Cherubini<sup>2</sup>, G. Maffei<sup>2</sup>, A. Chiari<sup>3</sup>;  
<sup>1</sup>University of Modena and Reggio Emilia, Modena, ITALY, <sup>2</sup>Terraria, Milan, ITALY, <sup>3</sup>Policlinico University Hospital, Modena, ITALY.

**Background/Aim** Exposure to air pollutants such as inhalable particulate matter has been linked to increased risk of chronic disease including neurodegenerative diseases, such as Alzheimer's dementia. In this study, we aimed to evaluate the effect of long-term exposure to outdoor air pollution, and specifically to particulate matter  $\leq 10 \mu\text{m}$  (PM10), on the risk of dementia in a cohort of subjects with mild cognitive impairment. **Methods** We recruited 53 subjects newly-diagnosed with mild cognitive impairment of non-vascular origin and residing in the Modena and Reggio Emilia provinces of Northern Italy. Using a Geographical Information System and a validated air pollution dispersion model, we assessed exposure to outdoor PM10 from motorized traffic at subjects' residence. We investigated the relation of these concentrations to subsequent onset of dementia, using a Cox proportional hazards model. We computed hazard ratio (HR) and 95% confidence interval (CI) according to fixed categories of PM10 exposure, adjusting for sex, age, and educational attainment level. **Results** During a median follow-up of 42 months, 19 participants developed Alzheimer's dementia, 3 frontotemporal dementia and 2 Lewy body dementia. Baseline PM10 exposure levels were  $9.6 \mu\text{g}/\text{m}^3$  on average. Using PM10 levels below  $5 \mu\text{g}/\text{m}^3$  as reference, we found a dose-response increase in any dementia risk with HR of 1.04 (95% CI 0.41-2.66) at  $5\text{-}10 \mu\text{g}/\text{m}^3$ , 1.32 (95% CI 0.36-4.92) at  $10\text{-}20 \mu\text{g}/\text{m}^3$ , and 1.38 (95% CI 0.14-13.13) above  $20 \mu\text{g}/\text{m}^3$ , respectively. **Conclusions** Our results suggest that exposure to particulate matter emitted by motorized vehicles increases the risk of conversion from mild cognitive impairment to dementia, though the low number of study participants suggests caution in the interpretation of these findings.

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Theme: **Neurologic**

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**P-0684**

**Environmental Exposures and Seizures Treated by Illinois Emergency Medical Services and Hospitals.**

**Presenter:** Hannah Matzke, University of Illinois at Chicago, Chicago, United States

**Authors:** H. Matzke, L. Friedman;  
University of Illinois at Chicago, Chicago, IL.

Up to 10% of the population will have at least one seizure in their lifetime, with young children and elderly having the highest risk (WHO 2019). Human epidemiological studies and controlled animal studies have shown that exposure to common environmental pollutants, including carbon monoxide, lead, and nitrogen dioxide may lead to neurotoxicity and alter human susceptibility to seizures. While the biomechanism causing altered human seizure susceptibility is not entirely clear, air pollution has been shown to increase oxidative stress and neuroinflammation in humans and animals. The small number of human studies have included populations exposed to high levels of ambient air pollution, but the results have been inconsistent in regard to an increase in seizure occurrence and sudden deaths among people with epilepsy. There remains no reported data on the presence and strength of an association between chronic low-level environmental exposures to common air pollutants and seizure risk. Using medical billing records from Illinois hospitals and emergency medical services data on ambulance runs from 2011-2019, we evaluated the association between point sources of pollution mixtures (Toxic Release Inventory sites, Superfund sites, highways) and ZIP code level seizure rates.

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Theme: **Neurologic**

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**P-0685**

**Low level long term fine particulate matter exposure and incidence of dementia in the Puget Sound**

**Presenter:** Rachel M. Shaffer, UW Seattle, Seattle, United States

**Authors:** R. M. Shaffer<sup>1</sup>, M. Blanco<sup>1</sup>, M. Carone<sup>1</sup>, S. D. Adar<sup>2</sup>, P. K. Crane<sup>1</sup>, E. B. Larson<sup>1</sup>, G. Li<sup>3</sup>, L. Sheppard<sup>1</sup>;

<sup>1</sup>UW Seattle, Seattle, WA, <sup>2</sup>University of Michigan, Ann Arbor, MI, <sup>3</sup>VA Puget Sound, Seattle, WA.

**Background:** Growing evidence links ambient air pollution to dementia. The extent to which these effects manifest at low exposure levels is unclear. We utilize a population-based cohort in Seattle to evaluate whether long-term exposure to low-level fine particulate matter (PM<sub>2.5</sub>) is associated with incidence of all-cause dementia and Alzheimer's Disease (AD) among the elderly. **Methods:** Dementia-free individuals aged 65 years and older from Group Health Cooperative (now Kaiser Permanente Washington) were enrolled in the Adult Changes in Thought (ACT) study beginning in 1994; recruitment is ongoing, with 5748 total participants as of January, 2020. We assigned PM<sub>2.5</sub> exposure based on national spatial models of annual averages linked to participant addresses. Dementia diagnoses were made using standardized ACT diagnosis protocols at biennial follow-ups. We conducted multivariate Cox proportional hazards regression to evaluate the association between time-varying, 10-year average PM<sub>2.5</sub> exposure and time to event for all-cause dementia. Our primary model utilized age as the time axis, included stratification for apolipoprotein E (APOE) genotype status, and adjusted for sex, education, race, neighborhood median household income, and birth cohort. We also ran secondary analyses using additional covariates, alternative exposure average periods, inclusion of nitrogen (NO<sub>2</sub>) dioxide as a co-pollutant, and restriction to AD.

**Results:** The mean (standard deviation) of 10-year average PM<sub>2.5</sub> was 7.9 (1.1) ug/m<sup>3</sup>, which is below the current national air quality standard. For our primary analysis, we estimated that 1 ug/m<sup>3</sup> higher 10-year PM<sub>2.5</sub> was associated with a 5% larger expected hazard of all-cause dementia; however, the confidence interval included the null (1.05 (0.94, 1.17)). Results were similar with inclusion of NO<sub>2</sub> (1.03 (0.95, 1.13)) and when restricting to AD (1.01 (0.90, 1.14)).

**Conclusions:** Our results are suggestive but inconclusive about the link between low-level PM<sub>2.5</sub> air pollution and neurodegeneration, including all-cause dementia and AD.

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Theme: **Neurologic**

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**P-0686**

**Dietary quality and dietary inflammatory potential during pregnancy and offspring emotional and behavioral problems in childhood: an individual participant data meta-analysis of four European cohorts**

**Presenter:** Kinga Polanska, Nofer Institute of Occupational Medicine, Lodz, Poland

**Authors:** K. Polanska<sup>1</sup>, P. Kaluzny<sup>1</sup>, A. M. Aubert<sup>2</sup>, J. Y. Bernard<sup>2</sup>, L. Duijts<sup>3</sup>, H. Marroun<sup>3</sup>, W. Hanke<sup>1</sup>, J. R. Hébert<sup>4</sup>, B. Heude<sup>2</sup>, A. Jankowska<sup>1</sup>, G. Mancano<sup>5</sup>, S. M. Mensink-Bout<sup>3</sup>, C. Relton<sup>5</sup>, N. Shivappa<sup>4</sup>, M. Suderman<sup>5</sup>, E. Trafalska<sup>6</sup>, E. Wesolowska<sup>1</sup>, R. Garcia-Esteban<sup>7</sup>, M. Guxens<sup>7</sup>, M. Casas<sup>7</sup>, C. M. Phillips<sup>8</sup>;

<sup>1</sup>Nofer Institute of Occupational Medicine, Lodz, POLAND, <sup>2</sup>Université de Paris, Inserm, Paris, FRANCE,

<sup>3</sup>Erasmus University Medical Center, Rotterdam, NETHERLANDS, <sup>4</sup>University of South Carolina, Columbia,

SC, <sup>5</sup>University of Bristol, Bristol, UNITED KINGDOM, <sup>6</sup>Medical University of Lodz, Lodz, POLAND,

<sup>7</sup>ISGlobal, Barcelona, SPAIN, <sup>8</sup>University College Dublin, Dublin, IRELAND.

**Background/Aim:** The impact of maternal diet during pregnancy on child neurodevelopment is of scientific interest and public health and clinical relevance. We evaluated associations of maternal dietary quality (based on Dietary Approaches to Stop Hypertension (DASH) score) and dietary inflammatory potential (based on energy-adjusted Dietary Inflammatory Index (E-DII) score) during pregnancy with offspring emotional and behavioral problems at 7-10 years of age. **Methods:** Individual participant data for 11,870 mother-child pairs from four European cohorts, participating in the ALPHABET consortium, were analyzed. Maternal antenatal DASH and E-DII scores were generated from self-completed food frequency questionnaires (FFQ). Symptoms of depression and anxiety, aggression and attention deficit and hyperactivity disorder (ADHD) in children were assessed using mother reported tests and classified within the normal or borderline/clinical ranges using validated cut-offs. Adjusted odds ratios (OR) were determined by multivariable logistic regression models and aggregated by the two-stage individual participant data meta-analysis method. **Results:** After adjustment for sociodemographic and lifestyle factors, higher maternal DASH scores (indicating better dietary quality) were associated with lower risk of depressive and anxiety symptoms (OR (95% CI) per 1 unit DASH score increase: 0.97 (0.95, 0.99)), aggressive symptoms (0.97 (0.95, 0.99)) and ADHD symptoms (0.97 (0.95, 0.98)) within the borderline/clinical ranges. A one-unit increase in E-DII scores (more pro-inflammatory diet) was associated with a 7% increased risk of all three analyzed emotional and behavioral problems (OR (95% CI): 1.07 (1.03, 1.11), 1.07 (1.02, 1.13) and (1.07 (1.00, 1.13) for symptoms of depression and anxiety, aggression and ADHD, respectively). **Conclusions:** Overall higher dietary quality during pregnancy is associated with lower risk of offspring emotional and behavioral problems during childhood, while higher dietary inflammatory potential with higher risk of that problems. Educational programs and interventions focused on healthy diet recommendations during pregnancy may improve offspring neurodevelopmental outcomes.

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Theme: **Neurologic**

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**P-0687**

**Air pollution and cognitive function among a cohort of older women in Germany**

**Presenter:** Rachel Tham, Australian Catholic University, Melbourne, Australia

**Authors:** R. Tham<sup>1</sup>, C. Wigmann<sup>2</sup>, H. Altug<sup>2</sup>, K. de Hoogh<sup>3</sup>, B. Hoffman<sup>4</sup>, T. Schikowski<sup>2</sup>;

<sup>1</sup>Australian Catholic University, Melbourne, AUSTRALIA, <sup>2</sup>IUF-Leibniz Research Institute for Environmental Medicine, Dusseldorf, GERMANY, <sup>3</sup>Swiss Tropical and Public Health Institute, Basel, SWITZERLAND,

<sup>4</sup>Institute for Occupational, Social and Environmental Medicine, Heinrich Heine University, Dusseldorf, GERMANY.

**Background:** Research on air pollution and cognitive function is limited particularly among older women. A genetic risk factor for cognitive decline is the allele apolipoprotein  $\epsilon 4$  (APOE  $\epsilon 4$ ) but little is known about its potential interaction with air pollution. We investigated associations between long-term exposure to ambient air pollution and cognitive status in older women. We assessed effect modification by APOE  $\epsilon 4$  status. **Methods:** In a follow-up examination of the SALIA cohort in 2012-13, 542 women aged  $\geq 65$  years living in Germany were clinically examined. Cognitive function was assessed using the CERAD-Plus neuropsychological test battery. APOE  $\epsilon 4$  polymorphisms were assessed using buccal swabs or blood samples. Covariate information was obtained by interview. Long-term concentrations of particulate matter  $< 2.5 \mu\text{m}$  in diameter (PM<sub>2.5</sub>), nitrogen dioxide, black carbon and ozone modelled by fine spatial scale (100m x 100m) hybrid land-use regression were assigned to residential addresses. Cross-sectional associations were assessed using logistic regression models adjusted for age, body mass index, APOE  $\epsilon 4$  status, depression, educational level, and smoking. Effect modification by APOE  $\epsilon 4$  status was tested with interaction analysis and stratification. **Results:** Annual ozone concentrations were associated with an increased risk of lower performance of psycho-motoric domains assessed by the trail-making test (OR=1.62, 95%CI 1.04-2.59). No associations were found with other cognitive domains. APOE  $\epsilon 4$  status modified the effect of: annual ozone in those without APOE  $\epsilon 4$  allele with lower semantic memory (OR=2.01, 1.36-3.03) compared to those with APOE  $\epsilon 4$  (OR=1.10, 0.62, 2.01); annual PM<sub>2.5</sub> in those with APOE  $\epsilon 4$  with lower visuospatial function (OR=1.90, 1.06-3.48) and psycho-motoric function (OR=1.93, 1.05-3.64) compared with those without APOE  $\epsilon 4$  (OR=0.79, 0.56, 1.12) and (OR= 0.94, 0.68, 1.30) respectively. **Conclusion:** Ozone and PM<sub>2.5</sub> exposures may be a risk factor for lower cognitive function among older women, but the risk may vary depending on APOE  $\epsilon 4$  status.

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Theme: **Neurologic**

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**P-0689**

### **Long-term Air Pollution and Noise Exposures and Structural Parameters of the Default Mode Network in the 1000BRAINS Study**

**Presenter:** Sarah Lucht, Environmental Epidemiology Group, Institute of Occupational, Social and Environmental Medicine, Centre for Health and Society, Medical Faculty, Heinrich Heine University Düsseldorf, Düsseldorf, Germany

**Authors:** S. Lucht<sup>1</sup>, L. Glaubitz<sup>1</sup>, S. Moebus<sup>2</sup>, S. Schramm<sup>2</sup>, B. Schmidt<sup>2</sup>, C. Jockwitz<sup>3</sup>, S. Caspers<sup>4</sup>, B. Hoffmann<sup>1</sup>;

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<sup>4</sup>Institute for Anatomy I, Medical Faculty, Heinrich Heine University Düsseldorf, Düsseldorf, GERMANY.

**Background/Aim:** While evidence suggests that long-term air pollution (AP) and noise may have negative effects on brain health and cognition, little is known about structural and functional changes in the brain networks that may underlie these associations. We investigated the association between AP and traffic noise exposures and structural parameters, including cortical thickness and the local gyrification index (IGI), of the Default Mode Network (DMN) in the brain, as it is important for resting-state brain function. Like what is seen in the DMN with aging, we hypothesized AP and noise exposures to be associated with decreased cortical thickness and more local atrophy (i.e., lower IGI). **Methods:** We used data from 559 participants of the 1000BRAINS study in Germany. Residential mean AP exposures (particulate matter [PM] 10, PM<sub>2.5</sub>, NO<sub>2</sub>, and accumulation mode particulate number concentration [PN<sub>AM</sub>]) were modeled for the years 2006-2008 using the validated EURAD chemistry transport model on a 1 km<sup>2</sup> scale. Long-term traffic noise was modeled at participants' homes according to European standards. Cortical thickness and IGI values in the left and right medial prefrontal cortex, posterior cingulate cortex, and inferior parietal lobule of the DMN were calculated from T1-weighted structural brain images collected between 2011 and 2015. Associations between environmental exposures and brain parameters were estimated using linear regression models, adjusting for demographic and lifestyle characteristics. **Results:** Exposure to PM<sub>10</sub>, PM<sub>2.5</sub> and PN<sub>AM</sub> was weakly associated with decreased cortical thickness in the left prefrontal cortex (e.g., -0.02 [95% Confidence-Interval: -0.03, 0.00] mm per 3.65 µg/m<sup>3</sup> increase in PM<sub>10</sub>). No associations were observed for AP and IGI or between traffic noise exposure and either DMN parameter. **Conclusion:** Weak associations between AP and structural parameters of the DMN in the brain were observed, but further studies are needed to validate this result.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0690**

**World Trade Center exposome: risk and protective factors for symptoms of post-traumatic stress disorder among WTC General Responders**

**Presenter:** Elena Colicino, -Mount Sinai, Mesaj yazın, United States

**Authors:** E. Colicino, E. Rechtman, C. Dasaro, C. Hahn, E. Navarro, S. Teitelbaum, A. Todd, M. Horton; -Mount Sinai, -New York, NY.

Background: Responders involved in the rescue and recovery effort following the attacks of September 11, 2001, were exposed to hazardous working conditions and toxic agents. To better define the associations between responders' experiences during the WTC rescue and recovery effort and the risk of adverse health outcomes, we proposed a data-driven, exposomics approach. We define the "WTC exposome" as a mixture of WTC-related experience, mental and physical health status, socioeconomic status and social support at the time of 9/11. In this abstract, we focus on associations between the WTC exposome and symptoms of post-traumatic stress disorder (PTSD). Methods: We studied 29,508 consented responders from WTC Health Program (WTCHP), who completed a baseline visit that included physical health, mental health and exposure assessment questionnaires, as well as a physical examination with at least one follow-up visit. We used generalized weighted quantile sum (gWQS) regression to examine positive and negative associations between an index of 55 WTC exposome factors (e.g., self-reported level of exposure to the dust cloud resulting from the towers' collapse, traumatic factors, levels of support) and symptoms of PTSD assessed via both the PTSD Checklist (PCL) and the WTCHP certification for PTSD. Each model was adjusted for age, ethnicity, gender, occupation and race. Results: A greater WQS mixture index was associated with higher PCL scores ( $\beta$ : 46.4;  $p < .001$ ) and increased likelihood of having PTSD certification ( $\beta$ : 5.12;  $p < .001$ ). Disappointment in the level of support from health professionals and the community, traumatic experiences and sleeping onsite were the largest contributors to this association. Conclusion: These findings identify WTC-related risk factors that will enable us to better identify WTC responders vulnerable to developing PTSD. This study may benefit others experiencing disaster-related exposures.

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**P-0691**

**Fine Particle Exposure and Hospital Admissions for Neurodegenerative Diseases in New York State**

**Presenter:** Yanelli Nunez, Columbia University Mailman School of Public Health, NEW YORK, United States

**Authors:** Y. Nunez<sup>1</sup>, A. K. Boehme<sup>2</sup>, M. G. Weisskopf<sup>3</sup>, D. B. Re<sup>1</sup>, R. V. Martin<sup>4</sup>, A. Navas-Acien<sup>1</sup>, A. V. Donkelaar<sup>5</sup>, M. Kioumourtzoglou<sup>1</sup>;

<sup>1</sup>Columbia University Mailman School of Public Health, NEW YORK, NY, <sup>2</sup>Columbia University Psychiatric Institute, NEW YORK, NY, <sup>3</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>4</sup>Washington University at St. Louis, St. Louis, MO, <sup>5</sup>Dalhousie University, Halifax, NS, CANADA.

**Background:** Environmental risk factors for neurodegenerative diseases, an increasing global problem, are largely unknown. Growing evidence suggests that air pollution may contribute to these conditions. We examined the association between exposure to fine particulate matter (PM<sub>2.5</sub>) and disease progression using Alzheimer's disease (AD), Parkinson's (PD) and amyotrophic lateral sclerosis (ALS) hospitalization data. **Methods:** We used data on hospital admissions and emergency department visits within New York State (NYS). Our analysis included annual AD, PD, and ALS counts of first hospitalizations (total and sex- and age-stratified) per county from 2000-2014 across NYS. We obtained estimates of annual PM<sub>2.5</sub> concentrations at a 1km<sup>2</sup> grid resolution from a well-validated prediction model and aggregated estimates to county level. The association was estimated using outcome-specific mixed quasi-Poisson models allowing for outcome-exposure nonlinear relationships. We included county-specific random intercepts and county population size as an offset term, and adjusted for potential confounders. **Results:** Increase in annual PM<sub>2.5</sub> concentration was associated with annual increase in total PD hospitalizations with a steeped slope at lower concentrations ( $p < 0.05$ ). We observed effect modification by age in ALS and PD but not by sex for any of the outcomes. Increase in PM<sub>2.5</sub> was nonlinearly associated with increase AD and PD hospitalizations in patients 50-70 years old ( $p < 0.05$ ). We found a linear negative association between PM<sub>2.5</sub> exposure and ALS hospitalizations in patients  $\geq 70$  (RR=0.94, 95% CI: 0.89-0.99) and a positive among those  $< 70$  (RR=1.06, 95% CI: 1.01-1.11). We also found a nonlinear positive association between PM<sub>2.5</sub> and PD hospitalizations in females ( $p < 0.001$ ). **Discussion:** Our findings suggest that annual increase in PM<sub>2.5</sub> concentrations, at the county level, may contribute to increases in neurodegenerative disease hospitalization rates in certain patient subpopulations. Further research is needed to better understand PM<sub>2.5</sub> differential effects by age and sex in association with these diseases.

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**P-0692**

**Making the Invisible Visible: Intervening on cumulative environmental neurodevelopmental risks using a system dynamics approach**

**Presenter:** Devon Payne-Sturges, University of Maryland School of Public Health, College Park, United States

**Authors:** D. Payne-Sturges<sup>1</sup>, E. Ballard<sup>2</sup>, D. Cory-Slechta<sup>3</sup>, R. Puett<sup>1</sup>, S. Thomas<sup>1</sup>, R. Hammond<sup>2</sup>, K. Ellickson<sup>4</sup>, J. Dilworth-Bart<sup>5</sup>, E. Hubertz<sup>6</sup>, G. Huerta-Montanez<sup>7</sup>, R. Prather<sup>8</sup>, M. Swanson<sup>9</sup>, N. Obot Witherspoon<sup>10</sup>, P. Hovmand<sup>2</sup>;

<sup>1</sup>University of Maryland School of Public Health, College Park, MD, <sup>2</sup>Washington University Brown School of Social Work, St. Louis, MO, <sup>3</sup>University of Rochester School Medical Center, Rochester, NY, <sup>4</sup>Minnesota Pollution Control Agency, Saint Paul, MN, <sup>5</sup>University of Wisconsin-Madison, Madison, WI, <sup>6</sup>Washington University School of Law, St. Louis, MO, <sup>7</sup>The Icahn School of Medicine at Mount Sinai, New York, NY, <sup>8</sup>University of Maryland College of Education, College Park, MD, <sup>9</sup>The Arc, Washington, DC, <sup>10</sup>Children's Environmental Health Network, Washington, DC.

**Background:** The combined effects of multiple environmental toxicants and social stressor exposures are widely recognized as important public health problems, likely contributing to health inequities. However cumulative environmental health risk and impacts have received little attention by US policy makers at state and federal levels to develop comprehensive strategies to reduce these exposures, mitigate cumulative risks and prevent harm. An area for which the inherent limitations of current approaches to cumulative environmental health risk are well illustrated is children's neurodevelopment which exhibits dynamic complexity, intergenerational effects and interdependent and causally linked nature of multiple factors. Systems science methods enable investigators to examine the dynamic relationships of variables at multiple levels of analysis simultaneously, while also studying the impact of the non-linear behavior of the system as a whole over time. Thus we contend that a systems approach, specifically system dynamics, may be better suited for devising policy solutions to address cumulative effects of multiple chemical, physical, biological and social environmental stressors. **Methods:** We convened a 2 1/2-day system dynamics workshop involving experts across multiple disciplines to formally describe the multiple interacting streams of social stressors and environmental neurotoxicants impacting children's neurodevelopment through the use of qualitative system maps and formal system dynamics simulation models. **Results:** An initial system dynamics causal map was developed, incorporating feedback mechanisms relevant to diverse disciplines. Potential high leverage intervention points for reducing disparities in children's cumulative neurotoxicant exposures and effects were identified. Workshop participants developed deeper level of understanding about the complexity of cumulative environmental health risks, increased their agreement about underlying causes, and enhanced their capabilities for integrating diverse forms of knowledge about the complex multi-level problem of cumulative chemical and nonchemical exposures. **Conclusion:** We conclude that this approach successfully enabled a multidisciplinary group to explore relationships in a complex dynamic system.

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**P-0696**

**Measurement of disability among people with severe mental disorders - pilot study to examine environmental impacts on mental health outcomes in Ghana**

**Presenter:** Kenneth Ayuurebobi AeNgibise, Kintampo Health Research Centre, Kintampo, Ghana

**Authors:** K. A. AeNgibise<sup>1</sup>, M. Hazelton<sup>2</sup>, C. Kewley<sup>2</sup>, O. S. von Ehrenstein<sup>3</sup>, K. P. Asante<sup>1</sup>;  
<sup>1</sup>Kintampo Health Research Centre, Kintampo, GHANA, <sup>2</sup>School of Medicine and Public Health, University of Newcastle, Newcastle, AUSTRALIA, <sup>3</sup>University of California Los Angeles, California, CA.

**Background/aim:** Mental Disorders are a leading cause of morbidity and suicide globally; around 2.15 million people live with mental disabilities in Ghana. While neurotoxic impacts of air pollution have been reported, little is known about effects on mental health outcomes. Possible impacts of household fossil fuel air pollution and mental disorders are largely unknown. In this exploratory study, we assessed participants' level of self-reported disability and explore differences in disability scores by important sociodemographic/environmental characteristics. **Methods:** This pilot study was conducted among patients living with severe mental disorders in the Kintampo North Municipality and Kintampo South District of Ghana. The 12-item validated WHO Disability Assessment Schedule (WHODAS) 2.0 was used to measure participant's level of functional disability. Descriptive statistics were calculated for all outcomes and patient characteristics. Household primary cookstove and fuel use for cooking or heating were assessed. We examined WHODAS scores by several characteristics, including gender, employment and marital status. **Results:** There were 70 participants who completed the survey within the pilot study period. The mean age was 38 years; the majority of participants were male (57%; 40/70). Most (31%; 22/70) of the study participants had Junior High/Middle School education, have never been married (57%; 40/70) and were not currently employed (83%; 58/70). More than half of the study participants (57%; 40/70) were living independently in their communities compared to 43% who needed assistance from family members. Overall, participants reported elevated WHODAS scores indicating their inability to function well on daily basis due to their mental disorder. About 93% (65/70) participants used traditional cookstove (3-stone fires) for cooking, with wood as the primary fuel. **Conclusion:** This pilot study provides preliminary findings to further explore environmental exposures, particularly household air pollution in relation to mental health outcomes and severity in a mixed-method study in Ghana.

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Theme: **Neurologic**

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**P-0697**

### **A Legacy of Confusion: Evaluation of Failed Prevention of Silicosis by Inhalation of Aluminum Powder**

**Presenter:** Tee L Guidotti, Occupational + Environmental Health & Medicine, Gaithersburg, United States

**Authors:** T. L. Guidotti<sup>1</sup>, J. Martell<sup>2</sup>;

<sup>1</sup>Occupational + Environmental Health & Medicine, Gaithersburg, MD, <sup>2</sup>Occupational Health Clinics for Ontario Workers, North York, ON, CANADA.

With the advent of mechanized mining equipment in the nineteenth century silicosis, already common, became a critical cause of mortality among mining and construction workers. Silicosis is easily preventable by increasing mine ventilation and suppressing dust levels by wetting, but at the time these preventive measures were expensive. In the search for a solution, a group treatment using finely divided aluminum powder was licensed and distributed by the McIntyre Research Foundation. Between 1943 and 1979, approximately 28,000 miners in Ontario alone were so treated on a mandatory basis as a work requirement, as well as additional thousands in other countries. No evidence exists that the treatment was efficacious in preventing silicosis, which eventually declined due to dust controls in the mines. There are three studies in the scientific literature that pertain to McIntyre Powder and outcomes, all concerned primarily with risk of neurological disorders, especially Alzheimer disease, and limited by lack of exposure data. Of the three, the Northern Ontario Miners Health Study (Rifat et al., 1990) is the most informative. It was conducted in two phases, in 1988 and 1994 (unpublished) and includes a determination of neurobehavioral performance using robust and accepted testing methods as well as results from an otherwise uninformative mortality study. The initial Rifat study strongly suggests a neurological effect consistent with an association between exposure and the prevalence of neurological signs consistent with dementia, but these findings were not apparent on follow-up. On review, it is evident that the follow-up study was underpowered and more subject to bias than the initial study. For this reason, the initial “positive” study commands more confidence than the follow-up study and should be given more weight. It strongly suggests, but does not conclusively demonstrate, that miners treated with McIntyre Powder experienced a higher rate of neurocognitive impairment.

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**P-0698**

**Air Quality Improvement and Brain Health: evidence from the WHIMS-ECHO study**

**Presenter:** Xinhui Wang, University of Southern California, Los Angeles, United States

**Authors:** X. Wang<sup>1</sup>, D. Younan<sup>1</sup>, A. J. Petkus<sup>1</sup>, D. P. Beavers<sup>2</sup>, M. A. Espeland<sup>2</sup>, J. Millstein<sup>1</sup>, H. C. Chui<sup>1</sup>, S. M. Resnick<sup>3</sup>, M. Gatz<sup>1</sup>, J. D. Kaufman<sup>4</sup>, G. A. Wellenius<sup>5</sup>, E. A. Whitsel<sup>6</sup>, J. E. Manson<sup>7</sup>, J. Chen<sup>1</sup>;

<sup>1</sup>University of Southern California, Los Angeles, CA, <sup>2</sup>Wake Forest School of Medicine, Winston-Salem, NC, <sup>3</sup>National Institute on Aging, Baltimore, MD, <sup>4</sup>University of Washington, Seattle, WA, <sup>5</sup>Boston University, Boston, MA, <sup>6</sup>University of North Carolina, Chapel Hill, NC, <sup>7</sup>Harvard Medical School, Boston, MA.

### Background/Aim

Air quality (AQ) improvement has benefited cardiopulmonary health and reduced mortality. However, whether and how brain health of older people benefit from AQ improvement is unclear.

### Methods

We examined associations between AQ improvement and brain health reflected by Episodic memory (EM) trajectories in the US-based Women's Health Initiative Memory Study-Epidemiology of Cognitive Health Outcomes (WHIMS-ECHO) cohort (N=2042, aged 74-92 in 2008). EM was measured annually (2008-18) using immediate recall total correct (3-trials) in telephone-based California Verbal Learning Test. AQ improvement was defined by reduction in 3-year average exposures from remote period 10 years earlier to recent years prior to ECHO inception. PM<sub>2.5</sub> (particulate matter <2.5µm) and NO<sub>2</sub> (proxy of traffic-related pollutants) exposures were estimated from validated regionalized universal kriging models. Considering heterogeneity in EM decline, we stratified the cohort by baseline age (≤80 vs. 80+). Latent-class mixed models were used to classify EM trajectories and examine associations with exposure, adjusting for sociodemographic, lifestyle and clinical covariates, and time-varying propensity scores to account for selective attrition.

### Results

AQ improved significantly over ~ 10 years with exposure reduction in both PM<sub>2.5</sub> (13.3±2.7µg/m<sup>3</sup> to 10.6±2.0µg/m<sup>3</sup>; p<0.001) and NO<sub>2</sub> (15.8±7.3ppb to 10.5±5.0ppb; p<0.001). In each subcohort, we identified two latent EM trajectories. Among those aged 80+ (N=1206), women with no apparent decline (30% subcohort) had improved EM function over time if residing in locations with greater exposure reduction (PM<sub>2.5</sub>: β=0.152/year, per inter-quartile-range [IQR]=1.78µg/m<sup>3</sup>, p=0.006; NO<sub>2</sub>: β=0.144/year, per IQR=3.96ppm, p=0.03), equivalent to slowing cognitive aging by 1.7-1.8 years. Such presumed benefits were not observed in those aged 80+ with steady decline (70% subcohort). No associations were found among women ≤80 years (N=836), regardless their respective EM trajectories.

### Conclusions

Improved AQ, especially PM<sub>2.5</sub>, was associated with better maintenance of EM function over time in the women aged 80+ with no apparent cognitive aging.

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Theme: **Neurologic**

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**P-0699**

### **Chronic exposure to ambient air pollution and cognitive function among Hispanic/Latinos in San Diego, California**

**Presenter:** Sindana Ilango, UC San Diego, La Jolla, United States

**Authors:** S. Ilango<sup>1</sup>, K. Gonzalez<sup>1</sup>, W. Tarraf<sup>2</sup>, T. Benmarhnia<sup>1</sup>;  
<sup>1</sup>UC San Diego, La Jolla, CA, <sup>2</sup>Wayne State University, Detroit, MI.

**Background:** Studies suggesting a link between air pollution and cognitive decline have been conducted in predominantly non-Hispanic white populations. Hispanic/Latinos are particularly vulnerable to adverse effects of air pollution and are projected to have the largest increase in dementia among race/ethnic minority groups. Thus, we examined the effect of chronic exposure to air pollution on cognitive function in a cohort of Hispanic/Latinos.

**Methods:** Data from the Hispanic Community Health Study/Study of Latinos, a prospective cohort study of Hispanic/Latinos from four U.S. cities was used for this analysis. Participants aged 45 years and older living in San Diego, California completed a neurocognitive battery of four tests examining domains of learning, memory, attention, and executive function. For each participant, chronic exposure to air pollution (fine particulate matter (PM<sub>2.5</sub>), mg/m<sup>3</sup> and ozone (O<sub>3</sub>), ppb) was assigned by averaging four years of interpolated daily estimates before study baseline at their zip code of residence. Linear regression models were generated to estimate the effect of air pollution on standardized test scores. All models accounted for complex survey design and were adjusted for demographic and socioeconomic characteristics.

**Results:** This analysis included 2,089 participants. For every unit increase in PM<sub>2.5</sub>, standardized performance of cognitive function exams was worse for tests of learning, but better for tests of memory and executive function. Similarly, for every unit increase in O<sub>3</sub>, we observed worse performance for tests of learning and executive function, but improved performance for tests of memory. Effect estimates were of negligible size and imprecise.

**Conclusions:** We found no consistent evidence to suggest an adverse impact of air pollution on cognitive performance among middle-aged Hispanic/Latinos in San Diego. Further studies of air pollution and cognitive function among an older cohort of Hispanic/Latinos are encouraged.

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Theme: **Neurologic**

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**P-0700**

### **Joint and interactive effects between health and environmental exposures in predicting amyotrophic lateral sclerosis**

**Presenter:** Andrea Bellavia, Harvard T.H. Chan School of Public Health, Cambridge, United States

**Authors:** A. Bellavia<sup>1</sup>, A. S. Dickerson<sup>2</sup>, R. S. Rotem<sup>1</sup>, J. Hansen<sup>3</sup>, O. Gredal<sup>3</sup>, M. G. Weisskopf<sup>1</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Cambridge, MA, <sup>2</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>3</sup>Danish Cancer Society, Copenhagen, DENMARK.

Amyotrophic lateral sclerosis (ALS) is a rare yet devastating neurodegenerative condition. The mechanisms leading to ALS are most certainly complex and likely involve a joint contribution of several factors with possible synergistic or antagonistic interactions. To provide a better understanding of the association between non-genetic factors and ALS, we evaluated the joint exposure to multiple health and environmental factors linked with ALS in our previous studies, also screening for high-dimensional interactions. We used data from a nested case-control study within the Danish population, with 1639 ALS cases from 1982-2013, jointly investigating 4 hospital-based diagnoses - diabetes, obesity, physical/stress trauma, cardiovascular disease (CVD) during 1977-2009; and 4 occupational exposures - lead, formaldehyde, diesel exhaust, solvents, assessed from individual employment history and Job Exposure Matrices. All covariates were evaluated as ever/never exposed, and we used targeted machine learning (ML) techniques (boosted regression trees and logic regression) to screen for important joint predictors and interactions. These were then evaluated in a final logistic regression model adjusting for potential confounders (age, SES, geography). All analyses were stratified by gender. Among men, trauma and solvents were associated with higher odds of ALS (OR=1.55, 95% CI: 1.08-2.23; OR=1.49, 95% CI: 1.17-1.89, respectively), and presented a negative interaction (OR=0.49, 95% CI: 0.30-0.80). The effects of diesel and CVD were reduced when jointly evaluated, but a positive diesel/CVD interaction was observed (OR=1.56, 95% CI: 0.94-2.60). Among women, solvents, trauma, lead, and CVD were associated with higher odds of ALS, and a negative lead/solvents interaction was documented (OR=0.52, 95% CI: 0.42-0.63). This study is the first attempt to evaluate joint and interactive effects of several risk factors on ALS. Both synergistic and antagonistic mechanisms are likely to be involved in the mechanisms leading to ALS, and future studies should focus on evaluating joint exposures to further understand these interactions.

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**P-0701**

**Sensitivity and specificity of an assessment tool (CDT, FAB and TMT) for the Screening of Neurotoxic effects in agricultural workers from Chile**

**Presenter:** Boris Lucero, Universidad Catolica del Maule, Talca, Chile

**Authors:** B. Lucero, P. Ceballos, M. Muñoz-Quezada;  
Universidad Catolica del Maule, Talca, CHILE.

The pesticides most used in agriculture in Chile are neurotoxic. To date there are no brief assessment tools that allow monitoring of cognitive impairment in agricultural workers. We developed a brief instrument, composed by the Clock Drawing test (CDT), an adapted version of the Frontal Assessment Battery (FABadj) and the Trail Making Test (TMT-A and B). The purpose of this work is to perform an analysis of the sensitivity and specificity of the tests that make up this tool. Method: We used the WAIS-IV as a Gold Standard for this analysis, and the full scale was applied to 18% (n = 41) of the total sample. We assumed a cut-off score of 79 in full scale IQ (borderline intelligence), for positive cases of cognitive impairment. For positive cases of each test, we assumed as a reference the lowest age group in the sample (19 - 37 years) with a cut-off from the 25th percentile for each test (CDT = 17; FABadj = 8; TMT-A = 52; TMT-B = 124). Results: the CDT has a sensitivity= 45% and a specificity= 83%. The positive predictive value (PPV) is 50% and the negative predictive value (NPV) is 81%. The sensitivity of FABadj is 64% and the specificity is 70%, with a PPV = 44% and NPV = 84%. As for the Trail Making test, the TMT-A shows a sensitivity of 73% and a specificity of 63%, with PPV=42% and NPV= 86%. The TMT-B showed 43% sensitivity and 52% specificity, with a PPV=18% and NPV=79%. Conclusion: The most sensitive instrument of the assessment tool is the TMT-A. The level of sensitivity for the other tests that make up the scale (CDT, FABadj, TMT-B) is lower, thus being more effective for ruling out cognitive problems rather than detecting signs of deterioration in agricultural workers.

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**P-0702**

### **Environmental Chemicals and Depression in US Adults**

**Presenter:** Nicole Danielle Fields, University of Massachusetts-Amherst, Amherst, United States

**Authors:** N. D. Fields, M. Mascari, Y. Oulhote;  
University of Massachusetts-Amherst, Amherst, MA.

Background: Evidence suggests that some chemicals (e.g. pesticides, phthalates, metals) may be associated with increased risk of depression, but findings are inconsistent. Additionally, no previous study investigated the individual and joint effects of multiple chemicals in relation to depression. Objective: To investigate individual and joint associations of a mixture of chemicals with depression scores and risk of depression in U.S. adults. Methods: We utilized data from the National Health and Nutrition Examination Survey (NHANES; 2005-2016) on 30,772 participants aged 18-80 years. Depression was self-reported using the Patient Health Questionnaire-9 and was analyzed both continuously and categorically. Sixty-six chemicals including phthalates, per- and polyfluoroalkyl substances (PFAS), parabens, and polycyclic aromatic hydrocarbons (PAHs), metals, thyroid antagonists, metals, pesticides were measured in blood, serum, and urine. We used Exposome Wide Association Study (ExWAS), Bayesian Kernel Machine Regression (BKMR), and SuperLearner to investigate individual and joint associations of these chemicals with depression scores and odds of depression. Results: Approximately 9% of NHANES participants were categorized as moderately/severely depressed (PHQ-9  $\geq 10$ ) with a sample geometric mean of 3.27 (95% CI: 3.24, 3.31). After adjustment for important confounders, a one standard deviation (SD) increase in blood cadmium concentration was associated with 0.24 SD (95%CI: 0.15, 0.32) higher depression scores. Parabens were associated with decreased depression scores. For instance, a 1-SD increase in ethyl paraben concentrations was associated with 0.16 SD (95% CI: -0.29, -0.03) lower depression scores. When analyzing depression scores categorically, a 1-SD increase in blood cadmium concentration was associated with 22% higher odds of depression (OR 1.22; 95% CI: 1.12, 1.33). Parabens were also associated with lower odds of depression. Conclusion: This is the first study to assess individual and joint associations of a mixture of chemicals in relation to increased or decreased risk of depression.

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**P-0703**

**Association between metals concentrations and cognitive performance, and effect modification by diet in older U.S. adults**

**Presenter:** Nasser Laouali, Inserm U1018, Gustave Roussy, Villejuif, France

**Authors:** N. Laouali<sup>1</sup>, F. Romana Mancini<sup>1</sup>, M. Boutron-Ruault<sup>1</sup>, B. Lanphear<sup>2</sup>, T. Benmarhnia<sup>3</sup>, Y. Oulhote<sup>4</sup>;  
<sup>1</sup>Inserm U1018, Gustave Roussy, Villejuif, FRANCE, <sup>2</sup>Simon Fraser University, Vancouver, BC, CANADA,  
<sup>3</sup>University of California, San Diego, San Diego, CA, <sup>4</sup>University of Massachusetts at Amherst, Amherst, MA.

Background: Chronic exposure to metals has been associated with adverse neurological outcomes in the elderly. Although the mechanisms are not completely understood, the inflammatory processes in the brain are suspected as a pathway by which metals exerts their neurotoxicity. In parallel, a high diet quality may protect against chronic inflammation. Objective: We sought to examine the joint associations of overall diet quality - as measured by the Adapted Dietary Inflammatory Index (ADII) and the Healthy Eating Index 2015 (HEI-2015) - and blood metals concentrations on cognitive performance in elderly. Methods: We used data on 1,777 adults aged  $\geq 60$  years from the US National Health and Nutrition Examination Survey (NHANES; 2011-2014). We derived the ADII and the HEI-2015 from two nonconsecutive 24-hour diet recalls. Cognitive performance was measured by the Consortium to Establish a Registry for Alzheimer's disease, the Animal Fluency test, and the Digit Symbol Substitution test. We calculated a composite z-score reflecting the overall cognitive performance. The effect of diet quality and blood metals concentrations on cognitive performances were assessed using generalized linear and additive models adjusted for appropriate confounders. Results: Mean score of overall cognitive performance was 87.8 (SD = 24.3). Higher HEI-2015 scores (reflecting higher diet quality), were associated with higher overall cognitive performance [B= 0.09; 95%CI: 0.02-0.16], while higher ADII scores (reflecting a pro-inflammatory diet) with lower cognitive performance [B= -0.09; 95%CI: -0.17;-0.02]. High lead concentrations were associated with poorer overall cognitive performance. However, this was observed only in subjects with low HEI-2015 or high ADII scores, while there was no association with lead concentrations in subjects with better-quality diets (p-interaction  $< 0.08$  for all). Conclusion: Our findings suggest that a better-quality diet, as assessed with a high HEI-2015 or a low ADII score may help prevent blood lead adverse cognitive effects among elderly people.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0704**

**Salivary cortisol as a marker of self-perceived stress while commuting on Atlanta roadways during peak hours**

**Presenter:** Amit Ugamraj Raysoni, The University of Texas Rio Grande Valley, Brownsville, United States

**Authors:** A. U. Raysoni<sup>1</sup>, H. Rodrigo<sup>1</sup>, R. Golan<sup>2</sup>, J. A. Sarnat<sup>3</sup>;

<sup>1</sup>The University of Texas Rio Grande Valley, Brownsville, TX, <sup>2</sup>Ben Gurion University of the Negev, Beer-Sheva, ISRAEL, <sup>3</sup>Emory University, Atlanta, GA.

Previous research has assessed individual exposures experienced during daily commuting, in occupational settings, and residences. In most metropolitan areas, the psychosocial stress factors also contribute to total daily environmental exposure. The aim of this work was to characterize differences in cortisol concentrations, a biomarker of psychosocial stress, collected in saliva before and following a scripted rush hour commute for 102 study participants. In addition, we compared salivary cortisol with other metrics of self-perceived stress, via questionnaire data. Results presented here were generated using data from two phases of the Atlanta Commuters Exposures studies (ACE-1 and ACE-2), which examined the impact of traffic air pollution on cardiorespiratory health while commuting on Atlanta roadways. Salivary cortisol was assessed by collecting saliva from study subjects immediately before and after the commute. The commutes each lasted for approximately 2 hours. In ACE-1 study, all the participants did two highway commutes separated by a one week period. Post-commute cortisol levels ( $1413.6 \pm 813.3$  pg/ml) were higher than pre-commute cortisol levels ( $730.6 \pm 602.3$  pg/ml). In ACE-2 study, each participant did a highway commute. Half of these study participants, the following week, also did a side street commute and the other half served as control i.e. did not do any commute and stayed indoors for the 2 hour period. Results indicated that the median cortisol concentrations post-commute was higher than pre commute for almost 95 percent of the study subjects. For highway commutes in ACE-2, the mean post-commute cortisol levels were  $1520.5 \pm 713.5$  pg/ml and pre-commute levels were  $713.5 \pm 725.2$  pg/ml. For side-street commutes the levels were: post-commute,  $1475 \pm 949.5$  pg/ml; pre-commute =  $652.7 \pm 532.7$  pg/ml. Cortisol levels for controls were  $1180.3 \pm 940.2$  pg/ml for post-control versus  $763.9 \pm 801.3$  pg/ml for pre-control period. These results indicate that salivary cortisol may be used an effective means of assessing self-perceived psychosocial stress during commuting.

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Theme: **Neurologic**

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**P-0705**

**Exposure to air pollution and incident dementia and modification by APOE gene in the UK Biobank**

**Presenter:** Kimberly L Parra, University of Arizona, Mel and Enid Zuckerman College of Public Health, Tucson, United States

**Authors:** K. L. Parra, Y. Klimentidis, M. Furlong;  
University of Arizona, Mel and Enid Zuckerman College of Public Health, Tucson, AZ.

**Background/Aims** Air pollution may cause inflammatory and oxidative stress damage to the brain, although the association between air pollution and specific types of dementia, and possible genetic modification by APOE status, is relatively underexplored. We examined the association between air pollution (PM<sub>2.5</sub>, PM<sub>10</sub>, PM<sub>2.5-10</sub>, PM<sub>2.5abs</sub>, NO<sub>2</sub>, NO<sub>x</sub>) and incident dementias (Alzheimer's disease (AD), fronto-temporal dementia (FTD), and vascular dementia (VAD)) and modification by APOE status.

**Methods** The UK Biobank repository followed >500,000 participants from enrollment through 2017. After restricting to individuals aged > 60 years, with no dementia diagnosis prior to 2010, our sample included 187,165 individuals (N= 680 incident AD, N=incident VAD, N= 63 incident FTD). Annual averages of air pollutant estimates were estimated from ESCAPE land use regression methods for 2010 and were scaled to interquartile ranges (IQR). Dementia was identified from NHS, hospital, and survey records. Time to incident dementia, and follow-up time was reported from baseline (January 1, 2010) to last censor event (death, last hospitalization, or loss to follow-up). Cox proportional hazard ratios (HR) were calculated to estimate the association of air particulates with risk for dementia.

**Results** We observed strong and consistent associations of PM<sub>2.5</sub> exposure with all measures of dementia except FTD. These include any incident dementia (HR for 1 IQR increase=1.20, 95%CI: 1.13, 1.27), incident AD (HR=1.20, 95% CI 1.09, 1.32), and with incident VAD (HR=1.15, 95% CI: 1.00, 1.31). NO<sub>2</sub> was also associated with any incident dementia (HR=1.21, 95% CI 1.13, 1.29), AD (HR=1.19; 95% CI 1.07, 1.32) and VAD (HR=1.21; 95% CI 1.06, 1.39). No associations were observed for any air pollutants with FTD. APOE did not modify the association between any air particulates and dementia risk.

**Conclusions** PM<sub>2.5</sub> and NO<sub>2</sub> may be associated with several types of dementia, and these associations are not modified by APOE in this cohort.

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Theme: **Neurologic**

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**P-0706**

### **Current Management of Traumatic Brain Injury (TBI) May Lead to Subsequent Risk**

**Presenter:** Niloofar Montazami, Milken Institute School of Public Health, George Washington University, Washington DC, United States

**Authors:** N. Montazami;  
Milken Institute School of Public Health, George Washington University, Washington DC, DC.

Background: Traumatic brain injuries (TBI) present military health providers with expanded clinical responsibilities. Such injuries can lead to lifelong consequences and have a remarkable impact on society and the economy. Between 2000 and 2016, more than 350,000 US active-duty military service members have sustained a TBI. A population-based historical cohort study revealed that medical care costs for persons with TBI were an average of \$4906 higher than costs for matched controls without TBI. Method: We conducted a peer-reviewed literature review. The hypothesis that arose indicates that the polytraumatic nature of TBI injuries and the complexity of diagnosing and managing care. A secondary hypothesis was veterans with mild and greater TBI were not being surveilled for latent sequelae. Results: During the past decades, following US military deployments, long combat operations engagements and numerous deployments increase TBI injuries. More than 80% of TBIs in US service members are clinically classified as mild TBI (mTBI). Unlike severe TBIs, the management of individuals with mTBI is still symptom-based, and guidelines continue to highlight nonpharmacologic interventions, and surveillance relies on patients' self-reported symptoms. This may lead to a missed diagnosis, management, or treatment procedure and a public health crisis for mTBI. Conclusion: To minimize the adverse effects of the injury, the recognition of veterans who bear mTBI, and the timely application of treatment and surveillance plans are essential. If service members have an untreated concussion and return to duty, they will be more vulnerable to subsequent injury, and their performance capability in critical situations can be diminished. Furthermore, they may be at risk for secondary brain injury that arises hours or days after the primary injury due to the release of pro-inflammatory mediators and the death of neural cells, even though they appear to have recovered, which contribute to further damage.

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Theme: **Neurologic**

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**P-0707**

**We need to know if the health effects of PM are driven by NLRP3**

**Presenter:** Wig Zamore, STEP, Somerville, United States

**Authors:** W. Zamore;  
STEP, Somerville, MA.

Inflammasomes drive maturation of IL-1 family cytokines in reaction to Pathogen Associated Molecular Patterns (PAMPs). The NLRP3 inflammasome, uniquely, responds to Danger Associated Molecular Patterns (DAMPs) including particles of both endogenous (fatty acids, oxLDL, MSU, amyloid) and exogenous (silica, alum, fabricated NPs, ambient ultrafines) origin. Advancement of many chronic diseases - cardiovascular, neurological, metabolic and genetic - is driven by NLRP3. After Charles Dinarello illuminated the role of IL-1 cytokines, a team led by Hal Hoffman (UCSD) discovered the links between NLRP3 and genetic familial diseases (2000). Another team led by Jurg Tschopp and Fabio Martinon (Lausanne) coined the term "inflammasome" to describe molecular platforms that activate inflammatory caspases and drive maturation of IL1 cytokines (2002). Brooke Mossman et al (UVM) tied occupational particle and fiber exposures to NLRP3 (2008+). Paul Ridker's CANTOS team has linked heart disease, lung cancer and CKD to NLRP3. AHA journals have 150+ papers. Teams at U Mass Worcester (Latz, Fitzgerald, Golenbock et al) and U Michigan (Nunez, Franchi et al) have discovered many of the mechanics of IL-1 sterile inflammation. Research is advancing in Brisbane AUS (Schroeder et al), Bonn GER (Latz et al) and Belfast IRE (Coll et al). Sharif, Wu et al (Harvard 2019) have a 3.8 A NLRP3 model. Inhibitors are a top pharma target. NLRP3 drives diseases of lifestyle and aging. And may underly estimated 2015 global PM2.5 mortalities of 9 million (Burnett 2018). There are a few studies on PM and NLRP3 (e.g., Villarreal Calderon 2012 and Cevallos 2017). And many on PM2.5, UFP and molecules tied to NLRP3 (IL-1b, IL-6, TNF, NFkB, etc.). Franklin Mangan and Latz (2016) have a solid review on crystals and NLRP3. We need to prioritize cohort, animal and cell studies of the relationship of NLRP3, PM and UFP.

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Theme: **Neurologic**

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**P-0708**

**Associations between preterm birth and low birth weight in parents and autism spectrum disorder (ASD) risk in their offspring: A population-based multigenerational cohort study in Denmark**

**Presenter:** Jingyuan Xiao, Department of Environmental Health Sciences, Yale School of Public Health, New Haven, United States

**Authors:** J. Xiao<sup>1</sup>, Y. Gao<sup>2</sup>, Y. Yu<sup>3</sup>, G. Toft<sup>3</sup>, Y. Zhang<sup>1</sup>, J. Luo<sup>1</sup>, Y. Xia<sup>2</sup>, K. Chawarska<sup>4</sup>, J. Olsen<sup>3</sup>, J. Li<sup>3</sup>, Z. Liew<sup>1</sup>;

<sup>1</sup>Department of Environmental Health Sciences, Yale School of Public Health, New Haven, CT, <sup>2</sup>Yale Center for Perinatal, Pediatric, and Environmental Epidemiology, Yale School of Public Health, New Haven, CT, <sup>3</sup>Department of Clinical Epidemiology, Aarhus University Hospital, Aarhus, DENMARK, <sup>4</sup>Child Study Center, Yale School of Medicine, New Haven, CT.

**Background:** Fetal exposure risk factors are associated with increased ASD risk. New hypotheses regarding transgenerational risk for ASD have been proposed, but epidemiological evidence is still lacking. We evaluated whether parental preterm birth or low birth weight was associated with ASD risk in offspring. **Methods:** We conducted a nationwide register-based cohort study that included 230,174 mother-child and 157,926 father-child pairs in Denmark. Logistic regression models were used to estimate Odds Ratios (OR) and 95% confidence intervals (CI) for offspring ASD according to the parental preterm (<37 weeks) and low birth weight (<2500 grams) status, with or without adjustment for grandmaternal sociodemographic factors. Mediation analyses were performed for selected parental and offspring health-related factors. **Results:** Offspring of mothers or fathers with adverse birth outcomes had about 31-43% higher risk for ASD (maternal preterm birth, OR=1.31, 95% CI= 1.12, 1.55; maternal low birth weight, OR=1.35, 95% CI: 1.17, 1.57; paternal preterm birth, OR=1.43, 95% CI=1.18, 1.73; paternal low birth weight, OR=1.38, 95% CI= 1.13, 1.70). Parents born very preterm (<32 weeks) marked a nearly 2-fold increase in ASD risk in their children. These associations were slightly attenuated upon adjustment for grandmaternal sociodemographic factors. Mediation analyses suggested a small magnitude of indirect effect of parental social-mental and offspring perinatal risk factors on the child, especially for maternal birth outcome associations. **Conclusions:** Offspring of parents born with adverse outcomes had an elevated risk for ASD. Transgenerational risk for ASD through maternal and paternal factors should be considered in future research on ASD etiology.

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Theme: **Neurologic**

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**P-0709**

**Prenatal triclosan exposure and neurodevelopment at 2 years of age in Shandong, China**

**Presenter:** Caifeng Wang, Shanghai Jiao Tong University, Shanghai, China

**Authors:** C. Wang, Y. Zhang, R. Shi, Y. Wang, Y. Gao, Y. Tian;  
Shanghai Jiao Tong University, Shanghai, CHINA.

**Background** Triclosan (TCS) has been widely detected in pregnant women. Limited epidemiological studies suggest that prenatal exposure to TCS may interfere with the neurodevelopment of school-age children. However, there is a lack of evidence for effects on children in early childhood, especially in China. **Methods** Based on Laizhou Wan Birth Cohort in Shandong, China, TCS concentrations were measured in urine among 489 pregnant women during their hospital admission for delivery. Neurodevelopment of their children was assessed using the Gesell Development Schedules (adopted by the Chinese Pediatric Association and widely used for assessing early child development in China, including gross motor, fine motor, adaptive, language, and social domains) at 2 years of age (n=294). Linear regression and generalized linear models were used to analyze the association between prenatal TCS exposure and the toddlers' developmental quotient scores (DQs). **Results** The median of maternal TCS concentrations was 0.24µg/L and 0.67µg/g creatinine. Although no association was found between prenatal TCS exposure and DQs in the five domains, adverse associations were detected after gender stratification. We found an inverse association between prenatal TCS concentrations and DQs in the language domain among boys. Specifically, for every 10-fold increase in TCS concentrations, DQs decreased by 2.13 points ( $\beta = -2.13$ ; 95% CI: -4.06 to -0.19,  $p = 0.03$ ). Besides, prenatal TCS concentrations were adversely associated with DQs in the adaptive domain among boys ( $p$ -trend=0.01) and DQs in the gross motor domain among girls ( $p$ -trend=0.03) by the trend across TCS quartiles. **Conclusions** Based on a Chinese population, our findings suggest that prenatal TCS exposure might have adverse effects on neurodevelopment at the age of 2 in a gender-dependent manner. Further studies to replicate our findings are needed and further investigations are required to examine the potential mechanisms underlying the association between early-life TCS exposure and neurodevelopment in early childhood.

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## ABSTRACT E-BOOK

Theme: **Neurologic**

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**P-0710**

### **The Associations of Dietary Copper with Incident Dementia: The Atherosclerosis Risks in Community (ARIC) Study**

**Presenter:** Jingkai Wei, George Washington University, Washington, United States

**Authors:** J. Wei<sup>1</sup>, E. Bennett<sup>1</sup>, E. A. Whitsel<sup>2</sup>, X. Xu<sup>3</sup>, E. Park<sup>3</sup>, R. L. Smith<sup>2</sup>, J. Stewart<sup>2</sup>, Q. Ying<sup>3</sup>, M. C. Power<sup>1</sup>;

<sup>1</sup>George Washington University, Washington, DC, <sup>2</sup>University of North Carolina at Chapel Hill, Chapel Hill, NC, <sup>3</sup>Texas A&M University, College Station, TX.

**Background/Aim:** Copper may be involved in Alzheimer's disease pathogenesis. In particular, a combination of high dietary copper intake and high cholesterol may accelerate cognitive decline. We aimed to examine the associations of dietary copper intake in the presence of a high fat diet with incident dementia in a community-dwelling sample in the United States. **Methods:** The Atherosclerosis Risks in Community (ARIC) Study was used for analysis. Dietary copper (including that from food and dietary supplements) and saturated fat intake were calculated as the average intake across the 1<sup>st</sup> (1987-1989) and 3<sup>rd</sup> (1993-1995) visits of the ARIC study, based on information collected from the 61-item Food Frequency Questionnaires. Dementia was ascertained based on in-person assessment, hospital discharge codes, and other supplemental methods throughout follow-up. Participants with diagnosed dementia at study baseline (Visit 4) were excluded from analysis. Cox proportional-hazards models were used to examine the associations of dietary copper (from food, supplements, total) with incident dementia. Potential interactions between dietary copper as continuous variables and high saturated fat intake (defined as the upper 25<sup>th</sup> percentile) were tested. **Results:** A total of 9,492 participants (mean age: 62.9±9.7 years, 43.9% male, 17.5% African American) were included in the analysis, with an average follow-up time of 16.3 years. Each 1 mg/day higher intake of total dietary copper (hazard ratio (HR): 1.45, 95% confidence interval (CI): 1.02, 2.06) and copper from food (HR: 1.42, 95% CI: 1.04, 1.94) were associated with higher incident dementia among those with a high intake of saturated fat after covariate adjustment. Intake of copper from supplements was not associated with dementia. **Conclusions:** The combination of a diet high in both copper and saturated fat may increase the risk of dementia among community-dwelling populations.

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Theme: **Noise**

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**P-0711**

### **NOISE POLLUTION IN A REGIONAL TOWN IN THE SOUTHERN BULGARIA**

**Presenter:** Jeni Staykova, Medical University Sofia, Sofia, Bulgaria

**Authors:** J. Staykova<sup>1</sup>, M. Georgieva<sup>2</sup>;

<sup>1</sup>Medical University Sofia, Sofia, BULGARIA, <sup>2</sup>Council of Ministers, Sofia, BULGARIA.

Noise Pollution in a Regional Town in the Southern Bulgaria  
Jeni Staykova<sup>1</sup>, Manoela Georgiva<sup>2</sup>, Rositsa Chilingirova<sup>3</sup>MU-Sofia, Council of Ministers - Republic of Bulgaria, RHI-Kardzhali

Noise is a major adverse factor for health in urbanized areas, influencing mainly the auditory organ, nervous and digestive systems. The objective of the research study is to determine the noise pollution in Kardzhali and to suggest appropriate measures to optimise the environment. Materials and methods. The noise level measurement is carried out at 15 points, close to intensive road and rail transport, to industrial sources and areas subject to noise protection. A measuring method and technical equipment of Bruel & Kjaer were applied subject to an ordinance of the Ministry of Health. Results. 55.6% of noise levels are above the limit values in the respective territories. According to the standards these are 44.4%. Levels within the range of 58-62 dB(A) are registered in one point, 63-67 dB(A) in three points, and 68-72 dB (S) - in five points. Compared to 2018 (67.8% above the reference), the results were better. Conclusions. To optimize the acoustic environment, architectural, urban, engineering, technical and organizational and hygienic measures must be undertaken by all interested parties. The main priority for the reduction of noise pollution in Kardzhali is the construction of a ring road.

Keywords: noise pollution, health, acoustic environment, protection measures

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Theme: **Noise**

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**P-0712**

**Empirical Analysis of Noise Pollution in Nigeria Cities; A case Study of Bida, Nigeria**

**Presenter:** Funke Morenike Jiyah, The Federal Polytechnic, Bida, Bida., Nigeria

**Authors:** F. M. Jiyah<sup>1</sup>, B. Wahab<sup>2</sup>, J. Jiyah<sup>1</sup>;

<sup>1</sup>The Federal Polytechnic, Bida, Bida., NIGERIA, <sup>2</sup>University of Ibadan, Ibadan., NIGERIA.

The findings from various research efforts have linked the incidence of different health issues to excessive noise pollution in all works of life. This study provides empirical analysis of the effects of noise pollution on the well-being of the residents of Bida Local Government Area, Niger State, Nigeria. The study adopted a case study research design, involving cross-sectional procedure. Field observations and medical reports were obtained to support the respondents' perception on the state of their well-being. The sample size for the study was selected using the housing stock in the various wards. One major street in each ward was selected. A total of 1,833 buildings were counted along the sampled streets and 10% of this was selected for the administration of structured questionnaire. The environmental quality of the wards was determined by measuring the noise level using Testo 815 noise meters. The result revealed that Bariki ward which houses the GRA has the lowest noise level of 37.8 dB(A) while the noise pollution levels recorded in the other thirteen wards were all above the recommended levels. The average ambient noise level in sawmills, commercial centres, road junctions and industrial areas were above 90 dB(A). The temporal record from the Federal Medical Centre, Bida revealed that, apart from malaria, hypertension (5,614 outpatients) was the most prevalent health issue in 2013 alone. The paper emphasised the need for compatibility consideration in the choice of residential location, the use of ear muffler and effective enforcement of zoning regulations. Key words: Noise, Environmental quality, Bida, Well-being, Decibels

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## ABSTRACT E-BOOK

Theme: **Noise**

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**P-0713**

### Appraisal of health impact of traffic noise in Tirana

**Presenter:** Shkurti Enkelejda, University of Medicine, Tirana, Albania

**Authors:** S. Enkelejda, S. Diamant;  
University of Medicine, Tirana, ALBANIA.

**Background** The association among environmental noise and health has been investigated in profundity. Considering the total number of people exposed, awareness should be focused on street traffic noise. The city of Tirana (Albania) is a very populated urban area in which 70% of all environmental noise exposure is related to traffic. The objective of this study was to measure preventable deaths consequential to reducing the impact of correspondent diurnal noise levels (LeqD) on daily cardiovascular and respiratory mortality between people aged  $\geq 65$  years in Tirana. **Methods** A health impact evaluation of LeqD and PM<sub>2.5</sub> levels was performed by means of previously reported risk estimates of mortality rates for 2015--2017: For cardiovascular reasons: LeqD 1.036 (1.004, 1.088) and PM 2.3 1.039(1.020, 1.057) and for respiratory causes: LeqD 1.054 (1.000, 1.117) and PM 2.5 1.029 (1.000, 1.058). **Results** The connection established among LeqD exposure and mortality for both origins recommends an significant health outcome. A decrease of 1dB(A) in LeqD implies an preventable annual mortality of 281 (31, 516) cardiovascular- and 182 (0, 187) respiratory-linked deaths in the study population. The extent of the health collision is comparable to reducing average PM<sub>2.5</sub> levels by 10 $\mu$ g/m<sup>3</sup>. **Conclusion** Despite of air pollution, exposure to traffic noise should be measured an important environmental feature having an important impact on health.

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**P-0714**

**Aircraft noise exposure and subjective sleep quality in the DEBATS longitudinal study**

**Presenter:** Lise Giorgis-Allemand, Univ Lyon, Univ Eiffel, IFSTTAR, Univ Lyon 1, Umrestte, UMR\_T9405, F-69675 Bron, France

**Authors:** L. Giorgis-Allemand<sup>1</sup>, A. Kourieh<sup>1</sup>, B. Laumon<sup>2</sup>, M. Lefèvre<sup>1</sup>, D. Léger<sup>3</sup>, A. M. Nassur<sup>1</sup>, A. S. Evrard<sup>1</sup>;

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### Introduction

Exposure to aircraft noise may impact human health and lead to sleep disorders in particular, which are associated with health comorbidities.

### Objectives

Our aim was to investigate the association between aircraft noise and subjective sleep quality in a longitudinal study in France.

### Methods

The DEBATS study included 1,244 participants living near three French major airports. These participants answered a detailed face-to-face questionnaire administered at home by a trained interviewer in 2013, 2015 and 2017. Total sleep time was estimated as the difference between the time of going to sleep and the time of getting up and considered short if less or equal to 6 hours. Outdoor aircraft noise levels were estimated at each home address using noise maps. Longitudinal analyses were performed using linear mixed models with a subject-specific random intercept and adjusted on potential confounders.

### Results

In 2013, 9% of the participants had a short total sleep time ( $\leq 6$ h) (8% in 2015 and 6% in 2017 respectively) while 30% woke up feeling rather or very tired in 2013 (24% in 2015 and 23% in 2017 respectively). A 10 dB(A) increase in the day-evening-night ( $L_{den}$ ) level was associated with a short total sleep time ( $n=1,235$ , Odds Ratio  $OR=3.1$ ; 95% confidence interval: 2.1-4.5) and with waking up feeling tired ( $n=1,235$ ,  $OR=1.3$ ; 95%CI: 1.0-1.6). Results remained similar when analyses were restricted to non-retired participants or participants that did not move in the past 5 years.

### Discussion

The results of this study provide further evidence that increased aircraft noise exposure was associated with decreased subjective sleep quality. Nevertheless, the role of annoyance due to aircraft noise and noise sensitivity must be investigated as they could mediate or moderate the observed associations.

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**P-0715**

### **Land-use regression model and machine learning algorithms in assessing outdoor noise exposure in Hong Kong**

**Presenter:** Chui Hei Wong, The Chinese University of Hong Kong, Hong Kong, Hong Kong

**Authors:** C. Wong;  
The Chinese University of Hong Kong, Hong Kong, HONG KONG.

Land-use regression model and machine learning algorithms in assessing outdoor noise exposure in Hong Kong

Background/Aim: There are epidemiological studies in reporting the association between environmental noise exposure and various health outcomes, including cardiovascular diseases and cognitive decline. However, evidence in using land-use regression (LUR) model in predicting noise is limited and not conclusive, while machine learning algorithms are seemed to be a novel method in improving the explanative power of noise prediction. In this study, random forest (RF) model was adopted to estimate outdoor noise level in Hong Kong and compare the performance between LUR and RF. Methods: A total of 102 measurement sites with 27 environment-related variables were used to estimate the spatial environmental noise variation. Two separate measurements for A-weighted equivalent sound pressure levels over 24 hours ( $L_{eq,24h}$ ) were conducted at each site during the 2019-2020 period. Land use types, traffic information and geographic information systems were chosen to the related variables for building models. Ordinary linear regression was adopted to be the traditional land-use regression model. Results: The annual mean of 102 measurement sites of  $L_{eq,24h}$  was 66.3 dB(A). The proportion of variation ( $R^2$ ) explained by the random forest model in full-frequency noise was higher than the traditional LUR ( $R^2$ : RF: 0.76, LUR: 0.69). Random forest performed also better in lower root mean squared errors (RF: 2.91 dB(A), LUR: 3.22 dB(A)). Further results on the noise level in different time periods and frequencies will be described in the conference. Conclusion: Random forest model is suggested to be a better alternative in estimating noise exposure. Further study on the application of the model on epidemiological studies can be conducted.

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## ABSTRACT E-BOOK

Theme: **Noise**

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**P-0717**

**Environmental noise and health: building citizen science community with internal and external stakeholders of elementary school in Ljubljana, Slovenia**

**Presenter:** Rok Novak, Institut "Jožef Stefan", Ljubljana, Slovenia

**Authors:** D. Kocman<sup>1</sup>, T. Števanec<sup>1</sup>, R. Novak<sup>1</sup>, J. Snoj Tratnik<sup>1</sup>, C. Jeraj<sup>2</sup>;

<sup>1</sup>Institut "Jožef Stefan", Ljubljana, SLOVENIA, <sup>2</sup>Spodnja Šiška elementary school, Ljubljana, SLOVENIA.

Exposure to noise is recognized as one of the crucial environmental stressors, especially in urban settings, and people increasingly perceive the quality of sound environment as a paramount aspect of their general quality of life. However, they are rarely involved in respective research. Here we present some preliminary results of an ongoing citizen science epidemiological study conducted in Ljubljana Slovenia within the European Commission's Horizon 2020 project called CiteS-Health (<https://citeshealth.eu/>) and focusing on link between exposure to noise and health impacts. To this end, community of citizen scientist is being build comprising various internal (pupils and teachers) and external (parents) stakeholders of elementary school. They will be involved in different phases of the project from defining research questions, designing and implementing studies, to analyzing, interpreting and communicating of the results. In this presentation we focus on specifics of recruiting participants and building interested community within and surrounding school environment, methods used to trigger their interest, identify environmental noise issues and related personal health concerns, and translate these concerns into research questions. Initial results of research conducted by pupils based on co-design with researchers and teachers as part of their school curriculum will also be presented. Overall, it is expected that new data obtained within Ljubljana pilot by citizen scientists will complement the existing datasets and generate new knowledge leading to more accurate or more realistic estimation of health risk due to noise exposure. Acknowledgement: This work has received funding from the European Union's Horizon 2020 Programme for research, technological development and demonstration under grant agreement No 824484 (CiteS- or Urban Environment and Health).

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Theme: **Noise**

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**P-0718**

**Exposure to nocturnal road traffic noise associated with the prevalence of hyperglycemia in Taichung, Taiwan**

**Presenter:** Ta-Yuan CHANG, China Medical University, Taichung, Taiwan

**Authors:** T. CHANG, Z. Lin, T. Li, C. Liu, C. Lin;  
China Medical University, Taichung, TAIWAN.

Background: Many studies have investigated the association between diabetes and exposure to road traffic noise, but few studies investigated the association between noise exposure at nighttime and at different frequency components. Objectives: This cross-sectional study elucidated the association between the prevalent hyperglycemia and nocturnal road traffic noise, and determined the impact from different noise frequency spectrum. Methods: We recruited 888 residents living in Taichung as the study subjects to collect personal information from the questionnaire and health examination. Land-use regression models were established to predict individual levels of full-frequency and octave-band frequency noise at nighttime and fine particles (PM<sub>2.5</sub>). The multivariable logistic regressions were conducted to estimate the odds ratio (OR) of prevalent hyperglycemia (fasting glucose level  $\geq 100$  mg/dL) after controlling for PM<sub>2.5</sub> and potential confounders. Results: Participants exposed to nocturnal noise levels  $\geq 62$  A-weighted decibels (dBA) had a significantly higher risk of hyperglycemia (Adjusted odds ratio [AOR]=1.51, 95% confidence interval [CI]: 1.10-2.06) compared with the low-exposure group. Per one-interquartile range (IQR: 2.7 dBA) increase in nighttime noise was associated with the increased risk of hyperglycemia (AOR=1.19; 95% CI: 0.98-1.45; p=0.08). In addition, participants exposed to 1-IQR (3.2 dB, 2.9 dB, and 1.8 dB, respectively) nocturnal noise at frequencies of 1000 Hz, 2000 Hz, and 4000 Hz had a significantly higher risk of hyperglycemia (all p values <0.05), and those exposed at 4000 Hz had the highest risk (AOR=1.30, 95% CI: 1.02-1.66). Conclusions: The present study showed that exposure to nocturnal road traffic noise was associated with the increased prevalence of hyperglycemia, and noise exposure at 4000 Hz had the highest risk.

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Theme: **Noise**

**P-0720**

**Long-term exposure to road traffic noise and incident heart failure in a Danish Nurse Cohort**

**Presenter:** Youn-Hee Lim, University of Copenhagen, Copenhagen, Denmark

**Authors:** Y. Lim<sup>1</sup>, J. T. Jørgensen<sup>1</sup>, R. So<sup>1</sup>, J. Cramer<sup>1</sup>, H. Amini<sup>1</sup>, A. Mehta<sup>1</sup>, L. H. Mortensen<sup>2</sup>, R. Westendorp<sup>1</sup>, B. Hoffmann<sup>3</sup>, S. Loft<sup>1</sup>, E. V. Bräuner<sup>1</sup>, M. Ketzel<sup>4</sup>, O. Hertel<sup>4</sup>, J. Brandt<sup>4</sup>, S. S. Jensen<sup>5</sup>, C. Backalarz<sup>6</sup>, T. Cole-Hunter<sup>7</sup>, M. K. Simonsen<sup>8</sup>, Z. J. Andersen<sup>1</sup>;

<sup>1</sup>University of Copenhagen, Copenhagen, DENMARK, <sup>2</sup>Denmark Statistics, Copenhagen, DENMARK,

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<sup>5</sup>Aarhus University, Aarhus, DENMARK, <sup>6</sup>DELTA Acoustics, Hørsholm, DENMARK, <sup>7</sup>University of Sydney, Sydney, DENMARK, <sup>8</sup>Diakonissestiftelsen, Frederiksberg, DENMARK.

**Objectives:** Evidence of the non-auditory effects of road traffic noise exposure on health is growing. We examined the association between long-term exposure to road traffic noise and incident heart failure (HF) using various exposure windows and thresholds of the road traffic noise. **Methods:** We used the Danish Nurse Cohort with 22,304 female nurses who at recruitment in 1993 and 1999 reported information on HF risk factors, and linked them to the Danish National Patient and Cause of Death Registries for the first hospital contact or out-of hospital death due to HF until 2014. Road traffic noise levels in 1970-2013 were estimated by Nord2000 model as the annual mean of a weighted 24h average ( $L_{den}$ ). We examined the associations between multi-year (up to 23 years) exposures to  $L_{den}$  and HF incidence using time-varying Cox regression models and estimated the effects at or above the thresholds using piece-wise linear regression models after controlling for individual covariates and air pollution levels. **Results:** We observed a non-linear relationship between incident HF incidence (n=438) and road traffic noise. Notably, in models adjusting for individual covariates, the hazard ratio (HR) (95% confidence intervals [CI]) of incident HF was 1.22 (95% CI: 1.05, 1.42) per 10 dB of 23-year exposures at or above 37 dB. After controlling for  $PM_{2.5}$ , the association was attenuated (HR:1.13 [95% CI: 0.96, 1.33]), but it remained robust to adjustment for  $NO_2$  (HR:1.21 [95% CI: 1.01, 1.46]). Associations were weaker with shorter exposure windows (1- and 3-year running mean of  $L_{den}$ ). **Conclusion:** Long-term exposure to road traffic noise may increase the risk of HF.

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## ABSTRACT E-BOOK

Theme: **Noise**

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**P-0722**

### Road traffic noise exposure and annoyance in two large cities in Slovakia

**Presenter:** Lubica Argalasova, Comenius University Faculty of Medicine, Institute of Hygiene, Bratislava, Slovakia

**Authors:** L. Argalasova<sup>1</sup>, T. Kimakova<sup>2</sup>, L. Kuzmova<sup>2</sup>, A. Filova<sup>1</sup>, D. Vondrova<sup>1</sup>, K. Hirosova<sup>1</sup>, Z. Dietzova<sup>3</sup>, J. Jurkovicova<sup>1</sup>;

<sup>1</sup>Comenius University Faculty of Medicine, Institute of Hygiene, Bratislava, SLOVAKIA, <sup>2</sup>Pavol Jozef Safarik University in Kosice, Institute of Public Health and Hygiene, Faculty of Medicine, Kosice, SLOVAKIA,

<sup>3</sup>Regional Public Health Authority in Kosice, Department of Hygiene and Environmental Health, Kosice, SLOVAKIA.

**Background.** Environmental noise has attracted widespread attention in recent decades as a major environmental health concern. In Slovakia, the rapid development in traffic density connected with the economic transformation since 1990 has brought new problems in relation to environmental noise, particularly road traffic noise. **Aim.** The aim of the study was to determine the impact of environmental noise on the psychosocial well-being of young healthy individuals in the two largest Slovak urban agglomerations Bratislava and Kosice and to assess and to compare noise annoyance as the most prevalent community response. **Methods.** The validated ICBEN methodology was used to assess noise annoyance, interference with activities and sleep disturbance; noise levels were objectified by direct measurement using sound level analyzer with a module for frequency analysis. The source population in Bratislava (533 respondents, 155 males) and Kosice (355 respondents, 111 males) who filled the anonymous validated "Noise annoyance questionnaire was composed of young adults in the age category from 20-30 years old. **Results.** The results showed that in both cities most of the subjects were in the medium noise exposure category ( $L_{Aeq, 24h} \geq 60$  dB). In Bratislava there were 27.82 % of respondents in the higher noise exposure category ( $L_{Aeq, 24h} \geq 70$  dB) and in Košice there were 39.9 % of respondents in the lower noise exposure category ( $L_{Aeq, 24h} \geq 50$  dB). Traffic noise annoys respondents especially in the higher noise exposure category in Bratislava (63.51 %) and interferes with reading and mental work, sleep and falling asleep even in the lower noise exposure category in Kosice (46.51 %). **Conclusion.** This study has shown the traffic noise as the environmental problem in large cities and emphasizes the need of protection of the possible vulnerable groups, especially during night-time.

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Theme: **Nutrition and metabolism**

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**P-0723**

**Proximity to freshwater blue space and type 2 diabetes onset: the importance of historical and economic context**

**Presenter:** Melissa N Poulsen, Geisinger, Danville, United States

**Authors:** M. N. Poulsen<sup>1</sup>, B. S. Schwartz<sup>2</sup>, J. DeWalle<sup>1</sup>, C. Nordberg<sup>1</sup>, J. S. Pollak<sup>2</sup>, J. Silva<sup>3</sup>, C. I. Mercado<sup>4</sup>, D. B. Rolka<sup>4</sup>, K. R. Siegel<sup>4</sup>, A. G. Hirsch<sup>1</sup>;

<sup>1</sup>Geisinger, Danville, PA, <sup>2</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>3</sup>Indiana University, Bloomington, IN, <sup>4</sup>Centers for Disease Control and Prevention, Atlanta, GA.

**Background:** Living near aquatic areas (blue space) may benefit health by reducing stress and providing physical activity spaces. Salutogenic effects of blue space remain underexplored, particularly in non-coastal and non-urban areas. **Methods:** We evaluated associations of residential proximity to inland freshwater blue space with new onset type 2 diabetes (T2D) in geographically diverse communities across 37 counties in Pennsylvania, USA, using medical records (2008-2016) to conduct a nested case-control study. T2D cases (n=15,888) were identified from diabetes diagnoses, medication orders, and laboratory test results and frequency-matched on age, sex, and encounter year to diabetes-free controls (n=79,435). Using national hydrography data, we calculated distance (0-0.24, 0.25-0.49, 0.50-0.74, 0.75-1.24, >1.25 miles) from each individual's residence to the nearest lake, river, tributary, or large stream. Logistic regression models adjusted for community socioeconomic deprivation and other confounding variables. Models were stratified by community type (townships [rural/suburban], boroughs [small towns], city census tracts). **Results:** Compared with individuals living farthest from blue space, those <0.25 and 0.25-0.49 miles away had higher odds (odds ratio [95% confidence interval]) of T2D in townships (1.13 [1.06, 1.21]; 1.11 [1.03, 1.18]) and boroughs (1.30 [1.17, 1.44]; 1.27 [1.13, 1.41]); in cities, individuals between 0.25-0.74 miles away had higher T2D odds. Residing within the 100-year flood zone and nearest blue space type (river/tributary versus lake) were also associated with higher T2D odds. We observed lower property values for residences nearest the Susquehanna River, the region's predominant waterbody, but were unable to adjust for property values due to limited data availability. **Conclusions:** Unmeasured confounding by socioeconomic disadvantage may explain our unexpected findings of higher T2D odds with closer proximity to freshwater blue space. Proximity to blue space may be detrimental to health depending on historic and economic context and interrelated factors such as flood risk, pollution, and lack of waterfront development.

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Theme: **Nutrition and metabolism**

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**P-0724**

**Long-term exposure to air pollutants (PM<sub>2.5</sub> and NO<sub>2</sub>) and incidence of type 2 diabetes in the Mexican Teachers' Cohort.**

**Presenter:** Karla Cervantes-Martínez, National Institute of Public Health, Cuernavaca, Mexico

**Authors:** K. Cervantes-Martínez<sup>1</sup>, H. Riojas-Rodríguez<sup>1</sup>, D. Stern<sup>2</sup>, J. Zamora-Muñoz<sup>3</sup>, H. Moreno-Macías<sup>4</sup>, R. López-Ridaura<sup>5</sup>, M. Lajous<sup>6</sup>, A. Cortes-Valencia<sup>6</sup>;

<sup>1</sup>National Institute of Public Health, Cuernavaca, MEXICO, <sup>2</sup>National Council for Science and Technology, Mexico City, MEXICO, <sup>3</sup>National Autonomous University of Mexico, Mexico City, MEXICO, <sup>4</sup>Metropolitan Autonomous University, Mexico City, MEXICO, <sup>5</sup>Ministry of Health, Mexico City, MEXICO, <sup>6</sup>National Institute of Public Health, Mexico City, MEXICO.

**Background/Aim:** Air pollution is a risk factor for type 2 diabetes (T2D). However, no longitudinal studies have evaluated this association in a low- and middle-income countries, where 80% of the worldwide cases of T2D occur. Our aim was to evaluate the association between incident T2D and long-term exposure to PM<sub>2.5</sub> and NO<sub>2</sub> in the Mexican Teachers' Cohort (MTC). **Methods:** We selected a subsample of female teachers from the MTC who lived and worked in the Mexico City Metropolitan Area, recruited in 2008 and with active follow-up every 3 years (n = 14,194). We assigned the time-weighted exposures (PM<sub>2.5</sub> and NO<sub>2</sub>) in home and work addresses, from 12 months before baseline to failure or censoring. We developed two high resolution (1km x 1km) spatio-temporal predictive Generalized Additive Models of PM<sub>2.5</sub> and NO<sub>2</sub>. We defined incident T2D when teachers self-reported at least two of the following questions: have a medical diagnosis, use of medical treatment, or date of diagnosis. We fitted time-varying Cox models to estimate hazard ratios of the relation between PM<sub>2.5</sub> and NO<sub>2</sub> and incident T2D; adjusting for confounding variables: age, passive and active smoking status, physical activity, SES, wood smoking and time spent outdoors. **Results:** Teachers were followed up for 11.5 years. There were 795 incident T2D cases (84 cases per 100,000 person-months). Incident T2D increased by 80% (HR = 1.8[1.6-2.1]) for each 10 µg/m<sup>3</sup> increase of PM<sub>2.5</sub> and 60% for every 10 ppb of NO<sub>2</sub> (HR = 1.6[1.4-1.9]). In two-pollutant models, effects were attenuated. **Conclusions:** PM<sub>2.5</sub> and NO<sub>2</sub> increased the risk of T2D in Mexico, in a larger magnitude than previous published studies. Despite improvements in air quality, there are still health risks related to current pollutant levels, arguing for even stricter regulation.

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Theme: **Nutrition and metabolism**

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**P-0725**

### **Dietary Fiber Intake and Urinary Creatinine: Methodological Implications for Epidemiological Studies**

**Presenter:** Hariharan Shanmugam, Boston College, Chestnut Hill, United States

**Authors:** H. Shanmugam<sup>1</sup>, Á. Mérida-Ortega<sup>2</sup>, M. E. Cebrián<sup>3</sup>, L. López-Carrillo<sup>2</sup>;  
<sup>1</sup>Boston College, Chestnut Hill, MA, <sup>2</sup>Center for Population Health Research, National Institute of Public Health, Morelos, MEXICO, <sup>3</sup>Department of Toxicology, CINVESTAV, Mexico City, MEXICO.

**Background/Aim:** Creatinine is used to estimate renal function and to correct for urinary dilution. However, urinary creatinine (UCR) is determined by genetic, morphological, and lifestyle characteristics that should be accounted for to increase comparability throughout epidemiological studies. Recently, dietary fiber has been proposed as a mediator of renal function. The aim of this study was to evaluate the relationship between dietary fiber and UCR, with an eye towards methodological implications for studies that utilize UCR-corrected measurements.

**Methods:** Available information regarding UCR, dietary fiber intake, age, and other UCR-related factors were analyzed in 801 women residing in Northern Mexico.

**Results:** Using linear regressions, we estimated a significant age-adjusted increase of 10.04 mg/dL UCR for a 10 g/day increase in dietary fiber intake.

**Conclusion:** Our results suggest that epidemiological studies should adjust UCR by dietary fiber intake in order to improve comparability of studies and overall accuracy.

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Theme: **Nutrition and metabolism**

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**P-0726**

**Street greenery is associated with healthy weight among women across 29 U.S. cities**

**Presenter:** Wei-Lun Tsai, U.S. Environmental Protection Agency, Research Triangle Park, United States

**Authors:** W. Tsai<sup>1</sup>, M. S. Nash<sup>2</sup>, S. E. Prince<sup>1</sup>, D. J. Rosenbaum<sup>3</sup>, A. A. D'Aloisio<sup>4</sup>, A. C. Neale<sup>1</sup>, D. P. Sandler<sup>5</sup>, T. J. Buckley<sup>1</sup>, L. E. Jackson<sup>1</sup>;

<sup>1</sup>U.S. Environmental Protection Agency, Research Triangle Park, NC, <sup>2</sup>U.S. Environmental Protection Agency, Newport, OR, <sup>3</sup>ORISE/U.S. Environmental Protection Agency, Research Triangle Park, NC, <sup>4</sup>Social & Scientific Systems, Durham, NC, <sup>5</sup>National Institute of Environmental Health Sciences, Research Triangle Park, NC.

**Background:** Excess body weight is a major risk factor for many chronic diseases. Studies have linked green environments to human health and wellbeing, including healthy weight. However, few have considered plausible effect pathways for ecosystem services. We introduce greenery metrics with defined spatial allocation to identify ecosystem services that may be most relevant to fitness-related health outcomes, examining their relationships with weight status across 29 U.S. cities. **Methods:** We used data on body mass index (BMI) and other factors collected in years 2012 – 2014 for 5,815 women from the National Institute of Environmental Health Sciences' Sister Study cohort who resided in the U.S. Environmental Protection Agency's EnviroAtlas communities. Neighborhood greenery metrics within sidewalk, street, and circular focal areas at near (500m) and distant (2000m) neighborhood extents around residences were developed from EnviroAtlas one-meter landcover data. Sidewalk and street focal areas delineate the pedestrian environment and capture exposure to greenery for shade and aesthetics. Circular focal areas, largely inaccessible to pedestrians but potentially contributing other ecosystem services such as biodiversity support, were generated for comparison. Gradient boosted regression trees were used to model the effects of greenery on the odds of being overweight or obese (BMI > 25). Differences by regional climate (arid, continental, temperate) and age (<55, 55 – 64, and >=65) were also examined. **Results:** Odds ratios of being overweight or obese given a 10% increase in street greenery metrics were 0.92 (95% CI: 0.87 - 0.97) or lower, with stronger effects in the arid climate (0.81, 95% CI: 0.68 – 0.96). Near-neighborhood greenery had stronger associations for women aged >= 65 than for other age groups. **Conclusions:** Greenery may facilitate healthy weight through ecosystem services in the pedestrian environment and be an easily implemented public health measure to prevent obesity. This abstract does not represent EPA policy.

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Theme: **Nutrition and metabolism**

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**P-0728**

### **Vitamin status on the association between organophosphate esters (OPEs) exposure and chronic kidney disease**

**Presenter:** Habyeong Kang, Seoul National University, Seoul, Korea, Republic of

**Authors:** H. Kang, K. Choi;  
Seoul National University, Seoul, KOREA, REPUBLIC OF.

**Background/Aim:** Organophosphate esters (OPEs) are used in various materials and consumer products as flame retardants and plasticizers. Both experimental and epidemiological studies have suggested adverse effects of OPEs on the kidney function. However, it is unknown whether vitamin plays protective role on the OPE-associated chronic kidney disease. In this study, effect modification of vitamin status on the association between OPE exposure and chronic kidney disease was hypothesized. Data from the US National Health and Nutrition Examination Survey (NHANES) 2013-2014 were employed. **Methods:** A total of 1515 adults were identified in the US NHANES 2013-2014 without kidney failure and current pregnancy and with relevant measurements, e.g., vitamin status (RBC folate, serum vitamin B12, and vitamin D), estimated glomerular filtration rate (eGFR), albumin-to-creatinine ratio (ACR), and urinary metabolites of OPEs. Linear regression models were constructed to evaluate effect modification of vitamin concentrations in the association of urinary metabolites of OPEs, i.e., bis(1,3-dichloro-2-propyl) phosphate (BDCIPP), bis(2-chloroethyl) phosphate (BCEP), and dibutyl phosphate (DNBP), with eGFR or ACR. Moreover, the association was evaluated following stratification by vitamin status (low-level: <30<sup>th</sup> percentile; mid-level: ≥30<sup>th</sup> and <70<sup>th</sup> percentile; high-level: ≥70<sup>th</sup> percentile). **Results:** Significant effect modification of vitamin D was observed. Increase of vitamin D was associated with decreased effect sizes of OPEs exposure on the association with eGFR. Following stratification, associations of OPEs exposure with eGFR were significant only in the low-level vitamin D group while the associations were insignificant, and the effect sizes were decreased in the mid- and high-level groups. However, vitamin D did not show any effect modification on ACR. For folate and vitamin B12, no effect modification was observed. **Conclusions:** Vitamin D status appears to modify the effects of OPEs exposure on chronic kidney disease in general population. Confirmations in other populations are warranted.

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**P-0729**

**Mobile phone use and body weight: evidence from the UK COSMOS and UK Biobank cohort studies**

**Presenter:** Mireille B Toledano, Imperial College London, MRC Centre for Environment & Health, London, United Kingdom

**Authors:** M. B. Toledano, J. Heller, R. Pazoki, J. Pham, I. Chang, P. Elliott, R. B. Smith; Imperial College London, MRC Centre for Environment & Health, London, UNITED KINGDOM.

Background/Aim: Television viewing and computer use has been associated with obesity due to the sedentary time associated with these activities. Mobile phone technology would not necessarily predict sedentary behaviour and thus obesity in the same way. However, literature on mobile phone use and weight is limited to a few studies in adolescents with inconsistent findings. Methods: This analysis included 81,113 and 330,285 adults from the UK COSMOS and UK Biobank cohorts respectively. Multiple linear and logistic regression were used to explore the association between weight outcomes (BMI, weight, obesity) and mobile phone use frequency (calls/day), duration (min/week) and lifetime mobile phone use (years), with adjustment for potential confounders. Analyses of UK Biobank were enhanced with the addition of genetic risk scores for BMI, sleep and personality traits, to investigate potential effect modification. Longitudinal analyses of UK COSMOS are ongoing. Results: Cross-sectional analyses revealed statistically significant positive dose-response relationships between increasing mobile phone use and increasing body weight, BMI, and odds of obesity in both populations independently. For example, after adjustment, spending  $\geq 7$  hrs per week on mobile phone calls was associated with mean difference in body weight of 2.1 kg (95% CI 1.7, 2.5) and 2.4 kg (95% CI 2.1, 2.6), for UK COSMOS and UK Biobank participants respectively, compared to those who spend 5-29 mins per week making calls. Longitudinal analyses from the UK COSMOS study will be presented. Conclusion: We found a novel association between mobile phone use and body weight. Further research with longitudinal data is essential to explore the direction of these relationships. However, given the widespread use of mobile phones by adults and children, and public health concerns regarding obesity, mobile phone use might be an important lifestyle factor that can be modified to help reduce obesity on a population level.

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Theme: **Nutrition and metabolism**

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**P-0730**

### **Addressing Data Gaps in Toxicity of Food Additive Chemicals using High-throughput Screening Technology**

**Presenter:** Brianna N VanNoy, George Washington University, Washington, United States

**Authors:** B. N. VanNoy, A. R. Zota;  
George Washington University, Washington, DC.

#### Abstract

**Background:** More than 8,000 chemical additives are permitted in food in the United States, however, most lack adequate health and safety information. High-throughput screening tools, such as Toxicity Forecaster (ToxCast), provide opportunities to quickly assess and prioritize thousands of food additives for further investigation. Given the significant lack of in vivo data for most chemicals, we aimed to characterize the toxicity data available for chemical food additives using ToxCast.

**Methods:** We developed an up-to-date inventory of chemical food additives utilizing information from the U.S. Food and Drug Administration, the Environmental Protection Agency, and private manufacturers. We quantified the number of chemicals with ToxCast data available, and conducted a preliminary analysis of toxicity data for selected phthalates and phthalate alternatives (di(2-ethylhexyl) phthalate (DEHP), diisononyl cyclohexane-1,2-dicarboxylate (DINCH), N,N-Diethylhydroxylamine (DEHA), and bis (2-ethylhexyl) terephthalate (DEHT)).

**Results:** Our updated inventory indicates that there are more than 9,000 chemicals allowed in contact with food, including direct and indirect additives, food packaging chemicals, pesticide residues, and substances generally recognized as safe. Preliminary analyses suggest that approximately 23% of these have ToxCast data available. Comparing bioassay data in ToxCast for selected phthalates and phthalate alternatives, we found DEHP to be the most toxic chemical, with 40 active endpoints related to cell morphology, DNA binding, and nuclear receptors. DEHT had seven bioactive endpoints, followed by DINCH and DEHA each with 3 active endpoints. DEHA was the only plasticizer with no bioactivity for nuclear receptor assays, one important biological pathway for toxicity in humans.

**Conclusions:** ToxCast may be a useful tool for characterizing the toxicity of chemical food additives. Future analyses will focus on more diverse biological endpoints and compare ToxCast results to available in vivo data. These analyses will help advance understanding on the appropriateness of ToxCast for regulatory decision-making.

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## ABSTRACT E-BOOK

Theme: **Nutrition and metabolism**

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**P-0731**

**Phthalates exposure, thyroid function and glucose metabolism: exploring associations and mediation effects in Taiwanese adults**

**Presenter:** Han-Bin Huang, National Defense Medical Center, Taipei, Taiwan

**Authors:** C. Siao<sup>1</sup>, P. Huang<sup>2</sup>, Y. C. Lo<sup>1</sup>, H. Huang<sup>1</sup>;

<sup>1</sup>National Defense Medical Center, Taipei, TAIWAN, <sup>2</sup>National Health Research Institutes, Miaoli, TAIWAN.

**Background:** Information regarding the mediation effects of thyroid function in associations between phthalates exposure and glucose metabolism including insulin resistance is unclear. **Objective:** Our aim was to examine whether thyroid hormone levels could mediate the associations between phthalates exposure and insulin resistance. **Method:** Eleven urinary phthalate metabolites levels, five thyroid hormone levels and insulin resistance (by using the Homeostatic Model Assessment of estimated Insulin Resistance [HOMA-IR]) were determined in a cross-sectional study comprised of 217 Taiwanese adults. Associations between urinary phthalate metabolite levels, serum thyroid hormone levels and HOMA-IR were explored using multiple regression models. Mediation analysis was conducted to assess the role of thyroid function in the associations between phthalates exposure and HOMA-IR. **Results:** Urinary mono-ethylhexyl phthalate (MEHP) levels were negatively associated with free thyroxine (free T<sub>4</sub>) ( $\beta = -0.018$ ; 95% confidence interval [CI]: -0.031, -0.005) and positively associated with HOMA-IR ( $\beta = 0.051$ , 95% CI: 0.012, 0.090), respectively. Urinary mono (2-ethyl-5-oxohexyl) phthalate (MEOHP) levels were associated with free T<sub>4</sub> ( $\beta = -0.036$ , 95% CI: -0.056, -0.017) and HOMA-IR ( $\beta = 0.070$ , 95% CI: 0.013, 0.126), respectively. Free T<sub>4</sub> was negatively associated with HOMA-IR ( $\beta = -0.757$ , 95% CI: -1.122, -0.392). The results of mediation analysis indicated that 24% of the association between urinary MEHP and HOMA-IR was mediated by free T<sub>4</sub>, as well as 35% of the association between urinary MEOHP and HOMA-IR was mediated by free T<sub>4</sub>. **Conclusions:** Our findings support the hypothesis that thyroid function could mediate the association between phthalates exposure and glucose metabolism in adults.

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**P-0732**

**Influence of nutrient intake and AS3MT polymorphisms on the association between type 2 diabetes mellitus and arsenic metabolism among women from Northern Mexico**

**Presenter:** Karla Fabiola Rangel Moreno, National Institute of Public Health, Cuernavaca, Mexico

**Authors:** K. F. Rangel Moreno<sup>1</sup>, B. Gamboa-Loira<sup>1</sup>, M. E. Cebrián<sup>2</sup>, L. López-Carrillo<sup>1</sup>;  
<sup>1</sup>National Institute of Public Health, Cuernavaca, MEXICO, <sup>2</sup>Cinvestav-IPN, Mexico City, MEXICO.

**Background/Aim:** Ingested inorganic arsenic (iAs) is eliminated through urine mainly as monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA). %MMA and the primary methylation ratio [PMR] (MMA/iAs), have been negatively associated with type 2 diabetes mellitus (T2DM). iAs metabolism is also related to arsenic exposure magnitude, genetic and dietary factors, that may influence the relationship between iAs and T2DM, however, insufficient evidence is available. Our aim was to assess T2DM association with iAs metabolism, considering the dietary intake of selected micronutrients (methionine, choline, folate, selenium and vitamin B12) and polymorphisms (AS3MT Met287Thr and AS3MT G12390C). **Methods:** We conducted a cross-sectional study with 227 diabetic women matched by age ( $\pm 5$  years) with two non-diabetics (n=454). They were identified in a population-based control group of a previous breast cancer study in northern Mexico. Women were interviewed with a validated semi-quantitative food frequency questionnaire. Urinary arsenic metabolites were measured by High Performance Liquid Chromatography coupled with mass spectrometry and iAs metabolism was assessed by metabolites percentages and ratios. Genotypes were determined by allelic discrimination. **Results:** Total urinary arsenic (TAs) ranged from 1.24 to 99.97  $\mu\text{g/L}$ . Diabetics had significantly lower %MMA, PMR, choline and selenium intake than non-diabetics. TAs, %Asi<sup>+3</sup>, %Asi<sup>+5</sup>, %DMA, second methylation ratio [SMR] (DMA/MMA) and selected polymorphisms were not significantly different between diabetics and non-diabetics. We did not find an association between T2DM and iAs metabolism. Polymorphisms and dietary variables of interest did not modify nor confuse the potential association assessed. Other T2DM co-factors, such as hypertension and waist-hip ratio were significantly associated with T2DM (OR<sub>Hypertension YesvsNo</sub>: 3.50, 95%CI: 2.46, 4.97; OR<sub>Waist-hip ratio >0.91vs≤0.91</sub>: 1.97, 95%IC: 1.37, 2.82). **Conclusions:** Our findings do not support an association between iAs metabolism and T2DM, but it is important to reduce the exposure considering iAs has been considered a risk factor for cancer and cardiovascular diseases.

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**P-0733**

**The effect of ambient ozone on glucose-homeostasis: A prospective study of non-diabetic older adults in Beijing**

**Presenter:** Ang Li, Chinese Academy of Medical Science, Beijing, China

**Authors:** A. Li, Y. Mei, M. Zhao, J. Xu, S. Seery, J. Zhao, Q. Zhou, Q. Xu;  
Chinese Academy of Medical Science, Beijing, CHINA.

**Objective:** To investigate potential effects of short- and medium-term exposure to low levels of ozone (O<sub>3</sub>) on glucose-homeostasis in non-diabetic older adults. **Methods:** 166 non-diabetic, older participants in Beijing were deemed eligible to partake in this longitudinal population-based study. Observations were recorded on three separate occasions from November 2016 up until January 2018. Concentrations of outdoor O<sub>3</sub> were monitored throughout the study period. Biomarkers indicative of glucose-homeostasis, including fasting blood glucose, insulin, hemoglobin A1c (HbA1c), glycated albumin percentage, Homeostatic Model Assessment of Insulin Resistance (HOMA-IR) and Homeostatic Model Assessment of Beta cell function (HOMA-B) were measured at 3 sessions. A linear mixed effects model with random effects was adopted to quantify the effect of O<sub>3</sub> across a comprehensive set of glucose-homeostasis markers. **Results:** short-term O<sub>3</sub> exposure positively associated with increased fasting blood glucose, insulin, HOMA-IR and HOMA-B. The effect on glucose occurred at 3-, 5-, 6- and 7-days, although the largest effect manifested on 6-days (5.6%, 95%CI: 1.4, 9.9). Significant associations with both insulin and HOMA-IR were observed on the 3- and 4-days, although the largest effect consistently occurred on 4-days with estimations of 90.0% (95%CI: 19.0, 203.4) and 96.5% (95%CI: 14.9, 235.9), respectively. For HOMA-B, positive associations were identified from 3- to 7-days with estimates ranging from 40.0% (95%CI: 2.3, 91.5) to 83.1% (95%CI: 25.3, 167.5). Stratification suggests that women may be more susceptible to short-term O<sub>3</sub> exposure with positive associations observed at 1-, 2-, 5-, 6-, and 7-days in both insulin and HOMA-IR. **Conclusions:** In this study, we found that O<sub>3</sub> exposure is at least partially related to the onset of type II diabetes in older adults with no prior history of this condition. O<sub>3</sub> therefore acts as a kind of catalyst for metabolic disorders, which is a particular concern when we consider the rise in global concentrations.

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**P-0734**

**Climate Change, Rain Fed Maize Productivity and Rural Malnutrition in Mexico**

**Presenter:** Sazcha Marcelo Olivera-Villarroel, Universidad Autonoma Metropolitana, Mexico D.f., Mexico

**Authors:** S. M. Olivera-Villarroel<sup>1</sup>, R. Torrico Lavayen<sup>2</sup>, A. De La Fuente<sup>3</sup>;

<sup>1</sup>Universidad Autonoma Metropolitana, Mexico D.f., MEXICO, <sup>2</sup>Instituto Nacional de Salud Publica, Mexico D.f., MEXICO, <sup>3</sup>World Bank, Washington, DC.

This paper estimates the impact of climate change on rain-fed maize productivity and its association with rural Mexican children's malnutrition. We use panel data for 2,196 municipalities to assess the effects of temperature and rainfall on maize yields from 2003-07. We then incorporate temperature and rainfall scenarios changes by 2030-2039 into the estimated coefficients to explore climate change's effects. We then investigate whether such drops on maize yields are associated with increased children malnutrition in rural areas. Children malnutrition does relate inversely to maize productivity shocks triggered by climate change. These estimates, however, may overstate the association of climate change with stunting in the sample since they only take into account spatial adaptive capacity. Households can adapt to changing climate conditions through spatial mobility, but also increased mean per capita output due to economic growth over the next 25 years. Predicting the impacts of climate change on maize yields and then its association with stunting is a starting point to address the vulnerability of those who have low resilience to adverse climatic events. It remains to see how fast will farmers adapt to changing climate conditions and if current policies are conducive to this end. The adaptive capacity of households is very heterogeneous, and we account for some of this adaptive capacity through spatial mobility. The government can also improve adaptation through economic growth, prices, transfers, and insurance. More food could be grown with better policies and incentives, and recent initiatives to revamp agricultural research and develop higher yield drought-resistant maize varieties are needed. Finally, the analysis presented here provides average estimates of maize losses and stunting increases associated with temperature and rainfall changes, both regionally and rural areas. However, it is also necessary to assess the distributional impact of climate change across population groups.

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**P-0735**

### **Fruit and Vegetable Intake Mediate the Association between Residential Greenness and Mortality among the Oldest Old**

**Presenter:** John S. Ji, Duke Kunshan University, Kunshan, China

**Authors:** A. Zhu<sup>1</sup>, J. S. Ji<sup>2</sup>;

<sup>1</sup>University of Heidelberg, Heidelberg, GERMANY, <sup>2</sup>Duke Kunshan University, Kunshan, CHINA.

**Background/Aim** Large-scale longitudinal cohort studies have illustrated the protective effects of residential greenness on mortality. Fruit and vegetable intake is linked to lower risks of chronic diseases and mortality. We aimed to study whether fruit and vegetable intake mediate the association between residential greenness and mortality among the oldest old. **Methods** We used five waves (2000-2014) of Chinese Longitudinal Healthy Longevity Survey (CLHLS). Our participants aged 80 years and older, were recruited from 22 provinces in mainland China. We assessed exposure to greenness through satellite-derived Normalised Difference Vegetation Index (NDVI) values in the 500m radius around the participants' residential address. We dichotomized intake of fruit, fresh vegetable, bean, garlic, and salted vegetable at baseline to almost daily, and occasional or rare intake. We applied binary logistic regression to test exposure mediator effect of residential greenness on fruit and vegetable intake. We used Cox proportional hazards models to examine the effects of residential greenness, fruit and vegetable intake, and their aggregate effects on mortality, separately. All regression models were adjusted for a number of covariates.

**Results** Among 23,757 participants totaling 79,950 person-years, we observed 18,947 deaths between 2000 and 2014. The mean age was 93 years old. 28.78%, 82.15%, 26.52%, 14.71%, and 20.06% of study participants reported daily intake of fruit, fresh vegetable, bean, garlic, and salted vegetable, respectively. Living in the greenest areas was associated to a 29% lower mortality rate (HR: 0.71, 95% CI: 0.68, 0.74), while occasional or rare intake of fresh vegetable was related to a 10% higher mortality rates (HR: 1.10, 95%CI: 1.06, 1.14). Living in greener areas were related to a HR of 0.90 of occasional or rare intake of fresh vegetable (95% CI: 0.82, 0.99).

**Conclusions** Daily intake of fresh vegetable may mediate the association between residential greenness and mortality among the oldest old.

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**P-0737**

### **The association of food-related anaphylaxis admissions with temperature and pollen counts in England**

**Presenter:** Holly CY Lam, Imperial College London, London, United Kingdom

**Authors:** H. C. Lam<sup>1</sup>, P. J. Turner<sup>1</sup>, D. Hemming<sup>2</sup>, D. L. Jarvis<sup>1</sup>;

<sup>1</sup>Imperial College London, London, UNITED KINGDOM, <sup>2</sup>Met Office Hadley Centre, Exeter, UNITED KINGDOM.

Background/Aim Small studies suggest that food-related anaphylaxis may be more common when temperature and pollen counts are higher. Robust quantitative evidence for such a relationship is lacking. We examined associations of food-related anaphylaxis hospital admissions (FRAHAs) with temperature and pollen counts in England. Methods Monthly counts of FRAHAs in England in 2010-2018 were linked to monthly central England temperature and pollen counts in England. Poisson generalized additive models for time-series were applied to examine the associations of admissions with temperature and pollen including adjustment for yearly and seasonal trend. Results Between 2010-2018 there were 15405 admissions. A seasonal peak of admission was observed in June with relative risk (RR) 1.22 (95%CI 1.13-1.31) compared to January. This seasonal peak disappeared after adjusting for *Betula* (birch) and *Fraxinus* (ash), both of which have a seasonal peak around April. Higher levels of *Ambrosia* (ragweed) (RR 1.16 95%CI 1.03-1.31; 95<sup>th</sup> vs. 5<sup>th</sup> percentile), *Quercus* (oak) (RR 1.12 95%CI 1.04-1.21) and lagged one-month *Fraxinus* (RR 1.05 95%CI 1.01-1.10) were associated with higher risk of admissions. Higher levels of *Poaceae* (all grass) were however associated with a lower risk of admissions (RR 0.86 95%CI 0.77-0.96). Temperature was weakly positively associated (RR 1.07 95%CI 0.99-1.16 per 10°C increase). Conclusions To the best of our knowledge, this is the first study quantifying the association of FRAHAs with temperature and pollen counts using time series approaches. Seasonality of admission was observed, with some evidence that this might be weakly related with temperature, and some pollen levels. Further studies applying species-specific data for grass and with more detailed spatio-temporal scale are needed. Individual level information on clinical characteristics of the admission are needed to fully understand the mechanisms involved. Such studies may be increasingly relevant in light of climate change and the general increase in food allergy across the world.

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**P-0739**

**Prenatal Nutrition measured by My Nutrition Index is associated with Birth Weight and Cognitive Function in Children at 7 years**

**Presenter:** Chris Gennings, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** C. Gennings<sup>1</sup>, A. Wolk<sup>2</sup>, N. Harkansson<sup>2</sup>, C. Bornehag<sup>3</sup>;

<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Karolinska Institute, Stockholm, SWEDEN,

<sup>3</sup>Karlstad University, Karlstad, SWEDEN.

Nutrition is a multi-faceted, complex construct, where good nutrition should be associated with improved health outcomes. This is particularly true during pregnancy when prenatal maternal nutrition may impact the child's development. Most research papers on nutrition focus on individual nutrients and health outcomes. In contrast, our focus is on a holistic measure of nutrition. My Nutrition Index (MNI) is an index that measures the nutrient quality (i.e., "nutritiousness") of a specified daily diet and is calculated based on quantification of dozens of macro- and micronutrients that are specific to an individual's nutritional needs (as defined by published recommended guidelines for individual nutrient target ranges) by incorporating dietary restrictions, subject characteristics, activity level, and health behaviors. Other nutrition indices are based on scored food groups consumed and may not adequately adjust for micronutrient inadequacies during pregnancy. The Swedish Environmental, Longitudinal, Mother and child, Asthma and allergy (SELMA) study is a pregnancy cohort in Värmland, Sweden, with prenatal endocrine disrupting chemicals (EDC) exposure and dietary data available, making it possible to test for the potential mitigating effect of good nutrition on health effects from EDCs. Using prenatal nutrients from food frequency questionnaire (FFQ) data to construct an individual's MNI, the index is significantly and positively associated with important metabolic (as measured by birth weight) and cognitive function at age 7 years (as measured by IQ-WISC) in children when adjusted for co-variables. Regression models included both prenatal concentrations of an EDC (bisphenol F and PFOA) and MNI demonstrating the adverse association with EDCs and the positive association of a nutritious diet during pregnancy. Thus, MNI is evidently a metric of the general nutritiousness of daily diets and is useful in environmental health studies in representing the impact of good nutrition. (We gratefully acknowledge support from NIEHS: #R01ES028811)

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**P-0740**

**Microbial succession pattern and changes in proximate parameters during fermentation of the avocado (*Persea americana*) fruit**

**Presenter:** Christiana Eleojo Aruwa, Federal University of Technology, Akure, Nigeria

**Authors:** C. E. Aruwa, G. B. Akinnuoye;  
Federal University of Technology, Akure, NIGERIA.

Background: The avocado (*Persea americana*) is not a fruit delight frequently consumed like other exotic fruits. This may be due to the nature and fat content of the fruit which reduce its use and exploitation even in the food industry. This study was aimed at boosting the economic value of the avocado by investigating the microflora associated with the fresh (unfermented) and fermented (liquid/submerged and solid fermented) fruits, and also determining the proximate properties during fermentation. Methods: Standard methods for fermentation, microbiological analysis for isolation/identification of microorganisms and proximate analysis were employed. Results: *Micrococcus* sp., *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Lactobacillus* sp. (lactic acid bacteria-LAB), *Klebsiella* sp. and *Bacillus* sp. were some of the bacteria isolated. On the other hand, fungal isolates included *Aspergillus*, *Penicillium*, *Mucor* and *Saccharomyces* species. Proximate parameters varied widely from 0-96 h and from unfermented, submerged and solid fermented avocado samples with reduction in anti-nutrient parameters, increase in moisture content and reduction in fat and crude fibre contents. Titratable acidity increased with increased hour of fermentation, while temperature showed slight fluctuation over time. Same species of bacteria and fungi were identified from the liquid and solid fermented samples. However, *Pseudomonas aeruginosa* and *Bacillus* sp. were predominant in solid and submerged fermented samples, respectively; while *Mucor mucedo* and *Penicillium* sp. were predominant in solid and submerged fermented avocado samples, respectively. Conclusions: In conclusion, while the avocado fruit has a high moisture and fat content, solid and submerged fermentation methods could suffice to reduce the fat content of the fruit. In addition, the fruit may also serve as a source of LAB, and new food products may be produced and enhanced for added health benefits to persons who do not usually consume the fruit.

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**P-0741**

**Combinative therapy of quercetin and vitamin E ameliorate intrinsic apoptotic via inhibition of mitochondrial pore shift in diabetic heart and liver**

**Presenter:** Oluwatoyin Ojo, Anchor University Lagos, Lagos, Nigeria

**Authors:** O. Ojo<sup>1</sup>, O. Olorunsogo<sup>2</sup>;

<sup>1</sup>Anchor University Lagos, Lagos, NIGERIA, <sup>2</sup>University of Ibadan, Ibadan, NIGERIA.

Combinative therapy of quercetin and vitamin E ameliorate intrinsic apoptotic via inhibition of mitochondrial pore shift in diabetic heart and liver

**ABSTRACT Aims/hypothesis** Complications due to excessive apoptosis is observed in all forms of diabetes. The Mitochondrial has been shown to perform critical role in apoptosis and in recent times employed in management of the complications arising from the disease. The present study is aimed to evaluate if treatment with a combination of quercetin/vitamin E would ameliorate excessive apoptosis in diabetic rat heart and liver. **Methods:** We treated streptozotocin (STZ)-induced diabetic male Wistar rat models with a combination of quercetin/vitamin E and investigated their ability to inhibit sensitivity of mitochondrial Permeability Transition (mPT) pore. We examined the effect on mitochondrial Adenosine Triphosphatase (mATPase) activity, mitochondrial lipid peroxidation (mLPO), excessive cytochrome c (cytc) release, activated caspase 3 and 9. Treatment was given daily and orally for 4 weeks. **Results:** Diabetic rat heart and liver showed mPT pore opening when compared with normal control and this was reversed by treatment with a combination of quercetin/vitamin E. Furthermore, treatment blunted the enhanced mATPase activity, mLPO, blood glucose and lesions observed in rats. A decreased cytc release was evident by treatment in diabetic rat heart and liver. Furthermore, treatment ameliorated diabetes-induced cardiomyocyte and hepatocyte excessive apoptosis via down-regulation of caspase 3 and 9 activation. **Conclusion/interpretation:** The findings show that treatment with a combination of quercetin/vitamin E diminished susceptibility to cardiomyocytic and hepatocytic excessive apoptosis in diabetes facilitated by shifts in mPT pore opening. It is also a blood glucose lowering molecule with potentials of treating diabetes-induced complications. **Keywords:** Diabetes. Mitochondrial. Apoptosis. Quercetin. Vitamin E. Heart. Liver

Word Count 241

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## ABSTRACT E-BOOK

Theme: **Nutrition and metabolism**

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**P-0742**

**Meat Handlers Hygiene Knowledge, Attitude and Practice, and Butcher Shops Sanitary Conditions**

**Presenter:** Wondwossen Birke, Jimma University, Jimma, Ethiopia

**Authors:** D. Teshome, W. Birke;  
Jimma University, Jimma, ETHIOPIA.

### Background

In developing countries like Ethiopia, there is a growing trend in the consumption of animal products such as meat with minimal attention on its safety. Since there is no previous study, this study aimed to assess Knowledge, Attitude and Practice (KAP) of meat handlers on hygienic handling of meat and sanitary condition of butcher shop in Jimma town, Southwest Ethiopia, from March-April 2019.

### Methods

Cross-sectional study design using quantitative method was conducted on a sample of 115 meat handlers from 62 butcher shops. Structured questionnaires were used to interview all meat handlers. A check list was used to assess the sanitary condition of the butcher shops. Results were analyzed manually. The findings were displayed in form of percentages, in tables and graphs.

### Results

The study showed that 56% and 93.9% of respondents had good knowledge and positive attitude, respectively. However, only 34% had good practice. Among the respondents, majority 92% were wearing gown of which 74% were wearing always and the rest were wearing sometimes. Sanitary conditions in the butcher shops were generally poor. The walls (51.6%) and floors (56.5%) of the butcher shops were not easily cleanable since they were cracked, and also had dust on it.

### Conclusions

The study revealed that there is high level of knowledge and attitude among workers. But level of practice is low. The butcher shops have poor sanitary condition. The management of municipality should follow and monitor the butcher shops and workers should attend proper training in the basic principle of meat safety and rules of personal hygiene in order to improve their meat handling practices.

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**P-0745**

**Digital technology use and adolescent body weight: Evidence from the SCAMP cohort study**

**Presenter:** Mireille Toledano, Imperial College London, London, United Kingdom

**Authors:** M. Toledano<sup>1</sup>, C. Shen<sup>1</sup>, I. Dumontheil<sup>2</sup>, M. Thomas<sup>2</sup>, M. Rössli<sup>3</sup>, P. Elliott<sup>1</sup>;

<sup>1</sup>Imperial College London, London, UNITED KINGDOM, <sup>2</sup>Birkbeck, University of London, London, UNITED KINGDOM, <sup>3</sup>Swiss Tropical and Public Health Institute, Basel, SWITZERLAND.

**Background/Aim:** Use of digital technologies such as mobile phones is ubiquitous in adolescents. We aimed to assess the social predictors of digital technology use and its association with body weight in a large cohort of adolescents.

**Methods:** We used baseline data from a subset of a large adolescent cohort of 39 schools across Greater London who participated in the Study of Cognition Adolescents and Mobile Phone (SCAMP) (n=1,474). Digital technology use included phone call, internet use on mobile phone, and video gaming on any device. Multi-level regression was used to assess the association between digital technology use and age- and sex-specific body mass index (BMI) z-score and overweight (including obesity) derived from objectively measured height and weight. We examined whether the associations were mediated by insufficient sleep.

**Results:** Generally, participants with lower socioeconomic status reported more use of digital technologies. Internet use on mobile phone for more than 3 hours per day was associated with higher BMI z-score and greater odds of being overweight, compared to low use ( $\leq 30$  min). Similar association between video gaming and body weight was found. Weekday insufficient sleep partly mediated the associations between internet use and video gaming and BMI z-score by an indirect effect.

**Conclusions:** We found an association between digital technologies and body weight, partly mediated by insufficient sleep, suggesting underlying mechanisms may be multi-factorial. Further research with longitudinal data is essential to explore the direction of relationships.

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**P-0746**

**Mechanistic insights of personal PM<sub>2.5</sub> and BC exposure on serum metabonomics**

**Presenter:** Yanwen Wang, National Institute of Environmental Health, China CDC, Beijing, China

**Authors:** Y. Wang, J. Fang, J. Wang, H. Du, L. Zhao, Q. Sun, T. Li, X. Shi;  
National Institute of Environmental Health, China CDC, Beijing, CHINA.

**Background:** Black carbon (BC) is important component of fine particulate matter (PM<sub>2.5</sub>), which has finer particle size and can adsorb variety of toxic substances, yet the magnitude and pathophysiologic mechanisms of health effects by BC remain unknown. **Methods:** 76 healthy elderly adults in Jinan were recruited in the study, and participated in 5 repeat visits from September 2018 to January 2019. Each participant was required to wear portable samplers to measure personal exposure of PM<sub>2.5</sub> (MicroPEM, RTI) and BC (AE51, AethLab Inc.) for three days during each visit. Ambient temperature and relative humidity were collected from nearest meteorological station. Participants were asked to complete detailed questionnaire and 24-hour time-activity dairy to investigate possible confounders. Serum samples were collected during each visit to perform untargeted metabolomics profiling analysis. We analyzed the association of personal exposure and metabolome using linear mixed-effects models and elucidated the involving metabolic pathways. **Results:** Personal exposure PM<sub>2.5</sub> and BC were significantly associated with 348 and 443 metabolic features. Enrichment analysis indicated significant pathways including arginine biosynthesis, and metabolisms of phenylalanine, glycolysis, sphingolipid, which were closely related to metabolic and cardiovascular system. 20 out of 53 matched pathways showed more metabolic features significantly associated with BC than with PM<sub>2.5</sub>, while 32 pathways showed same metabolic features with BC and PM<sub>2.5</sub>. Besides, BC was distinctively associated with two pathways of Vitamin B6 and Caffeine metabolism, indicating that BC might have stronger magnitude of health effects than PM<sub>2.5</sub>, and have particular adverse effects on nervous system. **Conclusions:** PM<sub>2.5</sub> and BC exposure can lead to adverse cardiometabolic effects by affecting metabolism processes. BC might be a more significant indicator of PM<sub>2.5</sub> in health effects analysis, and the toxicity and biomechanism should be further analyzed in the follow-up study.

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**P-0748**

**Cadmium dietary intake and blood levels in early childhood**

**Presenter:** Edna Isabel Rodríguez-López, National Institute of Public Health, Cuernavaca, Mexico

**Authors:** E. I. Rodríguez-López<sup>1</sup>, A. C. Ariza-Gutiérrez<sup>1</sup>, A. P. Sanders<sup>2</sup>, M. Solano-González<sup>1</sup>, M. M. Téllez-Rojo<sup>1</sup>, R. O. Wright<sup>2</sup>, M. Tamayo-Ortiz<sup>3</sup>;

<sup>1</sup>National Institute of Public Health, Cuernavaca, MEXICO, <sup>2</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>3</sup>CONACYT-INSP, Cuernavaca, MEXICO.

**Background:** Low level cadmium (Cd) exposure during childhood is common and may contribute to poorer children's health. Diet is the main source of Cd exposure in this population, however information on dietary Cd intake in children is limited. The aim of this study was to estimate the dietary Cd (DCd) intake from 1 to 6 years of age and its association with blood Cd levels (BCd). **Methods:** Diet was assessed longitudinally in children from the Programming Research in Obesity GRowth Environment and Social Stressors (PROGRESS) cohort in Mexico City, using a semi-quantitative food frequency past week questionnaire (FFQ) at 1 (n=558), 2 (n=452), 4 (n=593) and 6 (n=595) years of age. DCd was estimated using food composition tables from the US, European Food Safety Authority, Australia, Hong Kong, Canada and 5 food items from Mexico. Cd levels from the reports were averaged and standardized to mg/kg. We matched reported levels with the FFQ and estimated the individual DCd in grams at each time point. BCd was analyzed using ICP-QQQ. We modeled 4 year-old BCd and the arithmetic mean of 1, 2 and 4 year old DCd in tertiles, adjusted for child's sex, age, BMI z-score and environmental tobacco exposure. **Results:** The mean weekly DCd intake was 0.0033±0.0027g, 0.0042±0.0024g, 0.0058±0.0029g and 0.0066±0.0029g at 1, 2, 4 and 6 years old respectively. The most Cd-containing consumed food items changed across age of assessment, however milk, sweets, potatoes, rice and bread were consistently identified Cd sources in all stages. Compared to the 1<sup>st</sup> tertile, DCd 2<sup>nd</sup> tertile was associated with increased BCd and DCd 3<sup>rd</sup> tertile with decreased BCd. **Conclusion:** Our results show that children's Cd consumption increases with age and suggest a non-linear association between diet and blood Cd. Future studies will assess the relationship between DCd and children's renal health.

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## ABSTRACT E-BOOK

Theme: **Nutrition and metabolism**

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**P-0749**

**Metabolome-wide association study (MWAS) of plasma cystine in healthy aging men and women**

**Presenter:** Young-Mi Go, Emory University, Atlanta, United States

**Authors:** Y. Go, Z. R. Jarrell, D. Jones;  
Emory University, Atlanta, GA.

Background: Cystine (CySS) is an oxidized form of cysteine, abundant in plasma and having different distribution in males and females. Plasma CySS is a measure of oxidative stress and increases with age, but the mechanistic basis is unknown. We hypothesized that if environmental exposures causing oxidative stress in women contribute to increased CySS concentrations with age, a metabolome-wide association study of age should reveal environmental chemical associations with CySS. Aim: Perform metabolome-wide association study (MWAS) of plasma CySS in healthy aging women to test for association of environmental chemicals with CySS. Methods: Plasma from 65 women (20 to 62 y; mean, 42.6 y) and without known disease (PRE-MED cohort; NCT00336570) was used. Plasma CySS was quantified by HPLC (mean, 68.9  $\mu$ M). High-resolution metabolomics of plasma was used for relative quantification of environmental chemicals and metabolites. Samples were analyzed by LC-HRMS with +ESI on C18; data were extracted by apLCMS and xMSanalyzer and log-transformed prior to biostatistics and bioinformatics. Metabolome correlations with CySS and age were performed by xMWAS using Spearman correlation ( $r \leq 0.25$ ,  $P \leq 0.05$ ). xMSannotator with HMDB and KEGG was used for metabolome annotation and with the Toxin and Toxin-Target DataBase (T3DB) for environmental chemical annotation. Results: The results showed 265 metabolites positively associated with CySS and 285 positively associated with age ( $r \leq 0.25$ ,  $P \leq 0.05$ ). Of those associated with CySS, 30 matched environmental chemicals. A relatively high correlation with CySS was observed for phenol compounds (chloro-, nitro-, dinitrophenols) and lactofen ( $r \leq 0.4$ ). Of metabolites associated with age, 23 matched environmental chemicals. Correlation of benzofuran compounds with age was relatively high ( $r \leq 0.3$ ). Conclusions: The results show that environmental chemicals associate with plasma CySS in healthy aging women. The results indicate that cumulative environmental exposures or decline in elimination of environmental chemicals could contribute to increased oxidative stress with age.

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## ABSTRACT E-BOOK

Theme: **Nutrition and metabolism**

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**P-0750**

**Individual and contextual exposures and cardio-metabolic diseases in adults of Argentina. A contribution for epidemiological surveillance**

**Presenter:** Camila Niclis, Instituto de Investigaciones en Ciencias de la Salud (INICSA), Universidad Nacional de Córdoba - CONICET  
Escuela de Nutrición, Facultad de Ciencias Médicas, Universidad Nacional de Córdoba, Córdoba, Argentina

**Authors:** L. Aballay<sup>1</sup>, C. Niclis<sup>1</sup>, D. Roman<sup>1</sup>, S. Pou<sup>1</sup>, J. Becaria Coquet<sup>1</sup>, M. A. Eandi<sup>1</sup>, R. A. Fernandez<sup>2</sup>, G. Reartes<sup>1</sup>, M. Canale<sup>1</sup>, M. Carrillo<sup>1</sup>, M. Díaz<sup>1</sup>, S. Muñoz<sup>1</sup>, M. Butinof<sup>1</sup>;  
<sup>1</sup>Universidad Nacional de Córdoba, Córdoba, ARGENTINA, <sup>2</sup>Universidad Católica de Córdoba, Córdoba, ARGENTINA.

The aim of this study was to assess the association of individual and contextual exposures with cardio-metabolic diseases (CMD) occurrence in adults of Córdoba province (Argentina) for epidemiological surveillance purposes. Methods: A population-based study of 493 subjects (30-60 years-old) was performed in Córdoba Province, Argentina, in 2017. Bio-socio-economic individual characteristics (gender, age, BMI, tobacco habit, socio-economic status and occupational exposure); adherence level to characteristics dietary patterns (DP) (Argentine Pro-inflammatory-APP-, Fast food -FSP-, Simile-Mediterranean -SMP- and Prudent-PP-), and contextual exposure (farm machinery warehouse -FMW- and agricultural pesticide applications-NAP- within 100m from home) were assessed. Self-reported hypertension (HT), diabetes (DBT), and obesity (measured BMI) were the CMD considered. For the analysis, all CMD were considered together and independently (HT, DBT and obesity). Two steps were performed: 1) Multiple Correspondence Analyses (MCA) for exploring exposure profiles; 2) Logistic regression models were fitted to estimate the association between individual and contextual exposures and CMD (in the full sample and stratified by two socio-environmental and economically differentiated areas, north and south). Results: MCA identified two different profiles regarding sociodemographic and environmental indicators -coincident with areas studied- (71.39% of explained variation on first and second factors). 42% of all the individuals had at least one CMD (19% HT, 7.3% DBT and 32.52% obesity); age and a high socioeconomic status were directly and inversely associated to all CMD, together and independently. Also, BMI was associated with HT and DBT; SMP (overall) and PP (in North area) were inversely associated with all CMD together and specifically with obesity; the environmental exposure FMW was significantly associated with DBT, while NAP was associated with all CMD and particularly with HT, in the North area. Conclusions: In Córdoba province, epidemiological surveillance programs are required to reduce CMD epidemic; both individual and community - environmental factors needs to be addressed.

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Theme: **Nutrition and metabolism**

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**P-0751**

### **Phthalate and Novel Plasticizer Concentrations in Food Items from U.S. Fast Food Chains**

**Presenter:** Ami R Zota, The George Washington University Milken Institute School of Public Health, Washington, United States

**Authors:** A. R. Zota<sup>1</sup>, A. Yau<sup>2</sup>, N. L. McCray<sup>1</sup>, G. Adamkiewicz<sup>3</sup>;

<sup>1</sup>The George Washington University Milken Institute School of Public Health, Washington, DC, <sup>2</sup>Southwest Research Institute, San Antonio, TX, <sup>3</sup>Harvard T.H. Chan School of Public Health, Boston, MA.

#### Abstract

Background: Phthalates exposures are linked with adverse health outcomes, and limited toxicity data is available for phthalate alternatives such as dioctyl terephthalate (DEHT) despite increasing exposure trends. Given the importance of dietary exposures, we aimed to characterize phthalates and non-phthalate alternatives in food items and food handling gloves from popular fast food chains. Methods: We sampled fast food items in two phases from 2017 to 2018 in San Antonio, Texas. In phase one, we sampled burgers, chicken nuggets, fries, chicken burritos, and cheese pizzas from six chains (n=42). In phase two, we sampled burgers, fries, and chicken burritos from three of the same chains (n=22), and collected one pair of gloves from each (n=3). Twelve analytes were quantified in samples using gas chromatography mass spectrometry: butylbenzyl phthalate (BBzP), diisodecyl phthalate (DiDP), di-n-butyl phthalate (DnBP), diethyl phthalate (DEP), diisononyl phthalate (DiNP), di(2-ethylhexyl) phthalate (DEHP), diisobutyl phthalate (DiBP), dimethyl phthalate (DMP), di-n-octyl phthalate (DnOP), di(2-ethylhexyl) adipate (DEHA), 1,2-cyclohexane dicarboxylic acid diisononyl ester (DINCH), and DEHT. Results: Among all chemicals measured, DEHT was the most abundant in both fast food and glove samples. Chemical patterns differed by food type. DEHT levels were significantly higher in burritos compared with burgers (6000 ug/kg versus 2200 ug/kg; p <0.0001) and no DEHT was detected in fries. DEHT was detected in all glove samples (range: 1.24-1.88 g/glove). DnBP and DEHP were detected in 85% and 72% of food samples, respectively. Across both sampling phases, the highest median DEHP concentrations were in burgers (n=21, 36.0 ug/kg). Conclusions: To our knowledge, these are the first data available of DEHT in food, and the first data of plasticizers from US fast food chains. Phthalate alternatives were found at high concentrations, and several ortho-phthalates were also ubiquitous. Further research is needed to identify health implications and opportunities for intervention.

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Theme: **Nutrition and metabolism**

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**P-0752**

**Residential Urbanicity is Associated with glycosylated hemoglobin levels in Older Adults**

**Presenter:** Trenton Honda, University of Utah, Salt Lake City, United States

**Authors:** T. Honda<sup>1</sup>, J. Manjourides<sup>2</sup>, H. Suh<sup>3</sup>;

<sup>1</sup>University of Utah, Salt Lake City, UT, <sup>2</sup>Northeastern University, Boston, MA, <sup>3</sup>Tufts University, Medford, MA.

**Introduction:** Environmental pollutants have been previously associated with increased risk of diabetes mellitus (DM) and perturbations in glucose homeostasis. Little is known however about how, and to what extent, neighborhood urbanicity may impact biomarkers of glucose control.

**Methods:** We used mixed effects multiple regression models to evaluate neighborhood urbanicity and glycosylated hemoglobin (HbA1c) levels among 4,121 individuals >57 years of age enrolled in the National Social Life, Health, and Aging Project. We also examined for effect modification by race/ethnicity, socioeconomic status, health status, BMI, and age. Secondary analyses examined whether associations were mediated by PM<sub>2.5</sub>, NO<sub>2</sub>, and physical activity. Urbanicity measurements were calculated as the percentage of low- and high-intensity residential, and industrial/ commercial/ transportation land use within 1 km of each participants residence, using data obtained from the US Geological Survey National Land Cover Dataset. HbA1c levels were measured from dried blood spots and were log transformed prior to inclusion in models. All models were adjusted for demographic, socioeconomic, health behavior, medical history, and current medications which have been previously shown to affect HbA1c and DM risk.

**Results:** Each IQR increase in surrounding urban landcover was associated with a 1.0% (95% CI 0.1, 1.8) increase in HbA1c levels. In effect modification models, the associations were found to be over four times stronger among Black participants (4.7%, 95% CI: 0.7 -8.9) relative to White participants (0.8%, 95% CI: 0.0, 1.7;  $P_{interact}$  0.04). No significant mediation was observed by any investigated variables.

**Conclusions:** In a cohort of older US men and women, neighborhood urbanicity was significantly associated with HbA1c, with significantly larger effects in Black participants. These associations suggest that urbanicity may be an important contributor to perturbed glucose metabolism in older adults.

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Theme: **Nutrition and metabolism**

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**P-0753**

**Non-home-prepared meal and fast food intake as exposure sources to non-persistent pollutant among the US population, NHANES 2013-2014**

**Presenter:** Che-Jung Chang, Emory, Atlanta, United States

**Authors:** C. Chang, P. Tung, M. Smarr, D. Barr, P. Ryan;  
Emory, Atlanta, GA.

Background: Non-persistent pollutants (NPPs) have been widely used in commercial products, and proven to have adverse health impacts. Despite the various exposure pathways, dietary intake has received more attention due to potential contamination from food processing and packaging. Non-home-prepared meals and fast food are likely more processed and packaged, which may be important exposure pathways for some NPPs. Methods: To assess the associations of urinary NPPs with non-home-prepared meals, and with fast food intake, the data from the National Health and Nutrition Examination Survey (NHANES 2013-2014) were used (N=2,666 for organophosphate ester; N=2,777 for the other chemicals). Dietary information was collected through the questionnaire during household interview and 24-hr dietary recall interview; participants at or below the median were assigned to low exposure group, whereas those above were assigned to high exposure group. Multivariate linear regression accounting for the complex sampling design was applied, and all models were adjusted for sex, age, race/ethnicity, BMI, income, and urinary creatinine. Results: Based on the significance of trend, dose-response relationships were found in some phthalates metabolites, but not for bisphenols, parabens or organophosphate esters with non-home-prepared meals, and with fast food intake. The participants with low and high frequency of non-home-prepared meals have 15.3% (CI 3.7-28.1%) and 66.8% (CI 39.9-98.8%) increase in urinary  $\Sigma$ diisononyl phthalate metabolites ( $\Sigma$ DiNP<sub>m</sub>) levels compared to non-exposed group. Those with low and high fast food intake with in the past 24 hours have 31.1% (CI 9.8-56.4%) and 70.4% (CI 51.2-92.0%) increase in urinary  $\Sigma$ DiNP<sub>m</sub> levels compared to no intake group. Similar findings were also found for urinary  $\Sigma$ di(2-ethylhexyl)phthalate metabolites ( $\Sigma$ DEHP<sub>m</sub>), mono(carboxyisononyl) phthalate (MCiNP), and mono-(3-carboxypropyl) phthalate (MCPP). Conclusion: Human phthalate exposure may be attributed to non-home-prepared and fast food consumption, whereas paraben, bisphenol, and organophosphate ester exposures may have different exposure pathways among the US population.

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Theme: **Nutrition and metabolism**

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**P-0754**

**Associations of serum Phthalate concentrations with levels of Thyroid Hormones in adults from Southern Spain**

**Presenter:** Carolina DONAT-VARGAS, Autonomous University of Madrid, Madrid, Spain

**Authors:** C. DONAT-VARGAS<sup>1</sup>, C. Gomez-Peña<sup>2</sup>, F. Perez-Carrascosa<sup>3</sup>, V. Mustieles<sup>4</sup>, I. Salcedo-Bellido<sup>5</sup>, H. Frederiksen<sup>6</sup>, A. Åkesson<sup>7</sup>, J. Arrebola<sup>5</sup>;

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<sup>3</sup>Instituto de Investigación Biosanitaria ibs.GRANADA, Granada, SPAIN, <sup>4</sup>University of Granada, Center for Biomedical Research (CIBM), Granada, SPAIN, <sup>5</sup>University of Granada, Department of Preventive Medicine and Public Health, Granada, SPAIN, <sup>6</sup>Department of Growth and Reproduction, Rigshospitalet, Copenhagen University Hospital, Copenhagen, DENMARK, <sup>7</sup>Institute of Environmental Medicine, Karolinska Institutet, Stockholm, SWEDEN.

**Title:** Associations of serum Phthalate concentrations with levels of Thyroid Hormones in adults from Southern Spain  
**Background/objective:** Phthalates are used extensively in many consumer products, resulting in widespread exposure in the general population. Epidemiological research relating phthalate exposure to thyroid function remains inconclusive. This study aimed to investigate the associations between specific phthalate metabolites and indicators of thyroid function. **Methods:** We measured 11 serum phthalate metabolites and thyroid hormones –triiodothyronine (T3), thyroxine (T4) and thyroid stimulating hormone (TSH)– in a subsample of 207 adults from the GraMo cohort, recruited in Granada (Southern Spain). Data on socio-demographic and lifestyle factors were obtained by baseline questionnaire completion. Phthalates were log-transformed and categorized into tertiles. Cross-sectional associations of each phthalate with thyroid hormones were analyzed using multivariable-adjusted linear regression models, and beta coefficients ( $\beta$ ) and 95% Confidence Intervals (CI) were estimated. **Results:** The mono-ethyl phthalate metabolite (MEP) was found at notably higher levels than the rest of the metabolites (median 9.46, iqr 2.54 – 30.52). After adjusting for age, sex, body mass index, residence area, tobacco use, alcohol consumption, attained education and estradiol levels, the following phthalate metabolites were significantly associated with T3 in a dose-response manner: MMP ( $\beta$  0.90; 0.68, 1.12), MEP ( $\beta$  0.67; 0.44, 0.90), MiBP ( $\beta$  0.49; 0.21, 0.77), MiDP ( $\beta$  0.27; 0.03, 0.52), MBzP ( $\beta$  0.51; 0.28, 0.73), MEHP ( $\beta$  -0.59; -0.82, -0.35) and MiNP ( $\beta$  -0.43; -0.71, -0.14), when comparing the highest vs. the lowest tertile (=metabolite levels <LOD). No associations were observed for TSH or T4. **Conclusions:** Several phthalates were directly associated with circulating T3 levels. The cross-sectional nature of this analysis limits causal inference and further research is needed to ratify these findings and determine the clinical significance.

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Theme: **Occupational exposure**

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**P-0756**

**The acute response profile of inflammatory and oxidative stress biomarkers in welders**

**Presenter:** Shangzhi Gao, Harvard T.H.Chan School of Public Health, Boston, United States

**Authors:** S. Gao, L. Cadet, P. Huang, L. Jiang, L. Su, D. Christiani;  
Harvard T.H.Chan School of Public Health, Boston, MA.

**Objectives:** Welding fume is an occupational hazard that can cause a variety of health effects. We aimed to investigate inflammatory response profile and oxidative stress level after acute welding fume exposure. **Methods:** In 87 US adult boilermakers, we took measurements repeatedly immediately before and after a welding shift, as well as at two matched time points on non-welding days, following a self-controlled design. The measured plasma inflammatory biomarkers include IL-1 $\beta$ , IL-2, IL-6, IL-8, IL-10, TNF- $\alpha$ , VEGF, CRP, SAA, sICAM-1, and sVCAM-1; while urinary 8-isoprostane and 8-OHdG were measured as oxidative stress and DNA damage biomarkers, respectively. Individual level PM<sub>2.5</sub> exposure were measured during the welding task, as well as non-welding days. **Results:** The average PM<sub>2.5</sub> level was significantly higher during welding shifts, compared to baseline measured on non-welding days (0.42 vs. 0.12 mg/m<sup>3</sup>,  $p < 0.01$ ). The log(u-8-isoprostane) increased 0.21 unit ( $p < 0.01$ ) after welding shift, but did not change ( $p = 0.91$ ) during the matched period on non-welding days, adjusted for covariates. In a balanced subset, we observed the same but insignificant trend. Log(u-8-OHdG) was 0.07 unit higher ( $p = 0.04$ ) on welding days, at both time points. Also, log(IL-6) had opposite trends between welding shift and self-control ( $p_{\text{interaction}} = 0.03$ ). We found u-8-isoprostane and u-8-OHdG to be higher among smokers, and non-smokers were more sensitive to the effect of welding fume exposure. **Conclusions:** We studied the controlled health effect of welding fume exposure, and captured indicative signals, but it subjected to insufficient power. The result could promote understanding about pathogenesis of occupational diseases.

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**P-0757**

**Home and workplace neighborhood socioeconomic status and behavior-related health: a within-individual analysis**

**Presenter:** Auriba Raza, Stockholm University, Stockholm, Sweden

**Authors:** A. Raza, L. M. Hanson, H. Westerlund, J. Halonen;  
Stockholm University, Stockholm, SWEDEN.

Background: Individuals' health-related behaviors, important determinants of cardiovascular health, might be affected by social characteristics of residential and workplace neighborhoods. Although the influence of individual and home neighborhood socioeconomic status (SES) on behavior-related health has been widely studied, majority of the studies have neglected the possible impact of workplace SES. Objective: To investigate associations between home and work neighborhood SES and behavior-related health in employed individuals. Methods: Participants were from the Swedish Longitudinal Occupational Survey of Health with response to minimum of two surveys between 2012 and 2018. We had 13163 individuals with complete data on at least one exposure and covariates with total of 36925 observations. Neighborhood SES was determined as an index using mean income, education attainment, and unemployment rate within a 500 m buffer around home and workplace address. We used fixed effects method with conditional logistic regression to investigate longitudinal within-individual associations for home, workplace, and time weighted home and work neighborhood SES with self-reported obesity, physical activity, smoking, excessive alcohol consumption, sedentary lifestyle, and sleep problems. Age, marital status, occupational position, presence of children, chronic disease, depressive symptoms, and work strain were covariates. Results: Workers were more likely to consume alcohol excessively when their workplace was located in the highest SES area compared to time when their workplace was located in the lowest SES area (adjusted OR 1.98; 95% CI, 1.12-3.49). Contrarily, higher SES of the home neighborhood was non-significantly associated with low alcohol consumption. Furthermore, there was an indication of an increased risk of obesity when individuals had their workplace in the highest compared to the lowest neighborhood SES (adjusted OR 1.71; 1.02-2.87). No associations were observed for other outcomes. Conclusion: These within-individual comparisons suggest that workplace neighborhood SES may have a role in health-related behaviors, particularly alcohol consumption.

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Theme: **Occupational exposure**

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**P-0758**

**Health risks awareness of electronic waste scavengers in Lagos, Nigeria**

**Presenter:** Akeem Bayonle Ola, University of Ilorin, Ilorin, Nigeria

**Authors:** A. B. Ola<sup>1</sup>, B. Wahab<sup>2</sup>;

<sup>1</sup>University of Ilorin, Ilorin, NIGERIA, <sup>2</sup>University of Ibadan, Ibadan, NIGERIA.

Background: Electronic waste is considered as one of the most hazardous wastes due to its high harmful contents. The fact that it constitutes a substantial component of municipal wastes and also possesses high economic value because of its reusable and recyclable attributes makes it attractive to the waste scavengers. The characteristic unorthodox method of electronic waste handling by waste scavengers obviously exposes them to a range of hazardous substances which may likely affect their health. However, awareness of the health risks associated with electronic waste picking by the scavengers is imperative for their continued survival in the waste business. This paper, therefore, examined the awareness of electronic waste scavengers of the health risks associated with electronic waste picking with a view to determining the effects of the awareness on their health risks preventive measures. Methods: A cross-sectional study was used to assess the health risk awareness of waste scavengers in the three landfills in Lagos, Nigeria. A structured questionnaire containing information on occupational history, health risks awareness and preventive practices of the scavengers was used to elicit information from 210 waste scavengers randomly selected from the landfills. A five-point Likert Scale was used to establish their awareness while descriptive (frequencies and percentages) and inferential statistics (Multinomial Logistic Regression) were used to establish the effects of awareness on their preventive measures. Results: The study revealed low awareness of the health risks associated with electronic waste picking among the waste scavengers. The results of the logistic regression analysis confirmed the hypothesis that awareness of health risks influences the preventive measures by the scavengers. Conclusions: Raising awareness among the scavengers on the health hazards of electronic waste and the need to adopt the use of personal protective equipment as well as prompt seeking of modern healthcare during illness is recommended.

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**P-0759**

**Prevalence of non-fatal injuries in informal waste recyclers in landfill sites in Johannesburg, South Africa**

**Presenter:** Nisha Naicker, National Institute for Occupational Health, Johannesburg, South Africa

**Authors:** N. Naicker<sup>1</sup>, T. Kootbodien<sup>1</sup>, V. Ntlebi<sup>1</sup>, F. Made<sup>1</sup>, N. Tlotleng<sup>1</sup>, M. Ndaba<sup>1</sup>, S. Kgalamono<sup>1</sup>, K. Du Preez<sup>1</sup>, M. Mokone<sup>1</sup>, A. Mathee<sup>2</sup>, K. Wilson<sup>1</sup>;

<sup>1</sup>National Institute for Occupational Health, Johannesburg, SOUTH AFRICA, <sup>2</sup>South African Medical Research Council, Johannesburg, SOUTH AFRICA.

Background: Waste recyclers, informal economy workers at landfill sites, separate, collect and sell recyclable solid waste. They do not receive health and safety training, personal protective equipment (PPE), health care support or social protection. There is limited information of the extent of adverse health outcomes experienced by waste recyclers in South Africa. The objective of this study was to assess the prevalence and possible risk factors for injuries experienced by waste recyclers. Methods: A cross sectional study was conducted among waste recyclers working in two landfill sites. Interviews were conducted with 361 conveniently sampled waste recyclers using a structured questionnaire with information on socio-demographic history, self-reported exposures and injuries experienced. Results: The average age was 33.7 years, range of 18-81 year. The majority were male (73 %). The top ten self-reported exposures included dust (97%), strong gas smells (95%), rodents (91%), dirty water (89%), lifting heavy objects (87%), dogs (79%), chemicals (66%), needles (48%), blood (39%) and falling waste (38%). Although 90% of participants stated they wore some kind of PPE, this was not always suitable for the work conducted. Thirty-three percent (33%) of participants were injured in the last 6 months. The commonest injuries were lacerations (82%), falls on site (38%), muscular pain (28%), violence from other waste pickers (21%) and needle stick injuries (20%). Female participants experienced a higher proportion of cuts, falls and needle stick injuries compared to males. However, males were more likely to be injured due to violent altercations with other waste recyclers (18% vs 3%) and musculoskeletal injuries (22.7% vs 6%). Conclusion: There was a high prevalence of injuries experienced by waste recyclers at landfill sites. Occupational health and safety awareness and use of appropriate PPE should be provided to waste recyclers in order to prevent occupationally related injuries.

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**P-0760**

**Linkage of occupational history records and medical screening examinations as a tool for assessing the long-term health impacts of wildland firefighting**

**Presenter:** Erin O'Brien Semmens, University of Montana, Missoula, United States

**Authors:** E. O. Semmens<sup>1</sup>, C. Leary<sup>1</sup>, L. McCray<sup>2</sup>, C. W. Noonan<sup>1</sup>;

<sup>1</sup>University of Montana, Missoula, MT, <sup>2</sup>U.S. Department of the Interior, Boise, ID.

**Background.** Wildland firefighters (WFFs) work under intense and demanding conditions in the protection of human health, life, and property. Air pollutant exposures, heat, noise, disrupted sleep, emotional and psychological stress, and extreme physical exertion each may have short-term consequences for WFFs. Although countless population-based studies have established the long-term consequences of these exposures individually, to date little research has been devoted to their chronic effects in WFFs. The health and fitness of WFFs and the duration and intensity of their varied exposures combined with their limited use of personal protective equipment make WFFs a unique population in need of study. **Methods.** Occupational history as a WFF was assessed using Incident Qualification and Certification System (IQCS) responder records. These records contain information on specific fires to which a WFF was assigned, the duration of the assignment, and jobs for which a WFF is qualified and the number of times those jobs were performed. IQCS records were linked to Department of the Interior Wildland Fire Medical Standards Program medical screening examinations performed between 2014 and 2017. **Results.** Between 2014 and 2017, over 10,000 prospective and current WFFs completed comprehensive medical screening examinations to determine fitness for arduous duty firefighting. The median age was 33 years, and 85% of participants were male. Measured median systolic and diastolic blood pressures were 122 and 78 mm Hg, respectively, and 13% had an abnormal resting electrocardiogram. Forty-one percent of participants had available IQCS occupational history records. **Conclusions.** Preliminary analyses emphasized cardiovascular health among WFFs, and future work will investigate other health measures and their association with occupational history. The project establishes a framework for expanded studies of the occupational health risks linked to wildland firefighting, and findings have the potential to guide future screening and surveillance programs.

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## ABSTRACT E-BOOK

Theme: **Occupational exposure**

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**P-0761**

**Environmental health in the prevention of mesopathies: occupational dermatoses**

**Presenter:** Camila Feijó, Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, São Paulo, Brazil

**Authors:** M. Pustiglione<sup>1</sup>, C. Feijó<sup>1</sup>, S. Tognini<sup>2</sup>, S. Quevedo<sup>2</sup>;

<sup>1</sup>Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, São Paulo, BRAZIL,

<sup>2</sup>Secretaria da Saúde do Estado de São Paulo, São Paulo, BRAZIL.

Work-related skin diseases, occupational dermatoses (OD), can be defined as: alteration of mucous membranes, skin and its attachments, directly or indirectly, related to agents present in the activity or work environment. OD can be categorized into two major groups: dermatitis and dermatoses. It is an occupational disease (mesopathy) since they are acquired due to special conditions in which the work is performed. Thus, it is of fundamental importance to recognize the role of work and the forms of protection/prevention to be adopted to provide health actions for this segment of the population. In Brazil, notification of the event with the Information System for Notifiable Diseases (SINAN) is the main way to generate information for health surveillance actions at work. In order to highlight the importance of protection measures related to OD, a survey of cases was carried out at SINAN between 2014 and 2018 for the collection of sociodemographic and professional data. An average of 36 cases of OD were reported per year. Most of the workers were male (51.40%), race/color white (40.78%) between 25 and 39 years of age (43.02%) and with registered employment (formal contract) (71.51%). Regarding occupations, the most affected functions were: janitor (11.17%) and bricklayer (8.94%). Separating the cases according to the International Classification of Diseases (ICD-10), there were more dermatitis (64.25%) than dermatoses (6.71%). Of the dermatitis cases, 27.93% were due to allergic contact dermatitis. When the notification unit was studied, 68.72% of the OD were reported by the Reference Centers in Occupational Health (Cerest). The importance of structuring and implementing a line of care that includes quality care is highlighted, but, above all, acting in the area of prevention and health promotion is essential.

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Theme: **Occupational exposure**

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**P-0763**

### **Pediatric Mercury Exposure Among Children Involved in Artisanal and Small-Scale Gold Mining**

**Presenter:** Shilpi Misra, Milken Institute School of Public Health, Washington, United States

**Authors:** S. Misra, D. F. Goldsmith;  
Milken Institute School of Public Health, Washington, DC.

Background: Artisanal and small-scale gold mining (ASGM) accounts for approximately 15 to 25% of the world's gold production and is one of the largest sources of mercury released into the environment among low- and middle-income countries (LMICs).<sup>1</sup> The International Labour Organization states that there are 4 to 5 million women and children working in ASGM. Mercury vapor produced from heating mercury-gold amalgam can lead to tremors, memory loss, and respiratory dysfunction. As of March 2020, 128 signatories have ratified the Minamata Convention, an aggressive policy action designed to protect human and environmental health from adverse effects of mercury. Despite this action, ~1,400 tons of mercury emissions annually from more than 70 countries. Methods: Published literature was examined to summarize adverse pediatric health outcomes associated with gold mining. The literature review included identifying data gaps needed to conduct cohort studies including the age of workers, frequency of exposure, and personal protective equipment utilized, among other indicators. Results: Our preliminary analysis indicates mercury exposure is not only a significant health threat to children in LMICs, but also ASGM has lax child labor standards, and therefore, requires more attention by policy decision-makers and governmental organizations. Countries are not required to provide a comprehensive registry and there is an absence of any reliable census of those engaged in these operations. Conclusions: As a result of our assessment, the total disease burden is likely unknown, limiting what is known to be a neglected broad public health problem. Surveillance is immediately needed, not only to estimate the global burden of disease but also to conduct urgent field testing in highly exposed nations. Given that comprehensive official registries are needed, a journal article and corresponding policy guide are being drafted to detail mechanisms to increase transparency and monitoring of child labor and working conditions in ASGM.

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Theme: **Occupational exposure**

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**P-0764**

### **Consumer Purchasing to Improve Environmental and Worker Health**

**Presenter:** Mary O'Reilly, University at Albany School of Public Health, Rensselaer, United States

**Authors:** M. O'Reilly<sup>1</sup>, R. Neitzel<sup>2</sup>, D. Goldsmith<sup>3</sup>;

<sup>1</sup>University at Albany School of Public Health, Rensselaer, NY, <sup>2</sup>The University of Michigan, Ann Arbor, MI,

<sup>3</sup>George Washington University, Washington, DC.

Background: Consumers have the power to change how companies do business. For example, Remake promotes Fashion for Good by encouraging sustainable clothing with fair pricing. Empowering consumers to make responsible choices when purchasing clothing has the potential to significantly impact workplace and environmental health in countries where textiles and clothing are made. Methods: A pilot study done in 2018 at the University of Michigan indicated that 6% of consumers always think about environmental effects and 12% always think about worker health effects. Fifty-four percent (54%) and 62% of respondents reported that they sometimes think about worker and environmental health, respectively. The rest of the respondents never think about either when purchasing clothing. All 102 respondents who participated in this online survey purchased clothing. They ranged in age from 18 to 78 (median age, 38) and 75% were female. Their incomes ranged from \$29,700 to \$114,100 (median income, \$48,900). Results: About 75% of the respondents indicated that they would, or maybe would, be willing to pay more for clothing to protect environmental and worker health. The main barrier to paying more is uncertainty that the money would actually be used to those purposes. Lack of brand transparency and trustworthiness also reduced their willingness to pay more. Conclusions: Basic demographics is important to understand consumer needs. Several fashion companies and fashion-associated non-profits are promoting sustainable clothing lines and educating the public about the adverse health impacts of fast fashion. This pilot study is a first step to evaluating how market forces can induce a shift toward a public health focus on prevention and how sustainable fashion companies can better craft their message. Empowering consumers to improve environmental and worker health is an idea whose time has come.

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Theme: **Occupational exposure**

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**P-0765**

**Michigan Farmworker Project: Bridging our understanding of the complex interplay of environmental and occupational exposures with labor exploitation in migrant and seasonal farmworkers in Michigan**

**Presenter:** Alexis J Handal, University of Michigan, Ann Arbor, United States

**Authors:** A. J. Handal, L. Iglesias-Rios, M. A. Valentín Cortés, P. J. Fleming, M. S. O'Neill;  
University of Michigan, Ann Arbor, MI.

**Introduction:** Migrant and seasonal farmworkers (MSFWs) are a highly marginalized population that have historically been exempt from social and labor protections even though agriculture ranks among the most dangerous and lowest-paying occupations in the U.S. Despite the essential role they have in our society, these workers are exposed to a wide range of environmental and occupational exposures, as well as social risk factors such as labor exploitation and labor trafficking. **Methods:** The Michigan Farmworker Project, a community-based participatory study, assesses the working and living conditions of adult MSFWs. We conducted in-depth semi-structured interviews with 34 Latina/o farmworkers (predominantly from Mexico or of Mexican descent) and 21 key stakeholders in various regions of the state of Michigan (Fall 2019). We assessed indicators of labor exploitation, perceptions and awareness of labor exploitation and labor trafficking in the context of environmental and occupational exposures. **Results:** Our initial analysis suggests that labor exploitation is intrinsically related to the environmental, occupational, and psychosocial factors of the working environment for these workers. Emergent themes indicate that social vulnerability (e.g., being undocumented), excessive and hazardous working conditions, and dehumanization of the workers exacerbate labor exploitation and have an impact on farmworkers' health. Workers' awareness and perceptions of labor exploitation and labor trafficking is shaped by the historical vulnerability and marginalization of the social and working conditions of farmworkers. Additional thematic analysis will be completed by August 2020. **Conclusions:** Findings will allow us to understand what constitute the multiple risk factors related to environmental and occupational health, including "exploitation" and "forced labor", and will inform actions to facilitate better service provision and health interventions for MSFWs in Michigan. Findings will inform the development of a larger community-based participatory epidemiological study where we can quantify environmental and occupational exposures and connect these exposures to exploitative labor practices in Michigan.

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**P-0767**

### **HEALTH WORKERS HEALTH - EPIDEMIOLOGIC PROFILE OF 11400 MEDICAL APPOINTMENTS NOT REGULATED BY IN LATIN AMERICA'S LARGEST HOSPITAL COMPLEX**

**Presenter:** Eric Hara, Clinical Hospital of São Paulo University, São Paulo, Brazil

**Authors:** E. Hara<sup>1</sup>, F. Viana<sup>1</sup>, S. Lipp<sup>2</sup>, T. Nery<sup>1</sup>;

<sup>1</sup>Clinical Hospital of São Paulo University, São Paulo, BRAZIL, <sup>2</sup>University Center S. Camilo, São Paulo, BRAZIL.

Hospital das Clínicas is the biggest hospital complex in Latin America and it has around 21 thousand employees. Nowadays, Brazilian law ensures occupational healthcare as in hiring medical examination, dismissal, periodical, change of function and return to work examination, but not always those exams provide health whole profile or workers' complaints. It is essential to search alternatives that enable to identify and to characterize those professionals, so they would be better assisted. To analyze not regulated by law occupational medical appointments of the hospital and to identify their epidemiological profile. Descriptive review of corporative system data of HCFMUSP, 2014 - 2019. Inclusion criteria: Occupational health appointments which involve spontaneous demand of the worker or scheduled by supervisor and are due to complaint or need that may have to do with work activity. Exclusion criteria: Routine occupational appointments planned by the legislation; consultations outside of the analyzed period; occupational health appointments not performed. Analyzed a total of 11421 appointments. The major percent of patients was nursing assistants and technicians (30%). More prevalent workplaces were Central Institute and Heart Institute, which presented 34% and 18%, respectively. The unit that had the highest frequency was the ICU, with 80%. Women were the most prevalent in all years, with 74%. The average age was 49 years, but 25 workers, over the entire period, were over 75 yo. The results allowed us to identify that nursing and ICU professionals are those who seek care the most and are most likely those who need more attention from occupational physicians and multidisciplinary staff. Conclusion: By ensuring that occupational services in hospitals meet the staff through spontaneous demand and not just through standard consultation that follow routine examinations imposed by law, we can improve the adoption of preventive measures, appropriate referrals and treat illness early in occupational health.

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Theme: **Occupational exposure**

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**P-0768**

**Characterization of volatile organic compound (VOC) exposures and their determinants among U.S. hairdressers serving an ethnic clientele**

**Presenter:** Lucy Kavi, University of Maryland, College park, United States

**Authors:** L. Kavi<sup>1</sup>, M. Boyle<sup>1</sup>, V. de Jesus<sup>2</sup>, W. Pool<sup>3</sup>, L. Louis<sup>4</sup>, A. Pollack<sup>5</sup>, S. Thomas<sup>1</sup>, A. Rule<sup>4</sup>, L. Quiros-Alcala<sup>4</sup>;

<sup>1</sup>University of Maryland, College park, MD, <sup>2</sup>CDC, Atlanta, GA, <sup>3</sup>Centro de Apoyo Familiar, Riverdale, MD,

<sup>4</sup>Johns Hopkins University, Baltimore, MD, <sup>5</sup>George Mason University, Fairfax, VA.

Background: Hairdressers are routinely exposed to volatile organic compounds (VOCs) linked to adverse health effects. Over 32% of U.S. hairdressers are women of color who may experience disproportionate VOC exposures from their occupational and personal use of products formulated for ethnic (Black/Latina) clientele. While these exposures may reflect potential health disparities, little is known about VOC exposures and their determinants in this worker population. Objective: To characterize concentrations of urinary VOC (UVOC) exposure biomarkers and their determinants among female hairdressers primarily serving an ethnic clientele. Methods: We recruited 23 minority female hairdressers predominantly serving an ethnic clientele, and 17 office workers in the Maryland/DC metro area. We quantified concentrations of 28 biomarkers, representing 20 VOC parent compounds in end-of-shift urine samples, using isotope dilution ultra-performance liquid chromatography-tandem mass spectrometry. UVOC concentrations in hairdressers were compared to those among office workers and women in the U.S. general population (NHANES). We administered questionnaires to capture demographics and workplace behaviors. Results: The majority of hairdressers (65%) were black with a mean age of 40 years. Half of office workers were black with a mean age of 34 years. Geometric mean concentrations for 26 of the 28 UVOCs were higher in hairdressers than office workers, with statistically significant concentration differences observed for 10 biomarkers ( $p < 0.05$ ). Also, geometric mean concentrations for 21 of 23 biomarkers quantified by both NHANES and our study, were between 1.5-3.7 times higher in hairdressers than women participating in NHANES. Salon services including semi-permanent hair coloring and hair extensions with glue, were associated with higher concentrations of toluene, xylene and acrylonitrile. Conclusions: Our work is among the first to characterize VOC exposures among minority female hairdressers serving an ethnic clientele. Larger studies are warranted to further examine determinants of VOC exposures and associated adverse health effects among this disparately exposed population.

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**P-0769**

**Quantitative analysis of immigrant Mexican workers' changes in knowledge on heat safety**

**Presenter:** Truc Nguyen, Georgetown University, Washington, United States

**Authors:** T. Nguyen<sup>1</sup>, A. Galvan<sup>2</sup>, A. Liebman<sup>2</sup>, K. Kruse<sup>3</sup>, N. Crowell<sup>1</sup>, R. Sokas<sup>1</sup>;

<sup>1</sup>Georgetown University, Washington, DC, <sup>2</sup>Migrant Clinicians' Network, Washington, DC, <sup>3</sup>Migrant Clinicians Network, Washington, DC.

Immigrant Mexican workers in the United States face increased rates of workplace fatalities because of risk factors found in hazardous industries such as construction and agriculture, among others. Furthermore, farmworkers disproportionately suffer from higher rates of fatal heat-related illnesses (HRI) than other workers. The Migrant Clinicians Network (MCN) and the Ventanillas de Salud (VdS) partnered to offer occupational safety and health workshops to immigrant Mexican workers. Trainings including HRI prevention were conducted in Raleigh, North Carolina and California (Calexico and Oxnard) using a train-the-trainer participatory model. Training efficacy was determined through unpaired baseline and follow-up questionnaires administered at the time of training to assess changes in knowledge about heat safety-related prevention measures or risks. A total of 387 workers participated in training, with 327 usable questionnaires completed at baseline and 314 at follow-up. Quantitative evaluation was conducted following IRB exemption. Item analysis demonstrated that the largest knowledge gain concerned the need to remove clothing from a co-worker experiencing severe HRI (40.4%,  $p < 0.05$ ) across all locations. At baseline, there was a statistically significant difference ( $p < 0.05$ ) between workers from the two California sites who could identify rest breaks as a preventive measure. On the other hand, over 90% of respondents at all sites correctly prior to the training identified preventive measures such as wearing long shirts and brimmed hats, drinking water, and avoiding beer and caffeinated beverages, suggesting that immigrant Latino workers have basic preventive information.

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## ABSTRACT E-BOOK

Theme: **Occupational exposure**

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**P-0770**

**Blood lead (Pb) levels in informal foundry workers making cookware from scrap metal**

**Presenter:** Renee Anne Street, 1South African Medical Research Council, , South Africa

**Authors:** R. Street<sup>1</sup>, W. Goessler<sup>2</sup>, S. Naidoo<sup>3</sup>, B. Shezi<sup>1</sup>, N. Cele<sup>1</sup>, J. Rieger<sup>2</sup>, K. Ettinger<sup>2</sup>, T. Reddy<sup>1</sup>, A. Mathee<sup>4</sup>;

1South African Medical Research Council, Durban, SOUTH AFRICA, 2University of Graz, Graz, AUSTRIA, 3University of KwaZulu-Natal, Durban, SOUTH AFRICA, 4South African Medical Research Council, Johannesburg, SOUTH AFRICA.

Metal exposure remains a significant public health problem, particularly in the informal sector. Recycling of scrap metal into artisanal cookware is widespread in poorly resourced countries. The rise in informal foundries to cast scrap metal into artisanal cookware is widespread in low- and middle-income countries. The main aim of this study was to characterize metal exposure in artisanal cookware makers working in informal foundries in South Africa by measuring lead (Pb) in blood as well as sample metal concentrations on hands before and after work. The blood Pb distribution of the artisanal pot makers ranged from 1.1 to 4.6 µg/dl with the median blood Pb level being 2.1 µg/dl (IQR 1.7 - 2.5). The median blood Pb level in artisanal pot makers was 1.0 µg/dl higher compared with the community ( $p < 0.0001$ ). Before-and-after handwipe sampling revealed a median increase in all 22 elements. Pre and post aluminum (Al) load on the handwipes revealed a 7.3 factor increase (0.53 and 3.9 mg Al / handwipe respectively) ( $p = 0.003$ ). Hand Pb load before and after pot making revealed a 3.5-fold increase (median increase of 6.2 µg Pb / handwipe). An increase in backyard informal foundries is intricately linked to increased exposure to toxic metals for workers, family members and communities. This study has highlighted potential toxic metal exposure issues from foundry to fork in relation to artisanal cookware crafted from waste metal.

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Theme: **Occupational exposure**

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**P-0771**

### **Benchmark dose estimation for coke oven emissions based on oxidative damage in Chinese exposed workers**

**Presenter:** Kaili Zou, Department of Occupational Health and Occupational Diseases, College of Public Health, Zhengzhou University; The Key Laboratory of Nanomedicine and Health Inspection of Zhengzhou, Zhengzhou, China

**Authors:** k. Zou<sup>1</sup>, P. Wang<sup>1</sup>, X. Duan<sup>1</sup>, Y. Yang<sup>2</sup>, H. Zhang<sup>1</sup>, S. Wang<sup>3</sup>, L. Shi<sup>4</sup>, Y. Wang<sup>5</sup>, W. Yao<sup>6</sup>, W. Wang<sup>1</sup>;

<sup>1</sup>Department of Occupational Health and Occupational Diseases, College of Public Health, Zhengzhou University; The Key Laboratory of Nanomedicine and Health Inspection of Zhengzhou, zhengzhou, CHINA, <sup>2</sup>Department of Epidemiology and Biostatistics, College of Public Health, Zhengzhou University, zhengzhou, CHINA, <sup>3</sup>Henan Provincial Institute of Occupational Health, Zhengzhou, zhengzhou, CHINA, <sup>4</sup>Gangarosa Department of Environmental Health, Emory University, Atlanta, GA, <sup>5</sup>Department of Safety Management Office, Anyang Iron and Steel Company Limit by Share, Anyang, Anyang, CHINA, <sup>6</sup>Department of Occupational Health and Occupational Diseases, College of Public Health, Zhengzhou University, zhengzhou, CHINA.

Coke oven emissions (COEs) can cause oxidative stress of the body, which in turn induces the occupational lung disease and also increases the risk of other diseases. COEs are the major occupational hazard factors for coke oven workers. The aim of the study is to explore the influences of COEs exposure on oxidative damage and estimate the benchmark dose (BMD) of COEs. A group of 542 workers exposed to COEs and 237 healthy controls from the same city were recruited in this study. The corresponding measuring kits were used to determine the plasma biomarkers of oxidative damage level. Generalized linear models and trend tests were used to analyze the relationship between COEs exposure and biomarkers. EPA Benchmark Dose Software was performed to calculate BMD and the lower confidence limit of the benchmark dose (BMDL) of COEs exposure. The results showed the significant dose-response relationship was observed between COEs exposure and oxidative damage with T-AOC as a biomarker. The BMD of COEs exposure were 2.83 mg/m<sup>3</sup> and 1.39 mg/m<sup>3</sup> in males and females, respectively, and the corresponding BMDL were 1.47 mg/m<sup>3</sup> and 0.75 mg/m<sup>3</sup> in males and females, respectively. Our results suggested the exposure level of COEs below the current national occupational exposure limits (OELs) would induce oxidative damage, and the OEL of COEs based on the T-AOC damage was suggested at 0.03 mg/m<sup>3</sup> in this study. **Keywords:** Coke oven emissions, polycyclic aromatic hydrocarbons, oxidative damage, plasma total antioxidant capacity, benchmark dose, occupational exposure limits

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Theme: **Occupational exposure**

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**P-0772**

**Occupational exposure to fine particulate matter (PM<sub>4</sub> and PM<sub>2.5</sub>) during artisanal cookware manufacturing: personal, indoor and outdoor levels**

**Presenter:** Busisiwe Shezi, South American Medical Research Council, Johannesburg, South Africa

**Authors:** B. Shezi<sup>1</sup>, N. Cele<sup>2</sup>, S. Ndabandaba<sup>2</sup>, A. Mathee<sup>1</sup>, R. Street<sup>2</sup>;

<sup>1</sup>South American Medical Research Council, Johannesburg, SOUTH AFRICA, <sup>2</sup>South American Medical Research Council, Durban, SOUTH AFRICA.

Background: Occupational exposure to fine particulate matter is associated with adverse respiratory, cardiovascular and pregnancy outcomes. Artisanal cookware manufacturing involves preparing sand molds for casting and a smelting process to cast liquid aluminium melted from a collection of scrap metal. Objective: The aim of this study was to characterize occupational exposure to fine particulate matter (PM<sub>4</sub> and PM<sub>2.5</sub>) during artisanal cookware manufacturing, and to examine the relationship between personal, indoor and outdoor PM levels. Methods: Exposure to fine particulate matter was measured for 17 male participants across five artisanal cookware manufacturing sites during the winter season. SidePak personal aerosol monitors (AM520) were used to measure personal exposure to PM<sub>4</sub>, while a DustTrak monitor and an E-sampler were used to assess indoor and outdoor PM<sub>2.5</sub> levels, respectively. Personal measurements were undertaken for a period of 3 hours per participant. Indoor and outdoor sampling was performed for a period of 8 hours for each site. A questionnaire was administered face-to-face by field workers to capture information on demographic characteristics. Spearman's correlation coefficient between personal, indoor and outdoor levels was used. Time series record of 15-min averages for indoor and outdoor PM<sub>2.5</sub> levels were assessed. Results: Personal PM exposure levels at breathing zones of workers exceeded environmental levels. The mean (SD) was 490 µg/m<sup>3</sup> (3520), 150 µg/m<sup>3</sup> (390) and 20 µg/m<sup>3</sup> (50), respectively for personal PM<sub>4</sub>, indoor and outdoor PM<sub>2.5</sub>. Time series analysis showed higher indoor than outdoor PM levels with little evidence of elevated outdoor PM sources. In most cases, there were somewhat low correlations between personal, indoor and outdoor PM measurements. Correlation was higher between PM and meteorological factors in some of the sites. Conclusions: The levels of fine particulate exposure among artisanal cookware makers were elevated, especially in respect of personal breathing zone measurements.

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Theme: **Occupational exposure**

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**P-0773**

**Ergonomic risk assessment among artisanal cookware manufacturers**

**Presenter:** Busisiwe Shezi, South American Medical Research Council, Johannesburg, South Africa

**Authors:** B. Shezi<sup>1</sup>, N. Cele<sup>2</sup>, S. Ndabandaba<sup>2</sup>, A. Mathee<sup>1</sup>, R. Street<sup>2</sup>;

<sup>1</sup>South American Medical Research Council, Johannesburg, SOUTH AFRICA, <sup>2</sup>South American Medical Research Council, Durban, SOUTH AFRICA.

**Abstract Background:** The variations presented in the way the informal workers conduct activities present different exposure patterns for each individual trader with large day-to-day variation in activity. Ergonomic risk factors associated with musculoskeletal disorders among artisanal cookware manufacturing have not yet been assessed. **Objective:** This study aimed to evaluate the ergonomic risk levels, and identify ergonomic factors related to musculoskeletal disorders among artisanal cookware manufacturers in Limpopo and KwaZulu-Natal, South Africa. **Methods:** Eighteen artisanal cookware manufacturers were recruited from five manufacturing sites in Giyani (Limpopo) and Durban (KwaZulu-Natal) during the months of June and July 2019. Direct observation of the workers was conducted using an ergonomic risk assessment observational tool. Rapid Upper Limb Assessment (RULA) method was used to assess the ergonomic risk factors related to cookware manufacturing. For each task, a score was allocated based on the posture, muscle use and force as per the RULA tool. **Results:** Ergonomic factors related to musculoskeletal disorders included repetitive motion, extending arms, bending and twisting, long static body posture, contact stress, temperature, noise, vibration, and improper lighting. RULA final scores ranged in magnitude from 4 to 7, with each successive score representing an increased presence of risk factors. The results of this study showed that the artisanal cookware manufacturers had an average final RULA grand score of 7.0, and were only at action level 4 which indicated immediate investigation and work changes. **Conclusion:** The use of RULA in this study showed that most of the informal workers were exposed to the high ergonomics risk for musculoskeletal disorders. RULA proved to be an effective and reliable method for identifying ergonomic factors related to musculoskeletal disorders among informal workers.

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## ABSTRACT E-BOOK

Theme: **Pesticides**

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**P-0774**

### **Epigenome-wide Association Study of DNA Methylation and Specific Pesticide Use Among U.S. Farmers**

**Presenter:** Thanh T Hoang, NIEHS, RESEARCH TRIANGLE PRK, United States

**Authors:** T. T. Hoang<sup>1</sup>, M. Lee<sup>1</sup>, M. Richards<sup>2</sup>, S. Shrestha<sup>1</sup>, C. Parks<sup>1</sup>, S. Long<sup>2</sup>, S. J. London<sup>1</sup>;  
<sup>1</sup>NIEHS, RESEARCH TRIANGLE PRK, NC, <sup>2</sup>Westat, Durham, NC.

**Background:** Pesticide exposure is associated with certain cancers and neurologic diseases, but the underlying mechanisms are not fully understood. DNA methylation, an epigenetic modification, may play a role. DNA methylation patterns likely differ by specific pesticide, but no epigenome-wide association studies have evaluated methylation patterns across different pesticides. We conducted epigenome-wide analyses of DNA methylation in relation to several pesticides used among U.S. farmers.

**Methods:** The Agricultural Lung Health Study (ALHS) is a case-control study of asthma, nested within the Agricultural Health Study (AHS). For 1,170 ALHS male farmers, blood DNA methylation was measured with Illumina's MethylationEPIC array. Participants self-reported pesticide use in the AHS (past use) and ALHS (current use, defined as past 12 months). Pesticides were grouped by chemical class and active ingredients. Using robust linear regression, we analyzed 13 chemical classes and 16 active ingredients with 30+ exposed men. Analyses were adjusted for age, smoking status, packyears, state, asthma status, and estimated cell type proportions.

**Results:** Participants who reported past and current use of pesticide class or active ingredient were compared to those who never reported use. Using family-wise error rate ( $p < 9 \times 10^{-8}$ ) or false discovery rate ( $p < 0.05$ ), we identified differentially methylated C-phosphate-G (CpG) sites for 10 chemical classes and 9 active ingredients. Most differentially methylated CpG sites were unique to each active ingredient. For 5 of the 9 active ingredients, lifetime days of use was available and there was evidence of a dose-response at most differentially methylated CpG sites. Significant CpG sites were enriched for transcription factor motifs. We plan to correlate significant CpG sites with gene expression in external data.

**Conclusions:** We observed differential methylation associated with several chemical classes and active ingredients. These differential methylation patterns could be biomarkers of long-term exposure and may provide additional biological insight into health effects of pesticide exposure.

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**P-0775**

### **Persistent Organic Pollutants and Kidney Function over a 6-year follow-up: Findings from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL)**

**Presenter:** Jessica M. Madrigal, University of Illinois at Chicago, Chicago, United States

**Authors:** J. M. Madrigal<sup>1</sup>, A. C. Ricardo<sup>1</sup>, R. M. Sargis<sup>1</sup>, R. Kaplan<sup>2</sup>, S. Freels<sup>1</sup>, J. Cai<sup>3</sup>, M. Daviglius<sup>1</sup>, J. P. Lash<sup>1</sup>, V. Persky<sup>1</sup>, M. E. Turyk<sup>1</sup>;

<sup>1</sup>University of Illinois at Chicago, Chicago, IL, <sup>2</sup>Albert Einstein College of Medicine, Bronx, NY, <sup>3</sup>University of North Carolina-Chapel Hill, Chapel Hill, NC.

Background: Few studies have evaluated associations between persistent organic pollutants (POPs) and kidney function. We aimed to determine if levels of POPs measured at baseline were associated with estimated glomerular filtration rate (eGFR) and urine albumin-creatinine ratio (ACR) after 6 years of follow up. Methods: We measured serum levels of multiple polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs) and persistent pesticides, and markers of kidney function among participants in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) Persistent Organic Pollutants, Endogenous Hormones and Diabetes in Latinos Ancillary Study. The ancillary study selected males and females aged 45 to 74 years with normal glucose or prediabetes at baseline. Individual weighted linear regression models were used to examine if natural log (ln) transformed summary measures of POP concentrations were associated with eGFR and ln transformed ACR at study visit 2, adjusting for baseline kidney function, time between visits, and relevant covariates. Results: The study included 1,072 participants (mean age 54 years, 80% born outside the United States, baseline geometric mean ACR 6.3 mg/g, and mean eGFR 93 ml/min/1.73 m<sup>2</sup>). Total PBDEs were inversely associated with eGFR at visit 2 ( $\beta=-1.5$  (95% CI -2.8, -0.26) ml/min/1.73 m<sup>2</sup> for an increase of 1 lnPBDE,  $p=0.02$ ). An increase of 1 ln $\Sigma$ PCB concentration was associated with an increase of  $\beta=0.14$  (95% CI -0.01, 0.29) mg/g in lnACR ( $p=0.06$ ). We observed similar positive associations between total estrogenic PCBs ( $p=0.01$ ) and Warner CYP2B PCBs ( $p=0.04$ ) with ACR. An increase of 1 lnDDE concentration was associated with a decrease in lnACR ( $\beta=-0.08$  (95% CI -0.15, -0.01) mg/g,  $p=0.02$ ). Conclusions: The estimated changes observed suggest that POPs may play a role in kidney disease. Possible mechanisms awaiting further exploration include interference with cytochrome p450 activity by PCBs and inhibition of activity of endogenous androgens harmful to kidney function by DDT/DDE.

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**P-0776**

**Analysis of the Historical Series of Arbovirosis, Preventive Measures and use of Malathion in Sao Paulo state in Brazil. Period 2009 to 2019**

**Presenter:** TELMA NERY, INCOR FMUSP, São Paulo, Brazil

**Authors:** T. NERY<sup>1</sup>, R. A. Christensen<sup>2</sup>, E. Hara<sup>3</sup>, F. Viana<sup>3</sup>, C. Feijo<sup>3</sup>, R. Prestes<sup>3</sup>, M. Barbosa<sup>4</sup>;  
<sup>1</sup>INCOR FMUSP, São Paulo, BRAZIL, <sup>2</sup>Sucen, São Paulo, BRAZIL, <sup>3</sup>CeAC – Collaborator Service Center - Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo., São Paulo, BRAZIL, <sup>4</sup>Centro de Estudos do Hospital Santa Cruz, São Paulo, BRAZIL.

**Introduction:** The Ministry of Health of Brazil has been following cases of DENGUE since 1975 in a historical series. In the years 2014 to 2016, the cases increase from 1 million per year, with a peak in 2015. In the years 2017 and 2018 the numbers were below 300 thousand cases / year, however in 2019 these numbers surpass 1,500 cases. The state of São Paulo, with 645 municipalities and a population of 44 million people, was the state with the highest number of cases in 2019, with 445 thousand confirmed cases, which compared to 2018, about 16,800 cases there was an increase of 103%. Several preventive measures are adopted, including the number of sprayings with the insecticide Malathion, which has been showing important and growing use, despite the characteristics and classifications of the IARC (International Agency for Research on Cancer). **Objective:** This paper aims to discuss the increase in the number of Dengue cases in the 200 municipalities with the highest incidence in the state of SP, analyzing the preventive measures developed. **Methodology:** Data were collected from the Ministry of Health, the São Paulo State Department of Health, the state endemic disease control department (SUCEN) and the Phytosanitary Pesticide System (AGROFIT). The data refer to the number of cases, hospitalization and mortality, as well as the amount of Malathion used. Measures related to environmental sanitation were identified in the 200 municipalities with the highest incidence. **Results and conclusion:** In 2009, 1,996 liters of malathion were used. 2019 the total was 13,018 liters across the state targeting public health campaigns. Analyze identify that the year of 2019 presented an increase of 103% in the cases of dengue and need an important evaluation on the preventive measures adopted and the search for new ways to reduce the use of pesticides.

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**P-0777**

**Descriptive Analysis of Morbidities, Intoxications and Agrotoxic consumption of Itapetininga city in SP, Brazil. Period 2012 to 2017**

**Presenter:** TELMA CS. NERY, INCOR FMUSP, São Paulo, Brazil

**Authors:** T. C. NERY<sup>1</sup>, P. Demarchi<sup>2</sup>, P. D. Prado<sup>3</sup>, N. Bispo<sup>3</sup>, G. Moraes<sup>4</sup>, R. A. Christensen<sup>5</sup>, P. Paz de Lima<sup>6</sup>;

<sup>1</sup>INCOR FMUSP, São Paulo, BRAZIL, <sup>2</sup>University Center Sao Camilo, São Paulo, BRAZIL, <sup>3</sup>University Center Sao Camilo, São Paulo, BRAZIL, <sup>4</sup>Dep. Preventive Medicine USP, São Paulo, BRAZIL, <sup>5</sup>SUCEN, São Paulo, BRAZIL, <sup>6</sup>ABRAPPS Brazilian Association of Researchers and Researchers for Social Justice, São Paulo, BRAZIL.

Brazil is the largest agricultural producers and exporters in the world today. Seven out of the ten most exported products in the country are of this origin, thus establishing the main source of our economy. Brazil has been increasingly dependent on the use of pesticides in recent decades, as 72% of its consumption is destined for the cultivation of products designated for export. Parallel to the growth of pesticide use, we have the increased incidence of poisoning cases. Some municipalities with large agricultural production need to be analyzed. This study aims to perform an analysis of morbidity data from the municipality of Itapetininga regarding liver and biliary malignant neoplasms. Descriptive study. Based on data from the Ministry of Health DATASUS, from January 2012 to December 2017 in the municipality of Itapetininga. Total hospitalizations for cases of liver and biliary malignancies were identified and gender and age group analyzed. Deaths from the disease were compared in the municipality and in the Macroregion of Health to which it belongs. Total of 47 admissions for liver and biliary neoplasms. 60% men and 40% women. 21% were children between 5 - 9 yo. Adults 5 were between 30 - 49 yo (9.8%) and 18: 50 - 59 yo (35.2%). 60 - 69 yo represented 23,5% hospitalizations. The total period of hospital stay was 172 days, representing an average of 3.7 days overall. 12 deaths from diseases were computed, thus constituting a mortality rate of 25.53. Of the deaths, 6 were in 50 - 59 yo, 5 were 60 - 69 yo. The city ranks second in absolute number of hospitalizations for cases of liver and bile duct malignancies in the region. Conclusion: there is a need for cancer analysis in municipalities with large agricultural production and pesticide consumption. Acknowledgment: Thematic Health Committee of Forum Combat Pesticide.

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**P-0778**

**Validation of proximity-based estimates of residential exposure to emissions of dioxins and dioxin-like compounds in the U.S.**

**Presenter:** Jared Fisher, National Cancer Institute, Rockville, United States

**Authors:** J. Fisher<sup>1</sup>, M. Ward<sup>1</sup>, M. Friesen<sup>1</sup>, N. Deziel<sup>2</sup>, B. Graubard<sup>1</sup>, J. Sampson<sup>1</sup>, R. Jones<sup>1</sup>;  
<sup>1</sup>National Cancer Institute, Rockville, MD, <sup>2</sup>Yale School of Public Health, New Haven, CT.

**Background:** Polychlorinated dibenzo-p-dioxins (PCDDs), dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs) are persistent organic pollutants emitted from industrial sources. The relationship between proximity to emissions from these sources and personal exposure is poorly understood. **Methods:** We linked geocoded residential addresses and serum measurements of PCDDs, PCDFs, PCBs, and their derived TEQ (toxic equivalency quotient) for 5,725 participants in the 1999-2004 U.S. National Health and Nutritional Examination Survey (NHANES) to a U.S. Environmental Protection Agency database of 4,478 historical emission sources of dioxins and dioxin-like compounds (e.g., coal-fired power plants, solid waste incinerators). We calculated continuous and categorical (3, 5, 10km) exposure metrics reflecting distance to the nearest facility and estimated intensity of exposure with a distance- and toxicity-weighted average emissions index (AEI[ng TEQ/km<sup>2</sup>]). We used linear regression models to evaluate associations between proximity metrics and log-transformed sums of serum PCDDs, PCDFs, PCBs, and TEQ and used logistic regression to determine the extent these metrics predicted high (top quartile) serum levels. **Results:** Overall, 16%, 30%, and 53% of participants lived within 3, 5, or 10km of one or more facility, respectively. No consistent associations were observed between serum levels and simple proximity metrics reflecting distance to nearest facility. Mean serum concentrations of total PCDDs/PCDFs/PCBs and total TEQ were highest among participants in the top AEI<sub>5k</sub> quartile; an increasing trend was statistically significant only for PCBs (p<0.01). In adjusted models, participants in the highest AEI<sub>5k</sub> quartile had increased odds of having high levels of total PCBs (OR=1.8; 95%CI:1.3-2.5) and TEQ (OR=1.6; 95%CI:1.0-2.5) compared to those with no facilities within 5km. **Conclusion:** In this nationally representative population, we demonstrated that residential proximity to emissions was positively associated with serum total PCBs and TEQ. Findings from this effort support the use of distance- and emissions-based exposure proxies to estimate personal exposure.

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**P-0779**

**Residential proximity to specific crops and adverse birth outcomes in The Netherlands**

**Presenter:** Mariana Simoes, Utrecht University, Utrecht, Netherlands

**Authors:** M. Simoes<sup>1</sup>, A. Huss<sup>1</sup>, E. Krop<sup>1</sup>, N. Janssen<sup>2</sup>, R. Vermeulen<sup>1</sup>;

<sup>1</sup>Utrecht University, Utrecht, NETHERLANDS, <sup>2</sup>National Institute for Public Health and the Environment, Bilthoven, NETHERLANDS.

**Aim:** To explore associations between residential proximity to specific crops where pesticides are applied and adverse birth outcomes using individual level exposure and birth outcomes data. **Methods:** We selected all singleton births that occurred between 01-01-2009 and 01-01-2014 from the Dutch birth registry. We further selected mothers older than 16 years living in non-urban areas and who had complete address history and changed addresses at most once during pregnancy (N=325,435). We estimated the area of specific crops (maize, winter wheat, summer barley, summer wheat, other cereals, potatoes (consumption and starch), beets, ornamental plants, vegetables, fruit and flower bulbs) within buffers of 50, 100, 250 and 500 meters around the residence of each mother for the pregnancy period. We used generalized linear models to investigate associations between these exposure proxies and gestational age, birth weight, low birth weight, small for gestational age, large for gestational age, still births/infant mortality and prematurity, adjusting for individual and area-level confounders. **Results:** Our analysis provided no clear evidence that living in proximity to crops increased risks of adverse birth outcomes. We noted that babies from mothers living near summer barley had on average a higher birth weight ( $\beta$  [95% CI] in gram/hectare of summer barley: 50m buffer 327.7 [88.7, 566.6], 100m buffer 52.2 [5.9, 98.5], 250m buffer 0.9 [-6.4, 8.2], 500m buffer -0.2 [-1.7, 1.3]) and a greater chance of being large for gestational age (OR [95% CI] in the same buffers 16.3 [3.8, 70.2], 1.6 [1.2, 2.2], 1.0 [0.96, 1.08], 0.99 [0.98, 1.0]), although these results were not statistically significant after correction for multiple testing. **Conclusions:** Residential proximity to crops was not associated with adverse birth outcomes. However, the finding that babies of mothers living near summer barley crops tend to be larger should be further explored.

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**P-0780**

### **An Epigenome-Wide Analysis of Ambient Pyrethroid Pesticide Exposures in California's Central Valley**

**Presenter:** Melissa Furlong, University of Arizona, Tucson, United States

**Authors:** M. Furlong<sup>1</sup>, K. Paul<sup>2</sup>, Q. Yan<sup>2</sup>, Y. Chuang<sup>2</sup>, M. Cockburn<sup>3</sup>, J. Bronstein<sup>2</sup>, S. Horvath<sup>2</sup>, B. Ritz<sup>2</sup>;

<sup>1</sup>University of Arizona, Tucson, AZ, <sup>2</sup>University of California at Los Angeles, Los Angeles, CA, <sup>3</sup>University of Southern California, Los Angeles, CA.

**Background/Aim** Pyrethroid pesticide use is increasing worldwide, although the full extent of associated health effects is unknown. An epigenome-wide analysis study (EWAS) with exploratory pathway analysis may help identify potential pyrethroid-related health effects. **Methods** We performed an EWAS of chronic ambient pyrethroid exposure using control participants' blood in the Parkinson's Environment and Genes Study in California (N=237). We estimated associations of exposure to ambient pyrethroid pesticide applications in the 5 years prior to enrollment with differential methylation at enrollment, using beta regression and an FDR  $q < 0.05$  for significance. We normalized methylation values for type/I probe bias using BMIQ, evaluated batch effects with SVA, and adjusted for cell count. We also performed gene set overrepresentation analysis on the genes annotated to CpG sites that were associated with pyrethroids at a raw p-value cutoff of 0.05. For gene set overrepresentation analyses, we controlled for background counts of CpG sites on the Illumina450K chip, and identified Gene Ontology (GO) biological process terms with missMethyl, and OMIM and Glad4U disease-associated gene sets. We used an FDR  $q < 0.05$  to evaluate statistical significance of gene sets. **Results** 5 CpG sites were differentially methylated in relation to pyrethroid exposures. Two of these sites annotated to genes involved in calcium ion binding, a known primary target of pyrethroid pesticides. We also identified 40 GO terms, 14 of which were neurological/developmental in nature. For disease sets, we identified signals for Alzheimer's disease, leukemia and several other cancers, diabetes, birth defects, and other diseases. **Conclusions** Chronic ambient pyrethroid exposure is associated with differential methylation at CpG sites that annotate to a wide variety of disease states and biological mechanisms. While several of the identified diseases and gene processes are consistent with prior research, this EWAS also implicates several previously unidentified diseases for future investigation in relation to pyrethroid exposure.

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**P-0783**

### **Identification of biomarkers of neonicotinoid insecticides for human exposure assessment using biomonitoring**

**Presenter:** Maria Ospina, CDC, Atlanta, United States

**Authors:** M. Ospina, S. E. Baker, A. Bishop-Serafim, P. Morales-Agudelo, A. M. Calafat; CDC, Atlanta, GA.

**Introduction:** Neonicotinoids, neuroactive insecticides that have replaced more hazardous carbamates and organophosphates, are widely used in agriculture, landscaping, and on household pets. Neonicotinoid insecticides including imidacloprid, acetamiprid, thiamethoxam, clothianidin and dinotefuran, which represent approximately 20% of the insecticides currently used in the USA, were detected in common food staples in the U.S. diet. Because of their systemic properties they cannot be washed off from fruits and vegetables. Results from previous studies estimate that approximately 49% of the U.S. general population is exposed to neonicotinoids. The fact that neonicotinoid metabolites were detected at higher concentrations and at wider concentration ranges than the corresponding parent compounds suggests metabolites are better biomarkers of exposure. Because neonicotinoid use is on the rise and their risk to humans is not well known, identifying suitable neonicotinoid metabolites that can potentially be used as biomarkers of exposure is critical to improve the exposure assessment process. **Methods:** We used in-vitro approaches to generate metabolites of imidacloprid, acetamiprid, thiamethoxam, clothianidin and dinotefuran. We used mass spectrometry to identify these novel neonicotinoid biomarkers. **Results:** We identified several in-vitro metabolites of imidacloprid, acetamiprid, thiamethoxam, clothianidin and dinotefuran. Most of these metabolites were the result of common detoxification reactions of human xenobiotics (e.g., demethylation, hydroxylation, guanidine- and urea-derivatives). **Conclusions:** The newly identified neonicotinoid metabolites will be used as biomarkers of exposure to neonicotinoids and incorporated in population-based studies such as the National Health and Nutrition Examination Survey to improve our understanding of the potential health hazards from exposure to this widely used class of insecticides. **Disclaimer:** The findings and conclusions in this abstract are those of the authors and do not necessarily represent the views of the CDC.

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**P-0785**

**Spatio-temporal variation in pesticides air concentrations from homes near agricultural fields**

**Presenter:** Daniel Figueiredo, Institute for Risk Assessment Sciences (IRAS), Utrecht University, Utrecht, Netherlands

**Authors:** D. Figueiredo<sup>1</sup>, J. Duyzer<sup>2</sup>, A. Huss<sup>1</sup>, E. Krop<sup>1</sup>, R. Vermeulen<sup>1</sup>;

<sup>1</sup>Institute for Risk Assessment Sciences (IRAS), Utrecht University, Utrecht, NETHERLANDS, <sup>2</sup>TNO Urban Environment and Safety, Utrecht, NETHERLANDS.

Background Pesticides enter the atmosphere mainly through spray drift, volatilization and erosion. Exposure to these compounds may cause adverse health effects, therefore being important to accurately assess exposure for people living close to spraying sites. We collected air samples to evaluate presence, levels and distributions of different pesticides. Methods We deployed active samplers to collect outdoor air in 58 homes located within 250m from bulb fields and in 16 homes located further than 500m from any agricultural field (controls). We sampled during pesticides use periods, with 7 consecutive daily measurements following a spray event. two day samples were collected in the same homes during non-use periods. Indoor air was sampled for the first 24h after field spraying, in homes located within 50m from agricultural fields (n=18). We analysed a total of 46 pesticides and concentrations were determined using liquid chromatograph coupled to LC-MS/MS. Results During use period, 5 to 10 times higher concentrations were found for pesticides applied on bulbs as compared to non-use periods. We observed similar exposure contrasts when we compared concentrations between exposed homes and controls. We observed a significant decrease in concentrations with increasing buffer distance for 64% of the pesticides that were applied in fields located within 250m from the studied homes. For 82% of the pesticides, there was a moderate correlation (spearman > 0.4 - 0.7) between outdoor and indoor concentrations. Finally, some of the detected pesticides (n=11) were not sprayed during the sampling period. Conclusions Concentrations were higher closer to fields than further away. There is evidence that exposure to pesticides via air can also be bound to previous applications, and, although higher during use period, occurs also during the non-use period. Moderate, but not strong, correlations between outdoor and indoor air concentrations might be an indication of indoor sources and sinks of pesticides.

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**P-0786**

### **Agricultural Pesticide Use and Parkinson's Disease Admissions: A County-Level Study of New York State, 1995-2012**

**Presenter:** Jenni A. Shearston, Department of Environmental Health Sciences, Mailman School of Public Health, Columbia University, New York, United States

**Authors:** J. A. Shearston<sup>1</sup>, D. Berengere Re<sup>1</sup>, A. Boehme<sup>2</sup>, M. Kioumourtzoglou<sup>1</sup>;

<sup>1</sup>Department of Environmental Health Sciences, Mailman School of Public Health, Columbia University, New York, NY, <sup>2</sup>Department of Neurology, Vagelos College of Physicians and Surgeons, Columbia University; Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY.

**Background/Aim:** Parkinson's disease (PD) affects more than 10 million people worldwide. While its causes are unclear, several studies have identified pesticide exposure as a risk factor. Many studies use single-compound models to assess the relationship between pesticides and PD; however, individuals are frequently exposed to multiple pesticides simultaneously. To address this limitation, we investigated pesticide exposure and PD through a mixtures lens, grouping pesticides by their mechanism-of-operation, for an 18-year period in New York (NY) state. **Methods:** We used United States Geologic Survey county-level agricultural pesticide use estimates from 1995-2012, and counts of PD-related first hospitalizations (a surrogate of patient density) from NY's Statewide Planning and Research Cooperative System, including all non-VA hospitalizations. We first conducted exploratory analyses with quasi-Poisson mixed models for each compound (n=75) and each mechanism (n=27) separately. We then used a semi-Bayesian hierarchical mixed model to estimate mechanism-specific effects while accounting for compound-specific toxicity. **Results:** We did not observe robust relationships between pesticide exposure and PD hospitalizations. In compound-specific analyses, 8 compounds were significantly associated with increased risk for PD admissions, and 6 with decreased risk. For example, Maneb was associated with a 1.2% increased rate of PD (95% CI: 1.001-1.024). In mechanism-specific analyses, 1 mechanism (sterol biosynthesis in membranes) was associated with decreased rate for PD (RR: 0.985, 95% CI: 0.976-0.995). No significant associations were found in the two-stage analysis. **Conclusions:** Lack of expected associations in this study are likely the result of insufficient power, as many compounds in our dataset were not used in several years or counties. Additionally, people with PD are not generally hospitalized, thus our outcome likely underestimates PD density. However, we emphasize that the limitations of our data should not discourage other researchers from using a mixtures lens to address the important question of multiple pesticide exposures and PD.

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**P-0787**

### **Type II diabetes status, adipokines, and dioxin-like compounds in the Anniston Community Health Survey II**

**Presenter:** Tara C Serio, Agency for Toxic Substances and Disease Registry, Chamblee, United States

**Authors:** T. C. Serio<sup>1</sup>, M. Pavuk<sup>1</sup>, M. C. Cave<sup>2</sup>, C. Pinkston<sup>2</sup>, P. Rosenbaum<sup>3</sup>, L. S. Birnbaum<sup>4</sup>;  
<sup>1</sup>Agency for Toxic Substances and Disease Registry, Chamblee, GA, <sup>2</sup>University of Louisville School of Medicine, Louisville, KY, <sup>3</sup>SUNY Upstate Medical University, Syracuse, NY, <sup>4</sup>National Institute for Environmental Health Sciences, Research Triangle Park, NC.

**Background/Aim:** A polychlorinated biphenyl (PCB) production facility operated in Anniston, AL for several decades. Serum PCB concentrations were found to be about 3 times higher than the general U.S. population, and the Anniston Community Health Survey (ACHS 2005-07) found significant associations between PCBs and type II diabetes (T2D) prevalence. We also noted an inverse relationship between insulin and dioxin-like compounds in a subset of participants where the novel liver damage biomarker – cytoke-  
ratin 18 (CK-18) indicated non-alcoholic toxicant-associated steatohepatitis (TASH). Using data on serum concentration of dioxin-like compounds collected in the 2014 follow-up study (ACHS II), we investigated the association between dioxin-like compounds, insulin, measured cytokines, and adipokines as related to T2D status. **Methods:** T2D status was defined as previous physician diagnosis, measured glucose >125 mg/dL, or being on any glycemic medication; 135 (39.9%) of 338 participants were classified as diabetic. Adipokines were measured on HADK2MAG-61K and HADK1MAG-61K bead arrays (EMD Millipore, Billerica, MA). The polychlorinated dibenzo-p-dioxins (PCDD), dibenzofurans (PCDF), and non-ortho PCBs were measured using high-resolution gas chromatography/high-resolution mass spectrometry and expressed as dioxin toxic equivalents (TEQs, pg/g lipid). Linear regression models adjusted for age, sex, ethnicity, BMI, family history of diabetes, and smoking status. **Results/Conclusion:** We found significant associations between total dioxin concentration and insulin, leptin, and adiponectin for the total 338 participants. For insulin and leptin, this was primarily driven by PCDD/PCDF TEQ in those with diabetes ( $\beta=-0.31$ , p-value 0.034;  $\beta=-0.010$ , p-value 0.003). For adiponectin, these associations were stronger in those without diabetes ( $\beta=0.27$ , p-value 0.017). Participants with TASH saw a similar inverse relationship between PCDD/PCDF and insulin, and those with both diabetes and TASH had the largest measure of effect ( $\beta=-1.08$ , p-value 0.01). These findings suggest that these chemicals may affect concentrations of compounds regulating glucose levels as well as lipid metabolism and energy balance.

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**P-0788**

### Reviewing Glyphosate Genotoxicity in Humans

**Presenter:** Wil Lieberman-Cribbin, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** W. Lieberman-Cribbin, E. Taioli;  
Icahn School of Medicine at Mount Sinai, New York, NY.

**Background:** The carcinogenicity of glyphosate is at the center of scientific controversy. While the effects of glyphosate have been studied in animals and plants, research on its genotoxic effects on human cells are lacking. We reviewed the literature on glyphosate genotoxicity in humans. **Methods:** A review of scientific publications of the biological effects of glyphosate in human tissues was performed in Pubmed/Google Scholar using the keywords “glyphosate”, “1071-83-6”, “roundup”, “N-(Phosphonomethyl) glycine”, “AMPA”, “AMPA receptor”, “Aminomethylphosphonic acid” and “human”. Data were extracted on tissue type, assay(s), glyphosate doses, parameters, and results for each publication. The search returned 515 publications: 491 studies were excluded on abstract-review, 6 studies were excluded on full-text review, and 18 studies were included. **Results:** There were 10 studies on peripheral white blood cells (6 lymphocytes, 4 mononuclear cells), which generally implemented glyphosate doses above the residential (2.91 µg/ml; REL) and occupational (3.50 µg/ml; OEL) exposure limits, utilized multiple assay types, and measured sister-chromatid exchange, chromosomal aberrations, and DNA methylation. Three studies tested the recommended REL and OEL doses. Three studies reported a dose-response after glyphosate exposure, two showed no genotoxicity changes, three showed genotoxic effects starting at a dose of 84.5 µg/ml, one showed effects at high doses only, and one at low doses only. There were 6 in-vitro studies performed on human tissues and cell lines, all tested with the Comet assay; only one study utilized doses comparable to REL and OEL. Four experiments showed a dose response, one a transient dose response, and two showed no genotoxic effect. **Conclusion:** Few research has studied glyphosate genotoxicity in humans, and most literature reports the effects of glyphosate doses above the recommended REL and OEL levels. Heterogeneity in study design and doses prevents extensive comparisons across studies, although articles describe a genotoxic effect of glyphosate in human cells.

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**P-0789**

### **PHYTOCHEMICAL PROFILE AND LARVICIDAL POTENTIALS OF AGARATUM CONYZOIDES LEAF ON THE LARVAE OF ANOPHELES GAMBIAE.**

**Presenter:** DUE EMMANUEL AWAI, National Veterinary Research Institute, Vom, Vom, Jos, Nigeria

**Authors:** D. E. AWAI<sup>1</sup>, T. B. Hammed<sup>2</sup>, S. J. Ngene<sup>3</sup>, M. K. Sridhar<sup>2</sup>;

<sup>1</sup>National Veterinary Research Institute, Vom, Vom, Jos, NIGERIA, <sup>2</sup>Department of Environmental Health Sciences, College of Medicine, University of Ibadan, Ibadan, Nigeria, Ibadan, Oyo State, NIGERIA,

<sup>3</sup>Department of Department of Epidemiology, College of Medicine, University of Ibadan, Ibadan, Nigeria, Ibadan, Oyo State, NIGERIA.

**ABSTRACT**Background: There has been an increasing insecticide resistance among vectors of mosquito species with its attendant environmental hazards. Plant source may be better alternative for controlling mosquitoes.Objective: This study was carried out to determine the phytochemical properties and larvicidal effects of Agaratum conyzoides leaf on the larvae of Anopheles gambiae.Methods: The standard protocol of WHO was used for the larvicidal bioassay. Twenty instar larvae per treatment were exposed to Five aliquots of concentrations; 125ppm, 250ppm, 500ppm and 1000ppm fractions of crude methanol, (MCE), methanol (MF), hexane (HF), dichloromethane (DCM), ethyl acetate (EAF). Distilled water and sniper were used as positive and negative control respectively. Larvicidal parameters and mortality were recorded for 3 days. The LC<sub>50</sub> and LC<sub>90</sub> values were determined by probit analysis.Results: Phytochemical screening revealed that the presence of alkaloids, favonoids, terpenoids and glycosides in all the fractions. The larvicidal bioassay against Anopheles gambiae showed that crude methanol extract was the most active fraction with an LC<sub>50</sub> value of 348.45ppm; followed by DCM, methanol extract, ethyl acetate and hexane fraction with LC<sub>50</sub> values of 411.26ppm, 428.06ppm, 633.98ppm and 665.01ppm respectively. Conclusion and recommendations: Agaratum conyzoides leaf extract was highly toxic to the larvae of Anopheles gambiae and this resulted in reduction its population. Hence, it is a viable larvicide that can improve vector control and its production can be stimulated and sustained through local sourcing thereby reducing cost.Keywords: Anopheles gambiae, Larvicidal efficacy, Agaratum conyzoides, mosquitoes vectorWord count: 232

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**P-0791**

**Use of specific pesticides is associated with increased risk of developing shingles in the Agricultural Health Study**

**Presenter:** Christine G Parks, NIEHS, Durham, United States

**Authors:** C. G. Parks<sup>1</sup>, J. N. Hofmann<sup>2</sup>, L. E. Beane-Freeman<sup>2</sup>, D. P. Sandler<sup>1</sup>;  
<sup>1</sup>NIEHS, Durham, NC, <sup>2</sup>NCI, Bethesda, MD.

**BACKGROUND:** Some pesticides are immunotoxic and may increase risk of immune-mediated diseases. Risk of shingles, the clinical reactivation of varicella zoster virus (VZV), increases with aging and immunosuppression; little is known about associations with pesticides. **OBJECTIVE:** We evaluated pesticide use in relation to incident shingles among licensed pesticide applicators in the Agricultural Health Study, a prospective cohort in Iowa and North Carolina. **METHODS:** We identified 590 incident shingles cases among 12,820 applicators (97% male farmers) enrolled in 1993-7 and followed for a median of 12 years (IQR 11,13). We evaluated associations with ever-use of 48 pesticides reported at enrollment and examined exposure-response trends for cumulative intensity-weighted lifetime days of use. Hazard ratios (HR) and 95% confidence intervals (CI) were calculated using Cox proportional hazard models, adjusting for state and correlated pesticides, and allowing estimates to vary by median age of cases (60 years). **RESULTS:** Shingles risk was associated with ever-use of 14 pesticides (5 insecticides, 2 fumigants, 2 fungicides, and 5 herbicides (HRs 1.22 to 1.94). Increasing exposure-response trends ( $p < 0.01$ ) were seen for four insecticides (coumaphos, carbaryl, diazinon, permethrin on crops), two fumigants (methyl bromide, carbon tetrachloride), and two herbicides (trifluralin, and 2,4-D). In older participants, shingles was associated with self-reported history of a high pesticide exposure event (HR 1.89; 95%CI 1.45, 2.45). Findings were similar after excluding those with a history of leukemia/lymphoma or autoimmune diseases. **CONCLUSIONS:** Specific pesticides were related to shingles risk in farmers, with several demonstrating exposure-response trends. These novel findings support further investigation of pesticides in relation to shingles risk and VZV immunity. Some pesticides may compromise cell-mediated immune responses to VZV, as seen with aging and immunosuppressant medications, which may have broader implications for vaccine efficacy and susceptibility to other infections.

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**P-0792**

### **Environmental and occupational pesticide exposure and human sperm parameters: An updated review**

**Presenter:** Eric T Knapke, Milken Institute School of Public Health, George Washington University, Washington, United States

**Authors:** E. T. Knapke, M. J. Perry;  
Milken Institute School of Public Health, George Washington University, Washington, DC.

**Background:** In recent decades, global sperm counts have declined, and this has coincided with a proliferation of chemicals with endocrine-disrupting properties to which humans are frequently exposed. Previous reviews of studies published between 1991 through 2013 have reported several associations between environmental and occupational pesticide exposure and reduced human sperm quality, specifically adverse relationships between exposure and sperm concentration. **Objectives:** This review critically evaluated the current body of evidence associating sperm quality with contemporary pesticide exposure in epidemiological studies. **Methods:** We conducted a systematic literature review using the Navigation Guide systematic review framework. PubMed, Scopus, and Web of Science databases were searched for all English-language articles published since September 2012. Only original observational studies that assessed human sperm quality parameters and individual-level pesticide exposure data were included. **Discussion:** Eleven studies assessing environmental or occupational pesticide exposure and sperm parameters were included. Nine (82%) of these studies found at least one significant association with reduced sperm quality, specifically sperm concentration, motility, morphology, and DNA integrity. The quality of evidence was determined to be “moderate” following Navigation Guide protocol, but consistent negative effect estimates and alignment with the results of previous reviews led to the determination that there is sufficient evidence that pesticide exposure adversely affects sperm quality. **Conclusion:** Taken together with the results of previous reviews, which found significant negative associations between pesticide exposure and sperm quality in 13 of 20 studies published between 1991 and 2008, and in 14 of 17 studies published between 2008 and 2012, this review provides strong evidence associating pesticide exposure with reduced sperm quality. Actions should be taken to reduce global pesticide exposure.

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**P-0794**

**Additional burden of cancers due to the exposure to agricultural chemicals and its economic implications in healthcare: A population-based study in Newfoundland and Labrador, Canada**

**Presenter:** Arifur Rahman, Memorial University of Newfoundland, St John's, Canada

**Authors:** A. Sarkar<sup>1</sup>, M. Rahman<sup>1</sup>, F. McCrate<sup>2</sup>;

<sup>1</sup>Memorial University of Newfoundland, St John's, NL, CANADA, <sup>2</sup>Eastern Health Authority, St John's, NL, CANADA.

Background: Research has documented positive associations between exposure to agricultural chemicals (ACs; pesticides, fungicides, and herbicides) and certain cancers. Studies demonstrated that the population living within 500 meters of agricultural farms are exposed to ACs due to drift. Though Newfoundland and Labrador (NL) has very few agricultural farms, people living close to golf courses might be susceptible to the inhalation of ACs in ambient air. However, there is no population-based study that examined associations between exposure to ACs in the population living close to golf courses and incidences of cancers. This study is aimed to estimate the risk of cancers among people exposed to ACs due to living close to golf courses and additional financial burdens. Methods: Of the 18 golf courses in NL, nine has proximity to human habitations. Neighborhoods within 500 meters of those golf courses were selected as high-risk areas. For low-risk areas, sixteen communities were selected because they had no golf course and agriculture land nearby. Cancer data were extracted from the NL Cancer Registry for cases diagnosed from 2007 to 2016. Histology and topography of cancers and demographic information of cases (sex, year of birth, and residence at the time of diagnosis) were extracted. Risk ratios (RR) of cancer prevalence rates in both areas, an excess number of cancer cases in high-risk areas, and the average cost of cancer care (hospitalization and intervention) were calculated. Results: High-risk areas had a higher prevalence of cancers related to ACs exposure (RR 1.76, 95% CI 1.53-2.02) compared to low-risk areas. The estimated additional burden of cancer cases due to suspected agricultural chemical exposure was 112, incurring approximately C\$ 2.5 million for cancer care. Conclusion: Results suggested an elevated risk of cancer in high-risk areas associated with exposure to ACs and additional financial burden to the province's healthcare system.

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**P-0795**

### **Occupational Pesticide Use and Risk of Non-Hodgkin Lymphoma**

**Presenter:** Anneclaire J. De Roos, Drexel University, Philadelphia, United States

**Authors:** A. J. De Roos<sup>1</sup>, L. H. Schinasi<sup>1</sup>, L. Miligi<sup>2</sup>, J. J. Spinelli<sup>3</sup>, J. R. Cerhan<sup>4</sup>, L. Fritschi<sup>5</sup>, J. N. Hofmann<sup>6</sup>, A. Monnereau<sup>7</sup>, D. Baris<sup>6</sup>, Y. Benevente<sup>8</sup>, G. Benke<sup>9</sup>, J. Clavel<sup>10</sup>, S. de Sanjose<sup>8</sup>, T. Huynh<sup>1</sup>, S. Piro<sup>2</sup>, S. L. Slager<sup>4</sup>, C. Vajdic<sup>11</sup>, S. S. Wang<sup>12</sup>, Y. Zhang<sup>13</sup>, A. tMannetje<sup>14</sup>, L. Bernstein<sup>12</sup>, P. Cocco<sup>15</sup>;

<sup>1</sup>Drexel University, Philadelphia, PA, <sup>2</sup>Istituto per lo Studio e la Prevenzione Oncologica (ISPO), Florence, ITALY, <sup>3</sup>BC Cancer, Vancouver, BC, CANADA, <sup>4</sup>Mayo Clinic, Rochester, MN, <sup>5</sup>Curtin University, Perth, AUSTRALIA, <sup>6</sup>National Cancer Institute, Bethesda, MD, <sup>7</sup>Registre des Hémopathies Malignes de la Gironde, Bordeaux, FRANCE, <sup>8</sup>Institut Catala d'Oncologia, Barcelona, SPAIN, <sup>9</sup>Monash University, Melbourne, AUSTRALIA, <sup>10</sup>INSERM UMR\_S 754 - IFR 69 - Université Paris Sud, Paris, FRANCE, <sup>11</sup>University of New South Wales, Sydney, AUSTRALIA, <sup>12</sup>City of Hope, Duarte, CA, <sup>13</sup>Yale University, New Haven, CT, <sup>14</sup>Massey University, Palmerston North, NEW ZEALAND, <sup>15</sup>Universita di Cagliari, Cagliari, ITALY.

**Background.** Evidence on the human health effects of pesticides is needed to inform risk assessment. **Methods.** We conducted a large study of the relationship between occupational pesticide use and risk of non-Hodgkin lymphoma (NHL, including chronic lymphocytic leukemia and multiple myeloma) by pooling data from nine case-control studies participating in the InterLymph Consortium, including 7909 cases and 8644 controls from North America, the European Union, and Australia. Pesticide use was coded using a combination of self-report and expert assessment, for pesticide active ingredients (e.g., DDT, diazinon, 2,4-D, glyphosate) and chemical groups (e.g., organophosphate (OP) insecticides, phenoxy herbicides). We estimated the association between each exposure and risk of NHL using logistic regression to estimate odds ratios (ORs) and 95% confidence intervals (CI), with adjustment for age, gender, race, socioeconomic status, study location, and any pesticide use – for NHL, and separately for NHL subtypes. **Results.** OP insecticides were associated with increased risk of NHL. In particular, there was 43% higher risk associated with diazinon use (vs. never, 95% CI: 1.02, 2.00) and the association was stronger with longer duration (e.g., highest tertile duration vs. never, OR=2.40, 95% CI: 1.20, 4.78). We found no association between all NHL and pyrethroid insecticides or DDT. The phenoxy herbicide, 2,4-D, was associated with increased risk of NHL, and risk was most elevated for use within 20 years of diagnosis (i.e., unlagged) (e.g., ever vs. never: unlagged, OR=1.56, 95% CI: 1.06, 2.28; lagged, OR=1.23, 95% CI: 0.96, 1.56). Glyphosate use was not associated with risk of all NHL, but there were statistically significant risk increases for some NHL subtypes, specifically follicular lymphoma and NOS/unknown pathology. **Conclusions.** Our consortium-based pooled study produced evidence on potential carcinogenicity of certain pesticides. These findings are important because farming occupation and pesticides are among few leads for environmental causes of NHL.

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**P-0796**

**Exposure to environmental contaminants and risk of pregnancy induced hypertension and gestational diabetes mellitus**

**Presenter:** Roxana Khalili, University of California Irvine, Irvine, United States

**Authors:** R. Khalili, V. Vieira;  
University of California Irvine, Irvine, CA.

Introduction: Persistent organic pollutants (POPs), including polychlorinated biphenyls (PCBs) and hexachlorobenzene (HCB), are ubiquitously found in the environment and resistant to degradation. POPs, along with persistent organochlorine pesticides including p,p'-dichlorodiphenyl dichloroethylene (DDE) and heavy metals have been associated with various pregnancy outcomes but results are inconsistent. Objective: We assessed the associations between prenatal exposures to organochlorines and heavy metals and the development of gestational diabetes mellitus (GDM) and pregnancy induced hypertension (PIH). Methods: We used existing exposure models to predict prenatal levels of PCBs (using the sum of 4 prevalent congeners), DDE, HCB, lead (Pb) and mercury (Hg) for all pregnant women living in southeast Massachusetts between 1993-1998 (n=10,270). Outcome and covariate data were obtained from Massachusetts birth records. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for GDM and PIH were estimated using multivariable logistic regression models. Results: Approximately 1.8% of women in this study population developed GDM and 1.9% of women developed PIH. PCBs, DDE and HCB were strongly associated with the development of GDM, while no associations were observed for Pb and Hg exposure. After adjusting for weight gain during pregnancy, smoking during pregnancy, parity, race, and socioeconomic factors, the effects of PCBs (OR: 1.56; 95% CI: 1.10-2.22) and DDE (OR: 2.84; 95% CI: 1.90-4.25) on GDM remained. However, the risk associated with HCB exposure was no longer significant after adjusting for confounders. Associations with PIH were null. Conclusions: These results suggest that women with high prenatal levels of PCBs and DDE may have a higher risk of developing GDM. We found no associations between PIH and exposures to organochlorines and heavy metals.

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**P-0799**

### **Health Risks among Farmers Exposed to Pesticides in Southwest Ethiopia**

**Presenter:** Wondwossen Birke, Jimma University, Jimma, Ethiopia

**Authors:** K. Bedada, W. Birke;  
Jimma University, Jimma, ETHIOPIA.

#### Background

Chemical pesticides, regardless of their inherent hazard, are used intensively in the fast changing agricultural sector of Ethiopia. This study is aimed to assess illness patterns and potential health risks among farmers exposed to pesticides in rural villages of Jimma district, Southwest Ethiopia, from February to June 2019.

#### Methods

Community based cross-sectional study was conducted in 195 randomly selected rural farmer households. Data were collected with an interview method using structured questionnaires. Data compilation, categorization, processing and analysis was made with the help of SPSS version 20.

#### Results

Result showed that all of the farmers enrolled in the study had symptoms of illness after pesticide application. The symptoms were headache (36%), nausea (21%), vomiting (20%), skin and eye irritations (10% each), and other discomforts (3%) which are most likely because of acute poisoning. Several potential health risk factors were identified among the farmers exposing them to pesticides in this study. These included lack of awareness, unable to use personal protective equipment (PPE), absence of formal training, a casual attitude and unsatisfactory safety practice about pesticide application and handling.

#### Conclusions

Intervention programs targeting the frequently seen illnesses and their possible risk factors are suggested to reduce burden of illness in the farmers. Further work with rigorous statistical approach is also needed to test illness relationship with risk factors.

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**P-0800**

### **METHODOLOGY FOR ASSESS THE AIR AND HEALTH QUALITY PREVIOUS TO THE START-UP OF THE ENERGY VALORISATION PLANT**

**Presenter:** Aitana Lertxundi, University of Basque Country, Leioa, Spain

**Authors:** A. Lertxundi<sup>1</sup>, L. Santa Marina<sup>2</sup>, A. Irizar<sup>3</sup>, J. Alvarez<sup>4</sup>, A. Anabitarte<sup>3</sup>, J. Ibarluzea<sup>5</sup>;

<sup>1</sup>University of Basque Country, Leioa, SPAIN, <sup>2</sup>Department of Health of the Basque Government, Donostia, SPAIN, <sup>3</sup>BIODONOSTIA, Health Research Institute, Donostia, SPAIN, <sup>4</sup>Department of Health of the Basque Government, Zamudio, SPAIN, <sup>5</sup>Department of Health of the Basque Government, Donostia, SPAIN.

The constant increase in urban waste and its management is one of the problems we are currently facing as a society. The increasing generation of this type of waste, together with the difficulties in the search for new sites for its deposit has led to the choice of incineration as an alternative to the management of waste that could not be reused or recycled. This option has generated concern and a strong social debate about possible adverse health effects. Given this concern, the Gipuzkoa's province government, North of Spain, issued a public call for an epidemiological study before the start-up of the Energy Valorisation Plant, EVP 2017-2019. The EVP is scheduled to be launched at the end of March 2020. The study covers three lines of research; Line 1: air quality control, in exposure zone, ZE, control zone, ZC. ZE: municipalities located in the same valley; ZC: municipalities that are located in another valley with the same characteristics in terms of population and sources of pollution. 2513 PM<sub>2.5</sub> samples determinations, 2054 metal/PAH samples and 100 dioxin, furan and PCB samples, PCDD-Fs and PCBs, were analysed. Line 2: determine the level of contaminants; dioxins-furans, PCBs and trace elements in urine and blood in three different zones, ZC, ZE and intermediate zone, 228 persons in total. Line 3: long-term effects: construction of risk maps of incidence and mortality from cancer and congenital malformations of all Basque communities, and short-term effects; risk estimation derived from exposure to PM<sub>2.5</sub> and PM<sub>10</sub> in reproductive health and in deaths and hospital admissions recorded daily. The methodology used in this study is expected to be replicated after the launch of the EVP.

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**P-0801**

**A tiered approach to prioritizing registered pesticides for potential cancer hazard evaluations: Implications for decision making**

**Presenter:** Pamela J. Schwingl, ILS, Research Triangle Park, United States

**Authors:** P. J. Schwingl<sup>1</sup>, R. M. Lunn<sup>2</sup>, S. Atwood<sup>1</sup>, S. S. Mehta<sup>2</sup>;

<sup>1</sup>ILS, Research Triangle Park, NC, <sup>2</sup>Office of the Report on Carcinogens, Division of the National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC.

**Background:** The U.S. Environmental Protection Agency (EPA) conducts cancer hazard evaluations of pesticides during the registration process when often only limited pre-market animal data is available. Due to the prolonged nature of the re-registration process, new population-based observational studies on the carcinogenicity of pesticides may not be readily incorporated into updated assessments. We aim to identify new cancer epidemiology studies that could inform future hazard evaluations for pesticides currently used in high volumes and considered potentially carcinogenic by EPA. **Methods:** We used a two-step systematic, tiered review approach to scope the literature for epidemiologic studies of pesticide exposure and carcinogenicity. First, we identified pesticides in EPA databases that are currently registered for use, considered potentially carcinogenic (classified by EPA as “possible”, “suggestive”, or “likely” carcinogenic), and used in high volumes. We excluded carcinogens listed by National Toxicology Program’s Report on Carcinogens or the International Agency for Research on Cancer. Second, using PubMed we identified studies published after EPA’s last publicly-available cancer hazard evaluation, then used Health Assessment Workplace Collaborative and Tableau to map evidence by cancer type, pesticide type, and number of studies. **Results:** We identified 17 potentially carcinogenic high-volume pesticides of which over half were evaluated initially 20-35 years ago; epidemiology data were available for 15 pesticides. Most pesticides were primarily applied as herbicides and insecticides, or in household or agricultural settings. The most frequent reported cancer types include lymphohematopoietic cancers (i.e., adult leukemia, non-Hodgkin lymphoma, multiple myeloma), childhood leukemia, childhood cancers, and prostate cancer. There were  $\geq 5$  studies for one or more cancer sites for seven pesticides: carbaryl, chlorothalonil, dimethoate, mancozeb, metolachlor, permethrin and trifluralin. **Conclusions:** These results highlight the potential need for updated hazard evaluations. Our multi-step approach and utilization of evidence mapping can be used to inform future decision-making to update cancer hazard evaluations.

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**P-0802**

**Women's exposure to pesticides in a cohort of Brazilian smallholder family farmers**

**Presenter:** Rafael J Buralli, Brazilian Ministry of Health, Brasília, Brazil

**Authors:** R. J. Buralli<sup>1</sup>, R. C. Marques<sup>2</sup>, R. S. Leão<sup>3</sup>, J. D. Guimarães<sup>4</sup>;

<sup>1</sup>Brazilian Ministry of Health, Brasília, BRAZIL, <sup>2</sup>Universidade Federal do Rio de Janeiro, campus Macaé, Macaé, BRAZIL, <sup>3</sup>Centro de Tecnologia em Nanomateriais e Grafeno (CTNANO/UFMG), Belo Horizonte, BRAZIL, <sup>4</sup>Instituto de Biofísica, Universidade Federal do Rio de Janeiro, Rio de Janeiro, BRAZIL.

Women living in rural areas are at higher risk of pesticide exposure, especially when involved in agricultural tasks. Objective: To discuss women's exposure to pesticides among a cohort of Brazilian farmers. Methods: A cross-sectional study investigated pesticide exposure and health effects of family farmers from Rio de Janeiro State, providing relevant data to discuss women's potential exposure. Results: The assessed female farmers (n=37) had a mean age of 45y, and 57% were at bearing age (18-45y), which is an important risk for reproductive, gestational, and endocrine problems. They were mother of 21 children aged <10y and 22 from 11-18y, who are often taken to planting areas from very early ages. Female farmers were exposed to mixtures of multiple pesticides (31 classes including organophosphates, carbamates and pyrethroids) for 23y on average, and none of them had ever received occupational training. While men were mostly involved in pesticide manipulation and spraying, women daily performed other tasks without recommended personal protection. Most women lived close to cultivation sites with pesticide use (85% <1km), reported residential exposure (95%), storage of chemicals at home or nearby, and cleaning work-contaminated clothes and equipment, and that are additional sources of exposure for them. As a consequence, a high prevalence of poisoning (e.g. headache, tingling, cramps, dyspnea and cough) and mental health (e.g. depression and anxiety) symptoms were reported. Conclusion: The female farmers investigated are at higher risk of being exposed to pesticides throughout multiple pathways, which may have harmful impacts on their health and offspring. Technical support must be improved to smallholder family farmers in Brazil and risk mitigation strategies adopted to minimize women's exposure to pesticides in order to protect their health and families.

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**P-0803**

**Metabolome-wide association study of organophosphate pesticide exposure**

**Presenter:** Qi Yan, UCLA, Los Angeles, United States

**Authors:** Q. Yan<sup>1</sup>, K. Paul<sup>1</sup>, K. Uppal<sup>2</sup>, D. Jones<sup>2</sup>, B. Ritz<sup>1</sup>;  
<sup>1</sup>UCLA, Los Angeles, CA, <sup>2</sup>Emory University, Atlanta, GA.

Background: Organophosphates (OP) are widely used insecticides that acutely inhibit acetylcholinesterase enzyme activity. There is great interest in improving the understanding of molecular mechanisms related to chronic OP exposure induced toxicity. We aim to elucidate metabolomic changes associated with OP exposure using high-resolution metabolomics (HRM). Methods: In a population-based case control study of Parkinson's disease (PD), we retrieved serum samples of 178 controls and assessed ambient OP exposure via residential and workplace proximity to commercial applications for each subject. We used liquid chromatography-high resolution mass spectrometry to obtain untargeted metabolic profiles and partial least squares regression to select metabolic features associated with OP exposure. Pathway analyses were employed to identify biologic pathways related to OP exposure. Confounders including age, race/ethnicity, sex were controlled a priori. Results: In total we extracted 8,615 and 4,124 metabolic features from serum samples in hydrophilic interaction (HILIC) chromatography (positive ion mode) and C18 (negative ion mode) columns, respectively. Controlling for confounding factors, 151 and 50 discriminatory metabolic features (HILIC and C18, respectively) were selected (Variable Importance in Projection (VIP)  $\geq 2$ ). Pathway enrichment analysis for discriminatory features associated with OP indicated that in serum fatty acid oxidation and inflammation related pathways were altered, including arachidonic acid, leukotriene, and prostaglandin pathways. Conclusion: This study finds chronic low-level OP exposure is associated with differential metabolomic profiles in serum. Our study results suggest that long-term sub-acute OP exposure influences metabolites enriched for oxidative stress and inflammation pathways.

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**P-0804**

**Trends of chronic kidney disease mortality rates and pesticide expenditure in Brazil from 1996-2015.**

**Presenter:** Nathalia Ferrazzo Naspolini, Rutgers University, New Brunswick, United States

**Authors:** N. F. Naspolini<sup>1</sup>, C. G. Parks<sup>2</sup>, A. Meyer<sup>3</sup>;

<sup>1</sup>Rutgers University, New Brunswick, NJ, <sup>2</sup>National Institutes of Health, Bethesda, MD, <sup>3</sup>Federal University of Rio de Janeiro, Rio de Janeiro, BRAZIL.

Background/Aim: Emerging evidence suggests that exposure to pesticides may be contributing to the burden of chronic kidney disease (CKD) epidemic among agricultural communities. We investigated the association of pesticide expenditure with trends in CKD mortality rates in Southern and Southeastern Brazil from 1996-2015. Methods: We calculated CKD mortality rates between 1996-2015 for all Brazilian counties of the Southeast and South regions. We divided the total number of deaths due to CKD (ICD10: N18) by the total resident population between 1996-2015 and multiplied per 100,000. Temporal trend analyses and average annual percentage change (AAPC) were obtained for age (20-39, 40-59, and  $\geq 60$ ), sex, region (South and Southeast), place of residence (urban and rural counties) and tertiles of per capita pesticide expenditure (1996) using the joinpoint regression model. Results: The overall trend of CKD mortality rates maintained constant between 1996-2015 (AAPC: 0.1; 95%CI: -0.9-1.1), while a slight increase in rural (AAPC: 1.1; 95%CI: -0.2-2.4) and a decrease in urban (AAPC: -0.8; 95%CI: 1.7-0.0) counties was observed. The increase in rural counties was higher among women (AAPC: 1.9; 95%CI: 1.3-2.5) compared to men ages 60 and older (AAPC: 1.4; 95%CI: 0.8-2.0). Furthermore, the trend in CKD mortality rates increased by tertiles of pesticides expenditure (AAPC<sub>T1</sub>: 0.3; 95%CI: -1.2-1.8, AAPC<sub>T2</sub>: 1.9; 95%CI: 0.7-3.2 and AAPC<sub>T3</sub>: 2.8; 95%CI: 0.6-5.0). This trend was similar when limited to the older population (AAPC<sub>T1</sub>: 1.2; 95%CI: 0.4-1.9; AAPC<sub>T2</sub>: 1.7; 95%CI: 1.0-2.5 and AAPC<sub>T3</sub>: 2.2; 95%CI: 1.7-2.7). Sensitivity analysis confirmed a different behavior for diseases unrelated to pesticide exposure. Conclusions: Against a background of rising CKD mortality rates, the overall trend of CKD mortality rates remained constant over the study period in Southern and Southeastern Brazil. However, pesticide expenses and age stratifications suggest that pesticides use may be related to CKD mortality trends.

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**P-0805**

**Expansion of 2,4-D Use on U.S. Farmland and Rising 2,4-D Urine Concentrations in the U.S. Population, 1999 to 2012**

**Presenter:** Kimberly S. Kramer, The George Washington University, Washington, United States

**Authors:** K. S. Kramer<sup>1</sup>, C. M. Benbrook<sup>2</sup>, M. J. Perry<sup>1</sup>;

<sup>1</sup>The George Washington University, Washington, DC, <sup>2</sup>Heartland Study and Hygiea Analytics, Port Orchard, WA.

**Background/Aim:** Multiple studies in the 1990s reported associations between agricultural 2,4-dichlorophenoxyacetic acid (2,4-D) use and reproductive problems, birth defects, and sperm quality. In 2018, the International Agency for Research on Cancer classified 2,4-D as a possible human carcinogen. Over the past decade, the spread of weeds resistant to glyphosate-based herbicides began driving herbicide use upward. In response, seed and biotechnology companies developed genetically engineered crops resistant to glyphosate and legacy herbicides, 2,4-D or dicamba. In 2018, the Enlist® program, comprised of crops able to tolerate application of 2,4-D, was approved and sold commercially. About 4 million acres of Enlist® soybeans were planted in 2019 and 25+ million are projected in 2021. As a result, 2,4-D use will dramatically increase in the next few years. In order to determine if 2,4-D exposure corresponds to increased 2,4-D use, we compared 2,4-D agricultural trends with 2,4-D urine levels in the U.S. population between 1999 to 2012. **Methods:** 2,4-D use data comes from Hygiea Analytics' Pesticide Use Data System, which draws on publicly accessible data at the state and national levels. 2,4-D urine concentrations were obtained from NHANES cycles 1999/2000 to 2011/2012. **Results:** Soybean farmers applied 1.6 million pounds of 2,4-D in 2000, 6.3 million in 2012, and 8.9 million in 2018. Despite the relatively short half-life of 2,4-D in the environment and quick elimination of 2,4-D after human exposure, 2,4-D urine concentrations in the general U.S. population increased from GM= 0.11 ug/L (1999/2000) to GM=0.33 ug/L (2011/2012). **Conclusion:** Use of Enlist® soybean crops will nearly triple 2,4-D use from 2018 levels through 2023. With the upsurge in 2,4-D use and the concern for health effects from 2,4-D exposure, it is imperative that epidemiological studies investigate human health effects from long-term exposure to 2,4-D.

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**P-0806**

**Occupational pesticide use and self-reported olfactory impairment in United States farmers**

**Presenter:** Srishti Shrestha, National Institute of Environmental Health Sciences, Research Triangle Park, United States

**Authors:** S. Shrestha<sup>1</sup>, D. M. Umbach<sup>1</sup>, L. E. Beane Freeman<sup>2</sup>, S. Koutros<sup>2</sup>, M. Alavanja<sup>3</sup>, A. Blair<sup>2</sup>, H. Chen<sup>4</sup>, D. P. Sandler<sup>1</sup>;

<sup>1</sup>National Institute of Environmental Health Sciences, Research Triangle Park, NC, <sup>2</sup>National Cancer Institute, Bethesda, MD, <sup>3</sup>Formerly of National Cancer Institute, Bethesda, MD, <sup>4</sup>Michigan State University, East Lansing, MI.

Background: Pesticide exposure may impair human olfaction through direct damage to peripheral olfactory structures, or through neurotoxic effects on the central nervous system, but empirical evidence is largely lacking. Objective: We examined associations between occupational use of specific pesticides and olfactory impairment among 20,409 pesticide applicators (mostly farmers) in the Agricultural Health Study, an ongoing prospective study in Iowa and North Carolina. Methods: Participants provided information on ever-use and lifetime days of use of 50 specific pesticides at enrollment (1993-1997) and on self-reported olfactory impairment two decades later (2013-2016). We used logistic regression to estimate odds ratios (OR) and 95% confidence intervals (CI) for the associations, adjusting for age, sex, state of residence, education, smoking, whether involved in other activities (repairing engines, working in swine confinement areas, handling stored grain, welding, and painting), and correlated pesticides. Results: About 10% of participants reported olfactory impairment. The overall cumulative days of any pesticide use at enrollment was associated with a higher odds of reporting poor sense of smell twenty years later [OR (highest vs. lowest quartile): 1.17 (95% CI:1.02-1.34), p-trend=0.003]. In the analyses of 50 specific pesticides, ever-use of 20 pesticides showed modest associations with olfactory impairment, with ORs ranging from 1.11 to 1.33. Of these, higher lifetime days of use of 12 pesticides were associated with higher odds of olfactory impairment as compared to never use (p-trend  $\leq 0.05$ ), including five insecticides DDT, lindane (organochlorines), diazinon, malathion (organophosphates), permethrin (pyrethroid), one fungicide captan, and six herbicides (glyphosate, paraquat, petroleum distillates, 2,4-D, 2,4,5-T, and metribuzin). Conclusion: Occupational use of certain pesticides may be associated with olfactory impairment. Our findings of associations with multiple pesticides across several chemical classes may indicate that pesticides could affect olfaction through multiple pathways. Future epidemiological studies with objective measurement of olfaction are required to confirm these findings.

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**P-0807**

**Effect Size Magnification and Epidemiologic Design Calculations: their use in EPA's Office of Pesticide Programs in evaluating study size in epidemiology studies**

**Presenter:** David J. Miller, U.S. Environmental Protection Agency, Washington, United States

**Authors:** D. J. Miller, J. T. Nguyen;  
U.S. Environmental Protection Agency, Washington, DC.

While most researchers recognize issues associated with small/low powered studies vis-a-vis their lessened ability to detect true effects, fewer recognize issues associated with small/low powered studies and their tendency to produce inflated estimates if those estimated effects are required to pass a statistical threshold to be judged important, relevant, or “discovered”. Effect size magnification (ESM) is a term used to refer to this phenomenon. Specifically: low-powered studies that find evidence of an effect often provide inflated estimates of the size of that effect. This talk will discuss some of the regulatory implications of ESM and our efforts in EPA's Office of Pesticide Programs to understand, reproduce, and finally apply this knowledge to better evaluate the reliability of reported (statistically significant) effect sizes in epidemiology studies and put these into a fuller context. Routinely performing such ESM calculations (aka “post-hoc design calculations”) in epidemiology in a regulatory context can assist in determining the extent to which ESM may be an issue or should be accounted for in interpretation of epidemiological results. In particular, the talk will relate these design calculations to both judging adequacy of power and sample size issues vis-a-vis the observed effect size and in interpreting their potential implications for study conclusions. While such design calculations do not change a statistically significant result to a non-significant result, they do allow regulatory staff to consider that a reportedly large effect may in fact be much lower, to a degree that the effect may have less influence on regulatory decisions.

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**P-0808**

### **DENGUE IN THE STATE OF SÃO PAULO AND BRAZIL: ANALYSIS OF THE HISTORICAL SERIES OF ARBOVIRUS ROSE AND PREVENTIVE MEASURES AND USE OF MALATHION.**

**Presenter:** Eric Hara, Clinical Hospital of São Paulo University, São Paulo, Brazil

**Authors:** E. Hara, C. Feijó, F. Viana, R. Prestes, T. Nery;  
Clinical Hospital of São Paulo University, São Paulo, BRAZIL.

Introduction: The Brazilian Ministry of Health has been following through a historical series of dengue cases since 1975. In the years 2014 to 2016 cases exceeded 1 million per year, with peak in 2015. In 2017 and 2018 the figures were below 300,000 cases/year, but in 2019 these figures exceed 1,500 cases. The state of São Paulo, with 645 municipalities and a population of 44 million people, was the state with the highest number of cases in 2019, with 445,000 confirmed cases, which compared to 2018, about 16,800 cases increased by 103%. Several preventive measures are adopted, including the number of spray spraying with Malathion insecticide, which has been presenting important and increasing use, despite the characteristics and classifications of the International Agency for Research on Cancer. Objective: This work aims to discuss the increase in the number of dengue cases in the state of São Paulo, by region, analyzing the preventive measures developed. Methodology: Data from the Ministry of Health, the State Endemic Control Superintendence and the Phytosanitary Pesticides system were collected. The data refer to the number of cases, hospitalization and mortality, as well as quantitative Malathion used. Results and conclusion: Analyses identify that 2019 showed a 103% increase in dengue cases and require an important evaluation of the preventive measures adopted and search for new ways to reduce the use of pesticides.

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**P-0809**

**Advancing Kinetic Modeling for Polychlorinated Biphenyl (PCB) Mixtures Relevant to Human Exposures: A Case Study Applying the Keyword Analysis Tool to PCBs Congener-Specific Half-Lives**

**Presenter:** Raquel A. Silva, ICF, Durham, United States

**Authors:** K. A. Shipkowski<sup>1</sup>, J. Trgovcich<sup>1</sup>, N. Vetter<sup>1</sup>, B. L. Ingle<sup>1</sup>, R. A. Silva<sup>1</sup>, L. M. Carlson<sup>2</sup>, D. F. Kapraun<sup>2</sup>, P. M. Schlosser<sup>2</sup>, G. M. Lehmann<sup>2</sup>;

<sup>1</sup>ICF, Durham, NC, <sup>2</sup>U.S. Environmental Protection Agency, Research Triangle Park, NC.

Toxicity resulting from human exposure to PCBs is highly dependent on the absorption, distribution, metabolism, and excretion (ADME) properties of individual PCB congeners. A database of half-life of elimination values for individual congeners was assembled to advance the development of a comprehensive kinetic model for PCB mixtures relevant to human exposures. A novel strategy was employed to identify relevant literature. First, a literature search was conducted using keywords related to PCBs; this generated a database of 58,915 studies. Next, the Keyword Analysis Tool (KAT) was applied to select studies related to PCB congener-specific half-lives across mammalian species. KAT is a software tool designed to increase efficiency in literature screening; it allows users to calculate metrics on the utility of each keyword. By applying keywords related to half-life, elimination, and clearance, KAT identified 5,956 potentially relevant studies from the PCB literature database. A text analytics approach was implemented to further select studies for data extraction. Specifically, sentences from the full text of each study that harbored a keyword were reviewed in conjunction with titles and abstracts to ascertain study relevance. This effort identified 312 studies, 98 of which contained half-life values for 95 PCB congeners across mammalian species. Data from 33 studies identified half-life values for 36 PCB congeners in humans across lifestages, biological matrices, and exposure routes. A retrospective analysis of the KAT search results showed that of 64 keywords used, only 28 were associated with relevant studies, and only 24 keywords would have captured all relevant studies. Additionally, by including keywords relevant to ecological studies, KAT successfully helped prioritize other studies more likely to be relevant to PCB elimination in mammalian species. Thus, KAT identified a highly effective keyword set that can be applied to increase efficiency of future literature searches for chemical half-lives of PCB elimination in humans.

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**P-0812**

**Factors influencing household organophosphate pesticide levels in agricultural communities**

**Presenter:** Grace Kuiper, Colorado State University, Fort Collins, United States

**Authors:** G. Kuiper<sup>1</sup>, W. Benka-Coker<sup>1</sup>, G. Erlandson<sup>1</sup>, N. Martinez<sup>2</sup>, J. Mendoza<sup>2</sup>, C. Quinn<sup>1</sup>, S. WeMott<sup>1</sup>, B. Young<sup>1</sup>, S. Magzamen<sup>1</sup>;

<sup>1</sup>Colorado State University, Fort Collins, CO, <sup>2</sup>Central California Environmental Justice Network, Fresno, CA.

Background Organophosphate (OP) pesticide exposure is associated with various cancers, neurodegenerative diseases, and respiratory health outcomes. Proximity to agricultural operations and direct occupational contact are hypothesized to be important routes of exposure. Understanding these routes and exploring methods to estimate exposure will improve epidemiological studies, especially among agricultural communities where pesticide exposure due to drift and indirect contact is disproportionately high. To understand factors that influence household environmental exposures to OPs, we collected dust samples from homes in the Central Valley of California. We hypothesized that OP levels would be higher among samples collected during the agricultural spraying season and from homes in which a household member worked in agriculture. Methods Household dust samples were collected using a high-volume small surface sampler during the agricultural spraying (June) and non-spraying (January) seasons from 28 households located within 200 feet of agricultural fields. T-tests and paired t-tests were conducted to assess differences in total OP levels by occupational status and spraying season. Results A total of 50 samples were analyzed for the presence of OPs. Homes in which a household member worked in agriculture had significantly higher OP levels (130.0 parts per billion (ppb), SD 168.5), compared to homes without anyone working in agriculture (28.7 ppb, SD 24.2; p-value=0.001). No statistically significant differences were detected by spraying season (t=0.41, p-value = 0.69). Conclusions Our results demonstrate that detectable levels of OPs are prevalent in households within 200 feet of agricultural fields. Additionally, OPs may persist indoors for extended periods of time. Although the California Pesticide Use Registry indicates that OP application in our study area is seasonal, dust samples had similar levels across seasons. Our work will inform future research by revealing important factors related to routes of exposure to harmful pesticides experienced by agricultural workers and their families.

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**P-0813**

**Pesticide exposure in Chile and population health: urgency for decision making**

**Presenter:** Sandra Cortes, PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE. Department of Public Health. Advanced Center for Chronic Diseases. Centro de Desarrollo Urbano Sustentable, Santiago, Chile

**Authors:** S. Cortes<sup>1</sup>, L. Zúñiga-Venegas<sup>2</sup>, C. Saracini<sup>3</sup>, F. Pancetti<sup>4</sup>, M. Muñoz-Quezada<sup>5</sup>, B. Lucero<sup>5</sup>, C. Foerster<sup>6</sup>;

<sup>1</sup>PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE. Department of Public Health. Advanced Center for Chronic Diseases. Centro de Desarrollo Urbano Sustentable, Santiago, CHILE, <sup>2</sup>Centro de Investigación en Estudios Avanzados del Maule (CIEAM). Centro de Investigaciones en Neuropsicología y Neurociencias Cognitivas (CINPSI-Neurocog). Universidad Católica del Maule., Talca, Chile, Talca, CHILE, <sup>3</sup>Centro de Investigación en Estudios Avanzados del Maule (CIEAM). Centro de Investigaciones en Neuropsicología y Neurociencias Cognitivas (CINPSI-Neurocog). Universidad Católica del Maule., Talca, CHILE, <sup>4</sup>Laboratorio de Neurotoxicología Ambiental. Facultad de Medicina, Universidad Católica del Norte, Coquimbo, CHILE, <sup>5</sup>Centro de Investigaciones en Neuropsicología y Neurociencias Cognitivas (CINPSI-Neurocog). Facultad de Ciencias de la Salud, Universidad Católica del Maule, Talca, CHILE, <sup>6</sup>Instituto de Ciencias Agronómicas y Veterinarias, Universidad de O'Higgins, San Fernando, CHILE.

**Background:** In the last 25 years, Chile has had an expanding role as an agro-export country in the global economy, with efficient rates of productivity in the region, large areas with monocultures and the intensive application of agrochemicals. This form of agriculture has also lacked efficient regulations and surveillance, so it is difficult to estimate the real magnitude of the exposed population and its acute and chronic effects on health. **Objective:** to compile the epidemiological evidence on health effects associated with pesticide exposure and to promote a public discussion on pesticides used in Chile. **Methods:** in this review, epidemiological studies made in Chile were identified from Scielo and Pubmed databases according to PRISMA criteria. No restrictions by year were used. **Results:** 13 studies estimated exposure to pesticides and health effects; the other 6 studies only estimated exposure or susceptibility. Of the total number of articles, 50% included farmers, 25% children, and 25% women of childbearing age. The greatest effects being the neurotoxic (54%), genotoxic (31%) and reproductive (15%). Based on the highest quality published studies (n=5), significant associations were established between cognitive impairment (e.g., verbal comprehension, visual and auditive memory, and processing speed) and exposure in farmers and children; DNA damage levels were higher in farmers than controls. **Conclusions:** The evidence collected shows exposure to pesticides in the general and occupational Chilean populations. Despite several limitations observed in some studies, the evidence collected until now allow shows the urgency to protect the health of both the occupational and general population and especially children through stricter control of the sale and use of pesticides, with comprehensive surveillance systems in environmental health and educational actions in the context of vulnerable communities. It is a priority to strictly restrict the use of pesticides already prohibited in developed countries.

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**P-0814**

**The association between urinary glyphosate metabolites and biomarkers of oxidative stress among pregnant women in PROTECT birth cohort study**

**Presenter:** Jarrod Eaton, University of Michigan, Ann Arbor, United States

**Authors:** J. Eaton<sup>1</sup>, A. Cathey<sup>1</sup>, D. Watkins<sup>1</sup>, C. Velez-Vega<sup>2</sup>, Z. Rosario<sup>3</sup>, J. Fernandez<sup>1</sup>, J. Cordero<sup>3</sup>, A. Alshawabkeh<sup>4</sup>, J. Meeker<sup>1</sup>;

<sup>1</sup>University of Michigan, Ann Arbor, MI, <sup>2</sup>University of Puerto Rico, San Juan, PR, <sup>3</sup>University of Georgia, Athens, GA, <sup>4</sup>Northeastern University, Boston, MA.

**Background:** Glyphosate is a widely used herbicide in the global agriculture industry. Glyphosate and its primary metabolite, aminomethyl phosphonic acid (AMPA), have been shown to disrupt endocrine function and induce oxidative stress within in vitro and animal studies. To our knowledge, these relationships have not been previously characterized in epidemiological settings. Elevated urinary levels of glyphosate and AMPA may impact the health of vulnerable populations such as pregnant women via multiple mechanisms including oxidative stress. **Methods:** Glyphosate and AMPA were measured in 347 urine samples collected at multiple visits from pregnant women in the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) birth cohort. Urinary biomarkers of oxidative stress, comprising 8-isoprostane-prostaglandin-F<sub>2a</sub> (8-iso-PGF<sub>2a</sub>), its main metabolite 2,3-dinor-5,6-dihydro-15-F<sub>2t</sub>-isoprostane (8-iso-PGF<sub>2a</sub> metabolite) and prostaglandin-F<sub>2a</sub> (PGF<sub>2a</sub>), were also measured. One-way ANOVA tests evaluated differences in exposure and oxidative stress biomarker concentrations between study visits. Linear mixed effect models assessed the association between exposures and oxidative stress adjusting for maternal age, smoking status, alcohol consumption, household income and specific gravity. **Results:** No significant differences in exposure or oxidative stress biomarker concentrations were observed between study visits. An interquartile range (IQR) increase in AMPA was associated with 9.5% (95% CI: 0.5%-19.3%) higher 8-iso-PGF<sub>2a</sub> metabolite. Compared to the lowest exposure group, the second and third tertiles of AMPA were significantly associated with 12.8% (0.6%-26.5%) and 15.2% (1.8%-30.3%) higher 8-iso-PGF<sub>2a</sub> metabolite, respectively. An IQR increase in glyphosate was suggestively associated with 4.7% (-0.9%-10.7%) higher 8-iso-PGF<sub>2a</sub>. **Conclusions:** Urinary concentrations of the main metabolite of glyphosate, AMPA, were associated with higher levels of certain oxidative stress biomarkers. Associations with glyphosate reflected similar trends, although findings were not as strong. Additional research is required to better characterize the association between glyphosate exposure and biomarkers of oxidative stress, as well as potential downstream health consequences.

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**P-0815**

**Prenatal Exposure To DDT/HCH and Risk of Preterm Births: An Indian Study**

**Presenter:** MADHU ANAND, Dr. B R Ambedkar University, Agra, agra, India

**Authors:** M. ANAND, A. TANEJA;  
Dr. B R Ambedkar University, Agra, agra, INDIA.

Prenatal Exposure to DDT/HCH and Risk of Pre-term Birth: An Indian study Madhu Anand Department of Chemistry, Dr. B.R. Ambedkar University, Khandari Campus, Agra-282002, India Ajay Taneja Department of Chemistry, Dr. B.R. Ambedkar University, Khandari Campus, Agra-282002, India  
Background/Aim: In India, pre-term birth is the leading cause of death of infants and this number is continuously rising. Pre-term birth is an increasingly prevalent complex condition with multiple risk factors. Only handful of studies has focused on the effect of environmental pollutants such as metals, polycyclic aromatic hydrocarbons and organochlorine pesticides in pre-term deliveries. The aim of this study to analyse the organochlorine pesticide residues in placenta of the females with pre-term and full-term deliveries. Methods: Fifty cases of full-term deliveries and forty cases of pre-term deliveries were included in this case-control study. Residues of organochlorine pesticides like dichlorodiphenyltrichloroethane (DDT) and its metabolites (p,p-DDE, p,p-DDT, o,p-DDD) and isomers of hexachlorocyclohexane ( $\alpha$ -HCH,  $\beta$ -HCH,  $\gamma$ -HCH and  $\delta$ -HCH) were analysed by gas chromatography equipped with electron capture detector. Results: The concentration of all the pesticides were found higher in pre-term cases but the difference were not found statistically significant, only  $\alpha$ -HCH ( $39.75 \pm 39.73$ ), total-HCH ( $110.85 \pm 120.57$ ), p,p-DDE ( $13.95 \pm 12.14$ ) and total DDT ( $19.68 \pm 17.55$ ) were found significantly higher in pre-term cases. Conclusions: Prenatal Exposure to these organochlorine pesticides is associated preterm births in Indian Population. Future, multicentre studies are needed in larger population and longer follow-up periods.

Keywords: Organochlorine pesticides, preterm-births, placenta, gas chromatography

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**P-0816**

### **Urinary Metabolites of Pyrethroid Insecticide in Relation to GABA Level and Hand Wipes Sample of Young Children in Urban Area, Bangkok Thailand**

**Presenter:** Jadsada Kunno, College of Public Health Sciences, Chulalongkorn University, Pathumwan, Thailand

**Authors:** J. Kunno<sup>1</sup>, M. Robson<sup>2</sup>, W. Siriwong<sup>1</sup>;

<sup>1</sup>College of Public Health Sciences, Chulalongkorn University, Pathumwan, THAILAND, <sup>2</sup>School of Environmental and Biological Sciences, Rutgers University, New Brunswick, NJ.

Exposure to pyrethroids were commonly used in households affects the nervous system in children. Data on pyrethroids exposure were related to neurotransmitter gamma-aminobutyric acid (GABA) is unknown. This study was investigated relationship between 3-PBA metabolite and GABA concentration, hand wipes and determine factors related to pyrethroids metabolite among young children in urban areas. Children aged 2-3 years were provided urine sample (n = 80), and their mothers completed a questionnaire. Urine samples were analyzed for the 3-PBA metabolite and hand wipes samples were analyzed pyrethroids contamination. Both were analyzed by gas chromatography (GC/MS). GABA was analyzed from urine sample using an enzyme-linked immunosorbent assay kit (ELISA). Spearman correlations were used to determine relationship between 3-PBA metabolite and GABA concentrations, hand wipes sample and binary logistic regression were used to determine association between 3-BPA metabolite and factor variables. Our results were presented that an increase of 3-PBA metabolite concentration was significantly correlated with low GABA concentration in urine children sample ( $r_s = -0.230$ , p-value 0.004). Moreover, the increase of 3-PBA metabolite was significantly associated with increase hand wipes sample (including cypermethrin and allethrin) ( $r_s = 0.226$ , p-value < 0.05). In addition, genders and always walk bare feet inside household in a day were significantly associated with increased 3-PBA metabolite concentration (p-value = 0.041, OR = 0.333, 95%CI 0.116 - 0.956) and (p-value = 0.009, OR = 6.789, 95%CI 1.597 - 28.854), respectively. Hence, these factors could affect the levels of the neurotransmitter GABA in pyrethroids-exposed children. We suggest that should be provided education, awareness and management to reduce the risk from long-term PYR insecticide exposure of children living in households. Key words: 3-PBA metabolite, GABA, hand wipes sample, children, households

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**P-0817**

### **Maternal plasma concentrations of persistent organic pollutants and placental DNA methylation**

**Presenter:** Marion Ouidir, Epidemiology Branch, Division of Intramural Population Health Research, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, United States

**Authors:** M. Ouidir<sup>1</sup>, P. Mendola<sup>1</sup>, G. M. Buck Louis<sup>2</sup>, K. Kannan<sup>3</sup>, C. Zhang<sup>1</sup>, F. Tekola-Ayele<sup>1</sup>;  
<sup>1</sup>Epidemiology Branch, Division of Intramural Population Health Research, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD, <sup>2</sup>Office of the Dean, College of Health and Human Services, George Mason University, Fairfax, VA, <sup>3</sup>Wadsworth Center, New York State Department of Health and Department of Pediatrics, New York University School of Medicine, New York, NY.

**Background/Aim:** Prenatal maternal plasma persistent organic pollutants (POPs) concentrations have been associated with neonatal outcomes; however, the underlying mechanisms remain unknown. Placental epigenetics may be involved but no prior epigenome-wide studies have investigated such mechanisms. We studied the association between POPs in early pregnancy and epigenome-wide placental DNA methylation among 262 pregnant women from the NICHD Fetal Growth Studies. **Methods:** Epigenome-wide analyses using robust adjusted linear regression models were performed for each POP with more than 80% plasma concentration above the limit of quantification; including 3 organochlorine pesticides (hexachlorobenzene, trans-nonachlor, p,p'-dichlorodiphenyldichloroethylene), 1 polybrominated diphenyl ether (PBDE 47), 3 polychlorinated biphenyls (138/158, 153, 180) and 6 poly-and-perfluorinated alkyl substances (PFASs) (perfluorodecanoic acid, perfluorohexanesulfonic acid, perfluorononanoic acid, perfluorooctanesulfonic acid, perfluoroundecanoic acid (PFUnDA)). Genes annotated to the differentially methylated CpGs were tested for enrichment of molecular pathways. **Results:** At 5% false discovery rate, POPs concentrations were associated with a total of 193 differentially methylated CpGs in the placenta (nominal p-values ranging from  $8.37 \times 10^{-21}$  to  $1.52 \times 10^{-7}$ ). Among them, 21 CpGs were significantly correlated with placental expression of 18 unique genes (p-values < 0.05). Notably, PFUnDA was associated with higher methylation of 3 CpGs (cg13996963, cg12089439, cg18145877) annotated to TUSC3. Higher methylation at the three CpGs was correlated with decreased expression of TUSC3 in placenta; and decreased expression of TUSC3 was correlated with smaller birth length. Pathway analysis found that genes annotated to CpGs differentially methylated with PBDE 47 were enriched in birthweight (p-value =  $2.06 \times 10^{-5}$ ) and differentiation of embryonic cells (p-value =  $2.25 \times 10^{-5}$ ), while genes annotated to CpGs associated with PFASs were enriched in brain size (p-value =  $4.09 \times 10^{-4}$ ) and morphology (p-value =  $7.29 \times 10^{-3}$ ). **Conclusions:** The findings give insight into the potential for placental DNA methylation and gene expression mechanism to be involved in the prenatal toxicity of POPs and their associations with fetal growth outcomes.

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## ABSTRACT E-BOOK

Theme: **Pesticides and children**

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**P-0818**

**Prenatal exposure to pesticide mixtures and adolescent externalizing behavior in the CHAMACOS study**

**Presenter:** Carly Hyland, UC Berkeley, Berkeley, United States

**Authors:** C. Hyland, P. Bradshaw, R. B. Gunier, A. M. Mora, K. Kogut, J. Deardorff, S. K. Sagiv, A. Bradman, B. Eskenazi;  
UC Berkeley, Berkeley, CA.

**Background:** Previous studies have shown that prenatal pesticide exposure is associated with adverse child neurodevelopment, however it is unclear whether associations persist into adolescence and young adulthood. Moreover, previous research has focused primarily on exposure to single pesticides or pesticide classes at a time and has not accounted for co-exposure confounding by other pesticides. **Methods:** We implemented a two-stage Bayesian Hierarchical Model (BHM) to examine associations of prenatal exposure to mixtures of pesticides and maternal- and self-reported externalizing behaviors from the Behavior Assessment System for Children, 2<sup>nd</sup> edition (BASC-2) at age 16 years in the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) birth cohort (n=567). We characterized agricultural applications of 11 pesticides from 5 different classes within 3 km of maternal residences during pregnancy using California's Pesticide Use Reporting (PUR) data. **Results:** Associations for most pesticides were near null among all participants and in sex-stratified models, with some suggestive associations with self-reported behavior. Prenatal residential proximity to agricultural applications of imidacloprid, a neonicotinoid insecticide, was associated with more self-reported hyperactivity ( $\beta$  per 2-fold increase = 2.2; 95% Credible Interval (CrI): 0.2, 4.1), sensation seeking ( $\beta=2.2$ ; 95% CI: 0.2, 4.2), and attention problems ( $\beta=2.15$ ; 95% CI: 0.12, 4.13). We observed that associations of residential proximity to imidacloprid applications and self-reported hyperactivity were stronger in boys ( $\beta=3.7$ ; 95% CI: 1.0, 6.4) than girls ( $\beta=1.2$ ; 95% CI: -1.1, 3.4). **Conclusion:** We observed predominantly null associations of prenatal residential proximity to agricultural pesticide use and behavior among CHAMACOS participants at age 16, with some notable associations of proximity to imidacloprid applications and self-reported externalizing behaviors. Imidacloprid is now the most widely used insecticide in the world and additional studies are needed to evaluate its potential developmental neurotoxicity, particularly in the context of correlated exposure to multiple pesticides.

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## ABSTRACT E-BOOK

Theme: **Pesticides and children**

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**P-0819**

**Early life exposure to organophosphate pesticides, behavioral outcomes, and adaptive skills in adolescents from the CHAMACOS study**

**Presenter:** Ana Maria Mora, Universidad Nacional, Heredia, Costa Rica

**Authors:** A. Mora<sup>1</sup>, S. K. Sagiv<sup>2</sup>, S. Rauch<sup>2</sup>, K. Kogut<sup>2</sup>, C. Hyland<sup>2</sup>, R. B. Gunier<sup>2</sup>, J. Deardorff<sup>2</sup>, A. Bradman<sup>2</sup>, B. Eskenazi<sup>2</sup>;

<sup>1</sup>Universidad Nacional, Heredia, COSTA RICA, <sup>2</sup>University of California at Berkeley, Berkeley, CA.

Background: Epidemiologic studies have linked early life exposure to organophosphate (OP) pesticides with poorer cognitive and behavioral development in school age children. However, few studies have examined whether these associations persist into adolescence. Methods: We investigated associations of early life OP pesticide exposure, assessed by measurement of urinary dialkyl phosphate (DAP) metabolites in pregnant women (samples collected at 13 and 26 weeks' gestation) and their children (repeated samples collected from birth to 5 years), with maternal-reported behaviors assessed longitudinally at ages 14, 16, and 18 years using the Behavior Assessment System for Children, 2nd edition (BASC-2) in 335 adolescents participating in the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) study. We used generalized estimating equation models to assess longitudinal effects and examined differences by sex. Results: Median (IQR) prenatal dimethyl phosphate (DM), diethyl phosphate (DE), and total DAP concentrations were 97.8 (47.0-233.5), 23.9 (11.2-44.4), and 128.2 (72.3-290.1) nmol/g creatinine. We observed that higher prenatal creatinine-adjusted DAP concentrations were associated with more maternal-reported hyperactivity ( $\beta$  per 10-fold increase = 2.0; 95% CI: 0.3, 3.7), aggression ( $\beta = 1.5$ ; 95% CI: 0.1, 2.8), and withdrawal ( $\beta = 2.6$ ; 95% CI: 0.6, 4.5), and with poorer adaptability ( $\beta = -2.4$ ; 95% CI: -4.5, -0.2), activities of daily living ( $\beta = -3.3$ ; 95% CI: -5.6, -1.1), and functional communication ( $\beta = -3.3$ ; 95% CI: -5.3, -1.3). Associations were similar for prenatal DMs and generally stronger in boys than in girls. We observed null associations for prenatal DE concentrations and childhood OP pesticide metabolites. Conclusion: Our findings indicate that prenatal, but not childhood, OP pesticide exposure may be associated with behavioral problems and adaptive deficits that persist into adolescence. Public health interventions and public policy changes to protect developing brains from avoidable environmental insults, such as OP pesticides, are warranted.

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Theme: **Pesticides and children**

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**P-0820**

**Prenatal exposure to organophosphate pesticides and executive function in the Norwegian Mother, Father and Child Cohort**

**Presenter:** Jake E Thistle, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, United States

**Authors:** J. E. Thistle<sup>1</sup>, K. R. Roell<sup>1</sup>, G. Choi<sup>1</sup>, G. D. Villanger<sup>2</sup>, S. S. Drover<sup>1</sup>, A. K. Sakhi<sup>2</sup>, C. Thomsen<sup>2</sup>, P. Zeiner<sup>3</sup>, G. Knudsen<sup>2</sup>, T. Reichborn-Kjennerud<sup>4</sup>, K. R. Øvergaard<sup>3</sup>, A. Herring<sup>5</sup>, H. Aase<sup>2</sup>, S. M. Engel<sup>1</sup>;  
<sup>1</sup>Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC,  
<sup>2</sup>Norwegian Institute of Public Health, Oslo, NORWAY, <sup>3</sup>Division of Mental Health and Addiction, Oslo University Hospital, Oslo, NORWAY, <sup>4</sup>Institute of Clinical Medicine, University of Oslo, Oslo, NORWAY,  
<sup>5</sup>Department of Statistical Science and Global Health Institute, Duke University, Durham, NC.

Organophosphate pesticides (OPP) cause acute toxicity by inhibiting acetylcholinesterase, however neurodevelopmental effects have been found at relatively low exposure concentrations. Contamination of conventionally-grown produce with OPPs remains an important exposure route for the general population due to agricultural spraying. Previous research suggests a relationship between prenatal exposure and executive functions (EF), but no studies have performed a detailed assessment inclusive of rater and performance-based measures. Methods: We used data from the preschool ADHD sub-study of the Norwegian Mother, Father, and Child Cohort Study. 262 preschool children with clinical or subclinical ADHD symptoms and 78 typically developing children underwent an on-site evaluation including the Stanford-Binet nonverbal and verbal working memory (WM), the NEPSY-II statue test, and the cookie delay task. Rating-based assessments were the parent-rated Child Behavior Questionnaire (CBQ) and the parent- and preschool teacher-rated Behavior Rating Inventory of Executive Function (BRIEF). Non-specific OPP exposure was estimated by measuring total diethyl ( $\Sigma$ DEP) and dimethylphosphate ( $\Sigma$ DMP) metabolites in urine collected at 17-18 weeks' gestation. Change in EF z-score ( $\beta$ ) and 95% confidence intervals (CI) per log-unit increase in specific gravity standardized exposure was estimated using multivariable linear regression with adjustment for dietary factors and other covariates. Results: There was no consistent pattern of association between log- $\Sigma$ DEP or  $\Sigma$ DMP and performance-based assessments and parent CBQ and BRIEF measures. However, log- $\Sigma$ DMP was associated with more adverse scores on teacher BRIEF scales among preschool children with symptoms of ADHD (emotional control:  $\beta$ =-0.27, 95% CI: -0.53, 0.00; inhibition:  $\beta$ =-0.21, 95% CI: -0.48, 0.05; WM:  $\beta$ =-0.14, 95% CI: -0.41, 0.13) and typically developing children (emotional control:  $\beta$ =-0.27, 95% CI: -0.63, 0.10; inhibition:  $\beta$ =-0.31, 95% CI: -0.68, 0.06; WM:  $\beta$ =-0.34, 95% CI: -0.68, 0.00). Conclusion: We found some evidence that prenatal log- $\Sigma$ DMP was associated with more adverse EF in a population experiencing primarily dietary exposure.

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Theme: **Pesticides and children**

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**P-0822**

**First trimester pesticide-related exposure behaviors and NNNS scores in infants from the SAWASDEE birth cohort**

**Presenter:** Pei Wen Tung, Emory University, Atlanta, United States

**Authors:** P. Tung<sup>1</sup>, D. B. Barr<sup>1</sup>, P. Suttiwan<sup>2</sup>, T. Prapamontol<sup>3</sup>, S. Sittiwang<sup>3</sup>, N. Chayada<sup>3</sup>, P. Panuwet<sup>1</sup>, W. Naksen<sup>3</sup>, N. Fiedler<sup>4</sup>, M. M. Smarr<sup>1</sup>;

<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Chulalongkorn University, Bangkok, THAILAND, <sup>3</sup>Chiang Mai University, Chiang Mai, THAILAND, <sup>4</sup>Rutgers University, Piscataway, NJ.

Background: Prenatal pesticide exposures have been associated with adverse neurodevelopmental outcomes in several studies. A prospective birth cohort, the Study of Asian Women and their Offspring's Development and Environmental Exposures (SAWASDEE) evaluated the association between self-reported pesticide exposure behaviors during early pregnancy and neurodevelopment in infants. We examined behaviors associated with pesticide exposures in occupational settings to further understand potential sources of prenatal pesticide exposure and the implications for neurobehavioral outcomes in infants. Methods: Pregnant women working in agricultural settings provided information on pesticide-related exposures through detailed questionnaires. We investigated their pesticide-related exposure behaviors during the first trimester and their offspring's neurobehavioral outcomes measured by the NICU Network Neurobehavioral Scales (NNNS). Results: Among those with first trimester exposure information, 272 women reported working since their last menstrual cycle. 58% of working women handled and applied fertilizers and 38% handled containers of pesticides. Common crop types were fruit (tangerines and/or longan; 44.41%) and rice (23.90%). Participants reported wearing long-sleeved shirts (84.93%), other protective clothing (boots, apron, waterproof pants; 67.28%) and face covers (i.e. scarf/handkerchief; 52.94%) for personal protection against pesticide exposures. For NNNS scale scores ranging from 1 to 9, average summary scores were  $5.72 \pm 0.81$  for attention,  $3.69 \pm 0.54$  for arousal, and  $6.02 \pm 0.60$  for regulation. Handling scores ranged between 0 and 1, and the average was  $0.20 \pm 0.23$ . Maternal handling of pesticide containers did not increase infant's OR of having poorer attention (crude OR: 1.06; 95% CI: 0.41, 2.69) or arousal scores (crude OR: 1.02, 95% CI: 0.49, 2.13). However, working with tangerines during the first trimester increased infant's OR of having poorer handling scores (crude OR: 3.62; 95% CI: 1.44, 9.11). Conclusions: Prenatal pesticide-related behaviors in agricultural settings can lead to poorer neurobehavioral outcomes in the offspring, as demonstrated with the standardized NNNS summary scores.

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**P-0824**

### **In Utero Glyphosate Exposure and Anogenital Distance in Newborns from The Infant Development and Environment Study (TIDES)**

**Presenter:** Corina Lesseur, Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** C. Lesseur<sup>1</sup>, P. Pirrotte<sup>2</sup>, K. V. Pathak<sup>2</sup>, E. S. Barret<sup>3</sup>, R. H. Nguyen<sup>4</sup>, S. Sathyanarayana<sup>5</sup>, J. Chen<sup>1</sup>, S. H. Swan<sup>1</sup>;

<sup>1</sup>Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Collaborative Center for Translational Mass Spectrometry, Translational Genomics Research Institute, Phoenix, AZ, <sup>3</sup>School of Public Health, Rutgers University, Piscataway, NJ, <sup>4</sup>Department of Epidemiology & Community Health, University of Minnesota, Minneapolis, MN, <sup>5</sup>Department of Pediatrics, University of Washington, Seattle, WA.

**Background:** Human exposure to glyphosate has become ubiquitous as its presence in the environment rises. Recent studies have described some endocrine disrupting effects of glyphosate. Specifically, in our work in rodents we observed an association between gestational exposure to low-dose glyphosate and Roundup® (a glyphosate-based herbicide) and longer anogenital distance (AGD), a marker of the prenatal hormone milieu, in male and female pups, suggesting an androgenic effect. In this pilot human study, we examined relation between in utero glyphosate exposure and newborn AGD. **Methods:** We measured glyphosate and its degradation product aminomethylphosphonic acid (AMPA) in 2nd trimester maternal urine from 100 pregnant women from the TIDES cohort (50 females and 50 males). Study staff obtained two measures of AGD; the anopenile and anoscrotal distances (males) and the anoclitoral and anofourchette distances (females). We used the median glyphosate and AMPA concentration to classify subjects into low and high exposure. The relation between exposure and AGD was evaluated using sex-stratified multivariable linear regression adjusted for age at exam, weight-for-length Z-scores, study center, gestational age, maternal age and urine collection time. **Results:** Glyphosate and AMPA concentrations were above the limits of detection in 95% and 93% of the samples, respectively. Glyphosate and AMPA urinary concentrations were highly correlated ( $r=0.57$ ,  $P=7.6 \times 10^{-10}$ ), with glyphosate levels (median, 0.23 ng/mL) higher than AMPA (median, 0.15 ng/mL). High (above median) glyphosate and AMPA were both statistically significantly ( $P<0.05$ ) associated with increased AGD in females. In males, associations were also positive, but weaker and non-significant. **Conclusion:** These preliminary findings demonstrate measurable glyphosate exposure in the general population, and suggest a link between in utero glyphosate exposure and longer AGD particularly in females. Given the increasing glyphosate exposure in the US population and its potential role as an endocrine disruptor, this prevalent exposure warrants evaluation in larger studies.

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Theme: **Pesticides and children**

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**P-0825**

**Deaths and Poisoning by Agrotoxins in Brazilian States among children under one year and 14 years old. Period 2010 to 2017.**

**Presenter:** PAULO PAZ DE LIMA, ABRAPPS – Brazilian Association of Researchers and Researchers for Social Justice, São Paulo, Brazil

**Authors:** P. PAZ DE LIMA<sup>1</sup>, G. Moraes<sup>2</sup>, T. Nery<sup>3</sup>;

<sup>1</sup>ABRAPPS – Brazilian Association of Researchers and Researchers for Social Justice, São Paulo, BRAZIL,

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Brazil, the world's largest consumer of pesticides. The consequences of this sad reality are disastrous for the population, for the environment, for water contamination, especially for the health of children, whether they live in rural or urban areas. Objective: to analyze pesticide deaths and poisoning among children aged 0 to 14 yo in the Brazilian States (BS). Method: Descriptive cross-sectional study based on data from the Ministry of Health / DATASUS, between 2010 and 2017, by BS and Distrito Federal. Results: 2010 to 2017, 13,420 pesticide poisonings were reported in Brazil, among children 0 to 14 yo.. 82.7% lived in urban areas and 13.9% in rural areas. 50.8% women, 149 cases of intoxications evolved to deaths from poisoning and 280 deaths from other causes or cures with sequelae. The BS with the highest numbers of poisoning notifications were São Paulo (17.2%), Paraná (13.3%), Minas Gerais (13.1%), Pernambuco (9.5) and Goiás (6.1%) . The BS with the highest numbers of deaths were in Pernambuco (21.5%), Ceará (11.4%), Minas Gerais (9.4%) São Paulo (6.7%) and Bahia (6.7%) . Regarding color / ethnicity, black / brown children are the majority, representing 39.5% of the victims; white, 35.7%; 23.6% are ignored, yellow (0.6% and indigenous (0.6%). The Capitals with the highest numbers of intoxications were São Paulo (17.8%), Brasília (9.7%), Salvador (9 , 1%), Recife (8.8%), Curitiba (8.4%) and Fortaleza (7.7%). The consequences of this State policy, only tends to get worse. In 2019, 474 pesticides were released in Brazil .Conclusion: Brazilian children, since very early, are the biggest victims of the impacts of the use and consumption of pesticides in Brazil, an irresponsible and criminal act. The biggest victims of this practice, of consumption, are not in the countryside as imagined, but reside in cities.

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**P-0826**

**Longitudinal exposure to pyrethroids 3-PBA, trans-TCC & 2,4 D herbicides in rural schoolchildren, Maule, Chile.**

**Presenter:** María Teresa Muñoz-Quezada, Universidad Católica del Maule, Talca, Chile

**Authors:** M. Muñoz-Quezada<sup>1</sup>, B. Lucero<sup>1</sup>, V. Iglesias<sup>2</sup>, L. Zúñiga<sup>1</sup>, M. Muñoz<sup>2</sup>, J. Gutiérrez<sup>1</sup>;  
<sup>1</sup>Universidad Católica del Maule, Talca, CHILE, <sup>2</sup>Universidad de Chile, Santiago, CHILE.

Background: Several studies show that early exposure to pesticides and during the preschool and school stage affects the development and health of children. In Maule, a series of studies have shown the exposure of organophosphate pesticides(OP), however, there are no studies assessing exposure to pyrethroids and herbicide 2,4 D. Objective: To evaluate exposure to pyrethroids 3-phenoxybenzoic acid 3-PBA, trans-2,2-(dichloro)-2-dimethylvinylcyclopropane carboxylic acid trans-DCCA(Trans-TCC) and 2,4 D herbicides in schoolchildren. Method: Longitudinal study, 48 schoolchildren from 5 to 13 years old from two rural schools in the Maule. Specific metabolites of pyrethroids 3-PBA, Trans-TCC and 2.4 D in the urine of the school children were evaluated. The data were correlated with an earlier study that evaluated the exposure of OP metabolites. Two samples were taken in September and 2 samples in November, a total of 384 urine samples were obtained during 2016 and 2017. Data analysis: descriptive, U Mann Whitney for repeated measurements, Spearman and GEE. Results: The 100% of schoolchildren have more than two pesticide metabolites in their urine in both years, with the 3-PBA metabolite being the most frequent. 3-PBA in November 2017 increases its presence in urine compared to 2016(from 0.69 µg/L in 2016 to 1.90µg/L in 2017). In 2016, the specific metabolites of 3-PBA correlate with TCC, 2,4 D, chlorpyrifos, diazinon, paration. In 2017, 3-PBA was correlated with 2,4 D and TCC. Importantly, the concentrations of 3-PBA pesticide metabolites in urine found in Chilean children was higher than studies in the USA where there is an association of exposure from prenatal stage to these metabolites with difficulties in emotional control and attention. Conclusions: Promote the monitoring, training and active epidemiological surveillance of agricultural communities. The increased use of pyrethroids is worrying. Promote the intervention of school communities, involving government agencies and agricultural companies, considering preventing to the population.

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Theme: **Pesticides and children**

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**P-0827**

**Bioethics & environmental justice: the case of the presence of pesticides in schoolchildren in rural communities**

**Presenter:** María Teresa Muñoz-Quezada, Universidad Católica del Maule, Talca, Chile

**Authors:** M. Muñoz-Quezada, B. Lucero;  
Universidad Católica del Maule, Talca, CHILE.

Background: Currently, environmental drift due to the application of pesticides has generated various adverse effects on people's health and environmental pollution, as a result of the poor control and prevention of the spraying of the wide variety of pesticides. Objective: to elucidate the situation of exposure to pesticides in rural school communities and apply elements of bioethics and environmental justice to propose a change and actions that improve their quality of life and health. Methods: the scientific literature of the last 15 years was consulted in PubMed and SciELO, books of scientific dissemination, regulations and laws, websites of institutions and papers linked to pesticides in school children and bioethics and environmental justice. The contents of the documents were analyzed and the information was organized into three relevant topics: a) exposure to pesticides in children; b) pesticides and health effects of schoolchildren; and c) situation of exposure to pesticides in Chilean rural schoolchildren. Results: it is observed that the problem of food and environmental harmfulness in Chile is associated with agricultural cultivation and requires a priority discussion at the bioethical level that assesses the responsibility of decision makers in regulating the prioritization of mass production, of the exacerbation of the technoscientific in the rural world, focused on the foreign market over the quality of the internal consumption of Chileans and the right to receive safe products and control the exposure and application of these pollutants in the population. Conclusions: Environmental justice seeks much more than fairness and fair treatment and of similar quality to that of other non-vulnerable communities, seeks to promote that the same rural communities demand the need for a more egalitarian society that ensures the right to live in a clean environment, which at the same time respects its culture and worldview about life and nature.

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**P-0828**

### **Exposure to pyrethroid insecticides among pregnant women and their child in Rio de Janeiro City - Results from a birth cohort (PIPA Project)**

**Presenter:** Amanda Alzira Friaes Martins, Federal University of Rio de Janeiro (UFRJ), Rio de Janeiro, Brazil

**Authors:** A. A. Friaes Martins<sup>1</sup>, A. Souza Espindola Santos<sup>1</sup>, A. C. Simões Rosa<sup>2</sup>, C. Ildes Rodrigues Fróes Asmus<sup>1</sup>, V. de Magalhães Câmara<sup>1</sup>, A. Meyer<sup>1</sup>;

<sup>1</sup>Federal University of Rio de Janeiro (UFRJ), Rio de Janeiro, BRAZIL, <sup>2</sup>Oswaldo Cruz Foundation, Rio de Janeiro, BRAZIL.

**Background/aims:** Pyrethroid insecticides are largely used in Brazil, one of the world's largest consumers of pesticides. We investigated the exposure of pregnant women and their child at the time of birth and 3<sup>rd</sup> month of life to pyrethroids and its association with sociodemographic variables, self-reported diseases, and childbirth outcomes in the City of Rio de Janeiro. Few studies investigate levels of pyrethroid in neonates. **Methods:** We performed a cross-sectional analysis of data from Rio birth cohort (PIPA study). Pregnant women at 3<sup>rd</sup> trimester who received antenatal care at the Federal University of Rio de Janeiro's Maternity School. Mother's sociodemographic, daily habits, existing disease and some birth outcomes about child was collected. Mother's (n=138), newborn's (n=29) and 3-month old child's (n=46) urine samples was analyzed for detection of pyrethroid metabolites 3-PBA and 4-FPBA using liquid chromatography coupled to mass spectrometry. We did a descriptive analysis of the excretion profile of pyrethroids from mothers and their children. **Results:** From all samples, 70% of woman, 28% of newborns, 30% of 3 months old children showed urinary concentrations of pyrethroid metabolites. Pyrethroid metabolites geometric mean (GM) was 0,78 ng mg<sup>-1</sup> for mothers, 0,16 ng mg<sup>-1</sup> for newborns and 0,89 ng mg<sup>-1</sup> at 3<sup>rd</sup> month old. Mother's pyrethroid levels doesn't seem to have relationship with child's pyrethroid levels at follow up. Pregnant women with diabetes excreted higher levels of pyrethroids in the urine (p<0,01); newborns small for gestational age (SGA) excreted higher levels of pyrethroids in the urine (p=0,01); similarly, cephalic perimeter and Apgar was associated with pyrethroid exposure in 3<sup>rd</sup> month old babies (p=0,02; p=0,02). **Conclusions:** Newborns (28%) presented pyrethroids metabolites in urine even at birth. Pyrethroid exposure appears to be related with diabetes in mothers, withsize for gestational age in newborns and with cephalic perimeter and Apgar in 3 months old child.

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**P-0829**

**Insecticide and fungicide exposure and neurodevelopment in preschool children from the Infant's Environmental Health Study (ISA)**

**Presenter:** Jorge Ernesto Peñalosa Castañeda, Universidad Nacional de Costa Rica, Heredia, Costa Rica

**Authors:** J. E. Peñalosa Castañeda<sup>1</sup>, J. Mora Benamburgo<sup>1</sup>, M. Padilla Mora<sup>1</sup>, A. Mora Mora<sup>1</sup>, L. Córdoba Gamboa<sup>1</sup>, B. Eskenazi<sup>2</sup>, C. Lindh<sup>3</sup>, B. van Wendel de Joode<sup>1</sup>;

<sup>1</sup>Universidad Nacional de Costa Rica, Heredia, COSTA RICA, <sup>2</sup>University of California at Berkeley, Berkeley, CA, <sup>3</sup>Division of Occupational Health and Medicine, Lund University, Lund, SWEDEN.

Background: Fungicides and insecticides are extensively used in Costa Rican agriculture and evidence suggests that early-life exposure may impair children's neurodevelopment. We examined whether prenatal and current insecticide and fungicide exposure was associated with neurodevelopmental outcomes in preschoolers from the Infants' Environmental Health Study (ISA). Methods: We measured pesticide metabolite concentrations in maternal and children's urine collected 1-3 times during pregnancy and 1-3 times when children aged 5-6 years. We measured hydroxy-tebuconazole (TEB-OH) and 3,5,6-trichloro-2-pyridinol (TCPy) to evaluate exposure to tebuconazole and chlorpyrifos respectively. We administered the Child Behavior Checklist (CBCL) to the mothers (mean child age=5.7 ± 0.4 years) (n=292). We assessed attention using the Conners K-CPT 2™ and executive-function using the Dimensional Change Card Sorting test (DCCS). We ran separate linear regression models for log-10 transformed prenatal and current metabolite concentrations with CBCL or Conners scores and logistic regression models for DCCS scores, adjusting for relevant covariables. We also examined effect-modification by sex.

Results: Median (p25-p75) specific gravity-adjusted urinary prenatal and current TCPy were: 1.75 (1.31-2.53) and 1.67 (1.17-2.32) µg/L. Current median concentration of TEB-OH were 0.24 (0.14-0.40) µg/L. Higher current TEB-OH concentrations were associated with worse CBCL scores (total scale, β=3.29, 95%CI= 0.26, 6.32, per ten-fold increase in exposure) and particularly among girls (β=6.39, 95%CI 2.17-10.6, per ten-fold increase in exposure). Higher prenatal TCPy concentrations were associated with worse CBCL scores for the internalizing scale in girls (β=5.92, 95%CI= 0.65, 11.2, per ten-fold increase in exposure) but also with decreased hit-time (Conners test) (β=-3.12, 95%CI= -6.07, -0.18, per ten-fold increase in exposure) and worse executive-function scores (DCCS: OR =0.02, 95%CI= 0.00, 0.28) in the entire sample. Conclusion: Results suggest current fungicide exposure negatively affects young children's behavior; effects may be stronger for girls. Also, prenatal exposure to chlorpyrifos may negatively affect children's behavior, attention and executive-function.

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## ABSTRACT E-BOOK

### Theme: Pesticides and children

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**P-0830**

**Does exposure to organophosphate esters during pregnancy increase the risk of attention-deficit hyperactivity disorder in offspring?**

**Presenter:** Giehae Choi, Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, United States

**Authors:** G. Choi<sup>1</sup>, A. P. Keil<sup>1</sup>, D. B. Richardson<sup>1</sup>, J. L. Daniels<sup>1</sup>, K. Hoffman<sup>2</sup>, G. D. Villanger<sup>3</sup>, A. K. Sakhi<sup>3</sup>, C. Thomsen<sup>3</sup>, A. H. Herring<sup>4</sup>, S. S. Drover<sup>1</sup>, S. S. Drover<sup>1</sup>, R. Nethery<sup>5</sup>, H. Aase<sup>3</sup>, S. M. Engel<sup>1</sup>;  
<sup>1</sup>Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC, <sup>2</sup>Nicholas School of the Environment, Duke University, Durham, NC, <sup>3</sup>Norwegian Institute of Public Health, Oslo, NORWAY, <sup>4</sup>Department of Statistical Science and Global Health Institute, Duke University, Durham, NC, <sup>5</sup>Department of Biostatistics, Harvard T.H. Chan School of Public Health, Boston, MA.

**Background.** Elevated organophosphate esters (OPEs) during pregnancy has been associated with hyperactivity and attention problems in children. Such behaviors are often found in children with attention-deficit hyperactivity disorder (ADHD). However, no study has investigated OPEs in relation to clinically diagnosed ADHD.

**Aim.** To evaluate associations between prenatal exposure to OPEs and ADHD diagnosis, in a case-cohort substudy of the Norwegian Mother, Father and Child Cohort.  
**Methods.** We identified 297 ADHD cases through the Norwegian patient registry and sampled a sub-cohort of 555 participants among the eligible population. Diphenyl phosphate (DPHP), di-n-butyl phosphate (DnBP), bis(2-butoxyethyl) hydrogen phosphate (BBOEP), and bis(1,3-dichloro-2-propyl) phosphate (BDCIPP) were measured in urine collected at 17 gestational weeks. Binary exposure indicators were created for DPHP (cutoff: sub-cohort median), DnBP (limit of quantification, LOQ), BBOEP and BDCIPP (limit of detection, LOD). We estimated ORs using logistic regression, adjusting for the season of urine collection, child sex, birth year, maternal depression, maternal ADHD, and phthalate metabolite concentrations. Missing covariates were multiply imputed and estimates were pooled using Rubin's rules. Effect measure modification by child sex was investigated.

**Results.** DPHP was detected in nearly all samples (98%>LOD), with a higher geometric mean among ADHD cases (0.70 ng/ml) as compared to the sub-cohort (0.52 ng/ml). DnBP was commonly detected as well (6%<LOD; 39% LOD-LOQ; 55%>LOQ), while BBOEP (51%>LOD) and BDCIPP (21%>LOD) were detected less frequently. Children whose mothers had above the median DPHP concentrations during pregnancy were more likely to be diagnosed with ADHD (aOR: 1.41 [95% CI: 1.00, 1.99]). Similar positive associations were observed for BDCIPP (1.47 [0.99, 2.17]), but near-null associations were observed for DnBP (0.93 [0.67, 1.30]) and BBOEP (1.05 [0.75, 1.45]). We did not observe strong evidence of modification by child sex.  
**Conclusions.** DPHP and BDCIPP exposure during pregnancy may increase the risk of ADHD in offspring.

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## ABSTRACT E-BOOK

Theme: **Pesticides and children**

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**P-0831**

**The Role of Chemical Mixtures and Stress in World Trade Center-Related Birth Outcomes**

**Presenter:** Miranda Spratlen, Columbia University, New York, United States

**Authors:** M. Spratlen<sup>1</sup>, F. P. Perera<sup>1</sup>, S. A. Lederman<sup>1</sup>, M. Robinson<sup>2</sup>, K. Kannan<sup>2</sup>, J. Herbstman<sup>1</sup>, L. Trasande<sup>3</sup>;

<sup>1</sup>Columbia University, New York, NY, <sup>2</sup>New York State Department of Health, Albany, NY, <sup>3</sup>New York University School of Medicine, New York, NY.

Background: Fetal growth has been shown to be influenced by both maternal stress and exposure to environmental contaminants, including persistent organic pollutants. The terrorist attacks on the World Trade Center (WTC) on September 11, 2001 were a catastrophic disaster and resulted in the release of thousands of tons of chemicals as well as long-lasting psychological stress amongst both responders and New York City residents. Methods: Prenatal demoralization and exposure to persistent organic pollutants (including polybrominated diphenyl ethers, polychlorinated biphenyls, dioxins and perfluoroalkyl substances) were measured in 110 participants from a Columbia University birth cohort designed to study the effects of WTC exposures on pregnancy outcomes and development. Principal component analyses were conducted to characterize the mixture of exposure to the four groups of chemicals. Demoralization was measured using the PERI-D scale, a non-specific measure of psychological stress. We evaluated the associations between proximity to the WTC disaster with chemical exposure principal components and demoralization. We then evaluated the effect these variables had on previously reported associations between proximity to the WTC disaster and birth outcomes in this study population to understand their individual roles in the observed associations. We also evaluated the interactive effects of the chemical principal components and demoralization with birth outcomes. Results: The principal component reflecting higher dioxin exposure (PC4) was associated with proximity to the WTC disaster but there was no association for demoralization. Previously reported significant reductions in birth weight and birth length associated with living <2 miles from the WTC disaster were attenuated and no longer significant after adjusting for PC4. There were no significant interactions between principal components and demoralization with birth outcomes. Conclusions: Our findings suggest chemical exposures, specifically dioxins, explain some but not all of the previously observed associations between proximity to the WTC disaster and adverse birth outcomes.

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## ABSTRACT E-BOOK

Theme: **Pesticides and children**

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**P-0832**

**Prenatal Exposure to organophosphate and pyrethroid pesticides and children's cognitive development at five years in an Urban Cohort of Pregnant Women**

**Presenter:** Arin A. Balalian, Columbia University Mailman School of Public Health, New York, United States

**Authors:** A. A. Balalian, X. Liu, J. Herbstman, P. Factor-Litvak;  
Columbia University Mailman School of Public Health, New York, NY.

**Background/aim:** Pyrethroids and Organophosphate pesticides are used to protect crops and reduce the transmission of insect-borne diseases. Previous studies have found an inverse association between exposure to these pesticides and children's cognitive development. We aimed to investigate the effect of five urinary metabolites of pesticides, including pyrethroids, organophosphates, and 2,4-D herbicide among healthy pregnant women aged 18-43 living in New York City on the cognitive development of the children at five years old. **Methods:** Urinary biomarkers of exposure from 149 women in the Thyroid disruption and infant development cohort were measured. Values  $<LOD$  were assigned the value of  $LOD/(\sqrt{2})$ . The metabolites were divided by urinary creatinine to adjust for specific gravity. Linear regression models were used to evaluate the association between the log of the pesticide concentration adjusted for specific gravity and the child IQ measured by the third version of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-3) at five years old. We adjusted for race/ethnicity, maternal education, marital status, and household income during the prenatal period and maternal IQ, maternal education, and household income at age five. Associations were assessed for boys and girls separately. **Results:** We included 109 children with available WPPSI-3 IQ test measures at age five years in the analysis. We did not find association between prenatal exposure to any of the five pesticides and children's IQ at age five, with and without covariate adjustment in linear models. **Conclusions:** Our results indicated that the children's IQ at age five years may not be associated with prenatal exposure to a group of five organophosphate, pyrethroid pesticides, and 2,4-D herbicide.

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## ABSTRACT E-BOOK

Theme: **Pesticides and children**

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**P-0833**

**Pesticide exposure and health effects in Latin American and the Caribbean populations: A systematic review.**

**Presenter:** Liliana A. Zúñiga-Venegas, Centro de Investigaciones de Estudios Avanzados del Maule (CIEAM), Universidad Católica del Maule; Laboratorio de Investigaciones Biomédicas, Facultad de Medicina, Universidad Católica del Maule, Talca, Chile

**Authors:** L. A. Zúñiga-Venegas<sup>1</sup>, M. T. Muñoz-Quezada<sup>2</sup>, C. Hyland<sup>3</sup>, M. Butinof<sup>4</sup>, G. Calaf<sup>5</sup>, A. J. Handal<sup>6</sup>, L. Quirós-Alcalá<sup>7</sup>, S. Cortés<sup>8</sup>, A. M. Mora<sup>9</sup>;

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**Background:** Growing evidence suggests that exposure to pesticides may be associated with adverse health effects in different population groups, including farmworkers, pregnant women, and children. However, data on the current state of research on this topic in the Latin American and the Caribbean (LAC) region are scarce. We examined the available epidemiological literature on the health effects of pesticide exposure in LAC populations, with the goal of identifying knowledge gaps and capacity building needs. **Methods:** We searched PubMed and SciELO for epidemiological studies on environmental and/or occupational pesticide exposure and human health in LAC populations published between January 2007 and March 2019. Ultimately, 137 papers from 13 countries were selected and grouped by health outcome (genotoxicity and oxidative stress, neurotoxicity, placental effects and teratogenicity, cancer, endocrine disruption, reproductive health, and others). **Results:** Most papers (87%) reported associations of pesticide exposure with at least one of the health outcomes. The most frequently studied health effects included genotoxic and oxidative damage (26%), neurotoxicity (19%), and endocrine disruption (10%). Most published studies were conducted in Brazil (40%) and Mexico (23%), were primarily cross-sectional in design (75%), and examined farmworkers (42%) and children (22%). About half of the published studies used direct methods to assess exposure (e.g., exposure biomarkers; 47%) and were rated as high or intermediate-high quality (44%). **Conclusion:** Despite the small number of published studies and their limitations, our review suggests that pesticides are associated with adverse health outcomes among occupationally and/or environmentally exposed populations. Additional research would allow a better understanding of the potential health effects of pesticides in LAC populations and would help to identify effective intervention. An integration of research initiatives that bridge multiple disciplines and the establishment a regional network of researchers would also help address existing knowledge gaps and capacity building needs.



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## ABSTRACT E-BOOK

Theme: **Pesticides and children**

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**P-0834**

**Exposure to perfluoroalkyl substances is associated with impaired glucose homeostasis in Hispanic youth**

**Presenter:** Jesse Goodrich, University of Southern California, Los Angeles, United States

**Authors:** J. Goodrich<sup>1</sup>, K. Margetaki<sup>1</sup>, X. Hu<sup>2</sup>, T. L. Alderete<sup>3</sup>, D. Walker<sup>4</sup>, D. Valvi<sup>4</sup>, F. Gilliland<sup>1</sup>, Z. Chen<sup>1</sup>, K. Berhane<sup>5</sup>, D. Jones<sup>2</sup>, M. Goran<sup>6</sup>, D. Conti<sup>1</sup>, L. Chatzi<sup>1</sup>;

<sup>1</sup>University of Southern California, Los Angeles, CA, <sup>2</sup>Emory University, Atlanta, GA, <sup>3</sup>University of Colorado Boulder, Boulder, CO, <sup>4</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>5</sup>Columbia University, New York, NY, <sup>6</sup>Children's Hospital of Los Angeles, Los Angeles, CA.

**Background:** Animal studies show that perfluoroalkyl substances contribute to type 2 diabetes pathogenesis, even at low levels of exposure. However, evidence from human studies is inconclusive and largely based on cross-sectional studies in adults. We examined the associations between exposure to perfluorooctanoic acid (PFOA) and measures of glucose metabolism among Hispanic children at risk for type 2 diabetes. **Methods:** Overweight and obese Hispanic children were recruited from urban Los Angeles (N=312, age 7-15 years). All children underwent clinical measures and 2-hour oral glucose tolerance tests (OGTT). Insulin sensitivity was assessed by the Composite Insulin Sensitivity Index (ISI<sub>composite</sub>), and insulin resistance was assessed by the homeostatic model of insulin resistance (HOMA-IR). Plasma levels of PFOA were measured using high resolution mass spectrometry. Multiple linear regression models were used to assess the association between PFOA plasma concentrations and measures of insulin sensitivity and resistance after adjusting for covariates including age, sex, socioeconomic status, pubertal status, and body mass index. **Results:** Each two-fold increase in plasma PFOA was associated with 19.0% increase in HOMA-IR (95% CI: 9.2, 29.8%; p<0.001) and a 13.1% decrease in ISI<sub>composite</sub> (95% CI: -19.8, -5.7%). Plasma PFOA concentrations were also positively associated with fasting glucose and fasting insulin as well as two-hour post OGTT glucose and insulin measures. The effects of PFOA on HOMA-IR and ISI<sub>composite</sub> were similar among boys and girls (both p > 0.2). **Conclusion:** Our results indicated that childhood exposure to PFOA is associated with impaired glucose metabolism in overweight and obese Hispanic youth. Future work is required to elucidate underlying biological mechanisms between PFOA and glucose metabolism.

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Theme: **Pesticides and children**

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**P-0835**

**Residential proximity to greenhouse crops and pesticide exposure (via acetylcholinesterase activity) assessed from childhood through adolescence.**

**Presenter:** Noor Nazeeh, Loma Linda University, Loma Linda, United States

**Authors:** J. R. Suarez-Lopez<sup>1</sup>, N. Nazeeh<sup>2</sup>, G. Kayser<sup>1</sup>, J. Suarez-Torres<sup>3</sup>, H. Checkoway<sup>1</sup>, D. Lopez-Paredes<sup>3</sup>, D. R. Jacobs Jr.<sup>4</sup>, F. de la Cruz<sup>3</sup>;

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**Background:** Off-target drift of pesticides from farms increases the risk of pesticide exposure of people living nearby. Cholinesterase inhibitors (i.e. organophosphates and carbamates) are frequently used in agriculture and inhibit the enzymatic activity of acetylcholinesterase (AChE). Greenhouse agriculture is an important production method, but it is unknown how far pesticide drift from greenhouses can extend and expose people living nearby.

**Methods:** This study included 1145 observations from 3 exams (2008, Apr 2016 and Jul-Oct 2016) of 622 children aged 4-to-17 years living in agricultural communities in Ecuador. AChE and hemoglobin were measured from fingerstick blood samples. Geographic positioning of greenhouses and homes were obtained using GPS receivers and satellite imagery. Distances between homes and the nearest greenhouse edge, and areas of greenhouse crops within various buffer zones around homes were calculated. Repeated-measures regression adjusted for hemoglobin and other covariates estimated change in AChE relative to distance from greenhouses.

**Results:** The pooled mean (SD) of AChE activity was 3.58 U/mL (0.60). The median (25<sup>th</sup>-75<sup>th</sup> %tile) residential distance to crops was 334 m (123, 648) and crop area within 500 m of homes (non-zero values only) was 18,482 m<sup>2</sup> (7115, 61,841). Residential proximity to greenhouse crops was associated with lower AChE activity among children living within 275m of crops (AChE difference per 100m of proximity [95% CI]= -0.07 U/mL [-0.14, -0.002]). Lower AChE activity was associated with greater crop area within 500m of homes (AChE difference per 1000m<sup>2</sup> [95% CI]= -0.02 U/mL [-0.029, -0.010]) and especially within 150m (-0.026 U/mL [-0.046, -0.006]).

**Conclusions:** Residential proximity to floricultural greenhouses, especially within 275m, was associated with lower AChE activity among children, reflecting greater cholinesterase inhibitor exposure from pesticide drift. Analyses of residential proximity and crop areas near homes yielded complementary findings. Mitigation of off-target drift of pesticides from crops onto nearby homes is recommended.

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## ABSTRACT E-BOOK

Theme: **Pesticides and children**

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**P-0836**

**Prenatal exposure to insecticides and child weight trajectories in a South African birth cohort**

**Presenter:** Joanne Kim, Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Montreal, Canada

**Authors:** J. Kim<sup>1</sup>, S. Yang<sup>1</sup>, M. Obida<sup>2</sup>, R. Bornman<sup>2</sup>, B. Eskenazi<sup>3</sup>, J. Chevrier<sup>1</sup>;

<sup>1</sup>Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Montreal, QC,

CANADA, <sup>2</sup>Africa Institute for Sustainable Malaria Control, University of Pretoria, Pretoria, SOUTH AFRICA,

<sup>3</sup>Center for Environmental Research and Children's Health, University of California, Berkeley, CA.

Background: DDT or pyrethroid insecticides are sprayed inside dwellings as part of global malaria vector control programs, resulting in high levels of exposure to millions of people, including pregnant women. These chemicals are endocrine disruptors and may affect child growth. Study Design: The Venda Health Examination of Mothers, Babies and their Environment (VHEMME) is a birth cohort study based in Limpopo, South Africa (n=752). Maternal peripartum concentrations of DDT and its breakdown product DDE were measured in serum and pyrethroid metabolites were measured in urine. Child weight was measured at birth and at 1, 2, 3.5 and 5-year follow-up visits; weight measurements were also abstracted from medical records. Methods: We modelled child weight trajectories using SuperImposition, Translation and Rotation (SITAR) to estimate child-specific weight over time and age at peak weight velocity (APWV). We then estimated associations between insecticides and SITAR parameters using multivariable linear regression. We also investigated whether child sex and maternal energy intake sufficiency during pregnancy modified these associations. Results: Maternal p,p'-DDT was associated with greater weight among girls ( $\beta=14\text{g}$  per 10-fold increase; 95%CI=0, 28) and children of mothers with sufficient energy intake ( $\beta=18\text{g}$  per 10-fold increase; 95%CI=1, 35). We also found that pyrethroids may be associated with lower weight and earlier APWV among boys, particularly for cis-DBCA, which is specific to deltamethrin ( $\beta_{\text{weight}}=-24\text{g}$  per 10-fold increase; 95%CI=-52, 4;  $\beta_{\text{APWV}}=-2.6$  days per 10-fold increase; 95% CI: -5.3, 0.1). Conclusions: Maternal DDT and pyrethroid exposure may be associated with child growth through age 5. Positive associations between p,p'-DDT and weight among girls are consistent with its estrogenic properties, and inverse associations between pyrethroids and weight and APWV among boys may be related to their androgenic properties. These findings, as well as that of effect modification by maternal energy intake, support our previous research in this population.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0837**

### **Plasma concentrations of per- and polyfluoroalkyl substances and body composition from mid-childhood to early adolescence**

**Presenter:** Jaclyn A. Janis, Center for Outcomes Research and Evaluation, Maine Medical Center, Portland, United States

**Authors:** J. A. Janis<sup>1</sup>, S. L. Rifas-Shiman<sup>2</sup>, S. M. Seshasayee<sup>1</sup>, S. Sagiv<sup>3</sup>, C. J. Rosen<sup>4</sup>, E. Oken<sup>2</sup>, A. F. Fleisch<sup>1</sup>;

<sup>1</sup>Center for Outcomes Research and Evaluation, Maine Medical Center, Portland, ME, <sup>2</sup>Division of Chronic Disease Research Across the Lifecourse, Department of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute, Boston, MA, <sup>3</sup>Center for Environmental Research and Children's Health, School of Public Health, University of California, Berkeley, Berkeley, CA, <sup>4</sup>Maine Medical Center Research Institute, Scarborough, ME.

**Background:** Per- and polyfluoroalkyl substances (PFAS) may alter body composition by lowering anabolic hormones and increasing inflammation. Prior studies have shown inconsistent associations between PFAS exposure and fat mass; none have examined lean (i.e., muscle) mass, and there has been limited longitudinal investigation in children. **Methods:** We studied 426 children in the Boston-area Project Viva cohort. We examined associations of plasma concentrations of six PFAS in mid-childhood [median age 7.6 years; 2006-2010] with change in height-adjusted indices of body composition measured by dual-energy X-ray absorptiometry in mid-childhood and early adolescence [median age 12.8 years]. We used linear regression models adjusted for sociodemographics, breastfeeding duration, and other perinatal and child characteristics. We examined effect modification by sex. **Results:** Plasma concentrations were highest for perfluorooctane sulfonate (PFOS) [median (IQR) 6.5 (5.9) ng/mL]. Median (IQR) change in lean mass index was 1.7 (1.6) kg/m<sup>2</sup>, change in total fat mass index was 1.4 (2.2) kg/m<sup>2</sup>, and change in truncal fat mass index was 0.6 (1.0) kg/m<sup>2</sup> from mid-childhood to early adolescence. Greater plasma concentrations of PFOS, perfluorooctanoate, and perfluorodecanoate were associated with less gain in lean mass index [e.g., -0.27 (95% CI: -0.42, -0.11) kg/m<sup>2</sup> for each doubling of PFOS] from mid-childhood to early adolescence. Among girls only, greater plasma concentrations of PFOS were associated with less gain in total and truncal fat mass indices [e.g., change in truncal fat mass index was -0.20 (95% CI: -0.34, -0.05) kg/m<sup>2</sup> for each doubling of PFOS;  $p_{int}=0.04$ ]. **Conclusion:** In a large prospective US cohort, children with greater plasma concentrations of several PFAS had less gain in lean mass through early adolescence. This finding is important in light of emerging evidence suggesting that adolescents with lower muscle mass and strength may have adverse cardiometabolic health.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0838**

### Early-Life Exposure to Polyfluoroalkyl chemicals and ADHD Behavior Problems

**Presenter:** I-Jen Wang, Taipei Hospital Ministry of Health and Welfare; Taichung Hospital Ministry of Health and Welfare; National Taiwan University; National Yang-Ming University; China Medical University, New Taipei City, Taiwan

**Authors:** I. Wang;

Taipei Hospital Ministry of Health and Welfare; Taichung Hospital Ministry of Health and Welfare; National Taiwan University; National Yang-Ming University; China Medical University, New Taipei City, TAIWAN.

Background: Polyfluoroalkyl chemicals (PFCs) have been widely used in consumer products. Exposures in the United States and in world populations are widespread. PFC exposures have been linked to various health impacts, and data in animals suggest that PFCs may be potential developmental neurotoxicants. Little is known about the effect of PFCs on Attention Deficit/Hyperactivity Disorder (ADHD). This study investigated the associations (i) between postnatal PFCs exposure and ADHD in children; and (ii) between PFCs and IgE levels for the possible disease pathogenesis. Methods: A total of 453 children from Childhood Environment and Allergic Diseases Study cohort with urine samples were recruited in Taiwan. Urinary (PFCs) levels were measured by UPLC-MS/MS. The associations between BPAG levels and IgE levels and the risk of ADHD were evaluated by multivariate linear regression and logistic regression. Results: The geometric mean (SD) of PFCS concentrations was 8.84(2.57) ng/ml at age 6. Urinary PFCS levels were positively associated with the risk of ADHD at age 6 ( $\beta=3.21$  KU/I per ln-unit increase PFCS level; 95% CI, 0.99-10.51 KU/I), after adjusting for potential confounders. There was no significant gender difference. The FPCS levels were positively associated with IgE levels at age 6 ( $\beta=64.85$  KU/I per ln-unit increase BPAG level; 95% CI, 14.59-115.11 KU/I). Conclusions: PFCS exposures were positively associated with the risk of ADHD in children

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0839**

### **Prenatal Perfluorooctanoic Acid Exposure is Associated with Childhood Adiposity Trajectories**

**Presenter:** Joseph M Braun, Brown University, Providence, United States

**Authors:** J. M. Braun<sup>1</sup>, M. Elliot<sup>1</sup>, G. Papandonatos<sup>1</sup>, J. Buckley<sup>2</sup>, K. Cecil<sup>3</sup>, A. Chen<sup>4</sup>, K. Kelsey<sup>1</sup>, B. Lanphear<sup>5</sup>, C. Eaton<sup>1</sup>, K. Yolton<sup>3</sup>;

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**Background/Aim:** Gestational exposure to perfluoroalkyl substances (PFAS), a class of ubiquitous and persistent endocrine disrupting chemicals, is associated with increased risk of obesity and cardiometabolic disorders in children. However, it is unclear if PFAS exposure is associated with childhood adiposity trajectories. We examined if prenatal PFAS exposure was associated with children's body mass index (BMI) trajectories from 4 weeks to 12 years of age. **Methods:** In 295 mother-child pairs from Cincinnati, OH (enrolled 2003-2006), we measured perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid, perfluorononaic acid, and perfluorohexanesulfonic acid concentrations in maternal serum collected at 16-weeks gestation. At ages 4 weeks and 1, 2, 3, 4, 5, 8, and 12 years, we measured weight and length/height and calculated child BMI (1,827 repeated measures). Using linear mixed models and splines to account for repeated BMI measures and non-linear BMI patterns, respectively, we estimated BMI trajectories as a function of child age for PFAS tertiles, adjusting for covariates. **Results:** BMI trajectories varied by prenatal PFOA in a non-monotonic fashion. Compared with children in the 1<sup>st</sup> PFOA tertile, children in the 2<sup>nd</sup> tertile had lower BMI at age 4 weeks, an earlier adiposity nadir (-0.5 years, 95% CI:-1.1, 0.1), and higher BMI at age 12 years (2.2 kg/m<sup>2</sup>, 95% CI:1.0, 3.4). In contrast, children in the 3<sup>rd</sup> tertile had on average 0.3 to 0.5 kg/m<sup>2</sup> lower BMI values in the first five years of life, accelerated BMI gains between 8 and 12 years, and an earlier adiposity nadir (-0.3 years, 95% CI:-0.3, 0.0). We observed similar patterns for perfluorononaic acid, but not other PFAS. **Conclusion:** These results suggest that higher gestational PFOA exposure is associated with BMI patterns in children that have been linked to later life obesity and cardiometabolic disease.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0840**

### **Systematic map of the epidemiology evidence for health effects of 150 data poor per- and polyfluoroalkyl substances (PFAS)**

**Presenter:** Elizabeth Grace Radke, U.S. EPA, Washington, United States

**Authors:** E. G. Radke<sup>1</sup>, M. J. Wright<sup>2</sup>, K. Christensen<sup>1</sup>, R. Nachman<sup>1</sup>, C. J. Lin<sup>3</sup>, A. E. Goldstone<sup>3</sup>, K. Thayer<sup>4</sup>;

<sup>1</sup>U.S. EPA, Washington, DC, <sup>2</sup>U.S. EPA, Cincinnati, OH, <sup>3</sup>ICF, Durham, NC, <sup>4</sup>U.S. EPA, Durham, NC.

Introduction: Per- and polyfluoroalkyl substances (PFAS) are a group of chemicals with widespread use and persistence in the environment and in humans. They are a public health concern, but much of the research to date has focused on a small subset of PFAS, such as perfluorooctanoic acid (PFOA), with much less information available on the health effects associated with other chemicals in the class. Methods: We created a systematic evidence map of epidemiology studies for 150 PFAS. This included literature search and screening, study evaluation focused on risk of bias and sensitivity of the available studies, and extraction of health effect results. Results: Eighty-seven studies were identified with data on at least one health effect. All the studies evaluated exposure to multiple PFAS. Most PFAS (93%, 140/150) had zero studies identified. Among the remaining ten, six had 2-10 studies, three had 11-20 studies, and one (perfluoroundecanoic acid) had 68 studies. The most frequent health effects reported in these studies were reproductive (20), developmental (17), endocrine (16), metabolic (14), and cardiovascular (14). The majority were cross-sectional (47), followed by cohort (36) and case-control (11). In many cases, a large proportion of participants had exposure below the detection limit to the PFAS of interest, which will reduce statistical power and the ability to detect an effect. Discussion: Gaps in the database will limit the ability to draw conclusions about causal associations between these PFAS and associated health effects, and further study is complicated by the large number of PFAS (several thousand) and relatively low levels of exposure in the general population. Regardless, this is an important area to address due to their persistence and the potential for increasing usage as these PFAS are substituted into chemical processes that previously used high-profile PFAS.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0841**

**Analysis of the association between serum PFAS levels measured in NHANES and subsequent development of stroke or myocardial infarction as assessed through linked Medicare claims data**

**Presenter:** Andrea Winquist, U.S. Centers for Disease Control and Prevention, Atlanta, United States

**Authors:** A. Winquist, J. Daniel;  
U.S. Centers for Disease Control and Prevention, Atlanta, GA.

**Background/Aim:** Per- and polyfluoroalkyl substances (PFAS) are persistent chemicals used in many products and manufacturing processes. Human exposure to some PFAS has been associated with serum cholesterol concentrations, but observed cardiovascular disease (CVD) associations have been inconsistent. Previous cross-sectional analyses of PFAS-CVD associations used U.S. National Health and Nutrition Examination Survey (NHANES) data. We prospectively examined associations between NHANES serum PFAS concentrations and subsequent myocardial infarction (MI), ischemic stroke (IS) or any stroke (AS), using linked National Death Index and Medicare claims data, for participants aged  $\geq 65$  years with PFAS measurements and Medicare fee-for-service enrollment (study population). **Methods:** NHANES (1999-2000, 2003-2012) serum PFAS concentrations [perfluorooctane sulfonate, perfluorooctanoic acid (PFOA), perfluorononanoic acid, perfluorohexane sulfonate] were analyzed using quartile (among cases) indicator variables and the natural log of quartile geometric means (continuous variable, trend test). CVD outcomes occurring after serum collection were identified, among participants reporting no prior history of the outcome, using linked (through 2013) Medicare claims ICD-9-CM codes and underlying cause-of-death ICD-10 codes. Survival analysis models with an age time scale; weighted to account for survey design and Medicare matching; and stratified on body mass index; controlled for survey cycle, age, gender, race/ethnicity, smoking, alcohol consumption, physical activity, education, and income-to-poverty ratio.

**Results:** Among 1248 in the study population, 1078 reported no prior MI (72 developed MI) and 1102 reported no prior stroke (67 developed IS; 78 developed AS). Quartile-specific hazard ratios (HRs) and trends for all PFAS-outcome combinations were not statistically significant, but some elevated HRs were observed [e.g., IS HRs (95% confidence intervals) for PFOA quartiles 2-4 vs. 1: 2.04 (0.79-5.28), 1.98 (0.75-5.19), 1.63 (0.61-4.36)].

**Conclusions:** This analysis did not provide clear evidence of an association between serum PFAS concentrations and MI, IS, or AS. Results should be interpreted considering study limitations (e.g., limited power, single exposure measurement).

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0842**

### **Gestational perfluoroalkyl substance exposures and early adolescent bone mineral density in the HOME Study**

**Presenter:** Jessie P Buckley, Johns Hopkins Bloomberg School of Public Health, Baltimore, United States

**Authors:** J. P. Buckley<sup>1</sup>, J. R. Kuiper<sup>1</sup>, B. P. Lanphear<sup>2</sup>, K. M. Cecil<sup>3</sup>, A. Chen<sup>4</sup>, K. Yolton<sup>3</sup>, H. J. Kalkwarf<sup>3</sup>, J. M. Braun<sup>5</sup>;

<sup>1</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>2</sup>Simon Fraser University, Vancouver, BC, CANADA, <sup>3</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>4</sup>University of Cincinnati, Cincinnati, OH, <sup>5</sup>Brown University, Providence, RI.

**Background/Aim:** Perfluoroalkyl substances (PFAS) may impair bone health via endocrine disruption and nuclear hormone receptor activation. Bone mineral accrual during adolescence is important for long-term bone health, but human studies of PFAS and bone mineral density are primarily in adults or use a cross-sectional study design. We estimated associations of gestational PFAS exposures with early adolescent areal bone mineral density (aBMD) in a prospective cohort study. **Methods:** We examined 225 pregnant mothers enrolled from 2003-2006 in Cincinnati, OH and their children in the HOME Study. We measured concentrations of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), and perfluorohexanesulfonic acid (PFHxS) in maternal serum collected at 16 weeks gestation. When children were 12 years old, we measured lean body mass and total body, spine, total hip, femoral neck, and distal forearm (1/3 radius) aBMD with dual x-ray absorptiometry and calculated height-, age-, sex-, and race-specific aBMD z-scores. Using linear regression, we estimated covariate-adjusted associations in aBMD z-scores per doubling of gestational PFAS concentrations overall and stratified by sex. We estimated the proportion of total effects that were mediated by lean mass using structural equation modeling. **Results:** In adjusted models, higher PFOA concentrations were associated with lower aBMD z-scores of the forearm ( $\beta$ : -0.28, 95% CI: -0.49, -0.08), total hip ( $\beta$ : -0.28, 95% CI: -0.54, -0.02), and spine ( $\beta$ : -0.34, 95% CI: -0.61, -0.06) in males but not females. Lean mass mediated 29-50% of these associations. Higher PFHxS and PFNA concentrations were associated with lower aBMD z-scores of the forearm (PFHxS  $\beta$ : -0.11, 95% CI: -0.23, 0.00; PFNA  $\beta$ : -0.14, 95% CI: -0.35, 0.06), with no modification by sex or mediation by lean mass. PFOS was not associated with aBMD measures in either sex. **Conclusions:** Gestational PFAS exposures may reduce bone accrual in early adolescence, possibly in a sex-dependent manner.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0843**

**Serum per- and polyfluoroalkyl substances in relation to hearing loss**

**Presenter:** Ming-Chieh Li, China Medical University, Taichung, Taiwan

**Authors:** M. Li;  
China Medical University, Taichung, TAIWAN.

Background: Studies have shown that per- and polyfluoroalkyl substances (PFAS) are potential ototoxicants. However, no epidemiologic study has been conducted. We conducted a cross-sectional study to examine the associations of PFAS with hearing impairment. Methods: This study included data from the National Health and Nutrition Examination Survey (NHANES) 1999-2000, 2003-06, and 2009-14 because only these year cycles contained all the information we needed. Perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), perfluorohexane sulfonic acid (PFHxS), perfluorononanoic acid (PFNA), and perfluorodecanoic acid (PFDA) were measured in serum samples. Participants were divided into quartiles for each PFAS. Air conduction pure-tone audiometry was administered. Hearing impairment was defined as an average hearing threshold of more than 25dB at each hearing frequency. We assessed the relation of serum PFAS with hearing impairment by the generalized linear mixed model with a logit link and binary distribution. Tests for linear trend across quartiles of serum PFAS were conducted using the median serum PFAS in each quartile as a continuous variable. Results: A total of 2525 participants (women = 53.4%) aged 20 or above were included into the final analysis. After adjusted for age, sex, body mass index, education, ethnicity group, family income, and sampling weights, we found positive correlations between PFOA and hearing impairment at 2000 Hz (p-trend = 0.02) and 3000 Hz (p-trend = 0.01); between PFOS and hearing impairment at 2000 Hz (p-trend < 0.01) and 3000 Hz (p-trend = 0.01); between PFNA and hearing impairment at 3000 Hz (p-trend < 0.01), 4000 Hz (p-trend < 0.01), and 8000 Hz (p-trend = 0.03); between PFHxS and hearing impairment at 500 Hz (p-trend = 0.02), 1000 Hz (p-trend = 0.01), 2000 Hz (p-trend < 0.01), and 3000 Hz (p-trend = 0.03). Conclusion: Background serum PFASs are correlated with hearing impairment in the United States adult population.

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## ABSTRACT E-BOOK

Theme: **PFAS**

**P-0844**

### **Gestational and Childhood Exposure to Per- and Polyfluoroalkyl Substances and Children's Cardiometabolic Risk at Age 12 Years**

**Presenter:** Nan Li, Brown University, Providence, United States

**Authors:** N. Li<sup>1</sup>, Y. Liu<sup>1</sup>, G. Papandonatos<sup>1</sup>, A. Calafat<sup>2</sup>, K. Yolton<sup>3</sup>, B. Lanphear<sup>4</sup>, A. Chen<sup>3</sup>, J. Braun<sup>1</sup>;  
<sup>1</sup>Brown University, Providence, RI, <sup>2</sup>Centers for Disease Control and Prevention, Atlanta, GA, <sup>3</sup>University of Cincinnati College of Medicine, Cincinnati, OH, <sup>4</sup>Simon Fraser University, Burnaby, BC, CANADA.

**Background/Aim:** Per- and polyfluoroalkyl substances (PFAS) may adversely influence cardiometabolic risk by activating peroxisome proliferator-activated receptors and increasing cortisol levels. We examined the influence of gestational and childhood PFAS exposure on adolescent cardiometabolic risk. **Methods:** We quantified concentrations of four PFAS- (perfluorooctanoate [PFOA], perfluorooctane sulfonate, perfluorononanoate, and perfluorohexane sulfonate [PFHxS])- in sera collected during pregnancy, at birth, and at ages 3, 8, and 12 years for 221 mother-child pairs in the HOME Study (Cincinnati, Ohio). We assessed cardiometabolic outcomes using biological markers (after overnight fasting) and dual-energy X-ray absorptiometry scans at age 12 years. Overall cardiometabolic risk was assessed by summing population-specific standardized z-scores for homeostatic model assessment of insulin resistance (HOMA-IR), triglyceride to high-density lipoprotein ratio, adiponectin to leptin ratio (multiplied by -1), systolic blood pressure, and percent visceral fat. We used multiple informant models to estimate covariate-adjusted associations of serum PFAS concentrations (log<sub>2</sub>-transformed) at each visit with overall cardiometabolic risk score and its individual components, tested for differences in associations across visits. **Results:** Gestational and cord blood PFOA concentrations were positively associated with cardiometabolic risk score (gestational  $\beta=0.7$ , 95% confidence interval [CI]=0.0, 1.4; cord  $\beta=0.8$ , 95%CI=0.0, 1.6). In contrast, PFOA concentrations at other visits were not associated with cardiometabolic risk score (P for heterogeneity across visits=0.03). The positive associations for gestational PFOA were mainly driven by HOMA-IR ( $\beta=0.3$ ; 95% CI: 0.1, 0.5), adiponectin/leptin ratio ( $\beta=-0.5$ ; 95% CI: -1.0, 0), and percent visceral fat ( $\beta=2.6\%$ ; 95% CI: 0.4, 4.8). Similarly, gestational and cord PFHxS were associated with higher cardiometabolic risk score ( $\beta$ s [95%CIs]: gestational 0.8 [0.2, 1.4]; cord 1.0 [0.3, 1.7]), and the associations were driven by the similar individual components. No effect measure modification by child sex was identified. **Conclusions:** Gestational PFOA and PFHxS exposure are moderately associated with unfavorable cardiometabolic risk in children at age 12 years.

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## ABSTRACT E-BOOK

Theme: **PFAS**

**P-0845**

### **Perfluoroalkyl and polyfluoroalkyl substances and incidence of uterine leiomyomata: a prospective ultrasound study**

**Presenter:** Lauren Anne Wise, Boston University School of Public Health, Boston, United States

**Authors:** L. A. Wise<sup>1</sup>, A. K. Wesselink<sup>1</sup>, B. Claus Henn<sup>1</sup>, D. Baird<sup>2</sup>;

<sup>1</sup>Boston University School of Public Health, Boston, MA, <sup>2</sup>National Institute of Environmental Health Sciences, Durham, NC.

**Background:** Per- and polyfluoroalkyl substances (PFAS) are persistent synthetic endocrine-disrupting chemicals used in commercial and consumer products, including non-stick coatings, carpeting, and food packaging. We hypothesized that PFAS exposure would influence the incidence of uterine leiomyomata (UL), hormone-dependent neoplasms that are a major source of reproductive morbidity. **Methods:** We examined the association between PFAS exposure and UL incidence among 1,158 participants from the Study of Environment, Lifestyle, and Fibroids (SELF), a Detroit-based prospective cohort study of Black women aged 23-35 years. At baseline, we collected demographic, behavioral, and medical data via self-administered questionnaires, telephone interviews, and in-person clinic visits. We also measured seven PFAS in non-fasting baseline plasma using liquid chromatography-tandem mass spectrometry (MeFOSAA, PFDA, PFHxS, PFNA, PFUnDA, PFOA, PFOS). Participants underwent transvaginal ultrasound to detect UL at baseline and follow-up (20, 40, 60 months). We estimated hazard ratios (HRs) and 95% confidence intervals (CIs) from Cox models adjusted for age, SES, lifestyle, anthropometrics, and reproductive history. We stratified by parity, which was inversely associated with UL and PFAS. **Results:** During 60 months of follow-up, we identified 269 incident UL cases. PFHxS, PFNA, PFOA, and PFOS were detected in  $\geq 97\%$  of women; PFDA in 85%, MeFOSAA in 69%; and PFUnDA in 47%. UL incidence was inversely associated with MeFOSAA ( $\geq 0.5$  ng/ml vs. non-detected: HR=0.56, CI=0.32-0.97), PFDA ( $\geq 0.5$  ng/ml vs. non-detected: HR=0.59, CI=0.34-1.03), and PFUnDA (detected vs. non-detected: HR=0.70, CI=0.54-0.90), and positively associated with PFHxS ( $\geq 1.5$  vs.  $< 0.4$  ng/ml: HR=1.20, CI=0.75-1.90). PFOA, PFOS, or PFNA showed little association. Parity-stratified results were similar, with the exception of PFHxS, for which a stronger association was observed among parous women ( $< 0.4$  vs.  $\geq 1.5$  ng/ml: HR=1.67, CI=0.89-3.16). **Conclusions:** We provide the first epidemiologic evidence on PFAS exposure and UL incidence, indicating positive associations with PFHxS and inverse associations with MeFOSAA, PFDA, and PFUnDA.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0846**

### **ATSDR's PFAS Exposure Assessments: Results from Communities with Known Past Drinking Water Concentrations Greater than EPA's Health Advisory**

**Presenter:** Brad Goodwin, ATSDR, Atlanta, United States

**Authors:** B. Goodwin, K. Scruton, P. Kowalski, A. Pomales, J. Sautner, C. Reh, R. Rogers; ATSDR, Atlanta, GA.

The Agency for Toxic Substances and Disease Registry (ATSDR) is conducting exposure assessments (EAs) for per- and polyfluoroalkyl substances (PFAS) in selected communities with known PFAS contamination in drinking water near current or former military installations in the United States. Concentrations of PFAS were measured in serum and urine and exposure information was collected through a questionnaire. Tap water and indoor dust samples from a subset of participant homes were also analyzed for PFAS. These EAs provide the first large scale, multi-site analysis of PFAS body burden in communities with known PFAS concentrations in drinking water above the US Environmental Protection Agency's (EPA's) health advisory. ATSDR will complete data collection in June 2020. ATSDR compared aggregate EA concentrations of PFAS in serum and urine to national averages from the most recent National Health and Nutrition Examination Survey (NHANES). ATSDR compared tap water concentrations of PFOA and PFOS to EPA's health advisory. ATSDR presents PFAS concentrations in indoor dust to show the range found in participant homes. There is currently no benchmark to which PFAS dust concentrations can be compared. Biomonitoring results are interpreted using exposure data collected from the questionnaire (drinking water consumption rate, demographics, duration of residence, occupational history, etc.). In this presentation, ATSDR will present and discuss aggregate community-level results for four exposure assessment sites. The preliminary findings and conclusions are those of the authors and do not necessarily represent the views of the Agency for Toxic Substances and Disease Registry/Centers for Disease Control (ATSDR/CDC). The full manuscript is currently under development and has not yet been approved by ATSDR/CDC.

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## ABSTRACT E-BOOK

Theme: PFAS

P-0847

### Cross-Sectional Associations of Plasma Per- and Polyfluoroalkyl Substances with Kidney Function among Pre-Diabetic Adults-Report from the Diabetes Prevention Program

**Presenter:** Pi-i D. Lin, Harvard Pilgrim Health Care Institute and Harvard Medical School, Boston, United States

**Authors:** P. D. Lin<sup>1</sup>, A. Cardenas<sup>2</sup>, R. Hauser<sup>3</sup>, D. R. Gold<sup>4</sup>, M. Hivert<sup>1</sup>, T. F. Webster<sup>5</sup>, E. S. Horton<sup>6</sup>, E. Oken<sup>1</sup>;

<sup>1</sup>Harvard Pilgrim Health Care Institute and Harvard Medical School, Boston, MA, <sup>2</sup>University of California, Berkeley, School of Public Health, Berkeley, CA, <sup>3</sup>Harvard T.H. Chan School of Public Health, Department of Environmental Health, Boston, MA, <sup>4</sup>Brigham and Women's Hospital, Channing Division of Network Medicine, Boston, MA, <sup>5</sup>Boston University School of Public Health, Department of Environmental Health, Boston, MA, <sup>6</sup>Harvard Medical School, Joslin Diabetes Center, Boston, MA.

**Background:** Exposure to per- and polyfluoroalkyl substances (PFAS) has been linked with kidney cancer and reduced kidney function, but findings for plasma PFAS concentrations and kidney function are inconsistent. We evaluated cross-sectional associations of plasma concentrations of 6 PFAS [perfluorooctane sulfonate, perfluorooctanoate (PFOA), perfluorohexane sulfonate, N-ethyl-perfluorooctane sulfonamido acetate (EtFOSAA), N-methyl-perfluorooctane sulfonamido acetate, and perfluorononanoate] with estimated glomerular filtration rate (eGFR) and albumin-to-creatinine ratio (ACR) among prediabetic adults at risk for kidney disease. **Methods:** We used baseline data from the Diabetes Prevention Program (enrolled 1996-1999) and applied linear regression to estimate associations between plasma PFAS concentrations (log-2 transformed) with eGFR and ACR. We accounted for sex, age, race, marital status, income, smoking, menopause status, medication use, and diet score in the models, and tested for effect modification by sex and hypertension status. **Results:** Plasma PFAS concentrations of 925 overweight or obese adults (64.9% female, 57.8% non-Hispanic White) and those among the U.S. population were similar. Mean kidney functions were normal (eGFR:  $97.3 \pm 15.5$  ml/min/1.73m<sup>2</sup>; ACR:  $11.2 \pm 30.5$ ). We found no significant associations between PFAS concentrations and eGFR but detected inverse associations of EtFOSAA [ $\beta$ : -3.7 (95% CI: -7.1, -0.3)] and PFOA [ $\beta$ : -6.4 (95% CI: -12.3, -0.1)] with ACR. We observed potential effect modification by hypertension status (inverse associations among those with hypertension but positive associations among those without hypertension), but none of the effect estimates were statistically significant. **Conclusions:** We observed weak inverse associations between plasma concentrations of some PFAS with ACR, suggesting higher plasma PFAS concentrations are associated with lower microalbumin ratio in the urine, thus better kidney function. Our main limitation is the potential for reverse causation due to the cross-sectional nature of the data. Longitudinal studies are needed to establish temporality of associations.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0848**

### **A Community Survey of Residents Impacted by Per- and Polyfluoroalkyl Substance (PFAS) Contamination from a Manufacturing Facility—North Carolina, 2019**

**Presenter:** Jamie Pritchett, NC Department of Health and Human Services, Raleigh, United States

**Authors:** J. Pritchett, B. Dittman, A. Christensen, A. Graham, K. Gaetz, V. Guidry, Z. Moore; NC Department of Health and Human Services, Raleigh, NC.

**BACKGROUND:** In June 2017, the North Carolina Department of Environmental Quality began investigating contamination of the Cape Fear River with GenX and other per- and polyfluoroalkyl substances (PFAS). The source of these chemicals was the Chemours Fayetteville Works Facility, a PFAS manufacturing facility. In early 2019, the North Carolina Department of Health and Human Services (NCDHHS) surveyed residents living within 10 miles of Chemours to better understand their concerns related to PFAS and the impacts these chemicals have had on residents' lives.

**METHODS:** We obtained addresses through a data and marketing company and mailed surveys to all 15,319 residences within a 10-mile radius of Chemours. Surveys included questions about drinking water, activities around the home and community, health concerns, and communication preferences. We performed quantitative analyses using SAS 9.4 and qualitative analyses using NVivo 12 Plus.

**RESULTS:** We received responses from 1,858 households (12%). Thirty-four percent (N=543/1,585) of households reported changes in water usage, even if the level of GenX in their drinking water was below the NCDHHS provisional drinking water health goal. Thirty-eight percent (N=709/1,858) of respondents reported decreases or changes in other activities, such as fishing and gardening, after learning about PFAS in their community. Forty-four percent (N=615/1,409) of respondents expressed concerns about potential health effects, particularly cancer. Community members desired more information about PFAS and preferred information by mail.

**CONCLUSIONS:** Contamination from PFAS has had negative impacts on communities near Chemours, including concerns about potential health effects and changes in daily activities, many of which are important for health and well-being. Agencies and other stakeholders responding to environmental contamination in this area need to take more steps to address these impacts by providing better outreach and more timely action. These survey results will help improve outreach and tailor health education activities to better meet the community's needs.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0849**

**PFAS and cholesterol in epidemiological studies: causality, biomarkers, mixtures and relative potency**

**Presenter:** Tony Fletcher, LSHTM, London, United Kingdom

**Authors:** T. Fletcher<sup>1</sup>, T. Webster<sup>2</sup>;

<sup>1</sup>LSHTM, London, UNITED KINGDOM, <sup>2</sup>BUSPH, Boston, MA.

Concern continues about adverse effects, including raised cholesterol, associated with perfluorinated substances (PFAS) in general and perfluoro-octanoic acid (PFOA) in particular, and whether all associations are truly causal. There have been numerous epidemiological studies of blood concentrations (usually cross-sectional studies of serum concentrations) of PFOA and cholesterol. In addition to the usual sources of potential confounding, using serum PFOA as the exposure raises the possibility of confounding by physiology, for example, enterohepatic recirculation and correlated absorption of both PFAS and bile acids or cholesterol. Mechanistic toxicology studies of the pharmacodynamics of PFOA and cholesterol may shed light on the plausibility of these various causal and artefactual contributions to the associations, but the large and complex C8 dataset offers the possibility of assessing directly the strength of the epidemiological evidence in favour of this association being causal. District level measures of exposure offer a way of addressing exposure response immune from confounding by physiology, acting as instrumental variables for exposure. For 40,000 adults 18+ in the C8 study population, there was a strong and significant association of cholesterol, in relation to serum PFOA, adjusting for sex, age, race and other measured potential confounders. New results using the instrumental variable approach by water district contamination level showed a similar, significant dose response, and the concordance of the two approaches strongly supports a causal interpretation of the association. Comparison of slopes suggests that about half of the association with PFOA in single pollutant models is explained by confounding. A similar change in slope is achieved in cross sectional analyses by adding adjustment for other PFASs in the blood. Slopes for each PFAS in multi-pollutant models thus allow the estimation of relative potency which is helpful for risk assessment in populations with mixed PFAS exposure.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0850**

### **Prenatal exposure to per- and polyfluoroalkyl substances in association with autism spectrum disorder in the MARBLES study**

**Presenter:** Jiwon Oh, University of Texas, Arlington, United States

**Authors:** J. Oh<sup>1</sup>, D. H. Bennett<sup>2</sup>, A. M. Calafat<sup>3</sup>, D. Tancredi<sup>2</sup>, D. L. Roa<sup>4</sup>, R. J. Schmidt<sup>2</sup>, I. Hertz-Picciotto<sup>2</sup>, H. Shin<sup>1</sup>;

<sup>1</sup>University of Texas, Arlington, TX, <sup>2</sup>University of California, Davis, CA, <sup>3</sup>Centers for Disease Control and Prevention, Atlanta, GA, <sup>4</sup>UC Davis MIND (Medical Investigations of Neurodevelopmental Disorders) Institute, Sacramento, CA.

**Background/Aim:** Prenatal exposure to per- and polyfluoroalkyl substances (PFAS) may adversely affect child brain development, but epidemiologic evidence remains inconsistent. We examined whether prenatal PFAS exposure was associated with increased risk of autism spectrum disorder (ASD). **Methods:** Participants were 204 mother-child pairs from MARBLES (Markers of Autism Risk in Babies - Learning Early Signs), which followed younger siblings of children with ASD. Children were clinically classified into ASD ( $n = 57$ ), non-typical development (Non-TD,  $n = 31$ ), and typical development (TD,  $n = 116$ ). We quantified nine PFAS in maternal sera prospectively collected throughout pregnancy. Of 312 samples, 67, 142, and 103 samples were collected from the first, second, and third trimesters, respectively. We used multinomial logistic regression to investigate associations of individual PFAS concentrations with the risk of ASD and Non-TD.

**Results:** Overall, most associations of average prenatal maternal PFAS serum concentrations with the risk of ASD and Non-TD were statistically insignificant. When restricting analyses to each trimester, perfluorooctanoate (PFOA) was associated with increased risk of ASD in the third trimester (RRR = 3.58, 95% CI: 1.01, 12.6). When stratified by maternal age at delivery ( $<35$ ,  $\geq 35$  years), among mothers  $\geq 35$  years old at delivery, ASD risk was associated with prenatal PFOA (RRR = 8.84, 95% CI: 1.70, 46.1), perfluorononanoate (RRR = 7.03, 95% CI: 1.35, 11.7), and perfluorodecanoate (RRR = 3.37, 95% CI: 1.04, 10.9).

**Conclusions:** We found evidence that prenatal exposure to some PFAS was associated with increased risk of ASD among children whose mothers were 35 years old or older at delivery. Further studies should be conducted in the general population to confirm our findings.

**Keywords:** autism spectrum disorder, maternal serum, PFAS

**Disclaimer:** The findings and conclusions in this abstract are those of the authors and do not necessarily represent the views of the CDC.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0851**

### Exposure to Perfluorinated Compounds and Human Sperm Aneuploidy

**Presenter:** Heather A Young, George Washington University, Washington, United States

**Authors:** H. A. Young<sup>1</sup>, M. J. Perry<sup>1</sup>, P. Grandjean<sup>2</sup>, J. Halling<sup>3</sup>, N. Jorgensen<sup>4</sup>, N. Gasquet<sup>1</sup>, P. Weihe<sup>3</sup>, M. S. Petersen<sup>3</sup>;

<sup>1</sup>George Washington University, Washington, DC, <sup>2</sup>University of Southern Denmark, Odense, DENMARK,

<sup>3</sup>Faroese Hospital System, Torshavn, FAROE ISLANDS, <sup>4</sup>Rigshospitalet, Copenhagen, DENMARK.

Exposure to Perfluorinated Compounds and Human Sperm Aneuploidy Background: Sperm chromosomal abnormalities linked to infertility may be caused by environmental endocrine disrupting chemicals such as perfluoroalkyl and polyfluoroalkyl substances (PFASs). Relatively few studies have investigated the potential effects of PFAS exposure on male reproductive function, although some studies suggest effects on semen quality and concentration as well as reproductive hormone levels. Aim: We examined whether concurrent exposure to PFASs or blood concentrations measured at birth, ages 7, 14, 22, and 28 predicted sperm chromosomal abnormalities in adulthood. Methods: Serum and semen samples were obtained from 146 Faroese men. Serum concentrations included major PFASs (perfluorooctanoic acid (PFOA), perfluorhexane sulfonic acid (PFHxS), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), and perfluorooctane sulfonate (PFOS)) measured at ages 7, 14, 22, and 28. PFOA concentrations were measured in cord blood. Incidence rate ratios (IRR) measured associations between exposure tertiles and the risk of an extra X or Y chromosome (XX18, YY18 or XY18) in adult sperm as modeled by Poisson regression. Results: Higher tertiles of exposure at ages 7 and adulthood were strongly associated with increased rates of sperm chromosomal abnormalities (IRR ranging from 1.09-2.12; p-trend <0.001) for most of the measured PFASs. However, higher levels of PFOA, PFDA, and PFOS at age 14 were associated with significantly reduced risk of disomy (ranging from 13-37%). Exposure to PFOS in cord blood showed a significantly increased risk of disomy in the second tertile and a significantly decreased risk in the third tertile. Conclusions: The relationship between exposure to PFAS and sperm disomy appears to be complex with the possibility of risk varying by age of exposure. This suggests that the impacts of these widespread and persistent pollutants on testicular maturation and function need additional investigation.

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## ABSTRACT E-BOOK

Theme: **PFAS**

**P-0852**

### **Per- and polyfluoroalkyl substance plasma concentrations and metabolomic markers in the Diabetes Prevention Program**

**Presenter:** Susanna D Mitro, Harvard T.H. Chan School of Public Health, Boston, United States

**Authors:** S. D. Mitro<sup>1</sup>, J. Liu<sup>2</sup>, P. L. Williams<sup>1</sup>, L. M. Jaacks<sup>1</sup>, A. F. Fleisch<sup>3</sup>, G. A. Bray<sup>4</sup>, W. C. Knowler<sup>5</sup>, B. Laferrère<sup>6</sup>, W. Perng<sup>7</sup>, A. Wallia<sup>8</sup>, E. Oken<sup>9</sup>, T. M. James-Todd<sup>1</sup>, M. Temprosa<sup>2</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>2</sup>Biostatistics Center and Milken Institute School of Public Health, George Washington University, Rockville, MD, <sup>3</sup>Maine Medical Center, Portland, ME,

<sup>4</sup>Pennington Biomedical Research Center/Louisiana State University, Baton Rouge, LA, <sup>5</sup>National Institute of Diabetes and Digestive and Kidney Diseases, Phoenix, AZ, <sup>6</sup>Columbia University Medical Center, New York, NY, <sup>7</sup>Colorado School of Public Health, Aurora, CO, <sup>8</sup>Feinberg School of Medicine, Northwestern University, Chicago, IL, <sup>9</sup>Department of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute, Boston, MA.

**Background:** Per- and polyfluoroalkyl substances (PFAS) are widely used chemicals, some of which have been linked to type 2 diabetes. We tested whether PFAS concentrations were cross-sectionally associated with metabolites previously shown to predict incident type 2 diabetes at baseline using the Diabetes Prevention Program (DPP), a trial of individuals at high risk of type 2 diabetes. **Methods:** We evaluated 691 participants enrolled in the DPP with baseline measures of 10 PFAS (including total perfluorooctanoic sulfate (PFOS), total perfluorooctanoic acid (PFOA), and Sb-PFOA [branched isomers of PFOA]) and 77 metabolites. We used log<sub>2</sub>-transformed PFAS concentrations as exposures and standardized metabolite concentrations as outcomes in linear regression models adjusted for age, sex, race/ethnicity, use of anti-hyperlipidemic or triglyceride lowering medication, income, years of education, marital status, smoking, and family history of diabetes, with Benjamini-Hochberg linear step-up false discovery rate correction.

**Results:** Sb-PFOA was associated with the largest number of tested metabolites (29 of 77). Each doubling in Sb-PFOA was associated with higher leucine ( $\beta=0.07$  [95%CI: 0.02, 0.11] SD) and lower glycine (-0.08 [95%CI:-0.03, -0.13] SD). Each doubling in total PFOA and n-PFOA were both associated with -0.13 [95%CI:-0.04, -0.22] SD lower glycine. PFOA and Sb-PFOA were positively associated with multiple triacylglycerols and diacylglycerols, and total PFOS, total PFOA, and Sb-PFOA were positively associated with phosphatidylethanolamines.

**Conclusions:** These cross-sectional results suggest that PFAS may increase risk of type 2 diabetes through alterations in amino acid, glycerolipid and glycerophospholipid metabolism pathways, but further prospective research is needed to elucidate mechanisms.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0853**

### **Health and social concerns about living in communities affected by per- and polyfluoroalkyl substances (PFAS): A qualitative study in Australia**

**Presenter:** Kayla S Smurthwaite, Australian National University, Canberra, Australia

**Authors:** C. Banwell<sup>1</sup>, T. Housen<sup>1</sup>, K. S. Smurthwaite<sup>1</sup>, S. Trevenar<sup>1</sup>, L. J. Walker<sup>1</sup>, K. M. Todd<sup>1</sup>, M. Rosas<sup>2</sup>, M. D. Kirk<sup>1</sup>;

<sup>1</sup>Australian National University, Canberra, AUSTRALIA, <sup>2</sup>Ngaigu-Mulu Aboriginal Corporation, Katherine, AUSTRALIA.

**Background and aims** Exposure to per- and polyfluoroalkyl substances (PFAS) is a public health issue globally. In Australia high concentrations of PFAS have been found in environments close to sites where aqueous film forming foams were historically used for firefighting activities. This has resulted in significant community concern about the potential long-term health effects of these chemicals. This study aims to describe residents' perceptions and experiences of PFAS in three regional Australian towns affected by environmental contamination. **Methods** We conducted focus groups to generate free-flowing open discussion on PFAS in three affected communities: Williamtown in New South Wales, Oakey in Queensland and Katherine in the Northern Territory. An Elder facilitated discussions with Katherine First Nations Peoples on their community lands. We used an interview guide to generate discussion covering the following broad areas: health; risk perception and understanding of exposure; emotional responses; stigma; practical issues; connection to local land; and perceptions of media reports. Focus group transcripts were analysed thematically to identify major shared concerns. **Results** One hundred and eighty residents attended 15 focus groups that were conducted in the three communities, including 69 First Nations People living in communities near Katherine. Study participants were concerned about potential physical health effects of exposure to PFAS, such as 'cancer clusters', unexplained deaths, potential exacerbation of existing health conditions, and the future health of their children. They expressed feelings of stress and anxiety about living with uncertainty related to the possible health and the socio-economic impacts of PFAS contamination in their communities. **Conclusions** While there has been much focus in the literature on examining the health effects of PFAS, more attention needs to be given to the immediate psychosocial impacts of living in an affected community. This focus group study was the first phase in a sequential mixed-methods study–The PFAS Health Study.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0854**

### **Human exposure pathways to poly- and perfluoroalkyl substances (PFAS) from indoor media: A systematic review**

**Presenter:** Nicole M DeLuca, U.S. Environmental Protection Agency, Durham, United States

**Authors:** N. M. DeLuca, K. Thayer, M. Angrish, A. Wilkins, E. A. Cohen Hubal;  
U.S. Environmental Protection Agency, Durham, NC.

Human exposure to per- and polyfluoroalkyl substances (PFAS) has been primarily attributed to contaminated food and drinking water. However, PFAS exposure has also been linked to use of products. Few studies report relationships between these exposure media and human biomonitoring measurements. A systematic review (SR) is a transparent and rigorous method to evaluate a body of scientific evidence to answer a specific research or policy question. Although widely used in clinical medicine and epidemiology, the development of SR methods that are applicable to exposure science studies is ongoing. This study adapted SR methodologies to identify important PFAS exposure pathways from indoor environment media, including consumer products, household articles, cleaning products, personal care products, and indoor air and dust. Included studies present exposure measures from indoor media paired with occupant PFAS concentrations in blood serum, focusing specifically on perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate (PFOS). Searches were conducted of Web of Science, PubMed, and ToxNet databases, where approximately 6,000 studies were identified. Machine learning approaches were used during the literature scoping and title/abstract screening to prioritize pathways by automated tagging and to select studies for inclusion using an iterative predictive screening model. Studies were screened against inclusion criteria by two independent reviewers. The extraction and summarization of study characteristics were performed in DistillerSR software, visualized in Tableau, and will be available for download. The exposure assessment methods used in included studies were evaluated using an approach modified from the EPA's Systematic Review Protocol for IRIS Assessments and the Navigation Guide. This study presents innovative SR methodologies for exposure science studies, including the development of exposure pathway-specific search strings for use in artificial intelligence software. The evidence generated will increase our understanding of exposure to PFAS from indoor environment sources, identify key data gaps, and inform future research priorities.

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## ABSTRACT E-BOOK

Theme: **PFAS**

**P-0855**

### **Per- and Polyfluoroalkyl Substances (PFAS) and Hormone Levels during the Menopausal Transition: Study of Women's Health Across the Nation (SWAN)**

**Presenter:** Sioban D. Harlow, University of Michigan, Ann Arbor, United States

**Authors:** S. D. Harlow<sup>1</sup>, M. Hood<sup>1</sup>, J. F. Randolph<sup>1</sup>, E. B. Gold<sup>2</sup>, S. Park<sup>1</sup>;  
<sup>1</sup>University of Michigan, Ann Arbor, MI, <sup>2</sup>University of California, Davis, CA.

Background: PFAS are endocrine disrupting chemicals that have been associated with an earlier age at menopause. However, information on their association with serum hormone concentrations is limited and inconsistent. We examined longitudinal associations between serum PFAS concentrations at baseline and serial serum concentrations of follicle stimulating hormone (FSH), estradiol (E<sub>2</sub>), testosterone (T) and sex hormone-binding globulin (SHBG) in the Study of Women's Health Across the Nation (SWAN), a multi-racial/ethnic, community-based cohort of women transitioning through menopause. Methods: We assayed serum concentrations of perfluorooctanoate (PFOA), perfluorooctane sulfonate (PFOS), 2-(N-ethyl-perfluorooctane sulfonamide) acetate (EtFOSAA), 2-(N-methyl-perfluorooctane sulfonamide) acetate (MeFOSAA), perfluorohexane sulfonate (PFHxS), and perfluorononanoate (PFNA) in 1,398 women eligible for the SWAN Multi-Pollutant Study in 1999-2000 who were followed approximately annually to 2016. Serum PFAS concentrations were quantified by online solid phase extraction-high performance liquid chromatography-isotope dilution-tandem mass spectrometry. Hormone and PFAS concentrations were log-transformed. Linear mixed regression with random intercepts was used to analyze longitudinal associations, adjusting for menopausal status, smoking, parity, race/ethnicity, site and body mass index (BMI). Results: At baseline, women had a mean age of 49.5 years, a mean BMI of 28.0 and included white (50.5%), black (22.0%), Chinese (12.7%) and Japanese (14.8%) women. PFAS were not associated with E<sub>2</sub>. In adjusted models including BMI, FSH was positively associated with total PFOS ( $\beta=0.041$ , 95% CI=0.000, 0.0092), branched-PFOS, ( $\beta=0.044$ , 95% CI=0.006, 0.0083), and n-PFOA ( $\beta=0.055$ , 95% CI=0.008, 0.0103) but not with EtFOSAA, MeFOSAA, PFHxS, or PFNA. T and SHBG were negatively associated with PFOS, n-PFOA and EtFOSAA, but these associations were greatly attenuated and not significant after adjustment for BMI. Conclusions: The results of this prospective study suggest that PFAS, especially PFOS and its precursors (MeFOSAA and EtFOSAA), and PFOA are associated with higher FSH concentrations in women during the menopausal transition, consistent with findings that PFAS affects reproductive aging.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0857**

**Prenatal exposure to per- and polyfluoroalkyl substances and cognitive development in infancy and early childhood**

**Presenter:** Jiwon Oh, University of Texas, Arlington, United States

**Authors:** J. Oh<sup>1</sup>, D. H. Bennett<sup>2</sup>, A. Calafat<sup>3</sup>, D. Tancredi<sup>2</sup>, D. L. Roa<sup>4</sup>, R. J. Schmidt<sup>2</sup>, I. Hertz-Picciotto<sup>2</sup>, H. Shin<sup>1</sup>;

<sup>1</sup>University of Texas, Arlington, TX, <sup>2</sup>University of California, Davis, CA, <sup>3</sup>Centers for Disease Control and Prevention, Atlanta, GA, <sup>4</sup>UC Davis MIND (Medical Investigations of Neurodevelopmental Disorders) Institute, Sacramento, CA.

**Background/Aim:** Pregnant women are exposed to per- and polyfluoroalkyl substances (PFAS), suspected neurodevelopmental toxicants. A growing number of epidemiological studies have investigated associations between prenatal PFAS exposure and child's neurodevelopment, but the results varied by assessment time points and tools. We investigated associations between prenatal exposure to PFAS and child's cognitive development at multiple assessment time points.

**Methods:** We included 215 mother-child pairs from the MARBLES (Markers of Autism Risk in Babies - Learning Early Signs) longitudinal cohort study. Child's cognitive functions were assessed using Mullen Scales of Early Learning (MSEL) at 6, 12, 24, and 36 months of age. Nine PFAS were quantified in maternal serum samples collected during pregnancy. We used multiple linear regression to estimate the change in MSEL scores in association with prenatal maternal PFAS concentrations at each assessment time point.

**Results:** Higher prenatal maternal serum perfluorooctanoate (PFOA) was associated with lower MSEL Composite scores only at 24 months ( $\beta = -5.62$ , 95% CI: -10.6, -0.70). When compared to the lowest quartile, the third quartile of perfluorohexane sulfonate (PFHxS) was associated with increased Visual Reception scores at 6, 24, and 36 months. When stratified by child's sex, females showed stronger associations of PFOA ( $\beta = -7.84$ , 95% CI: -15.1, -0.61) and PFHxS ( $\beta = -7.91$ , 95% CI: -15.2, -0.62) with decreased MSEL Composite scores at 36 months, compared to males.

**Conclusions:** Our results suggest that prenatal PFOA may adversely affect child's cognitive development at 24 months of age. Further studies using the same assessment tool with larger sample sizes are needed to confirm our findings.

**Keywords:** cognitive development, Mullen Scales of Early Learning, PFAS, prenatal exposure

**Disclaimer:** The findings and conclusions in this abstract are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0858**

**PFAS Research, Education, and Action for Community Health**

**Presenter:** Martha Powers, Northeastern University, Boston, United States

**Authors:** M. Powers<sup>1</sup>, P. Brown<sup>1</sup>, C. Carignan<sup>2</sup>, A. Amico<sup>3</sup>, M. Fitzstevens<sup>4</sup>, S. Kasper<sup>5</sup>, C. Osimo<sup>6</sup>, L. Schaider<sup>4</sup>;

<sup>1</sup>Northeastern University, Boston, MA, <sup>2</sup>Michigan State University, East Lansing, MI, <sup>3</sup>Testing for Pease, Portsmouth, NH, <sup>4</sup>Silent Spring Institute, Newton, MA, <sup>5</sup>Toxics Action Center, Montpelier, VT,

<sup>6</sup>Massachusetts Breast Cancer Coalition, Franklin, MA.

Communities across the U.S are discovering drinking water contaminated by per- and polyfluoroalkyl substances (PFAS), a group of man-made chemicals widely used in industrial processes and consumer goods. There are currently no federal PFAS drinking water standards in the U.S. despite growing evidence from epidemiological and toxicological studies showing associations between PFAS exposure and a wide range of harmful health effects, including on children's immune systems. This project will characterize early-life PFAS exposure from firefighting foam-contaminated drinking water among U.S. children using serum biomarkers and will evaluate associations with antibody levels in response to routine vaccinations and metabolomic markers of inflammation. The project will address other important gaps, such as the difficulty for residents of affected communities to interpret blood and water testing results, the absence of a centralized way to connect affected communities, and a lack of understanding of potential health effects from unregulated contaminant exposures by medical professionals. PFAS-REACH (Research, Education, and Action for Community Health) is helping address these gaps by: 1. Evaluating potential effects of PFAS exposure on immune systems of young children at Pease Tradeport in Portsmouth, New Hampshire, and Hyannis, Massachusetts, communities with previous PFAS water contamination; 2. Developing an innovative online resource center, called the PFAS Exchange, with data interpretation tools and educational materials for affected community members, including guidance for medical professionals on how to best respond to patient contamination concerns; and 3. Conducting a social science analysis to assess individual, family, and community-level experiences in areas impacted by PFAS-contaminated drinking water. PFAS-REACH is using a community-based participatory research approach. Project partners include environmental health researchers, social scientists, and community activists. This project will provide both actionable results to protect children's health and support to help impacted communities reduce their exposures and health risk.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0859**

**Correlates of per- and poly-fluoroalkyl substances among reproductive-aged Black women**

**Presenter:** Lauren Anne Wise, Boston University School of Public Health, Boston, United States

**Authors:** L. A. Wise<sup>1</sup>, A. K. Wesselink<sup>1</sup>, B. Claus Henn<sup>1</sup>, D. D. Baird<sup>2</sup>;

<sup>1</sup>Boston University School of Public Health, Boston, MA, <sup>2</sup>National Institute of Environmental Health Sciences, Durham, NC.

**Background:** Per- and polyfluoroalkyl substances (PFAS) are persistent synthetic endocrine-disrupting chemicals used in commercial and consumer goods. **Methods:** We identified correlates of PFAS among 1,499 participants from the Study of Environment, Lifestyle, and Fibroids (SELF), a Detroit-based prospective cohort study of Black women aged 23-35 years (2010-2012). We collected socio-demographic, behavioral, and reproductive history data via self-administered questionnaires, telephone interviews, and in-person clinic visits. At baseline, we measured seven PFAS in non-fasting plasma using liquid chromatography-tandem mass spectrometry (MeFOSAA, PFDA, PFHxS, PFNA, PFUnDA, PFOA, PFOS). We fit linear regression models to calculate percent differences (%D) and 95% confidence intervals (CIs) for each baseline correlate with PFAS concentrations. **Results:** PFHxS, PFNA, PFOA, and PFOS were detected in  $\geq 97\%$  of women; PFDA in 85%, MeFOSAA in 69%; and PFUnDA in 47%. PFAS were positively correlated with each other (range: 0.09-0.68), but MeFOSAA showed the weakest correlations (range: 0.09-0.16). In models adjusted for all other correlates, age (32-35 vs. 23-25 years) was positively associated with PFAS (range of %D: 10.2 for PFOS to 23.6 for PFDA), except PFHxS (%D=-14.2, 95% CI: -24.1, -3.1). Current alcohol intake ( $\geq 14$  drinks/week vs. none) was positively associated with PFAS (range of %D: 6.6 for PFOA to 28.2 for PFUnDA) but not PFHxS. Current smoking ( $\geq 10$  cigarettes/day vs. never) was inversely associated with PFAS (range of %D: -4.3 for PFOA to -12.2 for PFNA), except MeFOSAA (%D=33.6, 95% CI: 11.1, 60.6). Annual household income ( $> \$50,000$  vs.  $< \$20,000$ ) was positively associated with most PFAS (range of %D: 8.8 for PFDA to 22.5 for PFHxS), but not MeFOSAA. Education, BMI, parity, and lactation were weakly inversely associated with PFAS, while birth order and having been breastfed in infancy showed little association. **Conclusions:** We identified several correlates of PFAS concentrations in Black women, including age, alcohol intake, cigarette smoking, and income.

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## ABSTRACT E-BOOK

Theme: **PFAS**

**P-0861**

**Prenatal exposure to per- and polyfluoroalkyl substances (PFASs) and child growth trajectories in the Norwegian Mother, Father and Child cohort study (MoBa).**

**Presenter:** Eleni Papadopoulou, Norwegian Institute of Public Health, Oslo, Norway

**Authors:** E. Papadopoulou<sup>1</sup>, L. S. Haug<sup>1</sup>, J. Botton<sup>2</sup>, I. H. Caspersen<sup>1</sup>, K. K. Ferguson<sup>3</sup>, G. D. Villanger<sup>1</sup>, P. B. Júlíusson<sup>1</sup>, A. Brantsæter<sup>1</sup>;

<sup>1</sup>Norwegian Institute of Public Health, Oslo, NORWAY, <sup>2</sup>Faculty of Pharmacy, Univ. Paris-Sud, Université Paris-Saclay, Paris, FRANCE, <sup>3</sup>Epidemiology Branch, Division of Intramural Research, National Institute of Environmental Health Sciences, Research Triangle Park, Durham, NC.

Early life low dose exposure to PFASs has been negatively associated with fetal growth, but the long-term effects on postnatal child growth are unknown. The interplay of additional factors that are important for postnatal growth, such as breastfeeding and sleep habits is also unknown. In 3,882 mother-child pairs from the MoBa study, we examined the associations between prenatal PFASs exposure and child body weight trajectories. The concentrations of 11 PFASs were measured in maternal blood (at 17-18 gestational weeks): perfluorohexanesulfonate (PFHxS), perfluoroheptanesulfonate (PFHpS), perfluorooctanesulfonate (PFOS), perfluoroheptanoate (PFHpA), perfluorooctanoate (PFOA), perfluorononanoate (PFNA), perfluorodecanoate (PFDA), perfluoroundecanoate (PFUnDA), perfluorododecanoate (PFDoDA), perfluorotridecanoate (PFTrDA), perfluorooctanesulfonamide (PFOSA). Individual growth trajectories were computed by modelling based on child's reported weight at 11 time points from 6 weeks to 8 years. For most PFASs exposure was categorized into quartiles, while PFHpA, PFOSA, PFDoDA and PFTrDA were dichotomized (<LOD/≥LOD). We used single-contaminant linear mixed effect regression models and studied interactions with breastfeeding duration (<6 months/≥6 months) and sleep duration at 6 months (less/as recommended (12-16 hours/day)). At 1.5 months, children born to mothers with PFDA levels in Q2 weighed 57g (95%CI=1,114g) more than their lower exposed peers (Q1). During the first 6 months, children prenatally exposed to PFUnDA level at Q2 weighed -53 to -56g (95%CI range=-116,4g) less than those in Q1. Among longer breastfed children (67%), we found a larger weight reduction corresponding to prenatal PFUnDA Q2 vs. Q1 (-94 to -81g, 95%CI range=-159, -11g). Among children with shorter sleep (4%), higher prenatal exposure to PFUnDA (Q2), PFHxS (Q4), PFHpS (Q3) and PFTrDA (≥LOD) was associated with reduced weight trajectories, compared to Q1. In this preliminary analysis of a European population with background exposure to PFASs, we observed negative associations between prenatal PFASs exposure and postnatal child growth which seemed stronger in breastfed and lower sleepers.

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## ABSTRACT E-BOOK

Theme: PFAS

P-0862

### Per- and Polyfluoroalkyl Substances (PFAS) and Incident Diabetes in Midlife Women: Study of Women's Health Across the Nation (SWAN)

**Presenter:** Sung Kyun Park, Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor, United States

**Authors:** S. K. Park<sup>1</sup>, X. Wang<sup>1</sup>, W. H. Herman<sup>2</sup>, B. Mukherjee<sup>3</sup>, S. D. Harlow<sup>1</sup>;

<sup>1</sup>Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor, MI, <sup>2</sup>University of Michigan School of Medicine, Ann Arbor, MI, <sup>3</sup>Department of Biostatistics, School of Public Health, University of Michigan, Ann Arbor, MI.

**Background:** Diabetogenic effects of per- and polyfluoroalkyl substances (PFAS) have been suggested. However, evidence based on population-based prospective cohort studies is limited. We examined the association between serum PFAS concentrations and incident diabetes in the Study of Women's Health Across the Nation (SWAN), a community-based population study of midlife women. **Methods:** We included 1,226 diabetes-free women aged 45-56 years at the baseline of the SWAN Multi-Pollutant Study in 1999-2000 who were followed up to 2016. Serum PFAS concentrations were quantified by online solid phase extraction-high performance liquid chromatography-isotope dilution-tandem mass spectrometry. We used k-means clustering and identified three overall PFAS concentration patterns as mixtures (low, medium, high). Cox proportional hazards models were used to compute hazard ratios (HRs) and 95% confidence intervals (CIs). **Results:** We identified 137 incident diabetes cases (median follow-up=16 years, incident rate=8.15 per 1000 person-years). After adjustment for age, race/ethnicity, site, education, income, body mass index, smoking status, alcohol, physical activity, menopausal status and hormone use, the HRs comparing the lowest with the highest tertiles were 1.56 (95% CI: 1.15-2.11) for n-perfluorooctanoate (n-PFOA) (p-for-trend=0.004); 1.56 (95% CI: 1.19-2.14) for perfluorohexane sulfonate (PFHxS) (p-for-trend=0.001); 1.43 (95% CI: 1.05-1.95) for branched-perfluorooctane sulfonate (branched-PFOS) (p-for-trend=0.02); and 1.61 (95% CI: 1.16-2.24) for 2-(N-methyl-perfluorooctane sulfonamide) acetate (MeFOSAA) (p-for-trend=0.003). The high overall PFAS concentration mixture pattern had a significantly higher HR of 1.44 (95% CI: 1.01-2.05) compared with the low mixture pattern.

**Conclusions:** This prospective cohort study with up to 17 years of follow-up suggests that PFAS, especially PFOA, PFHxS, and PFOS and its precursor (MeFOSAA), individually or as mixtures, may increase diabetes risk in midlife women. Reduced exposure to PFAS may be an important preventative approach to lowering population-wide diabetes risk.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0864**

### **Per- and Polyfluoroalkyl Substances (PFAS) Concentrations in Serum and Drinking Water in Pregnant Women from the Greater Cincinnati Area HOME Study**

**Presenter:** Shelley Ehrlich, Cincinnati Children's Hospital Medical Center, Cincinnati, United States

**Authors:** S. Ehrlich<sup>1</sup>, Y. Xu<sup>2</sup>, J. Wright<sup>3</sup>, M. A. Mills<sup>3</sup>, K. Dasu<sup>4</sup>, S. Nakayama<sup>5</sup>, A. Chen<sup>6</sup>, B. P. Lanphear<sup>7</sup>, J. Braun<sup>8</sup>, J. C. Khoury<sup>2</sup>, K. Yolton<sup>1</sup>;

<sup>1</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>2</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>3</sup>United States Environmental Protection Agency (US EPA), Cincinnati, OH, <sup>4</sup>Battelle Memorial Institute, Columbus, OH, <sup>5</sup>National Institute for Environmental Studies, Tsukuba, JAPAN, <sup>6</sup>University of Cincinnati, Cincinnati, OH, <sup>7</sup>Simon Fraser University, Burnaby, BC, CANADA, <sup>8</sup>Brown University School of Public Health, Providence, RI.

**Background:** The occurrence, fate, and transport of PFAS in the environment is understood, but the contribution of drinking water to serum PFAS concentrations in humans is poorly defined. **Methods:** We examined data from a prospective pregnancy and birth cohort (HOME Study) in Cincinnati, Ohio. We quantified PFOA and PFOS in sera of 227 pregnant women at 16 weeks gestation between 2003 and 2006. Tap water was collected from the participants' homes within one month of blood collection. We mapped serum and tap water PFAS concentrations using ArcGIS and examined clustering via spatial hotspot analyses for each participant. **Results:** The median (range) of PFOA serum concentration in pregnant HOME Study participants between 2003-2006 was 5.4 (0.5-24.5) ng/ml, which is over twice the geometric mean serum concentration of 2.4 ng/l as measured in a representative sample of pregnant women in NHANES 2003 and 2004. Median PFOA drinking water concentrations in samples collected from participants' homes were 3.7 ng/l in 2003, 4.5 ng/l in 2004, 6.4 ng/l in 2005 and 11.0 ng/l in 2006. For each doubling of water PFOA concentration, serum PFOA increased by 0.6 ng/l (95% CI: 0.02, 1.20) after adjusting for water source type (bottled/filtered vs tap water). For every doubling of water PFOS, serum PFOS increased 0.95 ng/l (95%CI: -0.10, 2.00). **Conclusions:** Drinking water is an important contributing source of PFAS exposure in pregnant women. This research adds to the literature, helping to delineate the relationship between drinking water and circulating serum concentrations of PFAS in pregnant women. The views expressed in this abstract are those of the authors and do not necessarily reflect the views or policies of the U.S. EPA.

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## ABSTRACT E-BOOK

Theme: **PFAS**

**P-0865**

### Exposure to perfluoroalkyl substances and thyrotropin levels in an exposed young adult population in the Veneto Region

**Presenter:** Elisa Gallo, Department of Cardiac, Thoracic, Vascular Sciences and Public Health, University of Padova, Padova, Italy

**Authors:** E. Gallo<sup>1</sup>, G. Barbieri<sup>1</sup>, M. Zare Jeddi<sup>1</sup>, F. Daprà<sup>2</sup>, M. Gion<sup>3</sup>, D. Gregori<sup>1</sup>, F. Russo<sup>4</sup>, T. Fletcher<sup>5</sup>, G. Pitter<sup>6</sup>, C. Canova<sup>1</sup>;

<sup>1</sup>Department of Cardiac, Thoracic, Vascular Sciences and Public Health, University of Padova, Padova, ITALY, <sup>2</sup>Laboratory Department-Regional Agency for Environmental Prevention and Protection-Veneto Region, Venezia, ITALY, <sup>3</sup>Regional Center for Biomarkers, Department of Clinical Pathology, Azienda ULSS 3 Serenissima, Venezia, ITALY, <sup>4</sup>Directorate of Prevention, Food Safety, and Veterinary Public Health-Veneto Region, Venezia, ITALY, <sup>5</sup>London School of Hygiene and Tropical Medicine, London, UNITED KINGDOM, <sup>6</sup>Screening and Health Impact Assessment Unit, Azienda Zero-Veneto Region, Padova, ITALY.

**Background:** Perfluoroalkyl substances (PFASs) are persistent and widespread environmental pollutants. People living in the North-East of Italy have been exposed from the late 1970s to 2013 to high concentrations of PFASs through drinking water. The role PFASs could play on thyroid function is still controversial and studies that focused on thyrotropin (TSH) showed inconsistent results. The aim of this study was to evaluate the association between serum PFASs and TSH levels and its dose-response shape in a large exposed population. **Methods:** A cross-sectional study was conducted in 14,993 individuals aged 20-39 living in the contaminated area. In the main analysis, patients with thyroid pathologies and pregnant women were excluded. Serum levels of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorohexanesulfonic acid (PFHxS) and perfluorononanoic acid (PFNA) were measured by HPLC-MS/MS. Generalized Additive Models were used to evaluate the association between TSH levels and serum PFASs, using thin plate spline smooth terms to model the potential non-linear relationship. Models were stratified by gender and adjusted for potential confounders. A secondary analysis was conducted to evaluate the association between PFASs and the prevalence of self-reported thyroid disorders. **Results:** In both males and females, a statistically significant non-linear association was found with PFOS. The shape of the slopes shows a decrease in TSH concentration at low levels of PFOS but an increase at higher serum PFOS. PFOA in females was instead found to have a modest linear positive association with TSH. No association was found between TSH and PFNA or PFHxs. We also found higher odds of reporting thyroid disease with increased measured PFNA concentrations in women. **Conclusions:** Serum PFASs concentrations were modestly associated with thyroid function in this highly exposed young adults population suggesting this substance to be a possible endocrine disruptor. There is evidence of a non-linear association with TSH for PFOS.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0866**

### **Associations of Perfluoroalkyl Substances with Incident Natural Menopause: the Study of Women's Health Across the Nation**

**Presenter:** Ning Ding, University of Michigan, Ann Arbor, United States

**Authors:** N. Ding<sup>1</sup>, S. D. Harlow<sup>1</sup>, J. F. Randolph<sup>1</sup>, A. M. Calafat<sup>2</sup>, B. Mukherjee<sup>1</sup>, S. Batterman<sup>1</sup>, E. B. Gold<sup>3</sup>, S. K. Park<sup>1</sup>;

<sup>1</sup>University of Michigan, Ann Arbor, MI, <sup>2</sup>Centers for Disease Control and Prevention, Atlanta, GA, <sup>3</sup>University of California Davis, Davis, CA.

**Context:** Previous epidemiologic studies of per- and polyfluoroalkyl substances (PFAS) and menopausal timing conducted in cross-sectional settings were limited by reverse causation because PFAS serum concentrations increase after menopause.

**Objectives:** To investigate associations between PFAS serum concentrations and incident natural menopause.

**Design and Setting:** A prospective cohort of midlife women, the Study of Women's Health Across the Nation, from 1999 to 2017.

**Participants:** 1120 multi-racial/ethnic premenopausal women (White, Black, Chinese and Japanese) aged 45-56 years in 1999-2000.

**Methods:** Serum PFAS concentrations were measured using an online solid phase extraction-high performance liquid chromatography-isotope dilution-tandem mass spectrometry. The final menstrual period was determined during the annual follow-up visits. Cox proportional hazards models were used to calculate hazard ratios (HRs) and 95% confidence intervals (CIs).

**Results:** Participants contributed 5466 person-years of follow-up, and 578 had incident natural menopause. Compared to the lowest tertile, women at the highest tertile of baseline serum concentrations had adjusted HR for natural menopause of 1.26 (95%CI: 1.02-1.57) for n-perfluorooctane sulfonic acid (n-PFOS) (Ptrend=0.03), 1.27 (95%CI: 1.01-1.59) for branched-PFOS (Ptrend=0.03), and 1.31 (95%CI: 1.04-1.65) for n-perfluorooctanoic acid (Ptrend=0.01). Women were classified into four clusters based on their overall PFAS concentrations as mixtures: low, low-medium, medium-high, and high. Compared to the low cluster, the high cluster had a HR of 1.63 (95% CI: 1.44-1.84), which is interpreted as 2.0 years earlier experience of natural menopause.

**Conclusion:** This study suggests that select PFAS serum concentrations are associated with earlier natural menopause, a risk factor for adverse health outcomes in later life.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0867**

### **The Mediating Role of Follicle-Stimulating Hormone in the Associations between Exposure to Perfluoroalkyl Substances and Incident Natural Menopause**

**Presenter:** Ning Ding, University of Michigan, Ann Arbor, United States

**Authors:** N. Ding<sup>1</sup>, S. D. Harlow<sup>1</sup>, J. F. Randolph<sup>1</sup>, B. Mukherjee<sup>1</sup>, S. Batterman<sup>1</sup>, E. B. Gold<sup>2</sup>, S. K. Park<sup>1</sup>;  
<sup>1</sup>University of Michigan, Ann Arbor, MI, <sup>2</sup>University of California Davis, Davis, CA.

Exposure to perfluoroalkyl substances (PFAS) has been associated with earlier natural menopause, possibly through depletion of ovarian reserve and disturbance of hormone homeostasis. We aimed to investigate and quantify the degree to which follicle-stimulating hormone (FSH) could mediate the associations between PFAS exposure and natural menopause among 1120 premenopausal women aged 45-56 years in 1999-2000 from the Study of Women's Health Across the Nation (SWAN). Serum concentrations of linear- and branched-chain perfluorooctane sulfonic acid (n-PFOS and sm-PFOS), linear-chain perfluorooctanoic acid (n-PFOA), perfluorohexane sulfonic acid (PFHxS), and perfluorononanoic acid (PFNA) were measured in 1999-2000 and included in the analyses because their detection frequency was larger than 70%. Accelerated failure time models were utilized to evaluate time to incident natural menopause. 578 women reached natural menopause, with a median survival time of 6.5 (95% CI: 6.1, 6.8) years. The proportion of the effect mediated through FSH was 8.5% (95% CI: -11.7%, 24.0%) for n-PFOS, 13.2% (95% CI: 0.0%, 24.5%) for sm-PFOS, 26.9% (95% CI: 15.6%, 38.4%) for n-PFOA, and 21.7% (6.8%, 37.0%) for PFNA. No significant associations were observed for PFHxS. PFAS are associated with an earlier age at natural menopause. The effect of PFAS on natural menopause may be partially explained by variation in FSH concentrations.

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Theme: **PFAS**

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**P-0868**

**Profile of the Per- and Polyfluoroalkyl Substances (PFAS) Health Study: Exposure to and health risks of environmental PFAS contamination in Australian communities**

**Presenter:** Kayla S Smurthwaite, Australian National University, Canberra, Australia

**Authors:** K. S. Smurthwaite, K. English, M. Harris, C. D'Este, R. Korda, S. Trevenar, M. D. Kirk; Australian National University, Canberra, AUSTRALIA.

The extensive distribution of per- and polyfluoroalkyl substances (PFAS) has led to concerns about environmental and human health impacts. Risk assessments of contaminated areas in Australia have evaluated PFAS exposure pathways but have not quantified PFAS exposure levels in affected communities or the associated health risks. The PFAS Health Study aims to investigate multiple aspects of the PFAS exposure pathway, including the environmental and behavioural factors that influence PFAS body burdens, as well as health outcomes and concerns associated with PFAS exposure. We conducted a cross-sectional study of current and former residents and workers of three Australian communities affected by environmental PFAS contamination—Williamtown in New South Wales, Oakey in Queensland and Katherine in the Northern Territory—and three comparison communities. This Study included biomonitoring and a self-administered survey. The findings will guide our understanding of the determinants of PFAS exposure, associations with self-reported psychosocial or physical health outcomes and concerns, and actions that residents have taken in PFAS affected communities to reduce their exposure. The study design was informed by a systematic review of the health effects of PFAS exposure and a qualitative study of the health and social concerns of people living in Australian communities affected by environmental PFAS contamination. This study will produce knowledge to assist affected communities in understating the impact, if any, of PFAS exposure on their health and to aid policy makers in responding to PFAS contamination issues. The PFAS Health Study is the first of its kind in Australia and will add to the body of international literature around the effects of environmental PFAS exposure on human health.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0869**

### **Plasma concentrations of per- and polyfluoroalkyl substances and pubertal timing: A prospective analysis in Project Viva**

**Presenter:** Jenny Carwile, Maine Medical Center Research Institute, Portland, United States

**Authors:** J. Carwile<sup>1</sup>, S. Seshasayee<sup>1</sup>, I. Aris<sup>2</sup>, S. Rifas-Shiman<sup>2</sup>, S. Sagiv<sup>3</sup>, E. Oken<sup>2</sup>, A. Fleisch<sup>1</sup>;  
<sup>1</sup>Maine Medical Center Research Institute, Portland, ME, <sup>2</sup>Harvard Medical School and Harvard Pilgrim Health Care Institute, Boston, MA, <sup>3</sup>University of California, Berkeley, Berkeley, CA.

**Background/Aim** Exposure to per- and polyfluoroalkyl substances (PFAS) may disrupt pubertal and adrenarchal timing. Animal and human studies have shown associations of prenatal PFAS exposure with delayed puberty in females; fewer studies have investigated childhood exposure. **Methods** We studied 636 children in Project Viva, a Boston-area prospective pre-birth cohort. We examined associations of plasma concentrations of 6 PFAS measured at mean 7.9 (SD 0.8) years (2006-2010) with markers of pubertal timing. At early adolescence (mean 13.1 (SD 0.8) years), parents reported pubertal signs (a 5-item pubertal development score) and children reported adrenarchal stage (pubic hair Tanner staging pictograph) on questionnaires. We calculated age at peak height velocity using research and clinical measures of height. We used sex-specific linear regression (for pubertal development score and age at peak height velocity) and ordinal logistic regression (for pubic hair staging) models, adjusted for demographic and socioeconomic factors. **Results** Plasma concentrations were highest for perfluorooctanesulfonic acid (PFOS) [median (IQR) 6.4(5.6) ng/mL], followed by perfluorooctanoate (PFOA) [4.4(3.0) ng/mL] and perfluorodecanoate (PFDA) [0.3(0.3) ng/mL]. Girls had earlier pubertal development than boys [pubertal development score mean (SD) 2.9(0.7) for girls and 2.2(0.7) for boys and age at peak height velocity mean(SD) 11.2(1.0) for girls and 13.1(1.0) for boys]. Girls with greater PFAS concentrations had delayed pubertal timing [e.g., each doubling of PFOA was associated with lower pubertal development score (-0.15 units; 95% CI: -0.29, -0.02) and older age at peak height velocity (0.29 years; 95% CI: 0.06, 0.51)], with strongest associations for PFOA, PFOS, and PFDA. Plasma PFAS concentrations were not associated with pubertal timing in boys or with adrenarchal timing in girls or boys. **Conclusions** In a large, prospective US cohort, higher plasma PFAS concentrations in mid-childhood were associated with later onset of puberty in girls, which may be a risk factor for infertility and osteoporosis.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0870**

**Lifetime PFAS exposures and childhood vaccine responses**

**Presenter:** Carmen Messerlian, Harvard T.H.Chan School of Public Health, Boston, United States

**Authors:** C. Messerlian<sup>1</sup>, A. Krogsgaard Andersen<sup>2</sup>, H. Paarup<sup>3</sup>, E. Budtz-Jorgensen<sup>2</sup>, P. Weihe<sup>4</sup>, C. Heilmann<sup>5</sup>, P. Grandjean<sup>1</sup>;

<sup>1</sup>Harvard T.H.Chan School of Public Health, Boston, MA, <sup>2</sup>University of Copenhagen, Copenhagen, DENMARK, <sup>3</sup>Odense University Hospital, Odense, DENMARK, <sup>4</sup>University of the Faroe Islands, Torshavn, FAROE ISLANDS, <sup>5</sup>National University Hospital, Copenhagen, DENMARK.

Background: Immunotoxicity has been selected as the critical effect of early-life exposures to perfluorinated alkylate substances (PFASs) in a 2020 draft opinion by the European Food Safety Authority. However, uncertainty prevails in regard to the most vulnerable age at exposure. Methods: A birth cohort of 490 children was recruited in the Faroe Islands in 2007-2009 and followed up with blood samples at ages 18 months, 5 and 9 years. PFAS concentrations were quantified in umbilical cord blood collected at birth and at postnatal examinations. Diphtheria and tetanus IgG antibody concentrations were quantified at ages 5 and 9 using ELISA assays. As blood samples from infancy were not available, we modeled serum-PFAS concentrations at ages 3 and 6 months using structural equations. We used linear regressions to examine PFAS associations with age-9 antibody concentrations allowing for sex-specific associations. Results: PFAS exposures were lower than in a previous Faroese birth cohort. In cross-sectional analyses at age 9, PFAS concentrations did not show any associations with tetanus or diphtheria antibodies. However, a doubling in the cord blood concentration of perfluorooctanoic acid (PFOA) was associated with a decrease in tetanus (12.6%; 95%CI: -22.1, -1.9) and diphtheria (16.3%; 95% CI: -28.2, -2.3) antibody concentrations. Tendencies were less clear at other ages and for other PFASs. A doubling of the modeled PFOA concentration at 3 months was associated with lower tetanus antibodies (20.8%; 95% CI: -35.0, -3.5%) at age 9. Weaker associations were observed for exposures at age 6 months. There was some indication of sex-specific associations that varied by antibody type. Conclusions; Early-life exposure to PFOA has the strongest impact on vaccine antibody concentrations in later childhood.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0871**

### **Metabolic Perturbation Associated with Per- and Polyfluoroalkyl Substances (PFAS) in an African American Pregnancy Cohort**

**Presenter:** Donghai Liang, Emory University, Atlanta, United States

**Authors:** D. Liang<sup>1</sup>, K. Li<sup>1</sup>, D. B. Barr<sup>1</sup>, P. Panuwet<sup>1</sup>, K. Uppal<sup>1</sup>, V. T. Ly<sup>1</sup>, D. P. Jones<sup>1</sup>, E. J. Corwin<sup>2</sup>, A. L. Dunlop<sup>1</sup>;

<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Columbia University, New York, NY.

**Background.** Per- and polyfluoroalkyl substances (PFASs) are suspected developmental toxicants that are ubiquitous and persistent in the environment. Exposures to PFASs during the prenatal period have been linked to adverse pregnancy and birth outcomes. Notably, communities of color and those affected by socioeconomic disadvantage, particularly African American (AA) pregnant women, disproportionately experience high levels of PFAS exposure and adverse health outcomes. Mechanisms underlying these relationships are complex and largely unknown. **Methods.** We used metabolomics, a high-throughput analytical method involving the identification and quantification of thousands of metabolic features associated with exogenous exposure and endogenous processes, to address these knowledge gaps. We measured serum levels of 12 PFAS and conducted high-resolution metabolic profiling on 320 maternal serum samples collected during the first trimester of pregnancy from Atlanta African American Maternal-Child cohort participants. We conducted untargeted Metabolome Wide Association Study (MWAS) to detect metabolic perturbations associated with PFAS exposures and explore underlying molecular mechanisms. **Results.** The average serum levels of perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) were  $0.94 \pm 0.57$  and  $3.28 \pm 1.67$  ng/mL, respectively. In total, 29,524 metabolic features have been reliably extracted from two technical columns. Using multivariate linear regression models, we found 125 metabolic features were significantly associated with one or more PFAS, when controlling for covariates and false positive discovery rate. Pathway analysis indicated several oxidative stress and inflammatory pathways associated with PFAS exposures, including aspartate, arginine, and glycosphingolipid metabolism. We validated five metabolites using authentic chemical reference standards, including aspartate and arginine, which are both significantly associated with PFOA, PFOS, and perfluorononanoic acid (PFNA). **Conclusions.** Using untargeted MWAS, we identified and verified several pathways and metabolites associated with PFAS exposures among AA pregnant women, which offer promising initial evidence to examine the underlying molecular mechanisms and provide opportunities for interventions to improve outcomes in exposed mothers and children.

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## ABSTRACT E-BOOK

Theme: **PFAS**

**P-0872**

**Prenatal exposure to perfluoroalkyl substances and behavioral difficulties in childhood at 7 and 11 years**

**Presenter:** Jiajun Luo, Yale School of Public Health, New Haven, United States

**Authors:** J. Luo<sup>1</sup>, J. Xiao<sup>1</sup>, Y. Gao<sup>2</sup>, C. H. Ramlau-Hansen<sup>3</sup>, G. Toft<sup>4</sup>, J. Li<sup>4</sup>, C. Obel<sup>3</sup>, S. L. Andersen<sup>5</sup>, N. C. Deziel<sup>1</sup>, W. Tseng<sup>6</sup>, K. Inoue<sup>7</sup>, C. Bonefeld-Jørgensen<sup>8</sup>, J. Olsen<sup>4</sup>, Z. Liew<sup>1</sup>;

<sup>1</sup>Yale School of Public Health, New Haven, CT, <sup>2</sup>Shanghai Jiao Tong University School of Medicine, Shanghai, CHINA, <sup>3</sup>Department of Public Health, Aarhus University, Aarhus, DENMARK, <sup>4</sup>Department of Clinical Epidemiology, Aarhus University, Aarhus, DENMARK, <sup>5</sup>Department of Endocrinology, Aalborg University Hospital, Aalborg, DENMARK, <sup>6</sup>Yale School of Medicine, New Haven, CT, <sup>7</sup>UCLA Fielding School of Public Health, Los Angeles, CA, <sup>8</sup>Department of Public Health, Centre for Arctic Health & Molecular Epidemiology, Aarhus, DENMARK.

**Background:** Perfluoroalkyl substances (PFAS) are suggested to interfere with thyroid hormone during pregnancy and influence fetal neurodevelopment. Epidemiological evidence regarding behavioral difficulties in childhood associated with prenatal PFAS exposure has been inconclusive. **Objective:** The study aimed to assess the association between prenatal PFAS exposure and behavioral difficulties at 7 and 11 years, and evaluated the potential mediating role of maternal thyroid hormones in these associations. **Methods:** Using pooled samples in the Danish National Birth Cohort, we evaluated the associations between concentrations of six types of PFAS in maternal plasma collected in early pregnancy (median, 8 gestational weeks) and child behavioral assessments from the Strength and Difficulties Questionnaire (SDQ), reported by parents at 7 years (n=2,421), and by parents (n=2,070) and children at 11 years (n=2,071). Behavioral difficulties were defined as having composite SDQ scores of the total, externalizing and internalizing behaviors above the 90th percentile. We used logistic regression to estimate the adjusted Odds Ratio (OR) by doubling increase of prenatal PFAS exposure. The possible mediating effect of maternal TSH and fT4 level in the association between prenatal PFAS and SDQ scores were also evaluated. **Results:** Prenatal perfluorononanoic acid (PFNA) was consistently associated with total and externalizing behavioral difficulties in all three SDQ measures reported by parents (OR=1.40, 95% CI: 1.14-1.73 for age 7; OR=1.27, 95% CI: 1.05-1.53 for age 11) or children (OR=1.32, 95% CI: 1.11-1.58) while no consistent associations were observed for other types of PFAS. A small magnitude of indirect effects via maternal TSH and fT4 level were observed for total and externalizing behaviors at 7 years reported by parents only. **Discussion:** Prenatal PFNA exposure was associated with externalizing behavioral difficulties in childhood in repeated SDQ measures at 7 and 11 years. The slight mediating effects of maternal thyroid hormones in early gestation warrant further evaluation.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0873**

### **Association between PFAS and thyroid hormones in US adults and the impact of smoking**

**Presenter:** Maaike van Gerwen, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** M. van Gerwen, M. Alsen, N. Alpert, E. Taioli, E. Genden;  
Icahn School of Medicine at Mount Sinai, New York, NY.

**Background/ Aim:** Perfluoroalkyl acids (PFAS) are known endocrine disruptors with widespread persistence in the environment and near ubiquitous presence in blood. Their presence in blood has been associated with thyroid function disruption. Smoking has also been shown to affect thyroid function, with conflicting results from previous studies. Our objective was to assess the association between PFAS and thyroid function and to investigate effect modification of PFAS-thyroid hormone associations by smoking status.

**Methods:** We used the laboratory subsample of the 2011-2012 National Health and Nutrition Examination Survey and selected adults (> 20 years) without reported thyroid disease or use of thyroid medication (n= 1,325). We extracted serum concentrations of the following PFAS: PFOA, PFOS, PFHxS and PFNA, as single compounds and summed them after converting compounds to molar weights (total PFAS). PFAS and thyroid hormones (TSH, free T4, total T4) were natural log transformed. Smoking status was defined using questionnaire data. Multivariable linear models were adjusted for sex, age, BMI and smoking; effect modification of smoking status was explored.

**Results:** The total serum PFAS geometric mean was 55.2 ( $\pm 1.7$ )  $\mu\text{mol/L}$ . After adjustment, there was a significant positive association between total PFAS and free T4 ( $\beta_{\text{adj}} = 0.023$  (95% CI: 0.009-0.038);  $p=0.0038$ ), but not with TSH and total T4. After stratification by smoking status, there was a significant positive association between total PFAS and free T4 in non-smokers ( $\beta_{\text{adj}} = 0.026$  (95% CI: 0.010-0.043);  $p=0.0036$ ), but not in smokers ( $p=0.7755$ ). There was no statistically significant multiplicative interaction between smoking status and total PFAS ( $p=0.2201$ ).

**Conclusion:** PFAS may disrupt thyroid function and are associated with increasing free T4; this association was not found in smokers. There is a critical need to better understand the complex thyroid hormone axis, which can be targeted by PFAS at various levels, and the role of smoking on this.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0874**

### **Prenatal PFAS Exposure Influences Infant Lean and Fat Mass**

**Presenter:** Alicia Peterson, University of Southern California, Los Angeles, United States

**Authors:** A. Peterson, T. Hodes, T. Chavez, S. Howland, B. Grubbs, L. Chatzi, F. Gilliland, T. Bastain, C. Breton;  
University of Southern California, Los Angeles, CA.

Background: Previous studies have shown maternal exposure to Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) during pregnancy to be associated with birthweight and infant body composition. Childhood obesity rates among Hispanic and African American populations continue to rise and understanding the role of modifiable chemical exposures may reduce the burden of childhood obesity. Methods: Maternal blood samples collected at a mean of 18.8±9.0 weeks gestation from 34 predominantly Hispanic (76.5%) pregnant mothers (mean age 29.5±6.4 years) from the Maternal and Developmental Risks from Environmental and Social Stressors (MADRES) cohort were assayed for levels of 14 PFAS. Infant body composition was measured at 1-2 months (52.9% female, mean age 37.9±6.9 days old) by novel technology using quantitative nuclear magnetic resonance (QMR) to assess infant fat and lean mass. Associations between prenatal PFAS levels and infant body composition were assessed by multiple linear regression. Results: Of the PFAS measured, Perfluorooctanesulfonic acid (PFOS, mean 1.3±0.9 ng/mL), Perfluorooctanoic acid (PFOA, mean 0.2±0.3 ng/ml), Perfluorononanoic acid (PFNA, mean 0.08±0.11 ng/mL), Perfluorodecanoic acid (PFDA, mean 0.05±0.04ng/mL), and Perfluorohexanoic acid (PFHXA, mean 1.1±0.6ng/mL) were detected above the limit of detection in more than 50% of samples. These chemicals were all significantly correlated to each other (R=0.51-0.80). After controlling for gestational age at time of blood collection and child age at scan, infant fat mass (mean 1.5±0.3 kg) was significantly inversely associated with PFHXS ( $\beta = -0.1, p=0.04$ ) while infant lean mass (mean 2.9±0.4 kg) was significantly positively associated with PFOS ( $\beta = 0.2, p=0.02$ ). Conclusion: In this subset of largely Hispanic mother child pairs, maternal exposure to PFHXS in pregnancy was inversely related to infant fat mass while PFOS was positively associated with infant lean mass. Although there is evidence for PFAS influencing newborn body composition, the exact relationships with infant and child body composition and growth over time remain unclear.

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## ABSTRACT E-BOOK

Theme: **PFAS**

**P-0875**

**Physiologically based pharmacokinetic (PBPK) modeling reliability in human exposure assessment after a perfluoroalkyl substances (PFAS) contamination occurred in northern Italy.**

**Presenter:** Lorenzo Vaccari, University of Modena and Reggio Emilia, MODENA, Italy

**Authors:** L. Vaccari<sup>1</sup>, A. Ranzi<sup>2</sup>, F. Daprà<sup>3</sup>, G. Pitter<sup>4</sup>, F. Russo<sup>5</sup>, C. Canova<sup>6</sup>, G. Barbieri<sup>6</sup>, M. Z. Jeddi<sup>6</sup>, T. Fletcher<sup>7</sup>, A. Colacci<sup>2</sup>;

<sup>1</sup>University of Modena and Reggio Emilia, MODENA, ITALY, <sup>2</sup>Centre for Environmental Health and Prevention, Regional Agency for Prevention, Environment and Energy of Emilia-Romagna, Modena, ITALY, <sup>3</sup>Laboratory Department—Regional Agency for Environmental Prevention and Protection, Venice, ITALY, <sup>4</sup>Screening and Health Impact Assessment Unit, Azienda Zero—Veneto Region, Padua, ITALY, <sup>5</sup>Directorate of Prevention, Food Safety, and Veterinary Public Health—Veneto Region, Venice, ITALY, <sup>6</sup>Unit of Biostatistics, Epidemiology, and Public Health—University of Padua, Padua, ITALY, <sup>7</sup>Public Health and Environmental Research Unit, London School of Hygiene and Tropical Medicine, London, UNITED KINGDOM.

**Background and goals:** A wide area in the Veneto region (northern Italy) has been faced a perfluoroalkyl substances (PFAS) contamination occurred mainly in groundwater and drinking water. Exposure of the population likely started in the Sixties, had a sure decrease after filters installation in 2013. The Veneto Region is conducting a biomonitoring study to investigate health conditions of the exposed population, collecting hundreds of serum samples. Some Physiologically based Pharmacokinetic (PBPK) models are being tested comparing PFOA and PFOS measured levels with the estimated ones. **Methods:** Original Loccisano model corrected by EFSA Scientific Panel was tested for this case study. A worst case scenario (WCS) and a best case scenario (BCS) were developed. Both scenarios took into account individual simulations carried out on 25 people (11 men and 14 women), aged 22-39 years, living in an area with both groundwater and drinking water contamination. WCS considered water intake from the private well, company water and bottled water in the same proportion. In the BCS we assumed 1/3 of the water intake from drinking water and 2/3 from bottled water. **Results:** Estimated average PFOA serum level obtained from the WCS was very near to the measured one for men (E:151.4±68.4;M:108.6±51.0 ng/mL), while was farther but still quite near the measured value for women (E:132.2±108.2;M:30.9±30.1 ng/mL). In the BCS the result is the opposite (men, E:23.9±10.4; women, E:22.1±13.2 ng/mL). **Conclusions:** Model seems to predict well PFOA serum levels in the exposed population even with high entity of uncertainties. Loccisano model is a multi-compartment PBPK model created specifically for PFAS, but with no modelization of menstruation and pregnancy losses. New simulations are being running to increase statistical significance but we are also looking at other models to take into account gender differences, to explain differences between men and women observed in measured data.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0877**

**A systematic literature review of PFAS chemicals in human serum and plasma**

**Presenter:** Julia R Kaplan, North Carolina State University, Raleigh, United States

**Authors:** J. R. Kaplan, J. A. Hoppin;  
North Carolina State University, Raleigh, NC.

Background/Aim: Per- and polyfluoroalkyl substances (PFAS) are persistent and ubiquitous in the environment. Concentrations of these chemicals vary by time and geographic region. Numerous studies have measured PFAS in blood, but, to date, there has been no formal data aggregation to assess patterns of PFAS globally over time. Methods: To create a comprehensive database of global blood PFAS levels, a structured literature review was conducted using PubMed, Web of Science, and Google Scholar. Articles were limited to human PFAS measurements in serum or plasma, using search terms including long-form and abbreviated chemical names (e.g., perfluorooctanoic acid (PFOA)), PFAS, and “blood or serum.” Review articles, meta-analysis, and related articles from the same study were excluded, as well as articles using US national NHANES data. Using a structured ontology, articles were categorized by data collection location, population (e.g. adults, children, pregnant women/birth cohorts, communities exposed to contaminated water), sample size, number of detected PFAS, specific PFAS detected, PFAS concentrations, sampling media (blood/plasma), and exposure source. Once data were extracted, summary statistics were calculated. NHANES (1999-2017) will be used as our comparison sample, as this is the largest sample of data representing the longest time frame. Results: To date, we have identified 112 articles published between 1997-2020 meeting our inclusion criteria. Reported PFAS results are from 1959-2019 blood draws. Publications focus on diverse populations from 23 countries and territories; with the highest number from China. The vast majority detected levels of PFOA (94%) and perfluorooctanesulfonic acid (PFOS) (93%), however, newer studies are reporting additional PFAS and their precursors. Upon completion of data extraction, values will be compared to NHANES. Conclusions: These data will be helpful in potentially identifying hot spots of PFAS contamination and in evaluating how PFAS levels are changing over time and space.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0878**

**Prenatal Exposure to Per- and Polyfluoroalkyl Substances and Obesity in Early Childhood**

**Presenter:** Jennifer Oliver, Boston University, Boston, United States

**Authors:** J. Oliver<sup>1</sup>, T. Webster<sup>1</sup>, H. Stapleton<sup>2</sup>;

<sup>1</sup>Boston University, Boston, MA, <sup>2</sup>Duke University, Durham, NC.

Per- and polyfluoroalkyl substances (PFAS) are commonly found in firefighting foams, textiles, Teflon, and consumer products, with major sources including fire training sites, industrial sites, and wastewater treatment plants. We assessed the association between maternal serum PFAS concentrations during pregnancy and child obesity between the ages of 2 and 6 years in 165 mother-child pairs from the TESIE Study (2009-2011). We used multivariate logistic regression models to estimate the association between maternal serum PFAS concentrations and child obesity, and directed acyclic graphs to identify confounders. Linear regression models were used to assess the linear relationship between each maternal PFAS concentration and child body mass index. There was not a statistically significant association between maternal serum PFAS concentrations and body mass index. There was a positive trend observed between maternal serum concentrations of perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorooctane sulfonamide (PFDeA) and the odds of child obesity, and a negative trend for perfluorohexane sulfonic acid (PFHxS). Each log increase in maternal serum PFNA concentration was marginally associated with a 15% increased odds of child obesity (95% confidence interval 0.99, 1.32). These findings suggest that prenatal exposure to PFAS may increase the odds of obesity in children in early childhood, and risk may differ by type of PFAS exposure.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0879**

**The role of genetic predisposition in the potentially diabetogenic effect of PFAS exposure**

**Presenter:** Damaskini Valvi, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** D. Valvi<sup>1</sup>, D. C. Christiani<sup>2</sup>, B. Coull<sup>2</sup>, K. Højlund<sup>3</sup>, F. Nielsen<sup>4</sup>, L. Su<sup>2</sup>, P. Weihe<sup>5</sup>, P. Grandjean<sup>2</sup>;

<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Harvard TH Chan School of Public Health, Boston, MA, <sup>3</sup>Odense University Hospital, Odense, DENMARK, <sup>4</sup>University of Southern Denmark, Odense, DENMARK, <sup>5</sup>The Faroese Hospital System, Torshavn, FAROE ISLANDS.

**Background:** Early life and adult exposure to perfluoroalkyl substances (PFAS) has been associated with insulin resistance and pancreatic beta-cell dysfunction in observational and animal studies. Genetic predisposition to diabetogenic effects from environmental toxicants may modify these associations; however this hypothesis has not been previously studied. **Methods:** We examined 97 single-nucleotide polymorphisms (SNPs) as effect modifiers of the PFAS association with markers of glucose homeostasis in 665 Faroese adults born in 1986-1987. SNPs were selected based on their suspected associations with the kinetics of environmental toxicants and/or type 2 diabetes risk. Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) were measured in cord whole blood at birth and in participants' serum from age 28 years. We calculated the Matsuda insulin sensitivity index (ISI) and the insulinogenic index (IGI) based on a 2h oral glucose tolerance test performed at age 28. Effect modification was evaluated in linear regression models adjusted for cross-product terms (PFAS\*SNP) and confounders. **Results:** PFOS was associated with decreased insulin sensitivity ( $\beta$  [95% CI] for logISI per PFOS doubling= -0.05 [-0.12, 0.01] for prenatal exposure, and -0.05 [-0.09, -0.01] for adult exposure) and increased beta-cell function ( $\beta$  [95% CI] for logIGI per PFOS doubling=0.12 [0.02, 0.22] for prenatal exposure and 0.04 [-0.03, 0.11] for adult exposure). PFOA associations were in the same direction as for PFOS but more attenuated. In preliminary analysis, we found 25 SNPs which adversely modified the associations of PFOS with ISI and/or IGI, from which 15 SNPs further modified the associations of PFOA with ISI and/or IGI (p-value for interaction<0.05). Most of these SNPs were in genes that encode important proteins for energy homeostasis and metabolism, such as the FTO and PPARG genes. **Conclusions:** These findings suggest that genetic predisposition may play a role in the effects of PFAS exposures on insulin resistance and beta-cell function.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0881**

### **PFAS exposure and association with polycystic ovarian syndrome**

**Presenter:** Sofia Hammarstrand, Occupational and Environmental Medicine, School of Public Health and Community Medicine, Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Göteborg, Sweden

**Authors:** S. Hammarstrand<sup>1</sup>, K. Jakobsson<sup>1</sup>, E. Andersson<sup>1</sup>, E. M. Andersson<sup>2</sup>;

<sup>1</sup>Occupational and Environmental Medicine, School of Public Health and Community Medicine, Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Göteborg, SWEDEN, <sup>2</sup>Occupational and Environmental Medicine, Sahlgrenska University Hospital., Göteborg, SWEDEN.

**Background:** Polycystic ovarian syndrome (PCOS) is a common endocrine disorder that affects women in reproductive age. Common features are irregular menses, hirsutism and anovulatory infertility. The etiology is multifactorial and the endocrine characteristics implicate that endocrine disruptive chemicals in the environment could be a driver for onset of disease. Perfluorinated and polyfluorinated substances (PFAS) are persistent manmade substances that may possess endocrine disrupting properties on reproductive hormones. The few studies available on PFAS exposure and PCOS indicates PFAS to play a role in the etiology of disease, but the results are inconclusive. In 2013 high levels of PFAS were found in the drinking water from one of the two waterworks in the municipality Ronneby, Sweden. Biomonitoring revealed very high serum levels of PFAS. The purpose was to investigate the association between PFAS exposure and PCOS. **Methods:** The cohort consisted of all women residing in Ronneby municipality between 1985 and 2013. Exposure was assessed based on yearly residence address and waterworks supply data. Diagnoses were obtained from the National Board of Health and Welfare in Sweden up to 2013. A Cox proportional hazards model, with calendar year on the time axis, was used to estimate the associations between PFAS exposure and disease.

**Results:** A total of 29 856 women were included between 1985 and 2013. Of these, 7823 (26%) had resided in the area with contaminated drinking water. In total there were 161 cases of PCOS. We found significantly increased HRs for PCOS in women aged 20 to 50 years old in the highest exposure category. Also, results for uterine fibroids and endometriosis will be presented.

**Conclusion:** PFAS exposure in drinking water was associated with an increased risk for PCOS.

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## ABSTRACT E-BOOK

Theme: PFAS

P-0883

### Plasma metabolites associated with exposure to perfluoroalkyl substances and risk of type 2 diabetes - a nested case-control study

**Presenter:** Tessa Schillemans, Karolinska Institutet, Stockholm, Sweden

**Authors:** T. Schillemans<sup>1</sup>, L. Shi<sup>2</sup>, C. Donat-Vargas<sup>3</sup>, A. Tornevi<sup>4</sup>, J. Sommar<sup>4</sup>, I. Johansson<sup>4</sup>, J. Koponen<sup>5</sup>, H. Kiviranta<sup>5</sup>, K. Hanhineva<sup>6</sup>, O. Rolandsson<sup>4</sup>, I. Bergdahl<sup>4</sup>, R. Landberg<sup>7</sup>, A. Åkesson<sup>1</sup>, C. Brunius<sup>7</sup>; <sup>1</sup>Karolinska Institutet, Stockholm, SWEDEN, <sup>2</sup>Shaanxi Normal University, Xi'an, CHINA, <sup>3</sup>Universidad Autónoma de Madrid, Madrid, SPAIN, <sup>4</sup>Umeå University, Umeå, SWEDEN, <sup>5</sup>National Institute for Health and Welfare, Kuopio, FINLAND, <sup>6</sup>University of Eastern Finland, Kuopio, FINLAND, <sup>7</sup>Chalmers University of Technology, Gothenburg, SWEDEN.

**Background:** Perfluoroalkyl substances (PFAS) are persistent environmental pollutants that may induce metabolic perturbations in humans. However, underlying molecular mechanisms are still unknown and both direct and inverse associations of PFAS exposures with T2D have been reported. Thus, in this exploratory study, we investigated PFAS-related plasma metabolites for their associations with type 2 diabetes (T2D) to gain insight in these PFAS-induced alterations.

**Methods:** We used data from plasma measurements of PFAS exposures and untargeted LC-MS metabolomics in a case-control study on T2D (n=187 matched pairs) nested within the Västerbotten Intervention Programme cohort in northern Sweden. Principal component analysis (PCA) showed that six PFAS appeared in two groups: 1) longer-chain PFAS (perfluorononanoic acid, perfluorodecanoic acid and perfluoroundecanoic acid) and 2) shorter-chain PFAS (perfluorohexane sulfonic acid, perfluorooctane sulfonic acid and perfluorooctanoic acid). A random forest algorithm was used to find metabolite features associated with PFAS exposure patterns, which were then investigated for their prospective associations with T2D using conditional logistic regression.

**Results:** Out of 171 PFAS-related metabolite features ( $0.16 \leq |r| \leq 0.37$ ), 35 also associated with T2D ( $p < 0.05$ ). PCA of the 35 PFAS- and T2D-related metabolites revealed two metabolite patterns, dominated by glycerophospholipids and diacylglycerols. Both metabolite patterns correlated positively with the longer-chain PFAS. The glycerophospholipid pattern associated with decreased T2D risk (OR = 0.2 per standard deviation (sd) increase in metabolite pattern score; 95% CI = 0.1-0.4), whereas the diacylglycerol pattern associated with increased T2D risk (OR = 1.9 per sd; 95% CI = 1.3-2.7).

**Conclusions:** Our results suggest that longer-chain PFAS associate with two metabolite patterns with opposite relations to T2D risk. The occurrence of these two metabolite patterns may imply co-occurring metabolic regulations, which could facilitate understanding of the conflicting results in the literature for PFAS and T2D associations.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0884**

### **Presence of Perfluoroalkyl Substances in Landfill-adjacent Surface Waters: Case Studies in Orange County and Sampson County, North Carolina**

**Presenter:** Aleah Walsh, UNC Chapel Hill, Chapel Hill, United States

**Authors:** A. Walsh, C. Woods, P. Cable;  
UNC Chapel Hill, Chapel Hill, NC.

Background/Aim: Perfluoroalkyl substances (PFAS) are a synthetic class of compounds used in consumer products. Landfills have been identified as major sources of PFAS into the environment, though they are not commonly monitored in surface and groundwater near landfills in the US. This study characterized PFAS in surface waters adjacent to two landfills in North Carolina: one in Sampson County (SC) and another in Orange County (OC). The site in SC accepts PFAS-containing industrial sludge. Both sites are close to predominantly African-American neighborhoods. Landfills pose an important public health risk, especially in low-income communities and communities of color that are disproportionately sited for landfills and in rural areas where private wells may be impacted. Methods: Water samples were collected along surface water features near the landfills at points that were upstream, adjacent, downstream and downgradient. Samples were collected every 3 weeks between October 2019 and January 2020. Concentrations of thirty-four PFAS were measured using liquid chromatography with tandem mass spectroscopy (LC-MS) using the large volume direct injection method. A simple t-test was performed to determine if the average concentrations measured adjacent and downstream of the landfill were statistically significantly different from concentrations upstream of the landfill. Results: Across the 35 samples collected, we detected twelve PFAS (six novel and six legacy). Legacy PFAS were detected in surface water near both landfills, with concentrations most elevated at sampling sites adjacent to the landfill, compared to upstream sites. Novel PFAS were only detected in surface water near the SC landfill, with similar concentration profiles as the legacy PFAS. Conclusions: Offsite migration of leachate is the likely contributor of PFAS measured in landfill adjacent surface waters in SC and OC. These findings support the need for more comprehensive and more frequent water monitoring near landfills and stricter regulation regarding the landfilling of industrial materials.

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## ABSTRACT E-BOOK

Theme: **PFAS**

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**P-0885**

**Per- and polyfluoroalkyl substances (PFAS) serum levels among a group of New Jersey volunteer firefighters and comparison with the US National Health and Nutrition Examination Survey (NHANES) (2015-16)**

**Presenter:** Judith Graber, Rutgers School of Public Health, Piscataway, United States

**Authors:** T. E. Brancard<sup>1</sup>, S. Lu<sup>1</sup>, T. M. Black<sup>1</sup>, J. L. Burgess<sup>2</sup>, N. N. Shah<sup>1</sup>, K. G. Black<sup>1</sup>, M. B. Steinberg<sup>1</sup>, J. M. Graber<sup>1</sup>;

<sup>1</sup>Rutgers University, Piscataway, NJ, <sup>2</sup>University of Arizona, Tucson, AZ.

**BACKGROUND/AIM:** High serum levels of some PFAS have been reported in paid firefighters (FFs), while most FFs are volunteers. PFAS are associated with health outcomes including modulated immune function, dyslipidemia, and some types of cancer. We described PFAS serum levels among New Jersey (NJ) volunteer FFs.

**METHODS:** Within the NJ Firefighters Cancer Prevention Study (CAPS), we enrolled members from the Toms River Fire Department (TRFD). Participants completed a detailed survey and provided blood samples for PFAS measurement. We defined firefighting experience as the average number of fire calls responded to per firefighter years (paid or volunteer). Because participants (n=138) were majority white (91%) and male (94%), we compared geometric means and 95% CIs for the eight PFAS reported by NHANES among non-Hispanic white males. We also assessed associations between PFAS levels and firefighting experience controlling for age, race/ethnicity, sex, education, and primary occupation using linear regression.

**RESULTS:** Average age was 46.6 (sd. 17.1). Serum levels of three PFAS were significantly elevated among participants compared with NHANES: perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDeA) and perfluorododecanoic acid (PFDoA) (34%, 51% and 51%, respectively). After adjusting for demographics and occupation, only the association between PFDoA serum level and years of firefighting experience remained significant ( $\beta=0.002$  ng/mL;  $p=0.019$ ).

**CONCLUSIONS:** To our knowledge, this is the first study of PFAS levels in volunteer FFs. Consistent with the literature in paid FFs, we observed significantly elevated levels for some PFAS, compared with the general population. Further, we saw a strong exposure-response relationship with firefighting experience and increased serum level of PFDoA. There is growing concern over the potential health impact of PFAS among FFs, it is important that volunteer FFs be included in future evaluations of PFAS burden among FFs.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0888**

**Long-term exposure to iron and copper in fine particulate air pollution and their combined impact on reactive oxygen species concentration in lung fluid: A population-based cohort study of cardiovascular disease incidence and mortality in Toronto, Canada**

**Presenter:** Zilong Zhang, Public Health Ontario, Toronto, Canada

**Authors:** Z. Zhang<sup>1</sup>, S. Weichenthal<sup>2</sup>, J. C. Kwong<sup>3</sup>, R. T. Burnett<sup>4</sup>, M. Hatzopoulou<sup>5</sup>, M. Jerrett<sup>6</sup>, A. Van Donkelaar<sup>7</sup>, L. Bai<sup>3</sup>, R. V. Martin<sup>7</sup>, R. Copes<sup>1</sup>, H. Lu<sup>3</sup>, P. Lakey<sup>8</sup>, M. Shiraiwa<sup>8</sup>, H. Chen<sup>1</sup>;

<sup>1</sup>Public Health Ontario, Toronto, ON, CANADA, <sup>2</sup>McGill University, Montreal, QC, CANADA, <sup>3</sup>ICES, Toronto, ON, CANADA, <sup>4</sup>Health Canada, Ottawa, ON, CANADA, <sup>5</sup>University of Toronto, Toronto, ON, CANADA, <sup>6</sup>University of California Los Angeles, Los Angeles, CA, <sup>7</sup>Dalhousie University, Halifax, NS, CANADA, <sup>8</sup>University of California Irvine, Irvine, CA.

**Background:** Exposure to fine particulate air pollution (PM<sub>2.5</sub>) is associated with increased cardiovascular disease (CVD) morbidity and mortality but less is known about specific PM<sub>2.5</sub> components, such as those from non-tailpipe sources, which have contributed to an important portion of primary particles. We investigated the associations of long-term exposure to iron (Fe) and copper (Cu) in PM<sub>2.5</sub> (two metal components mainly originating from non-tailpipe emissions), and their combined impact on the concentration of reactive oxygen species (ROS) in lung fluid, with incident acute myocardial infarction (AMI), congestive heart failure (CHF) and CVD death. **Methods:** We conducted a population-based cohort study in Toronto, Canada. Exposures to Fe and Cu in PM<sub>2.5</sub> and their combined impact on ROS were estimated using land use regression models. We used mixed-effects Cox regression models to examine the associations between the exposures and health outcomes. A series of sensitivity analyses were conducted, including indirect adjustment for individual-level cardiovascular risk factors (e.g. smoking), and adjustment for PM<sub>2.5</sub> and nitrogen dioxide (NO<sub>2</sub>). **Results:** In single-pollutant models, we found positive associations between the three exposure measures and all three CVD outcomes, with the strongest associations detected for the estimated ROS. The associations of AMI and CHF were sensitive to indirect adjustment, but remained robust for CVD death in all other sensitivity analyses. In multi-pollutant models, the associations of the three exposures generally remained unaltered. Interestingly, adjustment for ROS did not substantially change the associations between PM<sub>2.5</sub> and CVD, but attenuated the associations of Fe and Cu with ROS, and the association of Cu with NO<sub>2</sub>.

**Conclusions:** Long-term exposure to Fe and Cu in PM<sub>2.5</sub> and their combined impact on ROS were consistently associated with increased CVD death.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0889**

**Short-term exposure to air pollution and novel markers of cardiovascular effect: a repeated measures study in the Multi-Ethnic Study of Atherosclerosis (MESA)**

**Presenter:** Yu Ni, University of Washington, Seattle, United States

**Authors:** Y. Ni<sup>1</sup>, R. Tracy<sup>2</sup>, E. Cornell<sup>2</sup>, J. Kaufman<sup>1</sup>, A. Szpiro<sup>1</sup>, S. Vedal<sup>1</sup>;  
<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>University of Vermont, Burlington, VT.

**Background:** Several pathophysiologic mechanisms have been proposed to underlie the associations between ambient air pollutants and cardiovascular disease. We employed a repeated measures design to investigate the short-term associations of outdoor concentrations of four air pollutants – particulate matter smaller than 2.5 micrometers in diameter (PM<sub>2.5</sub>), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>) and sulfur dioxide (SO<sub>2</sub>) – with two blood markers involved in vascular effects of oxidative stress, soluble lectin-like oxidized LDL receptor-1 (sLOX-1) and nitrite, using data from the MESA study. **Methods:** 740 participants who submitted blood samples at three MESA exams between 2002 and 2007 were included. sLOX-1 and nitrite were measured in plasma samples. Daily concentrations of PM<sub>2.5</sub>, NO<sub>2</sub>, O<sub>3</sub> and SO<sub>2</sub> 0-7 days prior to blood draw at each exam were estimated from central monitors in the six MESA regions, pre-adjusted using splines of meteorology, indicators for day of the week, and splines of site-specific time trend. Unconstrained distributed lag linear mixed effect models and generalized estimating equations were used to estimate net effects over several days with adjustment for demographic, socioeconomic and behavioral factors.

**Results:** Median detectable nitrite and sLOX-1 concentrations were 24.7 umol/L and 94.5 pg/ml, respectively. Higher short-term PM<sub>2.5</sub> concentrations, but not other pollutants, were associated with elevated sLOX-1 level analyzed both as a continuous outcome (percent change per interquartile increase: 18.5%, 95%CI: 2.4-37.2%) and dichotomized at the median (odds ratio per interquartile increase: 1.21, 95%CI: 1.01-1.44); the finding was not meaningfully changed after adjustment for additional covariates or in several sensitivity analyses. Pollutant concentrations were not associated with nitrite levels. **Conclusion:** This study adds to the evidence that short-term PM<sub>2.5</sub> exposure is associated with higher sLOX-1 and supports the mechanistic hypothesis that oxidative modification of endogenous phospholipids in the lung by PM<sub>2.5</sub> drives vascular endothelial cell activation via cell surface pattern recognition receptors.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0890**

**Particulate air pollution and risk of subsequent cardiovascular events among those with a history of stroke or myocardial infarction**

**Presenter:** Noelle S Liao, Kaiser Permanente Division of Research, Oakland, United States

**Authors:** N. S. Liao<sup>1</sup>, S. E. Alexeeff<sup>1</sup>, K. A. Deosaransingh<sup>1</sup>, S. K. Van Den Eeden<sup>1</sup>, S. Sidney<sup>1</sup>, J. Schwartz<sup>2</sup>;

<sup>1</sup>Kaiser Permanente Division of Research, Oakland, CA, <sup>2</sup>Harvard T.H Chan School of Public Health, Boston, MA.

**Background/Aim:** Previous studies have found associations between fine particulate matter (PM<sub>2.5</sub>) and increased risk of cardiovascular disease (CVD) morbidity and mortality among populations with no history of cardiovascular events. Less is understood about susceptibility of patients with a history of CVD and subsequent air pollution-related CVD events and whether current regulation levels for PM<sub>2.5</sub> are protective for this population. **Methods:** This retrospective cohort study included 97,134 Kaiser Permanente Northern California adult members with a history of stroke or acute myocardial infarction (AMI). Outcome, covariate, and address data was obtained from electronic health records and linked to time-varying annual mean PM<sub>2.5</sub> exposure estimates based on residential location. Cox proportional hazard models were used to estimate risks of stroke, AMI, and CVD mortality associated with PM<sub>2.5</sub> exposure, adjusting for age, sex, race, study start year, body mass index, smoking, comorbidities, CVD history, revascularization, medication use, Medicaid insurance, and neighborhood education. Secondary analyses determined whether estimated risks occurred at exposure levels below the current federal and state regulation level for annual mean PM<sub>2.5</sub> exposure, 12 µg/m<sup>3</sup>. **Results:** A 10 µg/m<sup>3</sup> increase in annual mean PM<sub>2.5</sub> exposure was associated with a 18.2% increase in risk of CVD mortality (95% CI: 9.3%, 27.7%), but no increase in risk of stroke or AMI (hazards ratios 0.92 [95% CI: 0.81, 1.04] and 0.85 [95% CI: 0.77, 0.95] respectively). Increased risks of CVD mortality persisted below 12 µg/m<sup>3</sup>, with a 4.3% increase in risk for annual exposure 9-12 µg/m<sup>3</sup> (95% CI: 0.2%, 8.5%), relative to annual exposure <9 µg/m<sup>3</sup>. **Conclusions:** Patients with a history stroke or AMI are highly susceptible to the effects of PM<sub>2.5</sub> exposure on CVD mortality. Additionally, estimated effects occurred at exposure levels lower than the current regulatory level, highlighting that current PM<sub>2.5</sub> regulation levels may not be protective for this susceptible population.

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Theme: **PM and cardiovascular health**

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**P-0891**

**Indoor and outdoor particulate matter and serum levels of lead and cadmium among Korean housewives: a panel study**

**Presenter:** Dong-Wook Lee, Seoul National University, College of Medicine, Seoul, Korea, Republic of

**Authors:** D. Lee<sup>1</sup>, J. Oh<sup>2</sup>, Y. Kwag<sup>2</sup>, S. Ye<sup>3</sup>, W. Yang<sup>4</sup>, W. Yang<sup>4</sup>, Y. Kim<sup>5</sup>, E. Ha<sup>2</sup>;

<sup>1</sup>Seoul National University, College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Ewha Womans University, School of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Korea Occupational Safety and Health Agency, Occupational Safety and Health Research institute, Incheon, KOREA, REPUBLIC OF, <sup>4</sup>Catholic University of Daegu, Daegu, KOREA, REPUBLIC OF, <sup>5</sup>University of Ulsan, College of Medicine, Ulsan, KOREA, REPUBLIC OF.

Introduction Lead (Pb) and cadmium (Cd) are heavy metals that could cause harmful health effects to humans. It is known that particulate matter  $\leq \mu\text{g}$  (PM<sub>2.5</sub>) contains heavy metals, but whether they are significantly associated with body burden of heavy metals has yet been studied. We aimed to investigate the association between exposure to particulate matter and serum concentration of Pb and Cd. Methods A total of 101 housewives living in 2 Korean urban communities were recruited and were examined repeatedly 2 times during a 1-year period. We obtained lifestyle information including the time-activity pattern and dietary habits, and collected the blood samples of participants at the baseline for measuring serum concentration of Pb and Cd. We measured indoor PM<sub>2.5</sub> by using Gravimetric methods for a week before each examination, and indoor PM<sub>2.5</sub> by using the IoT smart sensor gadget between examinations. Results Exposure to particulate matter was significantly associated with serum Pb and serum Cd of Korean housewives, by using linear mixed model for considering repeated measurements. In crude analysis, 2-fold increase of PM<sub>2.5</sub> was associated with 0.089 ug/L increase of serum Pb and 0.097 ug/L increase of serum Cd. Discussion Our study shows significant association between air pollution and serum Cd and Pb, with the precise measurement of particulate matter. This result suggest that additional body burden of heavy metals caused by air pollution. More precautionary policy for potential health hazard of particulate matter on housewives are necessary to protect the health of women.

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## ABSTRACT E-BOOK

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**P-0893**

**Short term changes in ambient temperature and acute risk of atrial fibrillation episodes**

**Presenter:** Marcus Dahlquist, Karolinska Institutet, Stockholm, Sweden

**Authors:** M. Dahlquist<sup>1</sup>, V. Frykman-Kull<sup>2</sup>, K. Kemp-Gudmundsdottir<sup>2</sup>, E. Svennberg<sup>2</sup>, G. A. Wellenius<sup>3</sup>, P. L. Ljungman<sup>1</sup>;

<sup>1</sup>Karolinska Institutet, Stockholm, SWEDEN, <sup>2</sup>Danderyd University Hospital, Stockholm, SWEDEN, <sup>3</sup>Boston University School of Public Health, Boston, MA.

### Introduction

Atrial fibrillation is one of the most common arrhythmias, currently prevalent in approximately 1-3 % of the population but predicted to increase substantially due to an aging population. It is associated with a higher risk of stroke, dementia, and mortality, as well as reduced quality of life. A seasonal pattern of hospital admissions for atrial fibrillation has been observed, with increased cases during the colder months. Previous studies suggest associations between short-term decreases in ambient temperature and acute onset of atrial fibrillation episodes, but the evidence is limited.

### Method

We screened 8,899 randomly selected 75-yearolds living in Stockholm for atrial fibrillation using home-based short-term ambulatory 1-lead ECG-measurements 2-4 times a day for 14 days. Screenings were carried out in 2012-2013 and 2016-2018. We used generalized estimating equations to quantify the association between ambient temperature obtained from a fixed monitoring station and risk of atrial fibrillation, adjusting for day of week, time of day and relative humidity. We explored different exposure windows and susceptible subgroups.

### Results

Among 218 participants with 469 atrial fibrillation episodes during the screening period we did not observe a statistically significant association between 24-hour prior ambient temperature and atrial fibrillation [-1% (95% CI -2%; 1%) per 1°C). We explored different exposure windows ranging from 6 to 48 hours as well as lagged exposures 12-24 hours and 24-48 hours with similar suggestive but non-significant inverse associations. A more pronounced and statistically significant association was observed for participants with diabetes [-5% (95% CI -9%; -1%) per 1°C). We did not observe any difference in the association by sex or hypertension.

### Conclusion

Overall, short-term temperature was not strongly associated with triggering of atrial fibrillation episodes. However, there was some evidence to suggest an association between a drop in temperature and increased risk of atrial fibrillation among participants with diabetes.

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Theme: **PM and cardiovascular health**

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**P-0894**

**Neighborhood differences in the associations between PM<sub>2.5</sub> exposure and hypertension among heart failure patients in North Carolina, USA**

**Presenter:** Anne M Weaver, US Environmental Protection Agency, Chapel Hill, United States

**Authors:** A. M. Weaver<sup>1</sup>, E. R. Pfaff<sup>2</sup>, L. M. Neas<sup>1</sup>, R. B. Devlin<sup>1</sup>, J. Schwartz<sup>3</sup>, Q. Di<sup>3</sup>, W. E. Cascio<sup>1</sup>, D. Diaz-Sanchez<sup>1</sup>, C. K. Ward-Caviness<sup>1</sup>;

<sup>1</sup>US Environmental Protection Agency, Chapel Hill, NC, <sup>2</sup>North Carolina Translational and Clinical Sciences Institute, University of North Carolina, Chapel Hill, NC, <sup>3</sup>T.H. Chan School of Public Health, Harvard University, Boston, MA.

**Background** Both exposure to PM<sub>2.5</sub> air pollution and neighborhood socioeconomic status (SES) are associated with adverse cardiovascular outcomes, including hypertension. We used the EPA-CARES electronic health record database to study the joint impact of neighborhood SES and PM<sub>2.5</sub> exposure on hypertension among patients with heart failure in North Carolina. **Methods** We used block-group level factors of urbanicity, housing, and SES from the 2010 Census to identify seven neighborhood clusters (spatially noncontiguous) using Ward's hierarchical clustering algorithm. We then assigned neighborhood clusters to the primary residence of heart failure patients (N = 30,060). Participant residence-specific estimates of annual average PM<sub>2.5</sub> concentrations were modeled at a 1x1 km resolution using a hybrid satellite-based model developed at Harvard University. We examined the associations between PM<sub>2.5</sub> and hypertension, by neighborhood cluster and overall, using logistic regression models adjusted for age, sex, race, chronic kidney disease, diabetes, peripheral artery disease, hyperlipidemia, and chronic obstructive pulmonary disease. **Results** PM<sub>2.5</sub> concentrations ranged from 9.5 µg/m<sup>3</sup> (IQR 1.8 µg/m<sup>3</sup>) in lower-SES rural cluster to 10.4 µg/m<sup>3</sup> (IQR 2.8 µg/m<sup>3</sup>) in upper-middle-SES urban cluster. We observed associations between a 1 µg/m<sup>3</sup> increment in PM<sub>2.5</sub> and hypertension among lower-SES urban (OR=1.05, 95% CI 1.00-1.10), lower-middle-SES urban (OR=1.03, 95% CI 1.00-1.07), and middle-SES urban (OR 1.04, 95% CI 0.98-1.10) clusters and overall (OR=1.02, 95% CI 1.00-1.04). We did not observe associations between PM<sub>2.5</sub> and hypertension in rural, suburban, or upper-SES urban clusters. **Conclusions** Among heart failure patients, we observed associations between PM<sub>2.5</sub> and hypertension in lower- and middle-SES urban areas. These results suggest that associations between PM<sub>2.5</sub> and hypertension can vary by neighborhood among individuals with severe cardiovascular disease. This abstract does not necessarily reflect EPA policy.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0895**

### **Evaluation of PM<sub>2.5</sub> Air Pollution Sources and Cardiovascular Health**

**Presenter:** Anne M Weaver, US Environmental Protection Agency, Chapel Hill, United States

**Authors:** E. Slawsky<sup>1</sup>, A. M. Weaver<sup>1</sup>, C. K. Ward-Caviness<sup>1</sup>, L. M. Neas<sup>1</sup>, R. B. Devlin<sup>1</sup>, W. E. Cascio<sup>1</sup>, A. G. Russell<sup>2</sup>, W. E. Kraus<sup>3</sup>, E. Hauser<sup>3</sup>, D. Diaz-Sanchez<sup>1</sup>;

<sup>1</sup>US Environmental Protection Agency, Chapel Hill, NC, <sup>2</sup>Georgia Institute of Technology, Atlanta, GA, <sup>3</sup>Duke University Molecular Physiology Institute, Durham, NC.

Background: Air pollution exposure, notably fine particulate matter (diameter  $\leq 2.5 \mu\text{m}$ , PM<sub>2.5</sub>), is a global contributor to morbidity and mortality and a known risk factor for myocardial infarctions (MI) and coronary artery disease (CAD). Novel modeling methods can provide source-apportionment, to estimate the source-specific impacts on cardiovascular health. Methods: The Catheterization Genetics (CATHGEN) cohort consists of patients who underwent a cardiac catheterization at Duke University Medical Center (North Carolina, USA) from 2001-2010. History of MI was extracted from medical records. Severity of coronary blockage was determined by coronary angiography and converted into a binary indicator of clinical CAD. PM<sub>2.5</sub> source-specific yearly averages were estimated using an improved gas-constrained source apportionment model for North Carolina from 2002 to 2010 at 12x12 kilometer resolution. We tested six PM<sub>2.5</sub> source-specific mass estimates for associations with CAD and MI (per 1  $\mu\text{g}/\text{m}^3$  increase) using multivariate logistic regression adjusted for age, race, sex, smoking history, home value, urbanity, and education. Results: Of 5681 CATHGEN participants; 2497 (43.9%) had CAD, and 1652 (29.0%) had a history of MI. PM<sub>2.5</sub> fractions of ammonium bisulfate and ammonium nitrate were associated with increased prevalence of CAD (odds ratio [OR] 1.52; 95%CI 1.24-1.86 and OR 1.62; 95%CI 1.28-2.05, respectively). PM<sub>2.5</sub> from ammonium bisulfate and ammonium nitrate were also associated with increased prevalence of MI (OR 1.57; 95%CI 1.28-1.94 and OR 2.04; 95% CI 1.61-2.58, respectively). MI was associated with PM<sub>2.5</sub> from ammonium sulfate (OR 1.44; 95%CI 1.15-1.82). Gasoline source-apportioned PM<sub>2.5</sub> was inversely associated with CAD (OR 0.58; 95%CI 0.38-0.90). We did not observe association with diesel or secondary organic carbons PM<sub>2.5</sub>. Conclusion: Greater PM<sub>2.5</sub> fractions of ammonium bisulfate and ammonium nitrate are associated with greater MI and CAD prevalence. Our findings suggest analyses of source-specific PM<sub>2.5</sub> mass may reveal novel associations. This abstract does not reflect EPA policy.

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Theme: **PM and cardiovascular health**

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**P-0896**

### **Association of plasma PAHs with Ultrafine Particle Exposure and Cardiovascular Risk Biomarkers in a Near-Highway Study Population**

**Presenter:** Caitlin L. Johnson, Tufts University, Medford, United States

**Authors:** C. L. Johnson<sup>1</sup>, K. E. Manz<sup>2</sup>, M. Chung<sup>3</sup>, D. Brugge<sup>4</sup>, K. D. Pennell<sup>2</sup>;

<sup>1</sup>Tufts University, Medford, MA, <sup>2</sup>Brown University, Providence, RI, <sup>3</sup>Tufts University School of Medicine, Boston, MA, <sup>4</sup>UConn Health, Farmington, CT.

Background: Ultrafine particles (UFP) are elevated near roadways and exposure to UFP has been linked to adverse cardiovascular health outcomes, possibly due to their high content of polycyclic aromatic hydrocarbons (PAHs). The goal of this work was to investigate the relationship between plasma PAH levels, estimated annual average UFP exposure, and cardiovascular risk biomarkers in 58 plasma samples from non-smokers in the Community Assessment of Freeway Exposure and Health (CAFEH) study. Methods: Plasma samples from the CAFEH study were analyzed for 15 EPA priority PAHs (excluding naphthalene) using high-resolution gas chromatography-Orbitrap-mass spectrometry. The effects of plasma PAH levels and estimated UFP exposure on c-reactive protein, fibrinogen, and interleukin-6 were modeled using Bayesian kernel machine regression (BKMR), a nonlinear multivariate modeling technique. The models were adjusted for age, sex, and BMI. Results: Anthracene, phenanthrene, fluoranthene, pyrene, and benzo[ghi]perylene were measured in over 70% of the plasma samples. BKMR models indicated jointly positive relationships between mixtures of these PAHs and all three CV biomarkers. The model of benzo[ghi]perylene, fluoranthene, and pyrene with interleukin-6 showed strong positive associations, with 95% credible intervals indicating high confidence in model results. Variable selection revealed that estimated UFP exposure was less important than measured plasma PAH levels for models of all three cardiovascular biomarkers. Estimated UFP exposure was not strongly correlated (Spearman's rho < 0.1) with plasma PAH levels in this study population. Conclusions: Plasma PAH levels were positively associated with cardiovascular risk biomarkers in this population, in contrast to estimated UFP exposure. Although UFP exposure and plasma PAHs were not correlated in this study, this result may be due to the differing time scales of the two measurements (annual exposure estimate vs. point measurement in plasma). Additional research is necessary to determine whether higher plasma PAH levels could be due to short-term increases in UFP exposure.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0897**

**Short-term PM<sub>2.5</sub> exposure and acute incidence of myocardial infarction a time-stratified case-crossover study in China**

**Presenter:** Jie Ban, National Institute of Environmental Health, China CDC, Beijing, China

**Authors:** J. Ban, T. Li;  
National Institute of Environmental Health, China CDC, Beijing, CHINA.

Background Myocardial infarction (MI) and ambient fine particulate matter (PM<sub>2.5</sub>) pollution are two global public health concerns. Evidence investigating the association between PM<sub>2.5</sub> and acute incidence of MI in developing countries is limited. Methods A multicenter study based on a time-stratified case-crossover design including 36,679 cases from MI incidence registry data and PM<sub>2.5</sub> site monitoring data was conducted. Results With a 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub> concentration, there was an increase of 0.98% (0.40%, 1.57%) in acute incidence risk of MI on day lag02. The corresponding values for males and individuals aged over 74 years were 1.58% (95% CI: 0.82%, 2.35%) and 1.19% (95% CI: 0.35%, 2.05%) respectively, indicating higher risks than other groups. The non-linear concentration-response curve indicated a steeper slope under daily PM<sub>2.5</sub> below 50µg/m<sup>3</sup> and the marginal avoided premature morbidity attributed to per 10µg/m<sup>3</sup> reduction became larger under the current air quality standard. Conclusion This study is the first multicenter study to examine the association between the acute incidence of MI and short-term exposure to PM<sub>2.5</sub> in China. We provide solid evidence that PM<sub>2.5</sub> is a risk factor for accelerating MI incidence. A susceptible population was identified. The robust findings from this study may suggest the necessity for a continuous reduction of PM<sub>2.5</sub> concentration from the perspectives of public health.

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Theme: **PM and cardiovascular health**

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**P-0898**

**Associations between cardiac-specific troponin concentrations and short-term ambient PM<sub>2.5</sub> among myocardial infarction survivors**

**Presenter:** Gauri Kamat, University of North Carolina at Chapel Hill, Chapel Hill, United States

**Authors:** G. Kamat<sup>1</sup>, L. Wyatt<sup>2</sup>, A. Weaver<sup>2</sup>, J. Moyer<sup>2</sup>, D. Diaz-Sanchez<sup>2</sup>, W. Cascio<sup>2</sup>, C. Ward-Caviness<sup>2</sup>;  
<sup>1</sup>University of North Carolina at Chapel Hill, Chapel Hill, NC, <sup>2</sup>US Environmental Protection Agency, Chapel Hill, NC.

**Background/Aim:** Fine particulate matter (PM<sub>2.5</sub>) is associated with cardiovascular disease. One potential mechanism is via cardiac tissue damage. Here, we study the association between ambient PM<sub>2.5</sub> and troponin I, a biomarker for cardiac muscle damage, among myocardial infarction (MI) survivors. **Methods:** Our data was taken from electronic health records from University of North Carolina affiliated hospitals and comprised individuals seen between 2004 and 2016 who had a prior MI. Daily ambient PM<sub>2.5</sub> (µg/m<sup>3</sup>) was estimated using a neural network at 1km resolution. After excluding troponin I measurements within 7 days of a clinically indicated MI, we assessed associations between daily ambient PM<sub>2.5</sub> concentrations with troponin I concentrations using linear mixed models adjusted for age, race, sex, socioeconomic status, temperature, relative humidity, and time trend. Associations were estimated per 1 µg/m<sup>3</sup> increase in PM<sub>2.5</sub> for daily lags (up to 4 days prior) and the 2-day rolling average. **Results:** There were 71,970 troponin I measurements from 12,019 individuals that occurred outside of a clinically diagnosed MI. Same day and prior day PM<sub>2.5</sub> concentrations were both associated with elevated troponin, with stronger associations on the prior day (0.062 ng/mL per 1 µg/m<sup>3</sup> increase in PM<sub>2.5</sub>; 95 % Confidence Interval [CI]: 0.04, 0.08). Associations weakened with increasing lags and no associations were seen with 3 and 4-day prior PM<sub>2.5</sub> concentrations. Two-day rolling averages showed a similar pattern with associations being the strongest for the same day and the day prior average (0.05 ng/mL higher troponin per 1 µg/m<sup>3</sup> PM<sub>2.5</sub>; 95% CI: 0.03, 0.07). **Conclusions:** We observed that short-term changes in PM<sub>2.5</sub> were associated with increased blood troponin concentrations among MI survivors. These results suggest that short-term elevations in ambient PM<sub>2.5</sub> may be directly associated with cardiac tissue damage, and present a mechanism for PM<sub>2.5</sub>-induced cardiovascular events. This abstract does not reflect EPA policy.

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Theme: **PM and cardiovascular health**

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**P-0899**

**Long-term PM<sub>2.5</sub> exposure as a risk factor for 30-day hospital readmissions among heart failure patients**

**Presenter:** Cavin K Ward-Caviness, US Environmental Protection Agency, Chapel Hill, United States

**Authors:** C. K. Ward-Caviness<sup>1</sup>, A. M. Weaver<sup>1</sup>, J. M. Moyer<sup>1</sup>, M. D. Yazdi<sup>2</sup>, J. Schwartz<sup>2</sup>, D. Diaz-Sanchez<sup>1</sup>, W. E. Cascio<sup>1</sup>;

<sup>1</sup>US Environmental Protection Agency, Chapel Hill, NC, <sup>2</sup>Harvard TH Chan School of Public Health, Boston, MA.

Background: Hospital readmissions represent a health and economic burden to patients and the healthcare system. We understand little about the relationship between long-term environmental exposures and hospital readmission risk. Here, we use electronic health records linked to exposure data (EPA CARES) to quantify the associations between long-term PM<sub>2.5</sub> exposure at the time of heart failure (HF) diagnosis and the number of hospital readmissions – a key outcome metric for quality of care for hospitals and healthcare systems. Methods: Annual average PM<sub>2.5</sub> was estimated at 1x1 km resolution for each primary residence. We used stabilized inverse probability weights to account for imbalanced confounder distributions and the competing risk of death. We adjusted for age at HF diagnosis, race, sex, year of HF diagnosis, and neighborhood socioeconomic status in quasi-Poisson regression models with an offset of log(follow-up time). Associations are presented as the percent increase from the mean and associated 95% confidence interval (CI). Results: Among 34,459 HF patients, 18,078 had an inpatient or emergency admission, thus qualifying them to have a readmission and enter this analysis. A 1 µg/m<sup>3</sup> increase in annual average PM<sub>2.5</sub> was associated with an 11% (95% CI = 6 – 16) increase in 30-day readmissions; independent of short-term (5-day average) exposures prior to the readmissions. PM<sub>2.5</sub> exposure was also associated with a 13% (95% CI = 4 – 22) and 14% (95% CI = 10 – 18) increase in 7 and 90 day readmissions, respectively. Conclusion: Long-term PM<sub>2.5</sub> exposure is associated with increased hospital readmissions, including 30-day readmissions, a closely tracked metric by which hospitals and healthcare systems are evaluated. Associations were independent of short-term variations in PM<sub>2.5</sub> prior to readmission, indicating that long-term exposures may be an important contributor to hospital readmission risk that should be further explored. This abstract does not necessarily represent EPA policy.

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**P-0900**

**Exposure to ambient polycyclic aromatic hydrocarbons and cardio-pulmonary endpoints in Greece**

**Presenter:** Evangelia Samoli, National and Kapodistrian University of Athens, Athens, Greece

**Authors:** E. Samoli<sup>1</sup>, K. Dimakopoulou<sup>1</sup>, A. Stergiopoulou<sup>1</sup>, G. Baltatzis<sup>1</sup>, G. Touloumi<sup>1</sup>, A. Karakosta<sup>1</sup>, M. Kermenidou<sup>2</sup>, S. Karakitsios<sup>2</sup>, S. Karakitsios<sup>2</sup>, D. Sarigiannis<sup>2</sup>, K. Katsouyanni<sup>1</sup>;  
<sup>1</sup>National and Kapodistrian University of Athens, Athens, GREECE, <sup>2</sup>Aristotle University of Thessaloniki, Thessaloniki, GREECE.

**Background/Aim** In the framework of the EU project HBM4EU on health effects of selected chemicals we investigated the associations between estimated ambient exposures to total Polycyclic Aromatic Hydrocarbons (PAHs) Benzo[a]pyrene (B[a]P) and respiratory and cardiovascular health outcomes using the Greek National Morbidity and Risk Factors Survey (EMENO). **Methods** We used data for 1321 residents in Athens and 390 in Thessaloniki collected in the cross-sectional EMENO survey conducted in Greece in 2015-2016. We used as respiratory markers spirometry-derived FEV1 and FVC and as cardiovascular outcomes prevalent hypertension and mean arterial pressure (MAP) based on blood measurements. We estimated total PAH and B[a]P concentrations in ambient particles at the participant residential address using a location-specific conversion factor on concentrations of particles estimated by dispersion models that predicted annual average of PM<sub>2.5</sub> in Greece for 2012, provided by the Ministry of Environment and Energy. We applied generalized linear models to investigate the associations accounting for the two areas and adjusting for potential confounders such sex, age, education, body mass index, smoking habits, exposure to tobacco smoking, alcohol intake and adherence to the Mediterranean diet. We accounted for the different locations (Athens/Thessaloniki) by the inclusion of a factor variable. **Results** We found that an IQR increase in B[a]P (0.2 ng/m<sup>3</sup>) and in total PAH (10.9 ng/m<sup>3</sup>) individualized exposure concentrations was associated with an increase in MAP by 0.54 mmHg (95% CI: 0.18 to 0.89) mmHg and by 1.96 mmHg (95% CI: 0.81 to 3.12) mmHg, respectively. Spirometry indices were not related to B[a]P or PAH exposure. **Conclusions** Using an estimated ambient exposure to B[a]P and total PAHs at the residence of the participants of a survey conducted in representative population samples in the two largest cities in Greece, we found that exposure was associated with elevated arterial blood pressure.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0901**

**Air pollution exposure and coronary artery calcification. The Mexican GEA study.**

**Presenter:** Marco Sanchez-Guerra, National Institute of Perinatology, CDMX, Mexico

**Authors:** M. Sanchez-Guerra<sup>1</sup>, C. Osorio-Yáñez<sup>2</sup>, J. L. Texcalac-Sangrador<sup>3</sup>, P. Ostrosky-Wegman<sup>2</sup>, R. Posadas-Sánchez<sup>4</sup>, G. Vargas-Alarcón<sup>5</sup>;

<sup>1</sup>National Institute of Perinatology, CDMX, MEXICO, <sup>2</sup>Instituto de Investigaciones Biomédicas, Universidad Nacional Autónoma de México (UNAM), CDMX, MEXICO, <sup>3</sup>Centro de Investigación en Salud Poblacional, Instituto Nacional de Salud Pública, CDMX, MEXICO, <sup>4</sup>Department of Endocrinology, Instituto Nacional de Cardiología Ignacio Chávez, CDMX, MEXICO, <sup>5</sup>Department of Molecular Biology, Instituto Nacional de Cardiología Ignacio Chávez, CDMX, MEXICO.

**Background:** Coronary artery calcium (CAC) is a very strong risk marker of future ischemic vascular events and a better predictor of CVD than intima media thickness, C-reactive protein or the Framingham Risk Score. WHO has identified air pollution as the world's largest single environmental-health risk, and 80% of deaths related to outdoor air pollution result from ischemic heart disease and stroke, however studies about the association of CAC and air pollution are scarce, especially in Mexico City. Therefore, we evaluated whether environment PM<sub>2.5</sub> is associated with CAC in an adult population from Mexico City Metropolitan Area. **Methods:** In 1690 participants (24 to 81 yo) from the Mexican GEA cohort of Mexico City Metropolitan Area, PM<sub>2.5</sub> exposure were calculated (from 1-5y before the visit day) using inverse distance weighted of data from air quality monitors. CAC was measured by computed tomography in all participants of the GEA study. Three different groups were analyzed: 975 participants with CAC=0, 377 with subclinical atherosclerosis (median 26.4 Agatston units, IQR 88.5) and 338 participants with coronary artery disease (median 84.7, IQR 425.4). The association of CAC and PM<sub>2.5</sub> exposure was evaluated by Tobit regression model adjusted for confounding factors (BMI, sex, age, education, smoking, diabetes, CHDL, LDL, SBP and group). **Results:** A 10ug/m<sup>3</sup> increase of PM<sub>2.5</sub> exposure at year 4 (B=0.27, 95% CI 0.08, 0.46) was positively associated with increased CAC. Sensitivity analysis, excluding participants with coronary artery disease, confirms that a 10ug/m<sup>3</sup> increase of PM<sub>2.5</sub> exposure at year 4 (B=0.26, 95% CI 0.01, 0.50) was positively associated with increased CAC. **Conclusion:** Our preliminary results indicate that an increased in PM<sub>2.5</sub> levels are associated with CAC in adults from Mexico City, suggesting an urgent need to modify the air-quality guidelines and regulatory limits to reduce the impact on cardiovascular risk in adults from Mexico City.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0902**

### **The association of long-term air pollution exposure with supraventricular arrhythmia and atrial fibrillation in the Multi-Ethnic Study of Atherosclerosis**

**Presenter:** Thomas R. Austin, University of Washington, Seattle, United States

**Authors:** T. R. Austin<sup>1</sup>, W. S. Post<sup>2</sup>, L. Chen<sup>3</sup>, C. M. Sitlani<sup>1</sup>, J. D. Kaufman<sup>1</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>Johns Hopkins School of Medicine, Baltimore, MD, <sup>3</sup>University of Minnesota, Minneapolis, MN.

**Background/Aim:** Air pollution is an important contributor to cardiovascular morbidity and mortality. Acute exposure to O<sub>3</sub> and PM<sub>2.5</sub> is associated with episodes of atrial fibrillation (AF), and NO<sub>2</sub> exposure is associated with same-day hospitalization for ventricular and supraventricular arrhythmias. Studies investigating longer-term exposures on AF risk have shown mixed results and additional work clarifying the role of pollutants on atrial electrophysiology is needed. This analysis used long-term individual-level ambient pollutant exposure and two-week ambulatory electrocardiographic (ECG) monitoring to investigate the association between pollutants and atrial arrhythmias.

**Methods:** In the Multi-Ethnic Study of Atherosclerosis (MESA), we used estimated five-year average ambient PM<sub>2.5</sub>, NO<sub>x</sub>, and O<sub>3</sub> from validated hierarchical spatio-temporal models, and conducted two-week ambulatory ECG monitoring of participants. Supraventricular arrhythmia measures of interest were presence of AF during monitoring, average count of premature atrial contractions (PACs) per hour, and average runs per day of supraventricular tachycardia (SVT). Generalized estimating equations were used to account for multiple exposure and outcome measurements in individual participants, adjusting for MESA study site and other a priori defined potential confounders. Secondary analyses explored two-week exposure windows.

**Results:** In 1,324 participants, average age 74 years, five-year average ambient PM<sub>2.5</sub>, NO<sub>x</sub>, and O<sub>3</sub> levels were not significantly associated with AF, PACs, or SVT. In secondary analyses of two-week exposures, higher PM<sub>2.5</sub> was associated with greater runs of SVT, higher O<sub>3</sub> with greater odds of AF, and higher NO<sub>x</sub> with lower odds of AF.

**Conclusions:** Using recently developed study-specific exposure estimation and long-term ECG monitoring, we found no evidence that five-year average exposure to PM<sub>2.5</sub>, NO<sub>x</sub>, and O<sub>3</sub> was associated with supraventricular arrhythmias. Secondary analyses using two-week exposures suggested moderate associations, but given multiple testing, these associations may have arisen by chance. Additional work is needed to further investigate the relationship of long-term pollution with supraventricular arrhythmias.

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Theme: **PM and cardiovascular health**

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**P-0903**

### **Assessment of Long-term Fine Particulate Matter Exposure and Its Effect on Cardiovascular Disease in China**

**Presenter:** Fengchao Liang, Fuwai Hospital, Chinese Academy of Medical Sciences, Beijing, China

**Authors:** F. Liang<sup>1</sup>, F. Liu<sup>1</sup>, K. Huang<sup>1</sup>, X. Yang<sup>1</sup>, J. Li<sup>1</sup>, Q. Xiao<sup>2</sup>, J. Chen<sup>1</sup>, X. Liu<sup>3</sup>, J. Cao<sup>1</sup>, C. Shen<sup>4</sup>, L. Yu<sup>5</sup>, F. Lu<sup>6</sup>, X. Wu<sup>7</sup>, X. Wu<sup>1</sup>, Y. Li<sup>1</sup>, D. Hu<sup>8</sup>, J. Huang<sup>1</sup>, Y. Liu<sup>9</sup>, X. Lu<sup>1</sup>, D. Gu<sup>1</sup>;

<sup>1</sup>Fuwai Hospital, Chinese Academy of Medical Sciences, Beijing, CHINA, <sup>2</sup>Tsinghua University, Beijing, CHINA, <sup>3</sup>Guangdong Provincial People's Hospital and Cardiovascular Institute, Guangzhou, CHINA, <sup>4</sup>School of Public Health, Nanjing Medical University, Nanjing, CHINA, <sup>5</sup>Fujian Provincial Hospital, Fuzhou, CHINA, <sup>6</sup>Institute of Basic Medicine, Shandong Academy of Medical Sciences, Jinan, CHINA, <sup>7</sup>Sichuan Center for Disease Control and Prevention, Chengdu, CHINA, <sup>8</sup>Shenzhen University School of Medicine, Shenzhen, CHINA, <sup>9</sup>Emory University, Atlanta, GA.

Background Investigations on chronic health effects of fine particulate matter (PM<sub>2.5</sub>) exposure in China are hindered by the lack of continuous ground monitoring. With satellite-driven models to generate spatiotemporally resolved PM<sub>2.5</sub> levels, we aimed to estimate long-term PM<sub>2.5</sub> concentrations at high spatial resolution (1 km) and assess the risk of cardiovascular diseases associated with long-term exposure to PM<sub>2.5</sub> in China. Methods Monthly PM<sub>2.5</sub> concentrations in China from 2000 to 2016 were estimated using machine-learning approaches, with the Multi-Angle Implementation of Atmospheric Correction (MAIAC) aerosol optical depth (AOD) as a major predictor. A longitudinal cohort study, the project of Prediction for Atherosclerotic Cardiovascular Disease Risk in China was used, with 116,972 adults included. Follow-up information from 2000 to 2015 was analyzed using a Cox proportional hazards model with time-varying exposures. Results Machine-learning models for PM<sub>2.5</sub> estimation performed good with a random cross-validation R<sup>2</sup> of 0.93 at the monthly level. For the time period without ground monitoring, prediction R<sup>2</sup> were 0.67 at the monthly and 0.80 at the annual levels. For an increase of 10 µg/m<sup>3</sup> in annual PM<sub>2.5</sub> exposures, the estimated hazard ratios (HRs) for incidence and mortality of cardiovascular disease were 1.251 (95% CI: 1.220-1.283) and 1.164 (95% CI: 1.117-1.213), respectively. Steeper slopes were observed when the concentration-response functions tended to high PM<sub>2.5</sub> levels. Conclusions Satellite-based techniques provide a strong support for environmental health studies. Our findings on the chronic health effect of PM<sub>2.5</sub> exposure on cardiovascular diseases expand the current knowledge on adverse health effects of severe air pollution and highlight the potential cardiovascular benefits of air quality improvement in highly polluted regions.

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Theme: **PM and cardiovascular health**

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**P-0904**

**The spatial variation of associations between long-term exposure to PM<sub>10</sub> and incidence of cardiovascular disease in South Korea.**

**Presenter:** Sun-Young Kim, National Cancer Center, Goyang, Korea, Republic of

**Authors:** O. Kim, S. Kim;  
National Cancer Center, Goyang-Si, Gyeonggi-Do, KOREA, REPUBLIC OF.

While previous evidence suggested the regional variation of associations between particulate matter air pollution and cardiovascular disease, the regional characteristics that derive the variation remain uncertain. We aimed to identify regional characteristics which determines the variation of associations of PM<sub>10</sub> and cardiovascular disease (CVD) incidence across 16 provincial-level regions in South Korea. We used the National Health Insurance-National Sample cohort 2.0 which is constructed from the National Health Insurance database for the entire South Korean population for 2002-2015. Our study population included 155,017 adults who resided in the same regions for the entire follow-up period. South Korea is comprised of 16 regions: 7 metropolitan cities and 8 provinces (average size: 6,242 km<sup>2</sup>, [range: 501-19,031]; average population: 2,954,934 [531,887-10,415,399]). The incident CVD was defined as the first diagnosis for 2007-2015, while individual long-term PM<sub>10</sub> exposure was assessed as a 5-year average concentration for 2002-2006 predicted at district-level residential addresses. We applied time-dependent Cox's proportional hazard model to estimate region-specific hazard ratios (HRs) for incident CVD per a 10 µg/m<sup>3</sup> increase in PM<sub>10</sub> after adjusting for individual characteristics. For regional characteristics, we obtained 76 variables in seven categories: medical accessibility, socio-economic status, behavior, neighborhood facility, social awareness, emission sources, and air pollution and meteorology from various data sources such as census, national survey, and general statistics. To investigate the spatial variation of HR of CVD for PM<sub>10</sub>, we computed Pearson's correlation coefficients between HRs and each of regional variables across 16 regions. HRs varied between 0.67 and 1.46 across 16 regions. Region-specific HRs were significantly positively correlated with percent of paved roads, city gas supply, and gross generation from diesel power plants for 2007-2015.

Our results suggest that the impact of long-term PM<sub>10</sub> exposure on incident CVD could be stronger in the areas with industry-related emission sources.

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Theme: **PM and cardiovascular health**

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**P-0907**

**Home Air Filtration for Traffic-Related Air Pollution: Study Design and Methods**

**Presenter:** Doug Brugge, University of Connecticut, Farmington, United States

**Authors:** D. Brugge<sup>1</sup>, N. Hudda<sup>2</sup>, S. Hersey<sup>3</sup>, L. Meunier<sup>4</sup>, S. Lerman Ginzburg<sup>1</sup>, I. Hochman<sup>5</sup>, B. Echevarria<sup>6</sup>, D. Walker<sup>7</sup>, M. Thanikachalam<sup>2</sup>, L. Sprague Martinez<sup>8</sup>, J. Durant<sup>2</sup>, W. Zamore<sup>9</sup>, M. Eliasziw<sup>2</sup>; <sup>1</sup>UConn Health, Farmington, CT, <sup>2</sup>Tufts University, Boston, MA, <sup>3</sup>Olin College of Engineering, Needham, MA, <sup>4</sup>Independent Contractor, Boston, MA, <sup>5</sup>InTouchCorp, Cambridge, MA, <sup>6</sup>The Welcome Project, Somerville, MA, <sup>7</sup>The Main School of Science and Mathematics, Limestone, ME, <sup>8</sup>Boston University, Boston, MA, <sup>9</sup>Independent Contractor, Somerville, MA.

Despite reducing indoor particulate matter (PM) pollution from traffic, it is not established that freestanding air filters in homes benefits cardiovascular health. We are launching a randomized crossover efficacy trial of high efficiency particulate arrestance (HEPA) filters in homes near a highway in Somerville, MA, USA. The approach is community-engaged research with active participation of community partners. Drawing on lessons from our pilot studies, we will focus on colder seasons when windows are less likely to be open and exclude participants with serious health problems or use of antihypertensive or anti-inflammatory medications. Over 3.5 years we will recruit 210 homes with 240 study participants aged 40-75. Each home will receive, in random order, two HEPA units either with or without (sham) filters for one month. Following a one-month wash out period, the filtration condition will be reversed. We will exclude smoking households and people who work at jobs with significant PM exposure. At baseline and at one-month intervals we will interview each participant for demographics, relevant behaviors and health symptoms. Blood pressure (central and peripheral) and blood draws taken at monthly intervals will be the primary health outcomes. Blood samples will be stored at -80 °C and analyzed for inflammatory (IL-6) and coagulation (D-dimer) biomarkers. Secondary outcomes will be metabolome, asthma, allergy and cognitive function. We will monitor particle number concentration, PM<sub>2.5</sub>, PM size distribution and composition in a subset of homes for one week each during filtration and sham. Time activity will be self-reported monthly and we will measure time spent in the rooms with filters for a subset using custom Bluetooth technology. The results will provide evidence for or against use of air filters in homes to reduce health effects of traffic-related PM. We will investigate participant experience and reasons for compliance via interviews.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0908**

**Short-term effects of air pollution on hospital admission for heart failure among older adults: a time-series study**

**Presenter:** Dong-Wook Lee, Seoul National University, College of Medicine, Seoul, Korea, Republic of

**Authors:** D. Lee<sup>1</sup>, C. Han<sup>2</sup>, Y. Hong<sup>1</sup>, J. Oh<sup>3</sup>, H. Bae<sup>4</sup>, S. Kim<sup>5</sup>, Y. Lim<sup>6</sup>;

<sup>1</sup>Seoul National University, College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Chungnam National University, College of Medicine, Daejeon, KOREA, REPUBLIC OF, <sup>3</sup>Ewha Womans University, School of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>4</sup>Korea Environment Institute, Sejong, KOREA, REPUBLIC OF, <sup>5</sup>Ajou University, Suwon, KOREA, REPUBLIC OF, <sup>6</sup>University of Copenhagen, Department of Public Health, Copenhagen, DENMARK.

**Backgrounds** Even though the prevalence of heart failure (HF) has continuously increased, there is a lack of evidence for the association between fine particulate matter (PM<sub>2.5</sub>) and hospitalization for HF, and for its seasonal differences. We aimed to investigate the association between air pollution concentration levels and HF-related admissions among older adults in South Korea and determine whether the association is different by season.

**Methods** We used the daily hospital admission data of 3.1 million older adults in seven metropolitan cities from 2008 to 2016, derived from the National Health Insurance Service of South Korea. Daily counts of HF admissions were linked to the daily concentration of air pollutants including PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub>, CO, and O<sub>3</sub>. We estimated the association between air pollutants and daily HF admission using Poisson generalized additive models for each city. The pooled effects of the air pollutants were calculated by season. **Results** During the study period, 142,490 hospital admissions due to HF were noted. Increases in 10 µg/m<sup>3</sup> of PM<sub>2.5</sub> and PM<sub>10</sub>, and 10 ppb of SO<sub>2</sub>, NO<sub>2</sub>, CO were associated with 0.80% (95% CI: 0.41-1.19), 0.48% (0.25-0.71), 5.23% (1.74-8.84), 0.97% (0.32-1.62), and 0.05% (0.01-0.08) increases in HF admission of the same day, respectively. In the warm season, HF admissions of the older adults increased shortly after the increases in concentration levels of PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>2</sub> whereas the prolonged effects were observed in the cold season.

**Conclusion** Our study suggests the adverse effects of air pollution on HF. Moreover, the evidence of seasonality may provide protection guidelines for older adults.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0909**

### **Systematic Review on the Health Effects of Long-term Exposure to Nontailpipe Traffic Emissions**

**Presenter:** Allison P Patton, Health Effects Institute, Boston, United States

**Authors:** A. P. Patton<sup>1</sup>, H. Boogaard<sup>1</sup>, D. Crouse<sup>1</sup>, E. van Vliet<sup>1</sup>, A. van Erp<sup>1</sup>, M. Kutlar Joss<sup>2</sup>, H. E. I. Panel<sup>1</sup>; <sup>1</sup>Health Effects Institute, Boston, MA, <sup>2</sup>Swiss Tropical and Public Health Institute and University of Basel, Basel, SWITZERLAND.

With reductions in tailpipe emissions of particulate matter, there is an increasing interest in public health impacts of non-tailpipe emissions, specifically tire and brake wear and road dust. Following its well-cited 2010 critical review, a new Health Effects Institute (HEI) expert panel is conducting a systematic review of the epidemiological literature on the health effects of long-term exposure to TRAP, including non-tailpipe emissions. The Panel is using a systematic approach to search the literature, assess study quality, summarize results, and reach conclusions about the body of evidence. They developed a review protocol and registered it in Prospero. An extensive search was conducted of literature published between January 1980 and July 2019. Selected health outcomes include all-cause and cause-specific mortality, respiratory effects, cardiovascular effects, diabetes, and birth outcomes. In addition, the Panel has developed an exposure framework to guide the selection and evaluation of epidemiological studies on TRAP. The review is now well underway, and preliminary results will be presented. After a broad search identifying 1100 studies potentially relevant to the broader review, the panel included 14 studies reporting both relevant health outcomes and epidemiological results for non-tailpipe pollutants. Effect estimates were reported for all-cause mortality (3 papers), circulatory mortality (1 paper), cardiovascular effects (2 papers), respiratory effects (3 papers), and neurodevelopment in children (2 papers). Ten of the papers evaluated effects of copper (Cu) and iron (Fe); others evaluated only Cu (2 papers) or non-exhaust PM<sub>2.5</sub> mass (2 papers). Further evaluation of these papers will inform future research questions related to health effects of non-tailpipe emissions from motor vehicles.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0911**

**Changes in lipid profiles and blood pressure in response to acute exposure to ambient PM<sub>2.5</sub> and its carbonaceous compositions - results from the AIRLESS Study**

**Presenter:** Yiqun Han, Imperial College London, London, United Kingdom

**Authors:** Y. Han<sup>1</sup>, Y. Li<sup>1</sup>, X. Han<sup>2</sup>, W. Chen<sup>3</sup>, S. Cai<sup>1</sup>, M. Zheng<sup>3</sup>, Q. Chan<sup>1</sup>, Y. Wu<sup>4</sup>, J. Liu<sup>2</sup>, T. Zhu<sup>3</sup>, F. J. Kelly<sup>5</sup>;

<sup>1</sup>Imperial College London, London, UNITED KINGDOM, <sup>2</sup>Beijing Anzhen Hospital, Beijing, CHINA, <sup>3</sup>Peking University, Beijing, CHINA, <sup>4</sup>Peking University Clinical Research Institute, Beijing, CHINA, <sup>5</sup>Environmental Research Group, MRC Centre for Environment and Health, King's College London, London, UNITED KINGDOM.

**Background** Increasing evidence has shown ambient fine particles (PM<sub>2.5</sub>) as a key risk factor to cardiovascular and metabolic diseases. However, few human studies examined if the adverse effects were associated carbonaceous particles, the potential toxic species in PM<sub>2.5</sub>. **Methods** Based on AIRLESS project, we examined the changes in lipid profiles and blood pressure (BP) in response to acute exposure to ambient PM<sub>2.5</sub> and its carbonaceous compositions, namely elemental carbon (EC) and organic carbon (OC). 251 nonsmoking participants from urban (N=123) and peri-urban (N=128) Beijing, China, have completed 2 times clinical visits in winter, and another 2 in summer. During each visit, serum samples were collected for the lipid profile analysis of total cholesterol (TC), High-density lipoprotein cholesterol (HDL), Low-density lipoprotein cholesterol (LDL) and Triglycerides (TG), and BP were measured. Daily ambient PM<sub>2.5</sub>, EC and OC were measured in the monitoring station nearby the participants' communities. Associations between exposure and health outcomes were examined with linear mixed-effects model adjusted for demographic, socioeconomic and lifestyle parameters. **Results** Exposure to EC was significantly associated with all the cholesterol parameters, while PM<sub>2.5</sub> and OC were only associated with HDL. For example, an IQR increase in previous 1-day exposure to EC (3.9 µg/m<sup>3</sup>) was significantly associated with an elevation of HDL [1.4%(95% confidence interval (CI): 0.7-2.1%)], LDL [1.5%(CI: 0.3-2.7%)] and TC [1.3%(CI: 0.4-2.2%)] (p<0.05). All the three pollutants were significantly associated with the increase in systolic and diastolic BP, but not the changes in TG. A clear modified effect between sites were observed that may be partly attributed to the difference in the local emission sources given the significantly differed ratio of OC to EC between the two sites. **Conclusions** Elemental carbon may play an important role in the adverse cardiovascular and metabolic effect of PM<sub>2.5</sub>.

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**P-0912**

**Temporal changes in short-term associations between cardiorespiratory emergency department visits and PM<sub>2.5</sub> in Greater Los Angeles, 2005 to 2016**

**Presenter:** Jianzhao Bi, Emory University, Atlanta, United States

**Authors:** J. Bi<sup>1</sup>, R. R. D'Souza<sup>1</sup>, D. Q. Rich<sup>2</sup>, P. Hopke<sup>2</sup>, A. G. Russell<sup>3</sup>, H. H. Chang<sup>1</sup>, S. Ebel<sup>1</sup>;  
<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>University of Rochester Medical Center, Rochester, NY, <sup>3</sup>Georgia Institute of Technology, Atlanta, GA.

**Background:** Emissions control programs targeting certain air pollution sources may alter PM<sub>2.5</sub> composition, as well as the rate/risk of health events associated with PM<sub>2.5</sub>.  
**Objectives:** We examined whether there were temporal changes in associations between short-term exposure to PM<sub>2.5</sub> and daily emergency department (ED) visits for cardiovascular disease (CVD) and asthma in the Greater Los Angeles, California.  
**Methods:** Quasi-Poisson time-series models with unconstrained distributed lags were used to estimate associations between PM<sub>2.5</sub> and ED visits. Bi-pollutant models were considered by including individual PM<sub>2.5</sub> components and the rest of the PM<sub>2.5</sub> mass. The models were run separately for three predefined time periods, selected based on the implementation of multiple emissions control programs (early: 2005-2008; middle: 2009-2012; late: 2013-2016). Analyses stratified by age (<19, 19-64, 65+) and temperature (<20°C, 20-30°C, >30°C) were also conducted.  
**Results:** The relative rate of CVD per 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub> concentration in the previous 4 days (lag 0-3) increased from the early period (RR = 1.003; 95% CI = [0.996, 1.010]) to the late period (1.020, [1.010, 1.030]). For asthma, estimated effects were strongest in the early period (1.018, [1.006, 1.029]) and were weaker and insignificant in the following periods. Similar temporal differences in associations for CVD and asthma were observed among different age and temperature groups. No single component was identified as an obvious contributor to the changing PM<sub>2.5</sub> effects, but some (e.g., organic carbon, sulfate, and potassium) exhibited different temporal patterns from PM<sub>2.5</sub>.  
**Conclusions:** Significant temporal changes in the health effects of PM<sub>2.5</sub> were observed. These changes could be due to changes in PM<sub>2.5</sub> composition (e.g., increasing organic carbon and decreasing sulfate), although the evidence at the single-component level was not clear. Other factors, such as improvements in healthcare facilities and urban environments, exposure misclassification, and residual confounding, may also contribute to the changes.

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**P-0913**

### **Sickle Cell Disease-Related Hospital Admissions and Acute Particulate Matter 2.5 Exposures**

**Presenter:** Rosemary Ifeoma Ezeugoh, University of Maryland, College park, United States

**Authors:** R. I. Ezeugoh<sup>1</sup>, E. Rigterink<sup>1</sup>, J. Yanosky<sup>2</sup>, N. Crnosija<sup>1</sup>, N. Sieck<sup>1</sup>, T. Wen<sup>2</sup>, D. Payne-Sturges<sup>1</sup>, R. Puett<sup>1</sup>;

<sup>1</sup>University of Maryland, College park, MD, <sup>2</sup>Pennsylvania State University, Hershey, PA.

**Background**Few studies have examined the impact of ambient air pollution exposures on sickle cell disease (SCD)- related hospital admissions. The findings of these studies have suggested potential relationships between SCD-related hospital admissions with acute exposures to ozone and particulate matter but the findings have been inconsistent. **Methods**We evaluated the association between acute exposure to ambient particulate matter 2.5 (PM<sub>2.5</sub>) air pollution and SCD-related hospital admissions among residents of South Carolina (SC). We obtained data on the first incident hospital admission between 2003 and 2006. PM<sub>2.5</sub> exposures were estimated at the residential zip code level using spatio temporal statistical modeling. We used a semi-symmetric bidirectional case-crossover design to examine the association between hospital admissions and PM<sub>2.5</sub> exposures 0 to 7 days prior to hospital admission (for the case period) and an equivalent 0 to 7 day control period within the same month, same days of the week. Conditional logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs). **Results**Among 1,937 individuals with at least one SCD hospital admission, the median age was 22 years, and the median percentage of persons living below poverty in the census tract of residence was about 16%. The average PM<sub>2.5</sub> estimated exposure was about 10.1 ug/m<sup>3</sup> on the day of hospital admission. The OR between admission and PM<sub>2.5</sub> exposures on the day prior was 1.02 (95%CI: 1.00,1.03) while all other time windows examined hovered around 1.00 and were not statistically significant. **Conclusions**We observed some suggestion of increased risk for SCD-related hospital admission with an increase in PM<sub>2.5</sub> exposures on the day prior to admission. However further investigation is needed to confirm these results.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0914**

**Air pollutants and daily outpatient visits for cardiovascular and cerebrovascular diseases in central Taiwan**

**Presenter:** Ya-Yun Cheng, National Cheng Kung University, Tainan City, Taiwan

**Authors:** Y. Cheng, H. Guo;  
National Cheng Kung University, Tainan City, TAIWAN.

Background: This study aimed to evaluate the health impacts of air pollutants and meteorological factors (fog, haze, and low cloud) under megacity conditions in central Taiwan. In addition, we used the Kriging interpolation and land use regression for more accurate exposure assessment. Material and Method: We retrieved daily records of outpatient department (OPD) visits from the Health and Welfare Data Science Center of the Ministry of Health and Welfare of Taiwan and included those for ischemic heart and cerebrovascular diseases (ICD-9 codes 410 to 414 and 430 to 438; ICD-10 codes: I20 to I25 and I60 to I69) in 2016. We combined the air pollution data on the level of fine aerosol and chemical components obtained from the air quality monitoring stations established by the Environmental Protection Administration in the Taichung and Nantou areas with the meteorological data obtained from the Central Weather Bureau to assess their associations with the OPD visits. Autoregressive integrated moving average and classification and regression trees models were constructed to evaluate and describe the effects of air pollutants and meteorological factors on the OPD visits for ischemic heart and cerebrovascular diseases. Results: The PM<sub>2.5</sub> measured at station in Nantou and Changhua were significantly higher than those measured at stations in Taichung. The OPD visits for cardiovascular and cerebrovascular diseases by residents nearby the station in Nantou and Changhua were also significantly more than those paid by residents nearby the stations in Taichung. OPD visits for ischemic heart and cerebrovascular diseases had positive association with PM<sub>2.5</sub> concentration on the same day and the day before. Conclusions: The level of PM<sub>2.5</sub> was associated with OPD visits for ischemic heart and cerebrovascular diseases on the same day and the next day. Further studies are needed to identify the susceptible populations and evaluate the impacts.

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0915**

**Effects of fine particulate matter on acute health events during critics episodes: a case crossover study in Medellín-Colombia 2015**

**Presenter:** Juan Gabriel Pineros-Jimenez, Universidad de Antioquia, Medellín, Colombia

**Authors:** E. Nieto<sup>1</sup>, H. Grisales<sup>1</sup>, N. Montealegre<sup>1</sup>, A. Orrego<sup>2</sup>, A. Molina<sup>2</sup>, J. Pineros-Jimenez<sup>1</sup>;  
<sup>1</sup>Universidad de Antioquia, Medellín, COLOMBIA, <sup>2</sup>Area Metropolitana del Valle de Aburra, Medellín, COLOMBIA.

During March of 2015, two critics episodes of PM<sub>2.5</sub> were observed in Medellín-Colombia (levels over 75 µg/m<sup>3</sup>: three times the recommended by the World Health Organization, for three days or more). A case-crossover study stratified over time was carried out to establish the effects of these episodes in the use of emergency services for respiratory and cardiovascular events. Conditional logistic regression models were used to estimate the relative risks with 95% confidence intervals. Data of atmospheric conditions, particulate matter and the diagnostics in emergencia services were collected from public environmental information system and the individual records of health service provision. The analysis was made in populations under 5 years old and adults aged 65 years and over. In under 5 years old population every 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub> was associated with increases in the risk percentage of emergency room visits for asthma (2.8%), acute respiratory infection (2.0%) and pneumonia (2.2%) in the same day of exposure, and for acute respiratory infection (3.6%) in the first day of exposure. For adults 65 and older the increase of 10 µg/m<sup>3</sup> in PM<sub>2.5</sub> were associated to excess risks for emergencies room visits due to COPD complications in the first day of exposure (0.8%), cerebrovascular disease after two days of (7.2%) and acute respiratory infection in the same day of exposure and after seven days of cumulative exposure with increases in risk percentages of 0.6% and 0.5% respectively. These results confirm clear associations between ambient PM<sub>2.5</sub> and negative health effects in respiratory and cardiovascular systems during critic episodes in Colombia

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## ABSTRACT E-BOOK

Theme: **PM and cardiovascular health**

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**P-0916**

**Effects of a randomized biomass cookstove intervention on glycated hemoglobin among women in Honduras**

**Presenter:** Bonnie Nadyne Young, Colorado State University, Fort Collins, United States

**Authors:** B. N. Young<sup>1</sup>, J. L. Peel<sup>1</sup>, S. Rajkumar<sup>1</sup>, M. L. Benka-Coker<sup>2</sup>, E. S. Walker<sup>3</sup>, R. D. Brook<sup>4</sup>, T. L. Nelson<sup>1</sup>, J. Volckens<sup>1</sup>, C. L'Orange<sup>1</sup>, N. Good<sup>1</sup>, C. Quinn<sup>1</sup>, J. P. Keller<sup>1</sup>, Z. D. Weller<sup>1</sup>, S. Africano<sup>5</sup>, A. B. Osorto-Pinel<sup>6</sup>, M. L. Clark<sup>1</sup>;

<sup>1</sup>Colorado State University, Fort Collins, CO, <sup>2</sup>Gettysburg College, Gettysburg, PA, <sup>3</sup>University of Montana, Missoula, MT, <sup>4</sup>University of Michigan Medical School, Ann Arbor, MI, <sup>5</sup>Trees, Water & People, Fort Collins, CO, <sup>6</sup>Asociación Hondureña para el Desarrollo, Tegucigalpa, HONDURAS.

**AIM:** Using a stepped-wedge randomized controlled trial, we evaluated impacts of the wood-burning Justa cookstove (engineered combustion chamber, chimney) on glycated hemoglobin (HbA1c) among rural Honduran women. **METHODS:** We enrolled 230 cooks who were not pregnant, non-smoking, aged 24-59 years, and using a traditional stove. There were 6 study visits per participant, separated by 6 months. Participants were randomized to receive the Justa after 2 visits (Arm 1) or after 4 visits (Arm 2). We measured personal and kitchen 24-hour gravimetric fine particulate matter (PM<sub>2.5</sub>) and finger-stick HbA1c at each visit. We used linear mixed models adjusted for time and other covariates in intent-to-treat (assigned stove) and exposure-response (estimates per 1-unit higher log-transformed PM<sub>2.5</sub>) analyses. Sensitivity analyses included: limiting to the first 4 visits to approximate a parallel-trial design and, given large within-person variability in PM<sub>2.5</sub> across visits, using geometric mean PM<sub>2.5</sub> by assigned stove status for each participant as the exposure-of-interest. **RESULTS:** Among 227 women with 1,208 observations, Justa stove use reduced median (25<sup>th</sup>, 75<sup>th</sup> percentiles) personal PM<sub>2.5</sub> concentrations (traditional: 82 µg/m<sup>3</sup> [50, 142]; Justa: 43 µg/m<sup>3</sup> [27, 73]). Participants had non-significantly reduced HbA1c when using Justa compared to traditional stoves (-0.06%, 95% CI: -0.16, 0.04). No associations were observed between personal and kitchen PM<sub>2.5</sub> and HbA1c (0.01%, 95% CI: -0.03, 0.04; 0.02%, 95% CI: -0.01, 0.05; respectively). In sensitivity analyses limited to visits 1-4, a reduction in HbA1c was observed for Justa use compared to traditional stove use (-0.10%, 95% CI: -0.18, -0.01). Geometric mean personal and kitchen PM<sub>2.5</sub> exposures were associated with HbA1c (0.03%, 95% CI: -0.03, 0.09; 0.04%, 95% CI: 0.001, 0.08, respectively). **CONCLUSIONS:** The Justa intervention reduced PM<sub>2.5</sub> concentrations, but wide confidence intervals limit interpretations of HbA1c changes in primary analyses. Potentially relevant benefits were observed in sensitivity analyses and will be explored further.

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## ABSTRACT E-BOOK

Theme: **PM and children's health**

**P-0917**

### Characterization of prenatal polycyclic aromatic hydrocarbon (PAH) metabolites in 5 U.S. metropolitan areas

**Presenter:** Erin E Masterson, University of Washington, Seattle, United States

**Authors:** E. E. Masterson<sup>1</sup>, C. T. Loftus<sup>1</sup>, E. R. Wallace<sup>1</sup>, A. A. Szpiro<sup>1</sup>, C. Simpson<sup>1</sup>, R. Muralidharan<sup>1</sup>, L. Trasande<sup>2</sup>, E. Barrett<sup>3</sup>, R. H. Nguyen<sup>4</sup>, K. Kannan<sup>5</sup>, N. R. Bush<sup>6</sup>, S. Sathyanarayana<sup>7</sup>, K. Z. LeWinn<sup>6</sup>, C. J. Karr<sup>1</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>New York University, New York, NY, <sup>3</sup>Rutgers University, Newark, NJ, <sup>4</sup>University of Minnesota, Minneapolis, MN, <sup>5</sup>New York State Department of Health, New York, NY, <sup>6</sup>University of California, San Francisco, CA, <sup>7</sup>Seattle Children's Research Institute, Seattle, WA.

**Background/Aim:** Prenatal exposure to polycyclic aromatic hydrocarbons (PAH) has been associated with adverse birth and developmental outcomes in children. We characterized patterns of prenatal PAH exposure in a large and geographically diverse cohort study. **Methods:** We included 1,669 women who were enrolled in two ECHO PATHWAYS cohorts: TIDES (n=674; Minneapolis, Rochester, San Francisco, and Seattle) and CANDLE (n=995; Memphis). We measured seven individual metabolites of four PAH parent compounds (naphthalene, fluorene, phenanthrene, pyrene) in second trimester urine and adjusted for specific gravity. We analyzed PAH concentrations by region, season, and maternal sociodemographic characteristics. We calculated geometric means (GM) and standard deviations (GSD) and used analysis of variance to compare across subgroups. **Results:** Hydroxylated metabolites of naphthalene [GM=5.33 (GSD=2.81) ng/mL] and fluorene [0.89(2.49) ng/mL] were found at the highest concentrations, accounting for approximately 74% and 15% of total PAH exposure, respectively. GM (GSD) concentrations of hydroxylated naphthalene (1-NAP, 2-NAP), fluorene (2/3/9-FLUO) and pyrene (1-PYR) varied by site [range across sites: 2.33(3.14)-7.31(2.38), 0.54(2.05)-1.08(2.33), 0.01(3.82)-0.15(2.22) ng/mL, respectively]. The highest mean concentrations of all metabolites were in Memphis and Rochester samples. Overall, hydroxy-naphthalene concentration (1-NAP, 2-NAP) was higher among women who were younger [ $<24y$ : 7.77(2.40) v.  $>34y$ : 3.65(2.87) ng/mL], had a lower income [ $< \$15k/y$ : 8.18(2.74) v.  $> \$75k/y$ : 3.34(2.43) ng/mL], were less educated [less than high school: 9.19(2.54) v. some graduate level: 2.93(2.65) ng/mL] and were black [8.26(2.42) v. white: 3.73(2.67) ng/mL]. Hydroxy-fluorene (2/3/9-FLUO) concentration was higher among non-Hispanics [0.90(2.46) ng/mL] than Hispanics [0.82(3.06) ng/mL]. By study region, PAHs' relationships with sociodemographic characteristics and seasonality varied, though concentrations tended to be highest in summer and/or autumn. **Conclusions:** In this multi-site US sample, we observed evidence that women of color and lower socioeconomic status are disproportionately impacted by prenatal PAH exposure. Future studies will examine associations of these biomarkers with environmental exposures and child health outcomes.

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## ABSTRACT E-BOOK

Theme: **PM and children's health**

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**P-0919**

### **Cumulative Early-Life Traffic-Related Air Pollution Exposure and Sleep Disturbance Consistent with Sleep Disordered Breathing among 12-Year-Old Children**

**Presenter:** Ketrell L McWhorter, School of Science, Health, and Mathematics, Asbury University, Wilmore, United States

**Authors:** K. L. McWhorter<sup>1</sup>, C. Brokamp<sup>2</sup>, C. L. Jackson<sup>3</sup>, P. Ryan<sup>2</sup>;

<sup>1</sup>School of Science, Health, and Mathematics, Asbury University, Wilmore, KY, <sup>2</sup>Division of Biostatistics and Epidemiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>3</sup>Epidemiology Branch, National Institute of Environmental Health Sciences, National Institutes of Health, Department of Health and Human Services, Research Triangle Park, NC.

**Background/Aim:** Exposure to traffic-related air pollution (TRAP) may be linked to sleep disordered breathing. The aim of this study was to assess whether cumulative early-life exposure to TRAP is associated with loud snoring and frequent napping among 12-year-old children. **Methods:** We used data from the Cincinnati Childhood Allergy and Air Pollution Study, a prospective birth cohort study of children in the greater Cincinnati, Ohio metropolitan area. Annual average exposures to TRAP at residential addresses from birth to 12-years-old were estimated using a previously-validated land use regression model of elemental carbon attributable to traffic. TRAP was dichotomized as high versus low at the 75th percentile (0.41  $\mu\text{g}/\text{m}^3$ ) based on the distribution at age 12 years. Parental report of frequency of their child snoring loudly and napping was categorized as <3 times per week versus  $\geq 3$  times per week. Using log-binomial regression, we estimated prevalence ratios (PR) of frequent loud snoring and napping among children with high versus low TRAP exposure. Models were adjusted for age, sex, race/ethnicity, annual household income, secondhand smoke exposure, and obesity status (95th body mass index percentile). **Results:** Among 313 children, the prevalence of frequent loud snoring was 10.0% and frequent napping was 12.0%. There was an over 2-fold higher prevalence of frequent snoring among children with high versus low TRAP exposure in the fully-adjusted model (PR:2.20, 95%Confidence Interval [CI]:1.10-4.40,  $p=0.025$ ). There was over twice the prevalence of frequent napping among children with high versus low TRAP exposure in the unadjusted model (PR:2.48, 95%CI:1.38-4.46,  $p=0.002$ ); however, this association was attenuated in the fully-adjusted model (PR:1.12, 95%CI:0.65-1.92,  $p=0.68$ ). **Conclusions:** High levels of cumulative early-life TRAP exposure may contribute to symptoms consistent with sleep disordered breathing among children, which are both associated with a wide range of adverse human health effects including poor cardiometabolic health. More research is warranted.

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## ABSTRACT E-BOOK

Theme: **PM and children's health**

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**P-0920**

### **Prenatal particulate air pollution exposure and reduced lung function in Mexican children**

**Presenter:** Maria José Rosa, Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** M. Rosa<sup>1</sup>, M. Tamayo-Ortiz<sup>2</sup>, A. Mercado Garcia<sup>3</sup>, N. Rivera Rivera<sup>1</sup>, G. D. Tore<sup>4</sup>, D. Bush<sup>5</sup>, A. Lee<sup>6</sup>, A. C. Just<sup>1</sup>, I. Kloog<sup>7</sup>, M. M. Téllez-Rojo<sup>3</sup>, R. O. Wright<sup>1</sup>, R. J. Wright<sup>5</sup>;

<sup>1</sup>Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>National Council of Science and Technology (CONACYT), National Institute of Public Health (INSP), Mexico City, MEXICO, <sup>3</sup>Center for Nutrition and Health Research, National Institute of Public Health, Cuernavaca, MEXICO, <sup>4</sup>Mailman School of Public Health, Columbia University, New York, NY, <sup>5</sup>Kravis Children's Hospital, Department of Pediatrics, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>6</sup>Division of Pulmonary, Critical Care and Sleep Medicine, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>7</sup>Department of Geography and Environmental Development, Ben-Gurion University of the Negev, Beer Sheva, ISRAEL.

**Background:** Early life exposure to particulate matter <2.5 microns in diameter (PM<sub>2.5</sub>) may alter lung growth and development starting in utero in a time-sensitive manner. We examined associations between prenatal PM<sub>2.5</sub> exposure and lung function in children. **Methods:** Data are from 182 mother-child dyads enrolled in the Programming Research in Obesity, Growth, Environment and Social Stressors study in Mexico City. PM<sub>2.5</sub> exposure was estimated using residence in pregnancy to first year of life and a satellite-based spatio-temporal model. Lung function was tested at each participant's home in accordance with American Thoracic Society guidelines at ages 8-10 years. All tests were overread by a pediatric pulmonologist. Outcomes included percent predicted forced expiratory volume in one second (FEV<sub>1</sub>), forced vital capacity (FVC), FEV<sub>1</sub>/FVC and forced expiratory flow at 25-75% of the pulmonary volume (FEF<sub>25-75</sub>) in separate models. Associations were modeled using distributed lag models with daily PM<sub>2.5</sub> averages over pregnancy, adjusting for child's sex and birth-weight for gestational age z-score, mother's age and education at enrollment, report of smoker in the home in pregnancy and average 1<sup>st</sup> year postnatal PM<sub>2.5</sub>. **Results:** We found significant associations between higher PM<sub>2.5</sub> exposure at 10-36 weeks of pregnancy and lower percent predicted FEV<sub>1</sub> ( $\beta$ :-1.78, 95%CI [-3.27, -0.29]), at 2-12 weeks for lower FVC ( $\beta$ :-1.36, 95%CI [-2.48,-0.24]) and 13 weeks to end of pregnancy for lower FEF<sub>25-75</sub> ( $\beta$ :-6.34, 95%CI [-11.37, -1.31] per 5  $\mu\text{g}/\text{m}^3$  for all). We did not find associations between prenatal PM<sub>2.5</sub> exposure and FEV<sub>1</sub>/FVC. **Conclusions:** Increased PM<sub>2.5</sub> exposure during pregnancy is associated with reduced lung function in children on multiple measures of lung function, suggesting that pregnancy is an important exposure window. Understanding these temporal relationships may provide unique insights into mechanisms affecting lung growth and inform the development of interventions that will reduce exposure during pregnancy.

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## ABSTRACT E-BOOK

Theme: **PM and children's health**

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**P-0921**

### Identifying sensitive windows of exposure to NO<sub>2</sub> and fetal growth trajectories in a Spanish population-based birth cohort

**Presenter:** Jennifer Ish, Department of Epidemiology, Human Genetics, and Environmental Sciences, University of Texas Health Science Center at Houston (UTHealth) School of Public Health in San Antonio, San Antonio, United States

**Authors:** J. Ish<sup>1</sup>, A. Rector<sup>2</sup>, C. Iñiguez<sup>3</sup>, M. D. Swartz<sup>2</sup>, M. Guxens<sup>4</sup>, J. Ibarluzea<sup>5</sup>, E. Symanski<sup>6</sup>, S. P. Chauhan<sup>7</sup>, K. W. Whitworth<sup>6</sup>;

<sup>1</sup>Department of Epidemiology, Human Genetics, and Environmental Sciences, University of Texas Health Science Center at Houston (UTHealth) School of Public Health in San Antonio, San Antonio, TX,

<sup>2</sup>Department of Biostatistics and Data Science, UTHealth School of Public Health, Houston, TX, <sup>3</sup>Department of Statistics and Computational Research, Universitat de València, València, SPAIN, <sup>4</sup>ISGlobal, Barcelona, SPAIN, <sup>5</sup>Public Health Division of Gipuzkoa, Instituto Investigación BioDonostia, Basque Government, Gipuzkoa, SPAIN, <sup>6</sup>Center for Precision Environmental Health, Department of Medicine, Baylor College of Medicine, Houston, TX, <sup>7</sup>Department of Obstetrics, Gynecology and Reproductive Sciences, UTHealth McGovern Medical School, Houston, TX.

**Background:** The epidemiologic literature supports an association between air pollution exposure and adverse fetal development. Our group previously published associations between maternal exposure to nitrogen dioxide (NO<sub>2</sub>), averaged across pregnancy trimesters, and reduced fetal growth in the INMA (INfancia y Medio Ambiente) project. Here, we apply novel statistical methods with greater flexibility to identify narrower (i.e., weekly) periods of potential sensitivity of fetal growth to NO<sub>2</sub> exposure. **Methods:** This study includes 2,141 women from three INMA regions: Valencia, Sabadell, and Gipuzkoa. Abdominal circumference (AC), biparietal diameter (BPD), femur length (FL), and estimated fetal weight (EFW) were assessed via ultrasounds at 12, 20, and 34 weeks. Linear mixed models produced growth curves from which standard deviation scores were calculated to describe growth trajectories in the first 12, 12-20, and 20-34 weeks of pregnancy. Weekly NO<sub>2</sub> exposures were estimated using temporally adjusted land-use regression models and assigned to women based on their addresses during pregnancy. We used distributed lag non-linear models to identify gestational weeks during which fetal growth is sensitive to NO<sub>2</sub> exposure (per 10-μg/m<sup>3</sup>), adjusted for relevant covariates. **Results:** NO<sub>2</sub> exposure during gestational week 4 was associated with reduced EFW trajectories in the first 12 weeks ( $\beta=-0.019$ ; 95%CI: -0.037,-0.001), while exposure during gestational week 5 was associated with reduced EFW during weeks 20-34 ( $\beta=-0.004$ ; 95%CI: -0.007,0.00). NO<sub>2</sub> exposure during gestational week 11 was associated with reduced AC growth in the first 12 weeks ( $\beta=-0.051$ ; 95%CI: -0.097,-0.006), while exposures during weeks 7 and 8 were associated with reduced AC growth during weeks 12-20 ( $\beta=-0.010$ , 95%CI: -0.020,0.00;  $\beta=-0.024$ ; 95%CI: -0.008,0.00, respectively). NO<sub>2</sub> exposure in each of gestational weeks 6-16 was associated with decreased BPD trajectories during weeks 20-34. **Conclusions:** Our results suggest NO<sub>2</sub> exposures during specific weeks in early and mid, but not late, pregnancy are associated with reduced fetal growth.

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Theme: **PM and children's health**

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**P-0922**

**Fine particulate matter and its constituents in air pollution and gestational diabetes mellitus: A nationwide survey in China**

**Presenter:** Guoqi Yu, Shanghai Jiao Tong University, Shanghai, China

**Authors:** G. Yu<sup>1</sup>, J. Ao<sup>1</sup>, J. Cai<sup>2</sup>, H. Kan<sup>2</sup>, J. Zhang<sup>1</sup>;  
<sup>1</sup>Shanghai Jiao Tong University, Shanghai, CHINA, <sup>2</sup>Fudan University, Shanghai, CHINA.

Background: Ambient air pollution has been linked to the development of gestational diabetes mellitus (GDM). However, previous studies provided inconsistent findings and no study has examined the effects of complex chemical constituents of the particulate matter on GDM. Objectives: To investigate the associations of exposure to PM<sub>2.5</sub> (particulate matter  $\leq 2.5\mu\text{m}$ ) and its constituents with GDM. Methods: The China Labor and Delivery Survey was a cross-sectional investigation conducted in 24 provinces in China between 2015 and 2016. A random sample of all deliveries in each participating hospital was selected and detailed obstetric information was extracted from medical records. Average concentrations of PM<sub>2.5</sub> and six constituents (organic matter, black carbon, sulfate, nitrate, ammonium and soil dust) were estimated (1km $\times$ 1km) using a combined geoscience-statistical model. GDM was diagnosed based on an oral glucose tolerance test (OGTT) between 24th and 28th weeks of the pregnancy and according to IADPSG criteria. Generalized linear mixed models were used to adjust for potential confounders. Results: A total of 54,517 subjects from 55 hospitals were included. The incidence of GDM was 10.8%. An interquartile range (IQR) increase in PM<sub>2.5</sub> exposure in the 2<sup>nd</sup> trimester of pregnancy was associated with an increased GDM risk in the single pollutant model, [adjusted odds ratio (aOR)=1.11 and 95% confidence interval (CI): 1.01-1.22]. Moderate to high degree of correlations were found among various PM<sub>2.5</sub> constituents. Exposure to organic matter (aOR=1.14; 95%CI: 1.05-1.23), black carbon (aOR=1.15; 95%CI: 1.07-1.25) and nitrate (aOR=1.13; 95%CI: 1.02-1.24) during 2<sup>nd</sup> trimester were associated with increased risks of GDM. Associations between constituents and GDM were robust after controlling for total PM<sub>2.5</sub> mass and accounting for multi-collinearity. Conclusions: Exposure to PM<sub>2.5</sub> in 2<sup>nd</sup> trimester during pregnancy was associated with an increased risk of GDM. Organic matter, black carbon and nitrate may be the main culprits for the association.

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## ABSTRACT E-BOOK

Theme: **PM and children's health**

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**P-0923**

### **The Relationship between Traffic-Related Air Pollution Exposures and Allostatic Load among Youth with Type 1 Diabetes in the SEARCH Cohort**

**Presenter:** Robin Puett, Maryland Institute for Applied Environmental Health  
School of Public Health  
University of Maryland, College Park, United States

**Authors:** J. Montresor-López<sup>1</sup>, S. R. Reading<sup>2</sup>, J. D. Yanosky<sup>3</sup>, M. A. Mittleman<sup>4</sup>, R. A. Bell<sup>5</sup>, T. L. Crume<sup>6</sup>, D. Dabelea<sup>6</sup>, L. M. Dolan<sup>7</sup>, R. B. D'Agostino Jr.<sup>8</sup>, S. M. Marcovina<sup>9</sup>, C. Pihoker<sup>10</sup>, K. Reynolds<sup>2</sup>, E. M. Urbina<sup>11</sup>, A. D. Liese<sup>12</sup>, L. Quirós-Alcalá<sup>13</sup>, J. Smith<sup>1</sup>, P. Bueno de Mesquita<sup>1</sup>, R. C. Puett<sup>1</sup>;

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**AbstractBackground/Aim:** We investigated the effects of chronic exposures to particulate and traffic-related air pollution on allostatic load (AL), a marker of cumulative biological risk, among youth with type 1 diabetes. **Methods:** Participants were drawn from five clinical sites of the SEARCH for Diabetes in Youth study (n=2,338). Baseline questionnaires, anthropometric measures, and a fasting blood test were taken at a clinic visit between 2001 and 2005. AL was calculated using 10 biomarkers reflecting cardiovascular, metabolic, and inflammatory risk. Monthly and annual residential exposures to particulate matter < 2.5 µm in diameter (PM<sub>2.5</sub>) and proximity to heavily-trafficked major roadways were estimated for each participant. Separate linear mixed models adjusted for sociodemographic and lifestyle factors were conducted for each exposure. **Results:** No significant associations were observed between exposures to PM<sub>2.5</sub> or proximity to traffic and AL in our main analysis. However, several associations were identified in stratified analyses. Among non-white participants, an interquartile range (IQR) increase in monthly average PM<sub>2.5</sub> was inversely associated with AL (β=-0.18, 95% CI: -0.36, -0.01), while residing in proximity to heavily-trafficked major roadways was positively associated with AL (β=0.73, 95% CI: 0.19, 1.3) and the cardiovascular and inflammatory AL subscales. Among non-Hispanic white participants and female participants, an IQR increase in monthly average PM<sub>2.5</sub> was positively associated with the inflammatory AL subscale (β=0.10, 95% CI: 0.03, 0.18 and β=0.11, 95% CI: 0.02, 0.20, respectively). **Conclusions:** Among youth with type 1 diabetes, the effects of chronic exposures to particulate and traffic-related air pollution on AL and its subscales may differ by race/ethnicity and sex.

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Theme: **PM and children's health**

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**P-0924**

**Coal fly ash exposure and affective disorders in children aged 6 to 14.**

**Presenter:** Kristina M. Zierold, University of Alabama at Birmingham, Birmingham, United States

**Authors:** K. M. Zierold<sup>1</sup>, J. A. Pfeiffer<sup>2</sup>, L. Sears<sup>2</sup>;

<sup>1</sup>University of Alabama at Birmingham, Birmingham, AL, <sup>2</sup>University of Louisville, Louisville, KY.

**Background:** Fly ash, a waste product generated from burning coal for electricity, contains neurotoxic heavy metals, like arsenic and manganese. Fly ash is stored in landfills and surface impoundments, which may potentially expose communities to fugitive dust emissions. Small particles that escape from the storage facilities may cause affective disorders in children. Affective disorders include depression, bipolar disorder, and anxiety and have been estimated to impact about 7% of children according to the CDC. Although the toxicity of fly ash is great, limited information exists on the neurobehavioral impact of exposure to fly ash. **Methods:** We measure fly ash and neurobehavioral disorders in children living near coal ash storage facilities. Using personal modular impactors and lift tapes, we collect particulate matter that is analyzed for fly ash by scanning electron microscopy and energy dispersive x-ray spectroscopy. The child behavior checklist (CBCL) is used to collect information on neurobehavioral outcomes. Logistic regression was used to assess the association between fly ash and affective disorders. Odds ratios were adjusted for age and gender. **Results:** To date, we have enrolled 229 children, 45% who are female. The mean age is 10.8 years (SD=2.53) and 77% are white. The mean value of indoor PM<sub>10</sub> is 22.6 µg/m<sup>3</sup> (SD=17.6; Min=3.83, Max=164) and 45% of homes had fly ash. Overall, 14.4% of children had affective disorders. Children who were exposed to fly ash were 1.84 more times likely to have differences in mood and anxiety (AOR=1.84, 95% CI = 0.86-3.96). **Conclusion:** Although we have not yet collected our full sample of children (N=300), there may be a potential relationship between fly ash exposure and affective disorders in children. Fly ash storage is an emerging environmental health threat throughout the world. This study may provide impetus for understanding the health impacts from exposure and promote improved regulations.

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**P-0925**

**Associations of exposure to particulate matter and nitrogen oxides with prevalent asthma and other atopic diseases at age 17 in Israel: A population-based national study**

**Presenter:** Raanan Raz, The Hebrew University of Jerusalem, Jerusalem, Israel

**Authors:** R. Raz<sup>1</sup>, R. Lev Bar-Or<sup>1</sup>, A. Gileles-Hillel<sup>2</sup>, I. Levy<sup>3</sup>, R. Sinnereich<sup>1</sup>, I. Kloog<sup>4</sup>, A. Lyubarsky<sup>5</sup>, G. Twig<sup>5</sup>;

<sup>1</sup>The Hebrew University of Jerusalem, Jerusalem, ISRAEL, <sup>2</sup>Hadassah-Hebrew University Medical Center, Jerusalem, ISRAEL, <sup>3</sup>Israel Ministry of Environmental Protection, Jerusalem, ISRAEL, <sup>4</sup>Ben-Gurion University, Be'er Sheva, ISRAEL, <sup>5</sup>Israel Defense Forces Medical Corps, Ramat Gan, ISRAEL.

**Background:** Childhood exposure to particulate matter < 2.5 micrometer (PM<sub>2.5</sub>) or nitrogen oxides (NO<sub>x</sub>) is an established risk factor for the development of asthma. However, associations of these exposures with other atopic diseases and factors that modify these associations are less clear. We aim to study associations between exposure to PM and NO<sub>x</sub> and the prevalence of asthma and atopic manifestations at age 17 in Israel. **Methods:** The study population comprised of all Israeli born adolescents aged 17 at medical evaluation for mandatory army service between 1967 and 2017 (N = 2,523,745, of whom 5.9% had prevalent asthma). Average birth to age 17 exposure assessments were based on a land use regression model for NO<sub>x</sub> at 500 m resolution, and a hybrid satellite-based model for PM at 1 km resolution. Associations were calculated from logistic regression models adjusted for year of birth and census socio-economic status (SES). **Results:** Exposure to either PM<sub>2.5</sub> or NO<sub>x</sub> from birth to age 17 was associated with prevalent asthma in a dose-response manner, with an odds ratio for 5<sup>th</sup> quintile of each exposure of 1.49 (95% CI: 1.45-1.54) and 1.61 (1.56-1.67), respectively, in comparison to the lowest exposure quintile. Associations for both pollutants were stronger in males and much stronger in lower socio-economic strata. Associations of PM<sub>2.5</sub> and NO<sub>x</sub> were also found with prevalent rhinitis, conjunctivitis and dermatitis. Strongest associations were seen for asthma with comorbid rhinitis, with an almost two-fold increased odds of upper versus lower quintile of exposure for either PM<sub>2.5</sub> (OR = 1.9, 1.81-2.0) or NO<sub>x</sub> (OR = 1.96, 1.82-2.11). **Conclusions:** Early life exposure to air pollution is associated with asthma and atopic disease in a dose-dependent manner. The association is stronger in lower SES, providing important evidence for improving health disparities.

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**P-0926**

**Short-term effect of size-fractionated particulate matters and their constituents on renal function in children: a panel study**

**Presenter:** Miao Liu, School of Public Health, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

**Authors:** M. Liu, W. Guo, H. Yang, L. Zhao, Q. Fang, X. Zhang;  
School of Public Health, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, CHINA.

Background: Evidence available on the effects of exposure to size-fractionated particulate matters as well as their various constituents with renal function in children is lack. Objective: To investigate the association of short-term exposure to size-fractionated particle number counts (PNCs) and their multiple constituents with renal function among healthy children. Methods: We conducted a panel study among 149 children aged 4-12 years in Guangzhou, China with up to 3 repeated visits across 3 seasons from October 22, 2018 to May 31, 2019. We utilized single particle aerosol mass spectrometer to monitor real time size-fractionated PNCs along with analyzing their 23 constituents continuously for 3 days ahead of each round of health examinations. Renal function was determined by estimated glomerular filtration rate (eGFR). We estimated the effects of size-fractionated PNCs exposure and their constituents on eGFR over various lag times with linear mixed-effects (LME) models and Bayesian kernel machine regression (BKMR). Results: PNCs were dose-responsive related to decreased eGFR at lag 2 day. The strongest alteration of eGFR was induced by particles  $\leq 0.5 \mu\text{m}$ , and declined over increased particles size. Such relationships were more evident in girls. The robust inverse associations of eight constituents of PNCs (OC,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{NH}_4^+$ ,  $\text{Li}^+$ ,  $\text{Al}^{3+}$ ,  $\text{C}_2\text{O}_4^{2-}$ , TMA) and eGFR in single-constituent model, constituent-PNCs model and constituent-residual model. Moreover, the BKMR analyses showed the adverse cumulative effects of eight constituents on eGFR when their concentrations were all above the 75th percentile. And only OC displayed a significant negative effect on eGFR when all of the other constituents were fixed at 25th, 50th, 75th percentile. Conclusion: Dose-responsive effects of short-term exposure to size-fractionated PNCs on reduced eGFR increased with the decrease of particle size among healthy children, and the overall effects of their mixture constituents revealed that OC might play more important role than others.

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**P-0927**

**Residential air pollution measures are associated with perturbations in a placental gene coexpression network**

**Presenter:** Maya Deyssenroth, Columbia University, New York, United States

**Authors:** M. Deyssenroth<sup>1</sup>, S. Borden<sup>2</sup>, G. Wellenius<sup>3</sup>, C. Marsit<sup>4</sup>, J. Chen<sup>5</sup>;

<sup>1</sup>Columbia University, New York, NY, <sup>2</sup>Brown University, Providence, RI, <sup>3</sup>Boston University, Boston, MA, <sup>4</sup>Emory University, Atlanta, GA, <sup>5</sup>Icahn School of Medicine at Mount Sinai, New York, NY.

**Background:** A growing body of evidence has linked air pollution exposure to human health effects. Early life may pose a particularly vulnerable period, where impacts on the developing organ systems can reverberate across the lifespan. A number of studies suggest that the placenta plays a critical role in transmitting air pollution exposure to the developing fetus. These include observed associations between various air pollutants and candidate placental features, such as mitochondrial DNA content, DNA methylation and telomere length. However, gaps remain in delineating the role of the placenta as a conveyor of air pollution-related health effects, including a comprehensive profiling of placental processes impacted by intrauterine air pollution exposure. In this study, we examined alterations in a placental transcriptome-wide network in relation to ambient fine particulate matter (PM<sub>2.5</sub>) and black carbon (BC) exposure. **Methods:** We evaluated placental RNAseq data (n=200) generated from study participants enrolled in the Rhode Island Child Health Study. Residential PM<sub>2.5</sub> and BC exposure levels were estimated using a hybrid model incorporating land-use regression and satellite remote sensing. Differential gene expression analysis was performed using the DESeq2 R package. A transcriptome-wide gene coexpression network was generated using the WGCNA R package. **Results:** Testing each gene independently, we observed no significant differences in expression levels between the highest and lowest tertile of exposure for PM<sub>2.5</sub> or BC. Mapping PM<sub>2.5</sub> levels to the generated gene coexpression network, we observed significant correlations (p<0.05) to gene-sets enriched for DNA conformation change, cell adhesion and histone modification. BC levels were significantly correlated to gene-sets enriched for cellular respiration, gonadotropin secretion, protein targeting and organogenesis. **Conclusion:** The current study represents the most comprehensive assessment of genome-wide changes in placental gene expression and residential air pollution measures to date, revealing alterations in placental processes associated with PM<sub>2.5</sub> and BC levels.

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**P-0928**

**A systematic review of association between fine particle exposure and children's behavior**

**Presenter:** Hang Du, National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, Beijing, China

**Authors:** H. Du, Y. Wang, T. Li;  
National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, Beijing, CHINA.

**Background:** Fine particles (PM<sub>2.5</sub>) have a health effect on the nerves, which may further cause various behavioral problems. Children are susceptible groups, and behavioral problems can seriously affect children's growth and development and interpersonal communication. **Methods:** Online retrieval databases include PubMed, Web of Science, CNKI and Wanfang. All the published epidemiological literature on the relationship between fine particulate matter and children's behavior was collected by means of searching keywords and tracing related references. **Results:** A total of 25 qualified literatures were retrieved to study the relationship between PM<sub>2.5</sub> and children's behavioral problems mainly from two aspects: behavioral disorder disease and children's abnormal behavior score. The existence of this correlation requires reasonable physiological mechanisms. In future studies in China, longitudinal cohort studies should be carried out to enhance the demonstration of the causal relationship between fine particulate pollution and children's behavior problems. **Conclusions:** This review suggests that there is an association between PM<sub>2.5</sub> pollution and children's behavioral problems, and its impact on children's health cannot be ignored. Unlike diseases, there is no clear treatment for behavioral problems, which should be prevented during children's growth and development. **Key words:** Children; Behavior problems; Fine particulate matter. **Fund program:** National Natural Science Foundation of China (41907368, 21906156, 41907367)

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**P-0929**

**Ambient fine particulate matter and ozone exposures during pregnancy and DNA methylation in umbilical cord blood in the Healthy Start cohort study**

**Presenter:** Anne P Starling, University of Colorado Anschutz Medical Campus, Aurora, United States

**Authors:** A. P. Starling<sup>1</sup>, W. Zhang<sup>1</sup>, I. V. Yang<sup>1</sup>, D. S. Thomas<sup>2</sup>, J. L. Peel<sup>3</sup>, J. L. Adgate<sup>1</sup>, S. Magzamen<sup>3</sup>, S. E. Martenies<sup>3</sup>, W. B. Allshouse<sup>1</sup>, D. Dabelea<sup>1</sup>;

<sup>1</sup>University of Colorado Anschutz Medical Campus, Aurora, CO, <sup>2</sup>University of North Carolina Charlotte, Charlotte, NC, <sup>3</sup>Colorado State University, Fort Collins, CO.

**Background:** Prenatal exposure to air pollution has been associated with low birth weight and adverse childhood health outcomes. Long-term effects of prenatal environmental exposures may be mediated through changes to DNA methylation that, in turn, affect gene regulation and subsequent child phenotype. **Methods:** In a prospective cohort study of ethnically diverse mother-infant pairs in Colorado, USA, we estimated associations between prenatal exposure to ambient fine particulate matter (PM<sub>2.5</sub>) and ozone (O<sub>3</sub>) in each trimester of pregnancy and across the full pregnancy, and DNA methylation of umbilical cord blood cells collected at delivery (2010-2014). Analyses were restricted to 429 eligible women who reported no sustained smoking during pregnancy. Umbilical cord blood DNA methylation was evaluated using the Illumina Infinium 450K array. Linear regression models estimated associations between average air pollution in each period, and methylation (M-value) at each of 436,374 CpG sites remaining after filtering. **Results:** Median full-pregnancy average PM<sub>2.5</sub> concentration was 7.5 ug/m<sup>3</sup>. After covariate adjustment including technical batches and estimated cell proportions, methylation at 1 CpG was associated with 2nd trimester PM<sub>2.5</sub>, 39 CpGs were associated with 3rd trimester PM<sub>2.5</sub> and 13 CpGs were associated with full-pregnancy average PM<sub>2.5</sub> at a false discovery rate <0.05. Genes annotated to these differentially methylated positions included LEP, which produces an adipokine with prominent roles in energy homeostasis, appetite and satiety, and SLC12A5, involved in insulin secretion. Other annotated genes were implicated in immune system regulation and inflammation, neuronal function and neurodevelopment, and cancer. Methylation was not associated with O<sub>3</sub> during any period of pregnancy. **Conclusions:** Prenatal exposure to particulate air pollution was associated with differential methylation of umbilical cord blood DNA among mother-infant pairs in a low exposure setting. Future research should investigate whether epigenetic changes may mediate previously observed effects of air pollution on childhood adverse health outcomes including obesity.

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**P-0931**

**Impact of early life exposure to ambient PM<sub>2.5</sub> on child health in India**

**Presenter:** Sagnik Dey, Indian Institute of Technology Delhi, New Delhi, India

**Authors:** S. Dey<sup>1</sup>, P. Singh<sup>2</sup>, S. Chowdhury<sup>1</sup>, K. Bali<sup>1</sup>;

<sup>1</sup>Indian Institute of Technology Delhi, New Delhi, INDIA, <sup>2</sup>Brookings India, New Delhi, INDIA.

**Background:** Ambient PM<sub>2.5</sub> exposure is very high in India, yet local evidence of air pollution health impacts is limited. **Objective:** Here using a nationally representative survey, we examine the impact of early-life exposure to ambient PM<sub>2.5</sub> on children growth (height-for-age and weight-for-age) in India. **Results:** We use non-local fire-events as a measure for local pollution levels as they are not related to household behavioral choices or local economic activity, but affect local pollution levels as smoke and pollutants from these neighboring fire events can travel long distances. We found that one standard deviation increase in exposure to ambient PM<sub>2.5</sub> decreases height-for-age (measure for stunting) by 6.7% and weight-for-age (measure for wasting) by 7.8% for children under 5 years of age. The impact is larger for poorer households and households where mothers have less (till primary level) and no education. The negative impact is detectable for all age groups (<1 year, 1-2 years, >3 years). Using a point estimate of probability of being stunted due to air pollution, we found that one standard deviation increase in ambient PM<sub>2.5</sub> exposure in early-life decreases GDP (Gross Domestic Product) by 0.18% in India. **Discussion:** India has launched programs to improve sanitation and tackle malnutrition (the two biggest factors that negatively impact child growth) at national scale. Our study suggests that unless air pollution is also addressed at a national scale, the benefits of such welfare programs in improving child health may not be effective.

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**P-0932**

**Daily Personal PM<sub>2.5</sub> Exposure Level According to Four Major Activities among Children**

**Presenter:** Sungroul KIM, SCH University, Asan, Korea, Republic of

**Authors:** J. Woo<sup>1</sup>, G. Rudasingwa<sup>2</sup>, S. KIM<sup>1</sup>;

<sup>1</sup>SCH University, Asan, KOREA, REPUBLIC OF, <sup>2</sup>SoonChunHyang University, Asan, KOREA, REPUBLIC OF.

Particulate matters less than 2.5 micrometers in diameter (PM<sub>2.5</sub>), whose concentration has increased in Korea, has a considerable impact on health. From a risk management point of view, there has been interest in understanding the variations in real-time PM<sub>2.5</sub> concentrations per activity in different microenvironments. We analyzed personal monitoring data collected from 15 children aged 6 to 11 years engaged in different activities such as commuting in a car, visiting a commercial building, attending an education institute, and resting inside home from October 2018 to March 2019. The fraction of daily mean exposure duration per activity was  $72.7 \pm 18.7\%$  for resting inside home,  $27.2 \pm 14.4\%$  for attending an education institute, and  $11.5 \pm 9.6\%$  and  $5.3 \pm 5.9\%$  for visiting a commercial building, commuting in a car, respectively. And Daily median (interquartile range) PM<sub>2.5</sub> exposure amount was 88.9 (55.9-159.7)  $\mu\text{g}$  in houses and that in education buildings was 43.3 (22.9-55.6)  $\mu\text{g}$ . Real-time PM<sub>2.5</sub> exposure levels varied by person and time of day ( $p$ -value  $< 0.05$ ). This study demonstrated that our real-time personal monitoring and data analysis methodologies were effective in detecting polluted microenvironments and provided a potential person-specific management strategy to reduce a person's exposure level to PM<sub>2.5</sub>.

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**P-0933**

**Assessment of associations between air pollution and adolescent mental health in South Korea**

**Presenter:** Eunju EO, Korea University, Seongbuk-gu, Korea, Republic of

**Authors:** E. EO, J. Lee;  
Korea University, Seongbuk-gu, KOREA, REPUBLIC OF.

**Background/Aim** Adolescent mental health problem is increasingly recognized as a serious public health issue in South Korea, in which the suicide rate is the highest in OECD countries. There is growing evidence showing adverse effects of ambient air pollution on mental health. Several studies suggest air pollution rises levels of oxidative stress and inflammation in brain and may increase the risk of mental disorder. However, relatively few studies were conducted in adolescent population. Therefore, we aim to investigate the associations between air pollution and mental health in adolescents in South Korea.

**Methods** This study is a cross-sectional study with data obtained from the 13th Korea Youth Risk Behavior Web-based Survey (KYRBS, 2017). The study subject included 38,810 secondary school students (13-18 years old). Based on each subject's school address, we assigned the exposure as a 1-year average (July 2016 – June 2017) of air pollution concentration (PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>2</sub>) prior to the time of the survey. Associations between mental health (depressive mood (DM) and suicidal ideation (SI)) and air pollution were analyzed using logistic regression analysis. Adjustments were made for sex, self-rated socioeconomic status, drinking and smoking status, grade, self-rated GPA, and region.

**Results** The prevalence of DM and SI were 25.6% and 12.7% in the study population, respectively. DM was positively associated with NO<sub>2</sub> (OR 1.01; 95% CI: 1.00, 1.02; per 1ppb) and SO<sub>2</sub> (OR 1.05; 95% CI: 0.99, 1.11; per 1ppb). SI was positively associated with PM<sub>10</sub> (OR 1.20; 95% CI: 1.01, 1.43; per 10µg/m<sup>3</sup>), SO<sub>2</sub> (OR 1.10; 95% CI: 1.02, 1.18; per 1ppb), and NO<sub>2</sub> (OR 1.01; 95% CI: 1.00, 1.03; per 1ppb). Associations regarding PM<sub>2.5</sub> did not reach statistical significance.

**Conclusions** This study provides suggestive evidence about associations between air pollution and adolescent mental health.

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**P-0934**

### **Hourly, Daily, Seasonal, and Location-Dependent Trends of PM Exposure in Primary School Aged Children**

**Presenter:** Ian Ryan, State University of New York at Albany, Rensselaer, United States

**Authors:** I. Ryan;  
State University of New York at Albany, Rensselaer, NY.

Background Fine particulate matter (PM<sub>2.5</sub>) is a significant air pollutant which has been associated with increased risk of several respiratory diseases, cardiovascular disease (CVD), cognitive impairment, and premature death. Unfortunately, many adverse health outcomes associated with PM<sub>2.5</sub> are exacerbated in children. Most previous research on the topic, however, has looked at residential, not in-school, exposures. This study aimed to evaluate school children's exposure to PM pollution for 48 consecutive hours. Methods In this cross-sectional study, we recruited 105 participants from eight middle schools and two university departments around Albany county, NYS. Using personal monitors, we measured individual exposure to PM<sub>2.5</sub>, decibels of sound, temperature, and relative humidity over a 48-hour period. In addition, we measured in-class concentrations of several other PM pollutants and collected questionnaire/activity pattern data from most participants. Results In-class PM<sub>2.5</sub> concentrations never rose above the EPA 24-hour outdoor standard of 35 µg/m<sup>3</sup>. Nearly a third (29.08%) of the in-home measurements in the fall exceeded this EPA standard, which is 12.9 and 6.6 times as many measurements as in the winter (2.26%) and spring (4.38%), respectively. PM concentrations in winter were consistently lower than in fall and spring according to both personal monitoring (winter<sub>Median</sub> = 0.9 µg/m<sup>3</sup>; spring<sub>Median</sub> = 2.31 µg/m<sup>3</sup>; fall<sub>Median</sub> = 2.84 µg/m<sup>3</sup>) and in-class monitoring data. Conclusion Although in-school PM pollution levels rarely exceeded the EPA outdoor standards, PM<sub>2.5</sub> levels routinely exceeded these standards at home. Peak PM<sub>2.5</sub> concentrations in each season occurred at home and after 6pm, but far more frequently and severely in the fall. This suggests that cooking is likely responsible for nighttime PM<sub>2.5</sub> concentrations. Larger studies are needed to assess seasonal differences in student's exposure to PM pollution and help determine if the EPA should establish indoor PM limits for homes and schools.

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**P-0935**

**Genetic ancestry modifies the relationship between fine particulate matter and placental mitochondrial mutational load**

**Presenter:** Kelly Brunst, University of Cincinnati, Cincinnati, United States

**Authors:** K. Brunst<sup>1</sup>, H. L. Hsu<sup>2</sup>, L. Zhang<sup>1</sup>, I. Kloog<sup>3</sup>, A. Just<sup>2</sup>, A. Wilson<sup>4</sup>, B. A. Coull<sup>5</sup>, A. A. Baccarelli<sup>6</sup>, R. J. Wright<sup>2</sup>;

<sup>1</sup>University of Cincinnati, Cincinnati, OH, <sup>2</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>3</sup>Ben-Gurion University of Negev, Beer Sheva, ISRAEL, <sup>4</sup>Colorado State University, Fort Collins, CO, <sup>5</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>6</sup>Mailman School of Public Health, Columbia University, New York, NY.

**Introduction:** Exposure to ambient fine particulate matter (PM<sub>2.5</sub>) is linked to changes in placental mitochondrial DNA (mtDNA) copy number. Whether PM<sub>2.5</sub> impacts mitochondrial mutational load in placental tissue—another biomarker of oxidative damage and aging has not been studied. Further, genetic ancestry likely impacts this relationship and may inform health disparities. **Methods:** We examine the association between PM<sub>2.5</sub> and placental mtDNA mutational load in an urban multi-ethnic cohort (N=285). Mothers' daily exposure to PM<sub>2.5</sub> over gestation was estimated using a satellite-based spatio-temporally resolved prediction model. Whole mtDNA sequencing was performed and mutations and haplogroups were determined. Bayesian Distributed Lag Interaction regression models (BDLIMs) were used to statistically model and visualize the PM<sub>2.5</sub> timing-dependent pattern of associations with mtDNA mutations (total load and gene-specific) and explore effect modification by haplogroup. **Results:** Overall, increased PM<sub>2.5</sub> exposure across pregnancy was not associated with total mutational load. However, results varied by mtDNA haplogroup with increases in PM<sub>2.5</sub> being associated with higher total mutational load for African (cumulative effect 1.92, 95%CI 0.46, 3.48) and Asian (cumulative effect: 1.33, 95% CI 0.07, 2.73) haplogroups; a critical window was identified between 29 and 35 weeks gestation for African haplogroups only. Gene-wise analyses suggested that increased PM<sub>2.5</sub> exposure during mid pregnancy (20-25 weeks) might have a stronger impact on mutations located in genes coding for ATP synthase subunits regardless of haplogroup. **Conclusions:** Placental mtDNA mutations, associated with increased PM<sub>2.5</sub> exposure mid to late pregnancy, may have consequences on placental energy production, aging, and metabolic regulation that may impact offspring development. Understanding how these associations differ based on ancestry may further elucidate the etiology of environmentally-related disease disparities.

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## ABSTRACT E-BOOK

Theme: **PM and children's health**

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**P-0936**

**Is there an association between long-term exposure to particulate matter and events of severe hypoglycaemia in children and adolescents with type 1 diabetes?**

**Presenter:** Stefanie Lanzinger, Institute of Epidemiology and Medical Biometry, ZIBMT, Ulm University, Ulm, Germany

**Authors:** S. Lanzinger<sup>1</sup>, H. Altug<sup>2</sup>, T. Schikowski<sup>2</sup>, S. Khodaverdi<sup>3</sup>, J. Rosenbauer<sup>4</sup>, W. Rathmann<sup>4</sup>, S. Reger-Tan<sup>5</sup>, K. Praedicow<sup>6</sup>, D. Johnsen<sup>7</sup>, R. W. Holl<sup>1</sup>;

<sup>1</sup>Institute of Epidemiology and Medical Biometry, ZIBMT, Ulm University, Ulm, GERMANY, <sup>2</sup>Leibniz Research Institute for Environmental Medicine (IUF), Düsseldorf, GERMANY, <sup>3</sup>Clinic for Children and Adolescent Medicine, Clinical Centre Hanau, Hanau, GERMANY, <sup>4</sup>Institute for Biometrics and Epidemiology, German Diabetes Centre, Leibniz Centre for Diabetes Research at Heinrich Heine University Düsseldorf, Düsseldorf, GERMANY, <sup>5</sup>Clinic for Endocrinology, Diabetology and Metabolism, University Hospital Essen, Essen, GERMANY, <sup>6</sup>Clinic for Children and Adolescent Medicine, Diabetology and Endocrinology, Helios Clinical Centre Aue, Aue, GERMANY, <sup>7</sup>Department for Children and Adolescent Medicine, inland Clinic Rendsburg, Rendsburg, GERMANY.

**Background/Aim:** Studies on long-term exposure to air pollution and the impact on diabetes outcomes in children and adolescents with type 1 diabetes (T1D) are rare. We aimed at investigating the impact of particulate matter <math><10 \mu\text{m}</math> ( $\text{PM}_{10}$ ) and <math><2.5 \mu\text{m}</math> ( $\text{PM}_{2.5}$ ) on event rates of severe hypoglycaemia in young individuals with T1D. **Methods:** We studied 55,283 children and adolescents with T1D <math><21\text{yrs}</math> which were documented in German centres of the multicentre diabetes patient follow-up registry (DPV). Demographic and clinical data of the most recent treatment year between 2009 and 2018 was aggregated by patient.  $\text{PM}_{10}$ - and  $\text{PM}_{2.5}$ -yearly-averages prior to the respective treatment year were linked via the five-digit postcode areas of residency. Negative binomial regression models were used to study the association between PM-quartiles (Q1 lowest, Q4 highest concentration) and events of severe hypoglycaemia and hypoglycaemic coma per 100 patient years (PY). Models were adjusted for sex, age, diabetes duration, treatment year, migration background, type of treatment, degree of urbanisation and socioeconomic index of deprivation. **Results:** The included individuals with T1D had a median age of 15.8yrs (Q1:12.0-Q3:17.6; HbA1c 7.8% (7.1-9.0), 53% males, 45% insulin pump). Event rates of severe hypoglycaemia and hypoglycaemic coma were significantly higher at high  $\text{PM}_{10}$ -concentration  $\geq 18.0 \mu\text{g}/\text{m}^3$  (Q4: 12.5 events/100 PY (95%confidence interval:11.4-13.8) and 3.0 events/100 PY (2.6-3.4)) compared to lower  $\text{PM}_{10}$ -concentration  $<14.3 \mu\text{g}/\text{m}^3$  (Q1: 9.4 events/100 PY (8.5-10.4) and 1.5 events/100 PY (1.3-1.8)). Similar results were observed with  $\text{PM}_{2.5}$  (Q4  $\geq 12.9 \mu\text{g}/\text{m}^3$ : severe hypoglycaemia 11.7 events/100 PY (10.6-13.0), hypoglycaemic coma 3.0 events/100 PY (2.6-3.4), Q1  $<10.1 \mu\text{g}/\text{m}^3$ : 9.6 events/100 PY (8.6-10.7), 1.4 events/100 PY (1.2-1.7)). Additional adjustment for HbA1c did not change the results. **Conclusions:** Our results indicated a positive association between long-term exposure to particulate matter and events of severe hypoglycaemia at PMlevels well below the EU yearly limit values.

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Theme: **PM and children's health**

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**P-0937**

**Ultrafine particles, psychosocial stress, and sleep: new epidemiological links?**

**Presenter:** Kelly Brunst, University of Cincinnati, Cincinnati, United States

**Authors:** K. Brunst<sup>1</sup>, C. Wolfe<sup>2</sup>, P. H. Ryan<sup>2</sup>;

<sup>1</sup>University of Cincinnati, Cincinnati, OH, <sup>2</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH.

**Introduction:** Insufficient or poor-quality sleep during childhood is common and can have lifelong adverse health effects. Ultrafine particle (UFP) exposure and psychosocial stress can impact cardiovascular, respiratory, and neurological health but the effects of UFPs, particularly among children experiencing psychosocial stress, on sleep outcomes are unknown. **Methods:** This study includes 118 adolescents from the Ecological Momentary Assessment and Personal particle Exposure (EcoMAPPE) Study. A seven-day sampling period using a personal UFP monitor was completed and average daily concentrations of UFP were calculated. PROMIS® pediatric self-report measures were used to assess elevated levels (T-scores  $\geq 60$ ) of anxiety and depression symptoms over the sampling period. At the end of the sampling period, the child completed the Sleep Habits Questionnaire (SHQ); outcomes included sleep duration and frequency of night waking. Regression models were used to assess the associations between an IQR increase in UFP exposure and sleep outcomes and explore effect modification by concurrent psychosocial stress. **Results:** Increased UFP exposure was marginally associated with shorter weekend sleep duration ( $\beta = -0.43$ , SE 0.23,  $p=0.07$ ); UFP exposure was not associated with night waking. Among children reporting elevated anxiety symptoms, UFP exposure was associated with reduced sleep duration during the week ( $\beta=-1.01$ , SE=0.49,  $p_{UFP*anxiety}=0.04$ ) and weekend ( $\beta=-1.65$ , SE=0.71,  $p_{UFP*anxiety}=0.01$ ). Among children experiencing elevated depression symptoms, increased UFP exposure was significantly associated with reduced sleep duration during the weekend ( $\beta=-2.09$ , SE=0.81,  $p_{UFP*depression}=0.009$ ). All models controlled for child's age, race, gender, asthma status, maternal education, and exposure to environmental tobacco smoke. **Conclusions:** Exposure to UFPs alone does not result in poor quality sleep; however, concurrent UFP exposure and symptoms of anxiety/depression may have a negative impact on sleep outcomes. Understanding the potential synergistic effects between psychosocial factors and environmental toxins (e.g., UFP) will help inform health risks related to poor sleep outcomes among adolescents.

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**P-0938**

### **Impact of Data Cleaning on Personal Exposure to Black Carbon and DNA Methylation in Arginase-Nitric Oxide Synthase Pathway**

**Presenter:** Nan Ji, Rutgers, The State University of New Jersey, Piscataway, United States

**Authors:** N. Ji<sup>1</sup>, C. Cepeda<sup>1</sup>, K. Black<sup>1</sup>, A. Baptista<sup>2</sup>, M. Greenberg<sup>3</sup>, I. Colon<sup>4</sup>, P. Ohman-Strickland<sup>1</sup>, R. Laumbach<sup>1</sup>;

<sup>1</sup>Rutgers, The State University of New Jersey, Piscataway, NJ, <sup>2</sup>The New School, New York, NY, <sup>3</sup>Monmouth University, West Long Branch, NJ, <sup>4</sup>Ironbound Community Corporation, Newark, NJ.

**Background/Aim:** Previous reports have used time-resolved personal monitor to assess the relationship between acute exposure to traffic-related air pollutants (TRAP) and changes in DNA methylation of genes in the arginase (ARG)-nitric oxide synthase (NOS) pathways. We aim to use a data cleaning process to reduce potential artifactual errors from personal measurement and assess its impact on associations between exposure to black carbon (BC), a marker for TRAP exposure, and DNA methylation in ARG-NOS pathways in children with asthma. **Methods:** Ninety daily buccal cell samples (collected in 5 days) were collected from 18 children with physician-diagnosed asthma. Previous 24-hour personal BC was recorded using microaethalometers (AE51, Aethlabs). DNA methylation in promoter regions of NOS1 (6 sites), NOS2 (16 sites) and ARG1 (8 sites) was assessed by bisulfite pyrosequencing. A combination of two published cleaning methods was applied to the raw measurements. After multivariate analysis of variance (MANOVA), statistically significant associations between percent methylation and BC were analyzed by linear-mixed effect models adjusted for day-of-week, age, gender, and body mass index. **Results:** The mean ( $\pm$  standard deviation) of raw and cleaned BC were  $0.82 \mu\text{g}/\text{m}^3 (\pm 0.6)$  and  $1.63 \mu\text{g}/\text{m}^3 (\pm 1.36)$ , respectively. We found a significant decrease in methylation of position 1 in NOS3 with an interquartile increase in log-transformed BC in raw BC data (-5.8%, 95% Confidence Interval (CI): -9.4, -2.2) and in cleaned BC data (-5.5%, 95% CI: -8.9, -2.1), respectively. Increased raw BC, but not cleaned BC, was associated with a decrease in methylation of ARG1, in contrast to the hypothesized effects. No significant associations were found in methylation of NOS1 and BC. **Conclusions:** Compared with cleaned data, raw BC appeared to underestimate personal exposure and was associated with unexpected increase in methylation of ARG1 genes, although associations with decreased methylation in NOS3 were similar.

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**P-0939**

**Particulate matter exposure in utero is associated with childhood saliva DNA methylation at ages 9 and 15**

**Presenter:** Kelly M Bakulski, University of Michigan, Ann Arbor, United States

**Authors:** K. M. Bakulski, J. F. Dou, J. Fisher, A. M. Gard, E. B. Ware, C. M. Mitchell;  
University of Michigan, Ann Arbor, MI.

Background: Exposure in utero to particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>) is associated with health outcomes. Prenatal PM<sub>2.5</sub> and PM<sub>10</sub> exposures have cord blood DNA methylation signatures at birth, however signature persistence into childhood and saliva cross-tissue applicability have not been tested. Methods: In the Fragile Families and Childhood Wellbeing Study, a United States 20-city (200,000+) birth cohort, trimester-specific PM<sub>2.5</sub> and PM<sub>10</sub> was measured using air quality monitor inverse distance weighting. Saliva DNA methylation at ages 9 (n=835) and 15 (n=861) was measured using the Illumina HumanMethylation 450k BeadArray. Cumulative DNA methylation scores for particulate matter were estimated by mean centering participant DNA methylation, weighting by meta-analysis effect estimates, and standardizing the sums. Using multivariable linear regression, we tested cumulative DNA methylation scores at ages 9 and 15 for associations with pregnancy PM levels, adjusted for sex, income to needs ratio, city, nonmarital birth status, race/ethnicity, and cell type proportions. Results: Our study sample was 50.5% male, 20% non-Hispanic white, 55% non-Hispanic black, 21% Hispanic, and median income to needs ratio of 1.4. In the third trimester, mean PM<sub>2.5</sub> exposure levels were 26.97 ug/m<sup>3</sup>/day (standard deviation: 6.9) and PM<sub>10</sub> were 14.47 ug/m<sup>3</sup>/day (standard deviation: 3.2). At age 9, a one-standard deviation increase in cumulative PM<sub>2.5</sub> DNA methylation score was associated with 0.44 ug/m<sup>3</sup>/day (95% confidence interval: -0.07-0.96) higher third trimester PM<sub>2.5</sub> exposure. At age 9, a one-standard deviation increase in cumulative PM<sub>10</sub> DNA methylation score was associated with 0.76 ug/m<sup>3</sup>/day (95% confidence interval: 0.56-0.98) higher third trimester PM<sub>10</sub> exposure. Findings were consistent at age 15 and robust to adjustment for exposure at ages 1 and 3. Conclusion: In utero PM associated DNA methylation differences persist until ages 9 and 15 and can be detected in saliva. Benchmarking the persistence and cell type generalizability is critical for epigenetic exposure biomarker assessment.

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**P-0941**

### **Associations between satellite-derived estimates of PM<sub>2.5</sub> species concentrations and birth weight in California**

**Presenter:** Patrick Reuther, University of Nevada, Reno, Reno, United States

**Authors:** P. Reuther<sup>1</sup>, G. Geng<sup>2</sup>, Y. Liu<sup>3</sup>, L. Darrow<sup>1</sup>, M. Strickland<sup>1</sup>;

<sup>1</sup>University of Nevada, Reno, Reno, NV, <sup>2</sup>Tsinghua University, Beijing, CHINA, <sup>3</sup>Emory University, Atlanta, GA.

**Background:** Characterizing the spatial distribution of PM<sub>2.5</sub> species concentrations is challenging due to the geographic sparsity of the stationary monitoring network. Recent advances have enabled the estimation of PM<sub>2.5</sub> species concentrations using satellite remote sensing data. In this study, we linked these satellite-based estimates with California birth records to estimate associations between pollutant concentrations and birth weight.

**Methods:** Daily 24-hour average ground-level PM<sub>2.5</sub> species concentrations of organic carbon, black carbon, nitrate, and sulfate were estimated during 2005 - 2014 in California at approximately 1 km resolution using ground observations, fractional aerosol optical depth data from the multi-angle imaging spectroradiometer on the Terra satellite and community multiscale air quality modeling simulations. Birth records were provided by the California Department of Public Health - Vital Records. Pollutant exposures averaged across pregnancy were calculated for each birth by linking on maternal residential zip code. Continuous infant birth weight was modeled using multiple linear regression, adjusting for covariates contained on the birth records. **Preliminary Results:** There were 4.7 million live singleton births included with a median of 28 days of exposure measurements per pregnancy. We observed decreases in mean birth weight per 1 µg/m<sup>3</sup> increase in pregnancy-averaged pollutant exposure for organic carbon ( $\beta = -3.08$ , 95% CI: -3.64, -2.51), black carbon ( $\beta = -10.27$ , 95% CI: -11.86, -8.68), nitrate ( $\beta = -7.00$ , 95% CI: -7.55, -6.45), and sulfate ( $\beta = -16.21$ , 95% CI: -17.53, -14.88).

**Discussion:** The use of satellite remote sensing data to estimate PM<sub>2.5</sub> components is novel and may help overcome limitations related to the sparse monitoring network. Limitations of this study include uncertainty in the daily exposure estimates, as well as the potential for confounding by factors not ascertained on birth records.

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**P-0942**

### **Prenatal exposure to ambient air pollution and traffic and indicators of adiposity in early childhood: The Healthy Start Study**

**Presenter:** Lizan D. Bloemsma, Colorado School of Public Health, Aurora, United States

**Authors:** L. D. Bloemsma<sup>1</sup>, D. Dabelea<sup>2</sup>, D. S. Thomas<sup>3</sup>, J. L. Peel<sup>4</sup>, J. L. Adgate<sup>1</sup>, W. B. Allshouse<sup>1</sup>, S. E. Martenies<sup>4</sup>, S. Magzamen<sup>4</sup>, A. P. Starling<sup>1</sup>;

<sup>1</sup>Colorado School of Public Health, Aurora, CO, <sup>2</sup>University of Colorado Anschutz Medical Campus, Aurora, CO, <sup>3</sup>University of North Carolina Charlotte, Charlotte, NC, <sup>4</sup>Colorado State University, Fort Collins, CO.

Background: Prenatal exposure to ambient air pollution and traffic have been associated with lower birth weight, but relationships with weight and body composition in childhood are unclear. The aim of this study was to examine associations of prenatal exposure to ambient air pollution and traffic with indicators of adiposity in early childhood. Methods: We included 738 participants of the Colorado-based Healthy Start Study whose height, weight, waist circumference and/or fat mass (via air displacement plethysmography, n=652) were measured at age 4-6 years. We estimated residential exposure to ambient concentrations of particulate matter with a diameter of  $<2.5\mu\text{m}$  ( $\text{PM}_{2.5}$ ) and ozone ( $\text{O}_3$ ) averaged by trimester and throughout pregnancy via inverse distance-weighted interpolation of stationary monitoring data. We assessed the distance to the nearest major roadway and traffic density in multiple buffers surrounding the participants' homes. Associations of prenatal exposure to air pollution and traffic with overweight (yes/no), waist circumference and fat mass index (fat mass/height<sup>2</sup>) were assessed by logistic and linear regression, adjusting for potential confounders. Results: Third trimester average 8-hour maximum  $\text{O}_3$  was associated with a higher odds of being overweight (adjusted odds ratio 1.71 [95%CI 1.12, 2.62] per IQR increase) and higher fat mass index (adjusted difference 0.27kg/m<sup>2</sup> [95%CI 0.09, 0.44kg/m<sup>2</sup>] per IQR increase) at age 4-6 years. We found associations of third trimester  $\text{PM}_{2.5}$  with a lower fat mass index (adjusted difference -0.19kg/m<sup>2</sup> [95%CI -0.32, -0.07kg/m<sup>2</sup>] per IQR increase), while first trimester  $\text{O}_3$  was associated with a lower odds of being overweight and lower fat mass index. Residential proximity to a highway was associated with a higher odds of being overweight and a non-significant higher waist circumference and fat mass index. Conclusion: Higher ambient concentrations of  $\text{O}_3$  during the third trimester of pregnancy and residential proximity to a highway during pregnancy may contribute to overweight in early childhood.

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**P-0943**

**PM<sub>2.5</sub> Exposure in Public Primary Schools Kampala, Uganda**

**Presenter:** Samuel Etajak, Makerere University School of Public Health, Kampala, Uganda

**Authors:** S. Etajak<sup>1</sup>, L. Atuyambe<sup>1</sup>, W. Bazeyo<sup>1</sup>, F. Walyawula<sup>1</sup>, A. Nyabigambo<sup>1</sup>, A. Kumie<sup>2</sup>, K. Dessie<sup>3</sup>, J. Partz<sup>4</sup>, J. M. Samet<sup>5</sup>, K. Berhane<sup>6</sup>;

<sup>1</sup>Makerere University School of Public Health, Kampala, UGANDA, <sup>2</sup>Addis Ababa University, Addis Ababa, ETHIOPIA, <sup>3</sup>University of Southern California, Los Angeles, CA, <sup>4</sup>University of Wisconsin, Wisconsin, WI, <sup>5</sup>University of Colorado, Colorado, CO, <sup>6</sup>Columbia University, New York, NY.

**Background** Worldwide, 93% of the world's children under 15 years of age are exposed to ambient fine particulate matter (PM<sub>2.5</sub>) levels above WHO defined air quality standards of 25 µg/m<sup>3</sup> (24-hour mean). In low- and middle-income countries around the world, 98% of all children under 5 are exposed to PM<sub>2.5</sub> levels above WHO suggested three interim air quality targets. In comparison, in high-income countries, 52% of children under 5 are exposed to levels above WHO air quality guidelines. We measured daily levels of ambient PM<sub>2.5</sub> concentrations, temperature, relative humidity in public primary schools in Kampala City Uganda. **Methods** We conducted the Ambient PM<sub>2.5</sub> Concentration measurements using the E-samplers centrally installed in four public primary schools in divisions of Kawempe, Central, Makindye and Lubaga in Kampala City, Uganda. The E-Samplers generated real-time, data for PM<sub>2.5</sub> concentrations, Relative Humidity and Ambient Temperature. Data analysis was done using Excel 2016 to generate daily averages of PM<sub>2.5</sub> concentrations for the Month of June 2018. **Results** The results showed the lowest and highest average daily PM<sub>2.5</sub> concentrations for St. Paul Primary School Minimum 17 µg/m<sup>3</sup> and Maximum 44 µg/m<sup>3</sup>; Central - Buganda Rd. Primary School Minimum 14 µg/m<sup>3</sup> and Maximum 45 µg/m<sup>3</sup>; Makindye - Kibuli Demonstration Primary School Minimum 9 µg/m<sup>3</sup> and Maximum 46 µg/m<sup>3</sup>; Rubaga - Queen of Peace Primary School Minimum 9 µg/m<sup>3</sup> and Maximum 110 µg/m<sup>3</sup>). Studies have shown that exposure to high levels of PM<sub>2.5</sub> concentrations results increased morbidity and mortality from cardiovascular and respiratory conditions. **Conclusions** There was an observed increase in ambient PM<sub>2.5</sub> Concentration beyond World Health Organization defined limit of 25 µg/m<sup>3</sup> and US EPA 35 µg/m<sup>3</sup> (24-hour mean). **Funding Sources:** NIH Fogarty International Center, NIEHS, CDC/NIOSH, Canada's IDRC, GACC Grant # 5R24 TW009552 [AAU]; 5R24 TW009548 [USC]; 1U01TW010094 [AAU]; 1U2RTW010125 [USC]

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**P-0945**

### **Prenatal Exposure to Particulate Matter and Placental Gene Expression**

**Presenter:** Daniel A Enquobahrie, University of Washington, Seattle, United States

**Authors:** D. A. Enquobahrie<sup>1</sup>, M. Hussey<sup>1</sup>, C. Loftus<sup>1</sup>, T. Bammler<sup>1</sup>, J. MacDonald<sup>1</sup>, A. Paquette<sup>2</sup>, A. Szpiro<sup>1</sup>, J. Kaufman<sup>1</sup>, K. LeWinn<sup>3</sup>, N. Bush<sup>3</sup>, C. Karr<sup>1</sup>, S. Sathyanarayana<sup>1</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>Institute for Systems Biology, Seattle, WA, <sup>3</sup>University of California, San Francisco, San Francisco, CA.

**Background/Aim:** Previous studies of air pollution and placental gene expression were small, candidate gene studies. Further, few considered prenatal windows of exposure and the role of offspring sex. We examined overall and sex-specific associations of prenatal maternal exposure to fine particulate matter (PM<sub>2.5</sub>) with genome-wide placental gene expression. **Methods:** Participants with placenta samples and childhood health outcomes from the CANDLE (Memphis, TN) (n=428) and GAPPS (Seattle, WA) (n=114) cohorts of the ECHO PATHWAYS Consortium were included. Exposures to PM<sub>2.5</sub> during trimesters 1, 2, 3, and the first and last months of pregnancy were estimated using a spatiotemporal model. Cohort-specific linear models were fit for each exposure window and individual gene expression (>11,000 coding genes) from paired end RNA sequencing data, adjusted for batch, age, race, offspring sex, season, calendar year of birth, gestational age, mode of delivery, presence/absence of labor, smoking, education, and pre-pregnancy obesity. Models with interaction terms were used to examine sex-specific associations. A false discovery rate (FDR<0.10) was used to correct for multiple testing. **Results:** Average maternal age and gestational age at delivery were 31-32 years and 38 weeks, respectively. In CANDLE, expression of 41 genes (including SCUBE2, PAEP, PGR, and DKK1) was associated with PM<sub>2.5</sub> in the first month of pregnancy while expression of YIPF5 was associated with PM<sub>2.5</sub> in the final month of pregnancy. In GAPPS, expression of NBPF9 and IGFBP1 was associated with PM<sub>2.5</sub> in the final month of the pregnancy. Offspring sex and third trimester PM<sub>2.5</sub> exposure interactions were observed for 29 genes (including ETNK2, CRIM1, and VPS35) in CANDLE and two genes (MARCO and HAPLN3) in GAPPS. **Conclusions:** We found evidence suggesting association between prenatal PM<sub>2.5</sub> exposure, particularly during early and late pregnancy, and placental gene expression (including genes involved in signaling and hormone metabolism). Child sex may modify the association.

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**P-0947**

**UFP exposure and biomarkers of exposure/effect on small airways in school children**

**Presenter:** Christine T Cowie, South Western Sydney Clinical School, UNSW; Ingham Institute of Applied Medical Research; Centre for Air pollution, energy and health Research (CAR); Woolcock Institute of Medical Research, University of Sydney, Liverpool, Australia

**Authors:** C. T. Cowie<sup>1</sup>, F. Salimi<sup>2</sup>, W. Ezz<sup>3</sup>, S. Clifford<sup>4</sup>, M. Mazaheri<sup>5</sup>, L. Morawska<sup>6</sup>, P. D. Robinson<sup>7</sup>, B. G. Toelle<sup>8</sup>, G. B. Marks<sup>1</sup>;

<sup>1</sup>South Western Sydney Clinical School, UNSW; Ingham Institute of Applied Medical Research; Centre for Air pollution, energy and health Research (CAR); Woolcock Institute of Medical Research, University of Sydney, Liverpool, AUSTRALIA, <sup>2</sup>University Centre for Rural Health-North Coast, School of Public Health, University of Sydney; Monash University, Melbourne, Australia, Sydney, AUSTRALIA, <sup>3</sup>Respiratory and Environmental Epidemiology, Woolcock Institute of Medical Research, University of Sydney; Central Clinical School, The University of Sydney, Sydney, AUSTRALIA, <sup>4</sup>London School of Hygiene and Tropical Medicine, London; Queensland University of Technology, Brisbane, Australia, London, UNITED KINGDOM, <sup>5</sup>Department of Planning, Industry and the Environment, Sydney; Centre for Air pollution, energy and health Research (CAR); South Western Sydney Clinical School, UNSW, Sydney, AUSTRALIA, <sup>6</sup>Queensland University of Technology; Centre for Air pollution, energy and health Research (CAR), Brisbane, AUSTRALIA, <sup>7</sup>The Children's Hospital at Westmead; Woolcock Institute of Medical Research, University of Sydney, Sydney, AUSTRALIA, <sup>8</sup>Woolcock Institute of Medical Research, University of Sydney; Sydney Local Health District, Sydney, AUSTRALIA.

**Background/Aim** Ultrafine particles (UFP) are of health concern due to their small size and ability to diffuse into the circulatory system once inhaled. However, epidemiological studies of adverse respiratory effects from UFP exposure are uncommon and evidence is varied. There is a scarcity of data on its effects on small airways. We aimed to study associations between UFP exposure and markers of small airways exposure/impacts in school children. **Methods** We used a time-integrated model for particle number count (PNC) (UFP indicator), which combined measurements at schools and modelled PNC at home using land use and time trends, to assign annual average daily exposure. We measured biomarkers of small airways exposure/impact: respiratory system resistance (Rrs); respiratory system reactance (Xrs); and lung clearance index (LCI); in 577 children recruited from 25 schools. We estimated the effect of exposure to PNC on these outcomes using Bayesian generalised linear mixed effects regression models. Analyses adjusted for potential confounders, using three models: 1) age, sex, height; 2) Model 1 plus BMI, home air conditioning, carpet, garage, gas cooking, gas heating; home flooded or with visible mould (<12 months); blood cotinine levels (ETS); 3) Model 2 plus PM<sub>2.5</sub> mass (24 h prior to clinical testing) and annual average daily NO<sub>2</sub> exposure. **Results** The PNC model explained 26% of the variability of PNC measured at the schools. No statistically significant associations were observed between PNC and LCI or Xrs. Protective statistically significant associations were observed for respiratory resistance in Models 1 and 2, but not 3. **Conclusions** These results do not demonstrate a detrimental effect of UFP on biomarkers of small airways exposure/impact, and the results for resistance (reflecting airway calibre) are counter-intuitive to expected. This might be due to the low predictive capacity of the exposure model, therefore improved exposure measures are needed in future studies.

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## ABSTRACT E-BOOK

Theme: **PM and children's health**

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**P-0949**

**Estimation of the relationship between symptoms related with respiratory diseases and exposure to particulate matter less than 2.5  $\mu\text{m}$  in students of two schools at Guachetá municipality of Cundinamarca, Colombia**

**Presenter:** Barbara J Saavedra Bayona, Universidad Santo Tomas, BOGOTÁ D.C, Colombia

**Authors:** B. J. Saavedra Bayona, A. F. Sepúlveda Villamil, R. J. Sierra Parada, L. C. Blanco Becerra; Universidad Santo Tomas, BOGOTÁ D.C, COLOMBIA.

Introduction: in Colombia, economic development models have favored the exploitation of natural resources such as coal, generating health effects on population who are living inside the influence area of the production process. Objective: to determinate the relationship between symptoms related with respiratory diseases and exposure to particulate matter less than 2.5  $\mu\text{m}$  (PM<sub>2.5</sub>) in students of two schools at Guachetá municipality of Cundinamarca, Colombia. Methods: a cross-sectional study was carried out in children between 4 and 17 years old, in two schools at Guachetá municipality of Colombia, where prevalence of symptoms related with respiratory diseases (dryness in the nostrils, difficulty breathing, cough and sneezing) were evaluated through an applied survey. Also, the survey asked about general data, family history, habits, perception of the environment and concern about possible health effects. Schools were located one near and the other far from open pit coal mines. For the collection of PM<sub>2.5</sub> data was used an AirBeam device. Measurements were made during 11 days, for 6 hours per day. Descriptive statistical analysis of interest variables were performed using the SPSS software, while an analysis association between variables was carried out using the EPIINFO software. Results: daily average concentration at schools were: El Carmen (8,1  $\mu\text{g}/\text{m}^3$  S.D:  $\pm$  1,61) and for Gonzalo Jiménez school (6,7  $\mu\text{g}/\text{m}^3$  S.D:  $\pm$  1,9). Prevalence of symptoms related with respiratory diseases was higher for cough (74,4%) and sneezing (71%). Students from Carmen departmental school are more likely to have symptoms associated with respiratory diseases, especially difficulty breathing (OR = 5,12 p = 0,0002) that those students of Gonzalo Jiménez school. Conclusion: Children who were studying at the closest school to the open-pit coal mines had a greater presence of all symptoms related to respiratory diseases than those located at the furthest school from the mines.

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## ABSTRACT E-BOOK

Theme: **PM and children's health**

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**P-0950**

**Ecologic association between ambient air pollutants and NICU admissions in Florida between 2012 and 2018**

**Presenter:** Kayan A Clarke, University of Florida, Gainesville, United States

**Authors:** K. A. Clarke, E. S. Coker;  
University of Florida, Gainesville, FL.

**Background/ Aim** Neonatal intensive care units (NICU) in hospitals care for newborns with medical conditions such as preterm or low birthweight. While the association between ambient air pollution and adverse birth outcomes are well-studied, associations with NICU admission are under-studied. Our study investigates the ecological associations between short-term ambient PM 2.5 and NICU admissions and will assess if associations varies by place-based social stressors.

**Methods** We conducted an ecological time-series analysis of electronic medical records (EMRs; n=1,019,253) for the state of Florida from January 1, 2012 to December 31, 2018. EMRs of births along with NICU admission were obtained from the OneFlorida Data Trust. Daily air pollutant average concentrations were obtained from the US EPA air monitoring database. We assigned daily Zip Code-level air pollution concentrations using inverse distance weighting. Socioeconomic indicators, greenspace, and maximum daily temperatures were used to control for time-invariant and time-variant spatial confounders. All variables were analyzed at the 5-digit zip code level. We used a multivariable zero-inflated Poisson regression model to test the ecologic association between PM 2.5 and NICU admissions with a random effect for metropolitan statistical area.

**Results** Of the 1,019,253 neonates in our study, 4.8% (n=48,616) were admitted to a NICU. Controlling for daily maximum ambient temperature, socioeconomic status, and greenspace, random effects regression models showed each standard deviation increase of PM<sub>2.5</sub> was significantly associated with a higher incidence rate ratio (IRR) for NICU admissions of  $IRR_{PM2.5}=1.01$  (95%CI=1.00, 1.02; p=0.004).

**Conclusion** NICU admissions were significantly associated with short-term concentrations of PM<sub>2.5</sub>. This ongoing analysis will explore multiple day-lags of air pollutant levels as well as interaction between each air pollutant and place-based social stressors.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0951**

### **Prospective investigation of urinary polycyclic aromatic hydrocarbon metabolites and mortality in the United States: National Health and Nutrition Examination Survey (NHANES) and National Death Index (NDI) Linkage (2001-2015)**

**Presenter:** Suril S. Mehta, Office of the Report on Carcinogens, Division of the National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, United States

**Authors:** S. S. Mehta<sup>1</sup>, A. P. Patel<sup>2</sup>, A. J. White<sup>3</sup>, W. D. Arroyave<sup>4</sup>, A. Wang<sup>1</sup>, R. M. Lunn<sup>1</sup>;

<sup>1</sup>Office of the Report on Carcinogens, Division of the National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC, <sup>2</sup>Department of Epidemiology, University of North Carolina, Chapel Hill, Chapel Hill, NC, <sup>3</sup>Epidemiology Branch, National Institute of Environmental Health Sciences, Research Triangle Park, NC, <sup>4</sup>Integrated Laboratory Systems, Morrisville, NC.

**Background:** Polycyclic aromatic hydrocarbons (PAHs) are widely detected chemicals in the U.S. population. Exposure to PAHs has been associated with adverse health outcomes including lung cancer and cardiovascular disease (CVD) though population-based studies examining mortality in relation to PAH exposure is sparse. We aimed to prospectively investigate the relationship of PAH biomarkers and all-cause, cancer-specific, and CVD-specific mortality in a representative sample of the U.S. population. **Methods:** The study population included 8,168 individuals  $\geq 20$  years old who participated in NHANES from 2001-2012. Urinary measures of eight hydroxylated PAH metabolites (OH-PAHs) from four parent compounds (naphthalene, pyrene, phenanthrene, fluorene) were assessed at baseline. Mortality status was ascertained by death certificates through data linkage with the NDI, followed-up until 2015. Survey-weighted Cox proportional hazards regression estimated adjusted hazards ratios (HR<sub>adj</sub>) and 95% confidence intervals (95%CI). We stratified by active smoking and environmental tobacco smoke (ETS) exposure, sex and race. **Results:** 912 deaths from all causes were observed over follow-up (mean=8.31 years). A log<sub>10</sub> increase in  $\Sigma$ OH-PAHs was associated with a higher all-cause (HR<sub>adj</sub>: 1.39 [95%CI: 1.21, 1.61]), CVD-specific (HR<sub>adj</sub>: 1.48 [95%CI: 0.93, 2.34]), and cancer-specific mortality (HR<sub>adj</sub>: 1.12 [95%CI: 0.76, 1.66]). Stratified models suggest the risk of  $\Sigma$ OH-PAHs and all-cause mortality was higher for active smokers or those exposed to ETS (HR<sub>adj</sub>: 1.92 [95%CI: 1.39, 2.65]), compared to nonsmokers. In cancer-specific analyses, an increased risk was observed in women (HR<sub>adj</sub>: 1.49 [95%CI: 1.01, 2.20]), but not men. Compared to other races/ethnicities, risk of CVD-related mortality was highest for non-Hispanic black participants (HR<sub>adj</sub>: 1.97 [95%CI: 0.79, 4.91]). **Discussion:** Urinary  $\Sigma$ OH-PAHs was associated with higher all-cause, cancer-specific, and CVD-specific mortality among a representative sample of U.S. adults. This prospective examination of PAH biomarkers, representing exposure across multiple sources, suggests a role for PAHs in both overall mortality and diseases with the highest mortality rates.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0952**

### **Ambient PM<sub>2.5</sub> Exposure and Mortality in U.S. End Stage Renal Disease Patients Receiving In-center Hemodialysis: 2008-2014**

**Presenter:** Yuzhi Xi, UNC Chapel Hill; ORISE at EPA, Chapel Hill, United States

**Authors:** Y. Xi<sup>1</sup>, D. B. Richardson<sup>2</sup>, A. V. Kshirsagar<sup>3</sup>, T. J. Wade<sup>4</sup>, L. Wyatt<sup>4</sup>, G. C. Peterson<sup>5</sup>, A. G. Rappold<sup>4</sup>;

<sup>1</sup>UNC Chapel Hill; ORISE at EPA, Chapel Hill, NC, <sup>2</sup>UNC Chapel Hill, Chapel Hill, NC, <sup>3</sup>UNC Kidney Center and Division of Nephrology and Hypertension, Chapel Hill, NC, <sup>4</sup>United States Environmental Protection Agency, Chapel Hill, NC, <sup>5</sup>ORISE at EPA, Chapel Hill, NC.

Background/Aim: Air pollution is recognized as a potentially modifiable health risk factor, particularly among susceptible populations. This study examines the effect of short-term exposure to fine particulate matter (PM<sub>2.5</sub>) among a potentially susceptible population, the end-stage renal disease (ESRD) patients receiving in-center hemodialysis (HD). Methods: A time-series analysis of the association between daily ambient PM<sub>2.5</sub> and daily mortality was conducted for 2008-2014 in 1,833 US counties with dialysis clinics. Using the United States Renal Data System, we identified ESRD patients who 1) had Medicare as primary payer, 2) survived first 3 months of HD, and 3) visited dialysis clinics within study counties before death. County-level daily ambient PM<sub>2.5</sub> was estimated with a prediction model that incorporates monitored observations, satellite aerosol optical depth, chemical transport model simulations, meteorology, land-use and other variables. We considered non-accidental all-cause deaths and assessed same-day and lagged effects. Rate ratios (RR) are expressed per 10 ug/m<sup>3</sup> increase in PM<sub>2.5</sub>. Additionally, we assess effect modification by pre-existing conditions, age, and time since dialysis to identify vulnerable patient groups within the cohort. Results: A total of 238,621 all-cause deaths were included in the analysis. The average county-level daily PM<sub>2.5</sub> concentration was 9.2 ug/m<sup>3</sup>. For all-cause mortality, an elevated but not significant same-day effect was estimated (RR= 1.005, 95%CI: 0.998-1.013), and elevated lagged-effects were estimated for 0-1, 0-2, and 0-3 lag-periods with RR=1.009 (1.001-1.018), RR=1.010 (1.001-1.019), and RR=1.010 (1.001-1.019), respectively. The results on effect modification will be available at the time of the conference. Conclusions: A 10 ug/m<sup>3</sup> increase in ambient PM<sub>2.5</sub> exposure was associated with 1% increase in daily mortality rate among HD patients 1-3 days following the exposure. This study highlights an elevated mortality risk for this population with relatively low ambient PM<sub>2.5</sub> concentrations. This abstract does not represent EPA policy.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

**P-0953**

### Long-term Exposure to Low Concentration of PM<sub>2.5</sub> and Mortality: A Danish Nurse Cohort Study

**Presenter:** Rina So, Section of Environmental Health, Department of Public Health, University of Copenhagen, Copenhagen, Denmark

**Authors:** R. So<sup>1</sup>, J. T. Jørgensen<sup>1</sup>, Y. Lim<sup>1</sup>, H. Amini<sup>1</sup>, A. Mehta<sup>2</sup>, L. H. Mortensen<sup>2</sup>, R. Westendorp<sup>2</sup>, M. Ketzel<sup>2</sup>, O. Hertel<sup>2</sup>, J. Brandt<sup>2</sup>, T. Sigsgaard<sup>3</sup>, E. V. Bräuner<sup>4</sup>, S. S. Jensen<sup>2</sup>, C. Backalarz<sup>5</sup>, J. E. Laursen<sup>5</sup>, M. K. Simonsen<sup>6</sup>, S. Loft<sup>1</sup>, Z. J. Andersen<sup>1</sup>;

<sup>1</sup>Section of Environmental Health, Department of Public Health, University of Copenhagen, Copenhagen, DENMARK, <sup>2</sup>Department of Environmental Science, Aarhus University, Roskilde, DENMARK, <sup>3</sup>Institute of Environmental and Occupational Medicine, Department of Public Health, Aarhus University, Aarhus, DENMARK, <sup>4</sup>Juliane Marie Center, Department of Growth and Reproduction, Capital Region of Denmark, Rigshospitalet, Copenhagen, DENMARK, <sup>5</sup>DELTA Acoustics, Hørsholm, DENMARK, <sup>6</sup>Diakonissestiftelsen, Frederiksberg, DENMARK.

**Background/Aim.** The association between air pollution and mortality is well established, yet studies in areas with low levels of air pollution, below EU limit values, with adjustment for road traffic noise, are sparse. We examined the association of long-term exposure to fine particulate matter (PM<sub>2.5</sub>) with mortality due to cardiovascular disease (CVD), respiratory disease (RD), and diabetes as well as all-cause natural mortality. **Methods.** We used data on 24,541 female nurses from the Danish Nurse Cohort who, at recruitment in 1993 or 1999, reported information on risk factors. Data on death were obtained from the Danish Register of Causes of Death until the end of 2013. Annual mean concentrations of PM<sub>2.5</sub> in 1990-2013 at the nurses' residences were estimated using the Danish air pollution dispersion modeling system. We examined associations between the 3-year running mean of PM<sub>2.5</sub> with all-cause natural and cause-specific mortality by using time-varying Cox Regression models, adjusting for individual characteristics. **Results.** During the study time-period, 3,708 nurses died, and of these, 843 were due to CVD, 310 due to RD, and 64 due to diabetes. The mean level of PM<sub>2.5</sub> at the baseline was 20.5 µg/m<sup>3</sup>. In the fully adjusted models, including road traffic noise, we found positive associations of 3-year running mean of PM<sub>2.5</sub> with all-cause natural (hazard ratio; 95% confidence interval: 1.06; 1.01-1.11), CVD (1.14; 1.03-1.26), and diabetes mortality (1.41; 1.05-1.90), per interquartile range of 4.39 µg/m<sup>3</sup>. In subjects exposed to low levels of PM<sub>2.5</sub> (< 20 µg/m<sup>3</sup>), we found even stronger association with all-cause natural (1.19; 1.11-1.27), CVD (1.27; 1.01-1.46), RD (1.27; 1.00-1.60), and diabetes mortality (1.44; 0.83-2.48). **Conclusion.** In a Danish cohort of female nurses, long-term exposures to low-levels of PM<sub>2.5</sub> were associated with all-cause mortality, strongest for diabetes, and CVD, which persisted at the levels below the current EU limit values.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0954**

### **The relationship between black carbon and polycyclic aromatic hydrocarbon exposures and mortality in Allegheny County, Pennsylvania**

**Presenter:** Rebecca J Warren, Colorado State University, Fort Collins, United States

**Authors:** R. J. Warren;  
Colorado State University, Fort Collins, CO.

**Background:** Black carbon (BC) and polycyclic aromatic hydrocarbons (PAHs) are major components of fine particulate matter (PM<sub>2.5</sub>) that are associated with adverse health outcomes. However, little work has examined the effects of PM constituents on mortality risk.

**Methods:** Our multiple regression analysis estimated the effect of neighborhood-level ambient PM<sub>2.5</sub>, BC, and PAHs exposure on mortality in Allegheny County, PA. Utilizing local-scale land use regression models of these pollutant exposures, we estimated the potential effects on five-year census tract-level age-adjusted non-accidental, cardiopulmonary, cancer, and other mortality rates. Models were adjusted for age, percent of non-White residents, percent of residents ages  $\geq 25$  with less than a high school diploma, and percent of residents ages  $\geq 18$  with health insurance.

**Results:** Pollutant exposures were not consistently related to all types of mortality in the adjusted models. Only one adjusted model had an effect estimate that did not span the null, although the relationship was opposite our hypothesis. An interquartile range (0.25  $\mu\text{g}/\text{m}^3$ ) increase in BC concentration was associated with a 5.9% (95% CI: -11.07, -0.36%) decrease in log-transformed cancer mortality. However, in all mortality categories, education and health insurance covariates had a robust relationship with outcomes. In the adjusted BC model, a 1-point increase in the percentage of the population without a high school diploma was associated with a 2.3% (95% CI: 1.50, 3.01%) increase in log-transformed cancer mortality; a 1-point increase in the percentage of the population with health insurance was associated with a 2.1% (95% CI: -2.95, -1.26%) decrease in log-transformed cancer mortality.

**Conclusions:** We did not find a consistent relationship between PM<sub>2.5</sub>, BC, and PAH and age-adjusted mortality rates in Allegheny County, PA. However, we did find that having health insurance and having a high school diploma was associated with lower mortality risk.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0955**

**Lung cancer mortality associated with PM<sub>2.5</sub> in China: a national study based on county level**

**Presenter:** Ning Wang, QUT, Brisbane, Australia

**Authors:** N. Wang<sup>1</sup>, K. Mengersen<sup>1</sup>, S. Tong<sup>1</sup>, M. Kimlin<sup>1</sup>, M. Zhou<sup>2</sup>, Y. Liu<sup>3</sup>, W. Hu<sup>1</sup>;

<sup>1</sup>QUT, Brisbane, AUSTRALIA, <sup>2</sup>Chinese Center for Diseases Control and Prevention, Beijing, CHINA,

<sup>3</sup>Emory University, Atlanta, GA.

**Background:** The relative risk (RR) of PM<sub>2.5</sub> in lung cancer mortality (LCM) may vary spatially in China. However, previous studies applying global regression model have been unable to capture such variation. The research aimed to employ a geographically weighted Poisson regression (GWPR) model to estimate the county-specific RRs of LCM among the elderly (≥65 years) related to PM<sub>2.5</sub> and predict LCM in China. **Methods:** We obtained LCM data between 2013 and 2015 from the Chinese National Death Surveillance. We linked annual mean concentrations of PM<sub>2.5</sub> between 2000 and 2004 with LCM using GWPR model at the county level, after adjusting for smoking and socioeconomic covariates. County-specific coefficients from GWPR were used to predict LCM under different scenarios of PM<sub>2.5</sub> concentration according to the WHO Air Quality Guidelines. **Results:** The magnitude of the association between PM<sub>2.5</sub> and LCM varied with county. The medians of county-specific RRs of LCM among elderly men and women were 1.52 (range: 0.90, 2.40) and 1.49 (range: 0.88, 2.56) for each 10µg/m<sup>3</sup> increment in PM<sub>2.5</sub>, respectively. Higher RRs of PM<sub>2.5</sub> among elderly men were located at Southwest and South China, and higher RRs among elderly women were located at Northwest, Southwest, and South China. Our research estimated that around 411,201 (men: 269,389; women: 141,812) LCM among the elderly would be avoided in 2034, if PM<sub>2.5</sub> concentration met the WHO guideline (10µg/m<sup>3</sup>). **Conclusions:** The relative importance of PM<sub>2.5</sub> in LCM differed by county. The results could help the government design tailored and efficient interventions. Stringent PM<sub>2.5</sub> control is urgently needed to reduce LCM in China.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0956**

**Causal effects of air pollution on mortality in Massachusetts**

**Presenter:** Yaguang Wei, Harvard University, Boston, United States

**Authors:** Y. Wei<sup>1</sup>, Y. Wang<sup>1</sup>, X. Wu<sup>1</sup>, Q. Di<sup>2</sup>, L. Shi<sup>3</sup>, P. Koutrakis<sup>1</sup>, A. Zanobetti<sup>1</sup>, F. Dominici<sup>1</sup>, J. D. Schwartz<sup>1</sup>;

<sup>1</sup>Harvard University, Boston, MA, <sup>2</sup>Tsinghua University, Beijing, CHINA, <sup>3</sup>Emory University, Atlanta, GA.

**Background:** Epidemiologic studies of air pollution and mortality have primarily investigated long- and short-term exposures separately, have used multiplicative models, and have been associational studies. **Methods:** We analyzed 1.5 million Medicare beneficiaries living in Massachusetts with 3.9 billion person-days of follow-up during 2000-2012. We implemented a generalized propensity score adjustment approach, which accounted for joint confounding by the concurrent exposures, individual- and area-level covariates, meteorological covariates, seasonal variations, and long-term time trend, to evaluate causal effects of long- (one-year moving average) and short-term (two-day moving average) exposures to PM<sub>2.5</sub>, O<sub>3</sub>, and NO<sub>2</sub> on all-cause mortality. By modeling the binary outcome of death with linear probability model, we estimated the potential number of deaths that would occur per unit increase in each air pollutant exposure. **Results:** We found that long- and short-term PM<sub>2.5</sub>, O<sub>3</sub>, and NO<sub>2</sub> were all associated with an increased risk of mortality. Specifically, per 10 million person-days, each 1 µg·m<sup>-3</sup> increase in long- and short-term PM<sub>2.5</sub> were associated with 35.4 (95% confidence interval [CI], 33.4-37.6) and 3.04 (95% CI, 2.17-3.94) excess deaths, respectively; each 1 ppb increase in long- and short-term O<sub>3</sub> were associated with 2.35 (95% CI, 1.08-3.61) and 2.41 (95% CI, 1.81-2.91) excess deaths, respectively; and each 1 ppb increase in long- and short-term NO<sub>2</sub> were associated with 3.24 (95% CI, 2.75-3.77) and 5.60 (95% CI, 5.24-5.98) excess deaths, respectively. Importantly, risk differences associated with long-term effects of PM<sub>2.5</sub> and O<sub>3</sub> increased substantially when the exposure levels went below the increasingly stringent thresholds, including those well below the current National Ambient Air Quality Standards (NAAQS). **Conclusions:** The findings suggest that air pollution exposures were causally associated with mortality, even at levels below NAAQS. The estimates on additive probability scale provide clearer insights into the relative magnitude of air pollution effects.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0957**

**Health impacts of air pollution in 1027 European urban areas: identification of cities with the highest and lowest preventable mortality burdens.**

**Presenter:** Sasha Khomenko, Barcelona Institute for Global Health (ISGlobal), Barcelona, Spain

**Authors:** S. Khomenko<sup>1</sup>, M. Cirach<sup>1</sup>, E. Pereira<sup>1</sup>, N. Mueller<sup>1</sup>, J. Barrera-Gómez<sup>1</sup>, K. de Hoogh<sup>2</sup>, G. Hoek<sup>3</sup>, M. Nieuwenhuijsen<sup>1</sup>;

<sup>1</sup>Barcelona Institute for Global Health (ISGlobal), Barcelona, SPAIN, <sup>2</sup>Swiss Tropical and Public Health Institute, Basel, SWITZERLAND, <sup>3</sup>Utrecht University, Utrecht, NETHERLANDS.

Most of the health impacts of air pollution (AP) estimates are calculated on global, regional or country levels, evidencing the need for local estimates relevant for policy action. To address this gap, we estimated the premature mortality burden preventable upon the achievement of the WHO recommended and lowest measured AP levels in 1027 urban areas across 31 European countries, and identified the cities with the highest and lowest mortality impacts associated with AP exposure. We retrieved the data for defining cities from the Urban Audit 2018 and identified 978 cities and 49 greater cities based on the OECD-EC city definition. We conducted the Health Impact Assessment (HIA) at the 250m grid cell level ( $n = 1,135,485$ ) for the reference year 2015. The analysis estimated the impact of AP exposure (PM<sub>2.5</sub> and NO<sub>2</sub>) on natural-cause mortality for the urban adult population  $\geq 20$  years old ( $n = 168,180,047$ ). Cities were clustered based on the mortality burden associated with AP exposure. Compliance with WHO AP guidelines was estimated to prevent more than 50,000 deaths for the PM<sub>2.5</sub> exposure and almost 1000 deaths for the NO<sub>2</sub> exposure. The reduction of AP to the lowest measured levels was estimated to prevent more than 120,000 deaths for the PM<sub>2.5</sub> exposure and 80,000 deaths for the NO<sub>2</sub> exposure. The cluster with the highest PM<sub>2.5</sub> mortality impacts included Italian cities in the Po-Valley and cities in Poland and Czech Republic. The cluster with the highest mortality impacts due to NO<sub>2</sub> exposure included the bigger and capital cities (i.e. Madrid, Antwerpen, Paris, Torino, Milano and Barcelona). Our results reflect the main factors influencing AP levels across European cities, including stagnant meteorological conditions, domestic fuel burning, diesel car use and high traffic levels, and indicate policy actions needed to reduce AP and its adverse health impacts across European cities.

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Theme: **PM and mortality**

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**P-0958**

**Improvements in ambient PM<sub>2.5</sub> exposure was associated with reduced risk of mortality in adults: a longitudinal study**

**Presenter:** Xiang Qian Lao, the Chinese University of Hong Kong, Hong Kong, Hong Kong

**Authors:** X. Lao, Y. Bo, C. Guo;  
the Chinese University of Hong Kong, Hong Kong, HONG KONG.

Background: Previous epidemiological studies show that long-term exposure to fine particulate air pollution (PM<sub>2.5</sub>) may increase the risk of mortality. However, evidences concerning the effect of air quality improvements on mortality is scarce. It is crucial to document whether past efforts to reduce air pollution have yielded demonstrable improvements in public health and to better predict whether future efforts will continue to do so. We therefore investigated the relationship of reduction in exposure to long-term ambient PM<sub>2.5</sub> with the risk of overall and cause-specific mortality. Methods: We recruited 374,319 Taiwanese adults (aged 18 years or older) who joined a standard medical screening programme between 2001 and 2016. Each participant received at least one medical examination and was followed up till 2019. Vital statuses were obtained from National Death Registry System in Taiwan. PM<sub>2.5</sub> concentrations were estimated using a satellite-based spatio-temporal model. The change in PM<sub>2.5</sub> ( $\Delta$ PM<sub>2.5</sub>) was defined as the difference between the values measured during follow-up and during the immediately preceding medical examination. The time-varying Cox model was used to investigate the effects of  $\Delta$ PM<sub>2.5</sub> on the risk of mortality. Result: The PM<sub>2.5</sub> concentration in Taiwan increased during 2002-2004 and began to decrease in 2005. Every 5- $\mu$ g/m<sup>3</sup> decrease in the ambient PM<sub>2.5</sub> (i.e.,  $\Delta$ PM<sub>2.5</sub> of 5  $\mu$ g/m<sup>3</sup>) was associated with a decrease of 64% (95% CI: 64%-65%), 65% (64%-66%), 60% (58%-62%), 62% (59%-64%), 62% (57%-66%), 54% (50%-58%), and 62% (61%-63%) in the risk of mortality from all-cause, cancer, cardiovascular, cerebrovascular, chronic lower respiratory, influenza/pneumonia, and other or unknown disease, respectively. The stratified and sensitivity analyses generally yielded similar results. Conclusion: An improvement in PM<sub>2.5</sub> air quality is associated with a decreased risk of mortality. Our findings provided demonstrable evidences for air quality control and public health interventions both in Taiwan and worldwide.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0959**

### **Short- and Long-term Exposure to Nitrogen Dioxide and Mortality: A Systematic Review and Meta-Analysis**

**Presenter:** Shiwen Huang, Rollins School of Public Health, Emory University, Atlanta, United States

**Authors:** M. Wang<sup>1</sup>, H. Li<sup>1</sup>, S. Huang<sup>1</sup>, M. Xu<sup>1</sup>, Y. Liu<sup>1</sup>, H. Chang<sup>1</sup>, S. Papatheodorou<sup>2</sup>, L. Shi<sup>1</sup>;  
<sup>1</sup>Rollins School of Public Health, Emory University, Atlanta, GA, <sup>2</sup>Harvard T.H Chan School of Public Health, Boston, MA.

**Abstract**Background. Air pollution is a major public health concern. There has been growing interest in the health effects of traffic-related air pollution, in particular nitrogen dioxide (NO<sub>2</sub>).Methods. We conducted a systematic search for studies that were published from January 1, 2000 through January 1, 2020 and performed a meta-analysis of all available epidemiology studies that evaluated the associations of short- and long-term exposure to NO<sub>2</sub> with mortality. Pooled effect estimates and 95% confidence intervals were calculated using random-effects models.Results. Meta-analysis of effect estimates suggested significant associations between short- and long-term exposure to NO<sub>2</sub> and all-cause, cardiovascular, and respiratory mortality, with evidence of substantial between-study heterogeneity.Conclusion. Evidence on adverse health effects of both short- and long-term exposure to NO<sub>2</sub> is consistent.Keywords Nitrogen dioxide; Air pollution; Mortality; Meta-analysis; Systematic review

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**P-0961**

**Long-term exposure to PM<sub>2.5</sub> and risk of mortality for older population in North Carolina and Michigan**

**Presenter:** Ji-Young Son, Yale University, New Haven, United States

**Authors:** J. Son<sup>1</sup>, K. Lane<sup>2</sup>, B. Sabath<sup>3</sup>, M. Miranda<sup>4</sup>, F. Dominici<sup>3</sup>, M. L. Bell<sup>1</sup>;

<sup>1</sup>Yale University, New Haven, CT, <sup>2</sup>Boston University, Boston, MA, <sup>3</sup>Harvard University, Boston, MA, <sup>4</sup>Rice University, Houston, TX.

**Background/Aim:** Many epidemiological studies have consistently reported positive associations between long-term exposure to fine particulate matter (PM<sub>2.5</sub>) and risk of mortality. However, research on which residential environmental and social factors modify the effect of long-term exposure to air pollution on mortality risk is limited. In this study, we evaluated residential greenness and several individual- and community-level factors as effect modifier for long-term exposure to PM<sub>2.5</sub> and risk of mortality. **Methods:** We used data from all Medicare beneficiaries in NC and MI (2001-2016). Annual averages of PM<sub>2.5</sub> were estimated using spatio-temporal prediction models to assign zip-code level exposures based on the residence for each enrollee. We estimated the risk of death associated with a 1 µg/m<sup>3</sup> increase in PM<sub>2.5</sub> using a Cox proportional hazards model that controlled for demographic characteristics, Medicaid eligibility, and area-level covariates. We assessed health disparities by residential greenness using the Normalized Difference Vegetation Index (NDVI) and several individual- and community-level factors (e.g., race, socioeconomic status, urbanicity). We considered combined disparities (e.g., race and SES, urban green vs. rural green) and compared regional characteristics, exposure levels and thus effect estimates between MI and NC.

**Results:** PM<sub>2.5</sub> exposure was significantly associated with increased risk of non-accidental mortality for NC and MI. The hazard ratio (HR) for death was 1.124 (95% confidence interval (CI) 1.117, 1.130) and 1.007 (95% CI 1.001, 1.013) for NC and MI, respectively. Our preliminary analysis showed that higher risk of PM<sub>2.5</sub> exposure on non-accidental mortality was associated with some factors such as residential greenness, urbanicity and socioeconomic status. The HR was higher in areas with less green space and in areas with lower SES, with different patterns of effects by urbanicity and region. **Conclusions:** Our findings indicate that the multiple aspects of disparity factors may affect disproportionate mortality burdens from air pollution exposures.

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Theme: **PM and mortality**

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**P-0962**

**Does physical activity exacerbate the air pollution risk of mortality? A longitudinal cohort study**

**Presenter:** Cui Guo, Chinese University of Hong Kong, Shatn, Hong Kong

**Authors:** C. Guo, X. Lao, Y. Bo;  
Chinese University of Hong Kong, Shatn, HONG KONG.

### Background

Physical inactivity and air pollution are two major public health challenges worldwide. Given that physical activity (PA) increases ventilation rate, the increased intake of air pollutants may exacerbate the adverse health effects of air pollution. We investigated the combined effects of long-term exposure to fine particle matter (PM<sub>2.5</sub>) and PA on mortality in Taiwan.

### Methods

We included 384,130 adults (≥18 years) with 842,394 medical measurements from 2001 to 2016. The participants were then followed up until May 31, 2019. The vital data was from the National Death Registry maintained by the Ministry of Health and Welfare in Taiwan. Ambient PM<sub>2.5</sub> exposure was estimated using a satellite-based spatiotemporal model. We used Cox regression model with time-dependent covariates to investigate the main and combined effects of PM<sub>2.5</sub> and PA on all-natural cause mortality.

### Results

We observed that the risk of death decreased 11% [hazard risk (HR) is 0.89 with a 95% confidence interval (CI) of 0.88–0.91] for each 10 MET-h increase in PA, while the risk increased 20% [HR (95%CI): 1.20 (1.15–1.25)] for each 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub>. We found that active participants had a slightly higher risk of death due to PM<sub>2.5</sub>, although the overall combined effects of PA and PM<sub>2.5</sub> were not significant [HR (95%CI) is 1.00 (0.98–1.02)].

### Conclusions

PA was associated with lower risk of mortality, whilst PM<sub>2.5</sub> was associated with a higher risk. PA may amplify detrimental effects of PM<sub>2.5</sub> during exercise. We suggest that people could exercise in highly polluted regions, but they should reduce air pollution exposure during exercise to minimise PM<sub>2.5</sub> effects.

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Theme: **PM and mortality**

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**P-0963**

### **Short-term Effects of Ambient Air Pollution ( PM<sub>2.5</sub>) on Daily Hospital Mortality in Addis Ababa, Ethiopia**

**Presenter:** Zelalem Tazu, Addis Ababa University, ADDIS ABABA, Ethiopia

**Authors:** A. Kumie, Z. Zelalem;  
Addis Ababa University, ADDIS ABABA, ETHIOPIA.

Short-term Effects of Ambient Air Pollution ( PM<sub>2.5</sub>) on Daily Hospital Mortality in Addis Ababa, Ethiopia  
Author List: Abera Kumie<sup>1</sup>, Alemayehu Worku<sup>1</sup>, Zelalem Tazu<sup>1</sup>, Worku Tefera<sup>1</sup>, Getu Boja<sup>1</sup>, Molla Mekashaw<sup>1</sup>, Solomon Teferra<sup>2</sup>, Jonathan Patz<sup>3</sup>, Jonathan Samet<sup>4</sup>, Kiros Berhane<sup>5</sup>

<sup>1</sup>Addis Ababa University (Ethiopia), <sup>2</sup>Air Quality Management District (USA), <sup>3</sup>University of Wisconsin–Madison (USA), <sup>4</sup>University of Colorado (USA), <sup>5</sup>University of Southern California (USA).

**Abstract Background:** The present study aimed to examine the associations between daily mortality rates and ambient air pollution (PM<sub>2.5</sub>) for hospital patients in Addis Ababa, Ethiopia. **Methods:** A daily count of admitted hospital patient mortality data linked with time-series study with PM<sub>2.5</sub> monitoring were obtained for the period of April 1<sup>st</sup> - March 31<sup>st</sup>, 2018 from six hospitals in Addis Ababa. PM<sub>2.5</sub> was measured using MetOne® Beta Attenuation (Model BAM 1022). We used Poisson regression analysis using generalized additive model (GAM) with smoothing function of daily mean temperature, and relative humidity each at 6 df; and cubic spline for time trends with 8 df obtained from the data. **Results:** A total of 959 deaths due to non-accidental cases were included in the study including 155 were cardiovascular, 78 - respiratory, while the remaining 726 are from other causes of deaths. The daily concentrations levels varied between 15-131 µg/ m<sup>3</sup>. The annual average concentration was 43.56 ± 14.72 µg/ m<sup>3</sup>. GAM adjusted only for the meteorological variables alone provided a significant air pollution impact at lag 4 on all-cause mortality, which can be interpreted as a 11.4% increase in mortality is associated with a 10 µg/ m<sup>3</sup> increase in PM<sub>2.5</sub>. Significant findings were observed when we stratify the data analyses by gender and age. **Conclusions:** There is an association between all cause and cause-specific mortality. There is an indication for long-term effect studies to produce policy informed interventions. **Keywords:** Air pollution, Concentration, Time-series Study, Poisson, Generalized Additive Model (GAM). **Funding Sources:** The study was generously supported by NIH Fogarty International/USA and IDRC of CANADA.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0964**

**Long-term effects of traffic-related air pollution on mortality in the Southeastern US**

**Presenter:** Qiulun Li, Rollins School of Public Health, Emory University, Atlanta, United States

**Authors:** L. Shi<sup>1</sup>, Q. Li<sup>1</sup>, Y. Qian<sup>1</sup>, Q. Di<sup>2</sup>, X. Wu<sup>3</sup>, S. Papatheodorou<sup>3</sup>, J. Schwartz<sup>3</sup>, A. Zanobetti<sup>3</sup>, Y. Liu<sup>1</sup>;  
<sup>1</sup>Rollins School of Public Health, Emory University, Atlanta, GA, <sup>2</sup>School of Medicine, Tsinghua University, Beijing, CHINA, <sup>3</sup>Harvard T.H. Chan School of Public Health, Boston, MA.

Background Mounting evidence has shown that the long-term exposure to fine particulate matter and ozone can increase mortality. However, the health effects associated with long-term exposure to nitrogen dioxide (NO<sub>2</sub>) are less clear. Methods We conducted a large population-based cohort study that included all Medicare beneficiaries (aged ≥65, N=15,646,962) in the Southeastern US from 2000-2016, with 124,019,974 person-years of follow-up. We applied previously estimated spatially- and temporally-resolved NO<sub>2</sub> concentrations and assigned annual means to study subjects based on ZIP code of residence. Cox proportional hazards models were used to examine the association between long-term exposure to NO<sub>2</sub> and all-cause mortality, adjusting for potential confounders. Results We observed a statistically significant association between long-term exposure to NO<sub>2</sub> and all-cause mortality, with a hazard ratio (HR) of 1.036 (95% CI: 1.029, 1.043) in two-pollutant models (adjusting for PM<sub>2.5</sub>) and a HR of 1.032 (95% CI: 1.021, 1.043) in multi-pollutant models (adjusting for PM<sub>2.5</sub> and ozone), per 10 ppb increase in annual NO<sub>2</sub> concentrations. The penalized spline indicates a linear dose-response relationship across the entire NO<sub>2</sub> exposure range. Subjects who are female, Black, Medicaid-eligible, and residing in urban areas are more vulnerable to long-term NO<sub>2</sub> exposure. Conclusion Using a large cohort, we provide epidemiological evidence that long-term exposure to NO<sub>2</sub> was significantly associated with a higher risk of mortality, independent of PM<sub>2.5</sub> and ozone. Improving air quality by reducing NO<sub>2</sub> emissions may yield substantial health benefits.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0965**

**Short-term effects of ambient particles on mortality in Italy - a national approach**

**Presenter:** Massimo Stafoggia, Department of Epidemiology, Lazio Region Health Service / ASL Roma 1, Rome, Italy

**Authors:** M. Stafoggia<sup>1</sup>, S. Marchetti<sup>2</sup>, M. Renzi<sup>1</sup>, M. Pappagallo<sup>2</sup>, F. K. de' Donato<sup>1</sup>, M. Davoli<sup>1</sup>, M. Scortichini<sup>1</sup>, L. Frova<sup>2</sup>, P. Michelozzi<sup>1</sup>;

<sup>1</sup>Department of Epidemiology, Lazio Region Health Service / ASL Roma 1, Rome, ITALY, <sup>2</sup>Italian National Institute of Statistics, Rome, ITALY.

**Background.** Short-term exposure to particulate matter (PM) has been related to mortality worldwide. Most evidence comes from studies conducted in major cities, while little is known on the effects of low concentrations of PM and in less urbanized areas. We aim to investigate the relationship between PM and all-cause mortality at national level in Italy. **Methods.** Daily numbers of all-cause mortality were collected for all 8,092 municipalities of Italy, from 2006 to 2015. A satellite-based spatiotemporal model was developed to estimate daily PM<sub>10</sub> (inhalable particles) and PM<sub>2.5</sub> (fine particles) concentrations at 1-km resolution. Multivariate Poisson regression models were fit to estimate the association between daily PM and mortality at province level, then results were pooled with a random-effects meta-analysis. Associations were estimated by age, sex and degree of urbanization of the municipalities. Flexible functions were estimated to explore the shape of the associations at low PM concentrations. **Results.** We analyzed 6,552,257 deaths (40% among subjects older than 85 years, 55% occurring outside the main urban areas). National daily mean (interquartile range) PM<sub>10</sub> and PM<sub>2.5</sub> concentrations were 23 (12) µg/m<sup>3</sup> and 17 (9) µg/m<sup>3</sup>, respectively. Relative increases of mortality, per 10 µg/m<sup>3</sup> variation in lag 0-5 (average of last six days since death) PM<sub>10</sub> and PM<sub>2.5</sub>, were 0.80% (95% Confidence Intervals [CI]: 0.58%, 1.01%) and 0.72% (0.34%, 1.09%) respectively. Associations were highest among elderly and women, similar between rural and urbanized areas, and were present even at low concentrations, e.g. below WHO guidelines. **Conclusions.** Air pollution was robustly associated with peaks in daily all-cause mortality in Italy, both in large cities and in less urbanized areas of Italy. Current WHO Air Quality Guidelines for PM<sub>10</sub> and PM<sub>2.5</sub> are not sufficient to protect public health.

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Theme: **PM and mortality**

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**P-0966**

**Spatial and temporal trends in the mortality burden of ozone pollution in China: 2005-2017**

**Presenter:** Jiongchao Ding, Emory University, Atlanta, United States

**Authors:** J. Ding<sup>1</sup>, M. Liu<sup>2</sup>, Z. Ma<sup>2</sup>, R. Liu<sup>2</sup>, J. Bi<sup>2</sup>;

<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Nanjing University, Nanjing, CHINA.

**Introduction:** While recent assessments have quantified the burden of ozone pollution at the national scale in China, air quality managers would benefit from assessments that disaggregate health impacts over regions and over time. Taking advantage of a new daily maximum 8-hour averaged (MDA8) ozone concentration dataset, we analyze spatial and temporal trends of ozone-related mortality burden in China from 2005 to 2017. **Methods:** Population weighted exposure (PWE) was calculated by overlapping ozone concentrations and population maps. MDA8 ozone concentrations at 10 km resolution from 2005-2017 were from a nationwide prediction model that was based on the XGBoost algorithm and trained by MDA8 ozone observations from 2013 to 2017 combining with concurrent meteorological parameters and land use data. Population data are from Landscan Global Population Database. Using non-accidental total (NAT) deaths as target outcomes, we further calculated the excess deaths by applying exposure response functions from 272 Chinese cities. **Results and Discussion:** During 2005-2017, MDA8 ozone PWE fluctuated from 87.2  $\mu\text{g}/\text{m}^3$  to 92.2  $\mu\text{g}/\text{m}^3$ , with no obvious upward or downward trends. National PWE are higher than the national average ozone concentration, indicating that the overlap of dense population areas and heavy polluted areas aggravated the mortality burdens. National ozone related NAT deaths increased from approximately 145,000 (95% confidence interval (CI): 70,000-213,000) cases in 2005 to 167,000 (95% CI: 80,000-245,000) cases in 2017. The mortality burden exhibited strong spatial variations, with high excess deaths concentrated in Beijing-Tianjin Metropolitan Region, North China Plain, Yangtze River Delta, Pearl River Delta, Sichuan Basin, Wuhan Metropolitan Region, and Changsha-Zhuzhou-Xiangtan. Hotspots of mortality burden have not expanded significantly over time, that is to say, the regions with heavy mortality burdens appear to be the ones with rapid growth. This undoubtedly makes the health risk of ozone in these areas more severe.

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**P-0967**

**Daily mortality associated with short-term PM<sub>2.5</sub> exposures in Delhi, India**

**Presenter:** Bhargav Krishna, Harvard TH Chan School of Public Health, Boston, United States

**Authors:** B. Krishna<sup>1</sup>, S. Mandal<sup>2</sup>, D. Prabhakaran<sup>2</sup>, K. Reddy<sup>3</sup>, J. D. Schwartz<sup>1</sup>;

<sup>1</sup>Harvard TH Chan School of Public Health, Boston, MA, <sup>2</sup>Centre for Chronic Disease Control, Delhi, INDIA,

<sup>3</sup>Public Health Foundation of India, Gurgaon, INDIA.

Daily mortality associated with short-term PM<sub>2.5</sub> exposures in Delhi, India

**INTRODUCTION:** Ambient PM<sub>2.5</sub> levels in Delhi routinely exceed World Health Organization (WHO) guidelines and Indian National Ambient Air Quality Standards (NAAQS) for safe levels of daily exposure (1). While a number of studies are currently underway to examine the association of chronic exposures to respiratory and cardiovascular outcomes (2-4), only two have examined the short-term effects of exposure to high levels of PM on mortality in Delhi, and none with PM<sub>2.5</sub> as the exposure of interest (5,6). **AIM:** We aimed to analyse the association between short-term PM<sub>2.5</sub> exposures and all-cause mortality in Delhi, India.

**METHODS:** Using generalized additive poisson regression models, we examined the association between 2-day moving average PM<sub>2.5</sub> exposures against all-cause mortality data in the period between June 2010 and December 2016. Daily exposures to PM<sub>2.5</sub> are estimated using an ensemble averaging technique developed by our research group, and mortality data were obtained from the Municipal Corporations of Delhi (North, East and South), and the New Delhi Municipal Council, altogether comprising 97-99% of all deaths recorded in Delhi each year during that time period.

**RESULTS:** Median 2-day moving average exposure to PM<sub>2.5</sub> were 91.2 µg/m<sup>3</sup> (IQR: 70.4, 127.8), with minimum and maximum exposures of 27.3 µg/m<sup>3</sup> and 637 µg/m<sup>3</sup> respectively. 948,440 deaths were recorded in Delhi during the stated time period. Each 25 µg/m<sup>3</sup> increment in exposure was associated with a 0.3% (95% CI: 0.03, 0.7%) increase in all-cause mortality. The dose-response relationship was non-linear in nature, with relative risk tapering off above 500 µg/m<sup>3</sup>.

**CONCLUSION:** This study adds to the growing body of local evidence on air pollution and health, with implications for short-term and long-term policy to mitigate exposures in a megacity that is home to over 18 million.

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Theme: **PM and mortality**

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**P-0968**

**Fine particulate matter composition and mortality: a multi-country multi-city analysis**

**Presenter:** Francesco Sera, London School of Hygiene and Tropical Medicine, London, United Kingdom

**Authors:** F. Sera<sup>1</sup>, H. Kan<sup>2</sup>, C. Liu<sup>2</sup>, A. Vicedo-Cabrera<sup>3</sup>, E. Lavigne<sup>4</sup>, A. Gasparri<sup>1</sup>;

<sup>1</sup>London School of Hygiene and Tropical Medicine, London, UNITED KINGDOM, <sup>2</sup>School of Public Health, Fudan University, Shanghai, CHINA, <sup>3</sup>Institute of Social and Preventive Medicine (ISPM), University of Bern, Bern, SWITZERLAND, <sup>4</sup>School of Epidemiology and Public Health, University of Ottawa, Ottawa, ON, CANADA.

**Background/Aim:** Literature suggests that inter-regional variation in short-term associations between fine particulate air pollution (PM<sub>2.5</sub>) and mortality can be attributed to differences in particulate composition. However, empirical evidence is still limited. In this contribution, we used data from a multi-country study to evaluate how the associated short-term mortality risks varied depending on the average composition of PM<sub>2.5</sub>. **Methods:** We collected mortality, PM<sub>2.5</sub>, and weather data for 280 cities within 19 countries in 1985-2015 from the MCC Collaborative Research Network. Average composition of the PM<sub>2.5</sub> fractions, namely black carbon (BC); sulfate (SO<sub>4</sub><sup>2-</sup>); ammonium (NH<sub>4</sub><sup>+</sup>); nitrate (NO<sub>3</sub><sup>-</sup>); organic matter (OM); sea salt (SS); and mineral dust (DUST), were obtained from the Atmospheric Composition Analysis Group. We applied a two-stage time-series analytic approach. First, for each city we modelled the linear associations of two-day moving average PM<sub>2.5</sub> with total mortality using quasi-Poisson regression and distributed lag models. Second, we used multilevel meta-regression models to pool the city-specific estimates and evaluate the effect modification of each component. **Results:** In preliminary analyses, the percentage excess risk for mortality associated with a 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub> concentration was 0.57% (95%CI:0.26% to 0.87%) on average. We found significant increases in the mortality risk for an (interquartile range) IQR increase in the components for BC (0.24% to 0.51%, p<0.001) and NH<sub>4</sub><sup>+</sup> (0.04% to 0.43%, p=0.016), while cities with a higher percentage of sea salt have a lower percent mortality change (0.34% to 0.10%, p<0.001). **Conclusion:** This represents the largest study assessing effect modification in short-term mortality risks by composition of PM<sub>2.5</sub>, performed by comparing different populations across the world. Preliminary findings suggest that larger PM-mortality risks are linked to anthropogenic sources of fine particulate matter. Further steps will consider multi-components models to disentangle the effect of each component. On behalf of the MCC Collaborative Research Network

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Theme: **PM and mortality**

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**P-0969**

### **Association between long-term exposure to outdoor black carbon and mortality in the French Gazel Cohort**

**Presenter:** Emeline Lequy, CRCHUM, Montreal, Canada

**Authors:** E. Lequy<sup>1</sup>, J. Yang<sup>2</sup>, D. Vienneau<sup>3</sup>, K. de Hoogh<sup>3</sup>, M. Sakhvidi<sup>2</sup>, M. Zins<sup>4</sup>, J. Siemiatycki<sup>1</sup>, M. Goldberg<sup>4</sup>, B. Jacquemin<sup>2</sup>;

<sup>1</sup>CRCHUM, Montreal, QC, CANADA, <sup>2</sup>Inserm - Irset, Rennes, FRANCE, <sup>3</sup>Swiss Tropical and Public Health Institute, Basel, SWITZERLAND, <sup>4</sup>Inserm - UMS 011, Villejuif, FRANCE.

Background: Fine particulate matter (PM<sub>2.5</sub>) is associated with mortality, and recent evidence identified black carbon (BC) as one component of PM<sub>2.5</sub> that may at least partly explain the health effects. Yet, this remains poorly documented. This study aimed to examine the association between long-term exposure to BC and mortality in a population-based French cohort. Methods: We used data from the Gazel cohort collected between 1989-2015, including geocoded residential address history. We used land use regression models with temporal extrapolation to estimate the exposure to BC and PM<sub>2.5</sub> for 19,850 participants. We used extended Cox models with attained age as time-scale and time-varying average exposure to BC, adjusted for relevant covariates including sex, smoking status and cumulative pack-years, and including a 10-year lag, to estimate the association between long-term exposure to BC and all-cause and cardiovascular mortality. To handle confounding by PM<sub>2.5</sub>, we regressed BC against PM<sub>2.5</sub> and used the residuals as the exposure variable in a sensitivity analysis. Separate analyses by sex and smoking status were also done to examine effect modification for all-cause mortality. Results: The median long-term BC exposure was 2.34 10<sup>-5</sup>/m (inter-quartile range (IQR): 1.09). We found a significant association between BC and all-cause mortality (n=1794) using long-term average BC and residuals, with respective hazard ratios (HR) of 1.10 (95%CI: 1.04-1.17) and 1.19 (1.11-1.26) per IQR increase. We found a similar association between BC and cardiovascular mortality (n=271) with a HR of 1.15 (0.99-1.35). The association with all-cause mortality slightly varied across population subsets with HRs of 1.10 (1.03-1.18) and 1.09 (0.96-1.24) for men and women, and 1.10 (0.97-1.25) and 1.14 (1.07-1.23) for never- and ever-smokers, respectively. Conclusions: We found positive associations between long-term exposure to BC and increased mortality, reinforcing the emerging evidence that BC is a harmful component of PM.

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Theme: **PM and mortality**

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**P-0971**

**Understanding the joint impacts of fine particulate matter concentration and composition on the incidence and mortality of cardiovascular disease: a component-adjusted approach**

**Presenter:** Hong Chen, Health Canada, Ottawa, Canada

**Authors:** H. Chen<sup>1</sup>, Z. Zhang<sup>2</sup>, A. van Donkelaar<sup>3</sup>, L. Bai<sup>4</sup>, R. Martin<sup>5</sup>, E. Lavigne<sup>1</sup>, J. C. Kwong<sup>4</sup>, R. T. Burnett<sup>1</sup>;

<sup>1</sup>Health Canada, Ottawa, ON, CANADA, <sup>2</sup>Public Health Ontario, Toronto, ON, CANADA, <sup>3</sup>Dalhousie University, Halifax, NS, CANADA, <sup>4</sup>ICES, Toronto, ON, CANADA, <sup>5</sup>Washington University, St. Louis, MO.

Background: Past health impact assessments of ambient fine particles (PM<sub>2.5</sub>) have generally considered mass concentration only, despite PM<sub>2.5</sub> is a heterogeneous mixture. Given constant changes in the concentration and the composition of atmospheric aerosol, uncertainty exists as to whether the current focus on PM<sub>2.5</sub> mass or individual components may fully characterize the health burden of PM<sub>2.5</sub>. Methods: We proposed a component-adjusted method that jointly estimates the health impacts of PM<sub>2.5</sub> and its major components while allowing for a potential nonlinear PM<sub>2.5</sub>-outcome relationship. Using this method, we quantified the effects of PM<sub>2.5</sub> on the risks of developing acute myocardial infarction (AMI) and dying from cardiovascular causes in comparison to three traditional approaches in the entire adult population across Ontario, Canada. Results: We observed that PM<sub>2.5</sub> was positively associated with AMI incidence and cardiovascular mortality with all four methods. Comparing to the traditional approaches, however, the new component-adjusted approach demonstrated a significant improvement in explaining the health impacts of PM<sub>2.5</sub>, especially in the presence of a nonlinear PM<sub>2.5</sub>-outcome relationship. Using the new approach, we found that the effects of PM<sub>2.5</sub> on AMI incidence and cardiovascular mortality may be 10% to 27% higher than what would be estimated from the conventional approaches examining PM<sub>2.5</sub> alone. Conclusions: We showed that future research on the health effects of PM<sub>2.5</sub> could benefit from integrating information about the relative distributions of major components into health risk assessments. The new approach we proposed can provide superior predictive power and a refined understanding of the health effects of PM<sub>2.5</sub> compared with a range of alternative modeling approaches.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0972**

**Ambient Carbon Monoxide and Daily Mortality: A Global Time-Series Study in 337 cities**

**Presenter:** Kai Chen, Yale School of Public Health, New Haven, United States

**Authors:** K. Chen<sup>1</sup>, S. Breitner<sup>2</sup>, K. Wolf<sup>2</sup>, M. Stafoggia<sup>3</sup>, F. Sera<sup>4</sup>, A. M. Vicedo-Cabrera<sup>5</sup>, A. Gasparrini<sup>4</sup>, A. Schneider<sup>2</sup>;

<sup>1</sup>Yale School of Public Health, New Haven, CT, <sup>2</sup>Helmholtz Zentrum München–German Research Center for Environmental Health, Neuherberg, GERMANY, <sup>3</sup>Lazio Regional Health Service, Rome, ITALY, <sup>4</sup>London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM, <sup>5</sup>Institute of Social and Preventive Medicine, and Oeschger Center for Climate Change Research, University of Bern, Bern, SWITZERLAND.

Background Epidemiological evidence on the short-term association between ambient carbon monoxide (CO) and mortality is inconclusive and limited to single cities, regions, or countries. Generalization of results from previous studies is challenged by potential publication bias and different modeling approaches. We, therefore, assessed the associations between short-term exposure to CO and daily mortality in a multi-city multi-country setting.

Methods We collected daily data on air pollution, meteorology, and total mortality from 337 cities in 18 countries from the Multi-Country Multi-City Collaborative Research Network. We first estimated city-specific associations using confounder-adjusted generalized additive models with a quasi-Poisson distribution; then, we pooled the estimates using a random-effects multilevel meta-analytical model. We also assessed the overall shape of the exposure-response curve and evaluated the existence of a threshold value. Results Overall, a 1 mg/m<sup>3</sup> increase in the average CO concentration of the previous day was associated with a percent increase of 0.91% (95% confidence interval [95% CI]: 0.32%, 1.50%) in daily total mortality. The pooled exposure-response curve showed a continuously elevated mortality risk with increasing CO concentrations, suggesting no evidence for a threshold. Larger mortality risk estimates were found at daily CO levels below 1 mg/m<sup>3</sup> and persisted at concentrations as low as below 0.2 mg/m<sup>3</sup>. Conclusions This international study is, to our knowledge, by far the largest epidemiological study on short-term CO-related mortality. We found significant associations between short-term exposure to ambient CO and daily mortality, even at levels well below the current global and national air quality guidelines. The study was conducted on behalf of the MCC Collaborative Research Network

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0973**

**Evaluating the potential health benefits associated with the air quality alerts system in Paris: a difference-in-differences analysis.**

**Presenter:** Anna Alari, INSERM - Sorbonne University, Paris, France

**Authors:** A. Alari<sup>1</sup>, B. Chaix<sup>1</sup>, G. Le Nir<sup>2</sup>, S. Medina<sup>3</sup>, T. Benmarhnia<sup>4</sup>;

<sup>1</sup>INSERM - Sorbonne University, Paris, FRANCE, <sup>2</sup>AirParif, Paris, FRANCE, <sup>3</sup>Santé Publique France, Paris, FRANCE, <sup>4</sup>Department of Family Medicine and Public Health and Scripps Institution of Oceanography, University of California, San Diego, San Diego, CA.

Background: In order to fight against air pollution and attenuate adverse health effects, many big cities in different countries adopt public policies based on a system of air quality alerts, triggered when air pollution forecasts predict a day with one or more pollutants concentrations beyond the regulatory standards. These programs focus exclusively on reducing emissions on days when air pollution warnings exceed the threshold level and, despite the large investment on this kind of measures, their effectiveness and their benefits on the population health have never been verified. The potential health benefits associated with air quality alert policies implemented in the city of Paris is assessed herein. Methods: Data of daily mortality for non-accidental, cardiovascular and respiratory causes were obtained from the French National Institute of Health and Medical Research for the period going from 2000 to 2015. Data of mean daily PM10 concentrations were collected from the local air quality monitoring networks. A quasi-experimental design was used by combining a propensity-score-matching method with Difference-in-Differences models. The difference in mean daily PM10 concentrations and in daily mortality was compared between eligible and non-eligible days before and after the definition of regulatory standards for PM10 concentrations (2000-2007 versus 2008-2015) and before and after the implementation of lower thresholds values (2008-2011 versus 2012-2015). Results: A significant reduction associated to the implementation of the air quality alerts system in Paris was detected in PM10 concentrations but no evidence was found for an impact on mortality. Conclusions: By capitalizing on natural experiments, this study addresses the question of the pertinence of local public health policies with regard to air quality and health issues and its findings suggest that investing on long-term interventions could be preferable to emergency measures concentrate exclusively on acute-air polluted days.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0974**

**Does air pollution modify the effect of heat on mortality during the warm season? Results from a multi-country study.**

**Presenter:** Francesca Katherine de'Donato, Lazio Regional Health Service - ASL Roma 1, ROMA, Italy

**Authors:** F. K. de'Donato, M. Scortichini, M. Stafoggia, M. Davoli, P. Michelozzi;  
Lazio Regional Health Service - ASL Roma 1, ROMA, ITALY.

**Background:** The health effects of heat on mortality are well known worldwide, less is known on the synergistic effect of heat and air pollutants. The aim of the study is to estimate the role of air pollution as effect modifier of the association between temperature and mortality effects during the warm season (6 months) in 24 countries across the globe.

**Methods:** Time-series analysis was run for each city. Heat effects were estimated as the percent change in mortality for increases in mean temperature between the 75th and 99th percentile. To evaluate the interaction, a bivariate tensor product between mean air temperature (lag 0-1) and either PM10 or ozone (both lag 0-1) was defined and temperature estimates were extrapolated at three pollutant percentile levels: low (10th), medium (50th), and high (90th).

**Results:** Daily mortality, mean temperature (°C) and air pollution data (PM10 and ozone) for 482 cities were considered. Meta-analytical results showed statistically significant effects of heat on mortality for increasing levels of ozone and PM10. Considering the interaction with PM10, temperature estimates rose from 7.1% (CI 95%:3.1%-11.2%) to 14.5% (CI 95%:10.2%-9.0%) in the low and high levels respectively. A similar trend was observed when considering effect modification by ozone, with estimates ranging from 3.4% (CI 95%:1.0%-5.8%) to 12.8 % (CI 95%: 8.7%-17.1%) in the low and high levels respectively. Considering country specific estimates some heterogeneity was observed with a positive trend in the effect of heat by levels of PM10 in Australia, Brazil, Canada, S. Korea, and most European countries and similarly in Australia, Canada, Japan, Thailand, USA and European countries for ozone.

**Conclusion:** This study shows the synergistic effect of heat and pollution on mortality during summer, which is important when considering the future health impacts of climate change.

On behalf of the MCC collaborative group.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0976**

**Estimation of the effects of particulate matter on mortality; three-way interaction by green space, socio-demographic factors, and particulate matter**

**Presenter:** Choi Yongsoo, Korea university, Seoul, Korea, Republic of

**Authors:** C. Yongsoo;  
Korea university, Seoul, KOREA, REPUBLIC OF.

Although several studies have reported effect modification of green space on the risk of particulate matter (PM<sub>10</sub>), it has not been studied whether such beneficial effects work in common for all. In this study, we investigated whether the effect modification of green space on PM<sub>10</sub> are homogeneous across socio-demographic factors. The study is conducted for 122 districts in Korea for 2008-2016. Daily time series analysis stratified by individual characteristics is conducted to estimate the risk of respiratory and circulatory mortality. The multivariate meta-regression model is used to estimate the effects of green space, which are measured by the NDVI. In districts with higher green space, the effects of PM<sub>10</sub> on respiratory mortality increased, whereas circulatory mortality decreased. The attenuation in the risk of PM<sub>10</sub> was mainly observed in males and the elderly who were more vulnerable to PM<sub>10</sub>. Green space seems to be beneficial in reducing the health effects of PM<sub>10</sub>, not only reducing its risk but also alleviating inequalities.

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## ABSTRACT E-BOOK

### Theme: PM and mortality

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P-0977

#### Low-level air pollution and cause-specific mortality in Denmark: the ELAPSE project

**Presenter:** Amar J Mehta, University of Copenhagen Department of Public Health, Copenhagen, Denmark

**Authors:** A. J. Mehta<sup>1</sup>, Z. Andersen<sup>1</sup>, M. Stafoggia<sup>2</sup>, B. Oftedal<sup>3</sup>, R. Atkinson<sup>4</sup>, S. Rodopoulou<sup>5</sup>, D. Vienneau<sup>6</sup>, M. Bauwelinck<sup>7</sup>, N. Janssen<sup>8</sup>, T. Sogaard<sup>9</sup>, M. Ketzel<sup>10</sup>, J. Brandt<sup>10</sup>, C. B. Pedersen<sup>9</sup>, O. Hertel<sup>10</sup>, G. Hoek<sup>11</sup>, B. Brunekreef<sup>11</sup>;

<sup>1</sup>University of Copenhagen Department of Public Health, Copenhagen, DENMARK, <sup>2</sup>Department of Epidemiology, Lazio Region Health Service / ASL Roma 1, Rome, ITALY, <sup>3</sup>Norwegian Institute of Public Health, Oslo, NORWAY, <sup>4</sup>St George's, University of London, London, UNITED KINGDOM, <sup>5</sup>Department of Hygiene, Epidemiology and Medical Statistics, Medical School, National and Kapodistrian University of Athens, Athens, GREECE, <sup>6</sup>Swiss Tropical and Public Health Institute and University of Basel, Basel, SWITZERLAND, <sup>7</sup>Scientific Institute of Public Health Brussels and Vrije Universiteit Brussels, Brussels, BELGIUM, <sup>8</sup>National Institute for Public Health and the Environment, Bilthoven, NETHERLANDS, <sup>9</sup>Institute of Environmental and Occupational Medicine, Department of Public Health, Aarhus University, Aarhus, DENMARK, <sup>10</sup>Department of Environmental Science, Aarhus University, Roskilde, DENMARK, <sup>11</sup>Institute for Risk Assessment Sciences, Utrecht University, Utrecht, NETHERLANDS.

**Background**The association between air pollution and mortality requires further investigation in areas with low air pollution levels for evaluation of current air quality limits. Within the Effects of Low-Level Air Pollution: A Study in Europe (ELAPSE) study we examined associations between long-term exposure to air pollution and cause-specific mortality in a Danish national administrative cohort. **Methods**We linked 3,334,143 Danish adults aged  $\geq 30$  years in 2000 to the Danish Cause of Death Registry until 2015. Annual mean concentrations of fine particulate matter (PM<sub>2.5</sub>), nitrogen dioxide (NO<sub>2</sub>) and black carbon (BC) were centrally modelled with European-wide hybrid ELAPSE land-use regression model in 2010 at 100m<sup>2</sup> resolution. We applied Cox proportional hazard models for natural and cause-specific mortality in association with annual mean air pollution with age as underlying time, and adjusting for sex, education, employment status, birth country, area-level income and unemployment, and area-level lung cancer and COPD mortality rates.

**Results**During 45,932,793 person-years of follow-up, we observed 817,029 deaths from natural causes in total, of which 245,489, 89,909, and 67,389 deaths were due to cardiovascular disease (CVD), respiratory disease (RD), and cerebrovascular disease (CeVD), respectively. Mean levels of PM<sub>2.5</sub>, NO<sub>2</sub> and BC were 12.4  $\mu\text{g}/\text{m}^3$ , 20.2  $\mu\text{g}/\text{m}^3$  and 1.0  $10^{-5}\text{m}^{-1}$ , respectively. Hazard ratios and 95% confidence intervals for associations of PM<sub>2.5</sub>, NO<sub>2</sub> and BC with natural mortality were 1.13 (1.11-1.16) per 5  $\mu\text{g}/\text{m}^3$ , 1.09 (1.08-1.10) per 10  $\mu\text{g}/\text{m}^3$ , and 1.08 (1.07-1.10) per 0.5  $10^{-5}\text{m}^{-1}$ , respectively. Corresponding estimates for CVD mortality were 1.11 (1.08-1.15), 1.07 (1.06-1.09) and 1.07 (1.05-1.08); for RD mortality were 1.13 (1.09-1.18), 1.12 (1.10-1.15) and 1.10 (1.08-1.13); and for CeVD mortality were 1.07 (1.02-1.11), 1.04 (1.02-1.07) and 1.04 (1.02-1.06). Associations persisted below PM<sub>2.5</sub> and NO<sub>2</sub> EU limit values for all outcomes. **Conclusions**Long-term exposures to PM<sub>2.5</sub>, NO<sub>2</sub> and BC were associated with mortality even below EU limit values.

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Theme: **PM and mortality**

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**P-0979**

**Long-term exposure to moderate fine particulate matter concentrations and cause-specific mortality in an aging society**

**Presenter:** Youn-Hee Lim, University of Copenhagen, Copenhagen, Denmark

**Authors:** Y. Lim<sup>1</sup>, J. Oh<sup>2</sup>, C. Han<sup>3</sup>, H. Bae<sup>4</sup>, S. Kim<sup>5</sup>, Y. Jang<sup>6</sup>, E. Ha<sup>2</sup>, Y. Hong<sup>7</sup>;

<sup>1</sup>University of Copenhagen, Copenhagen, DENMARK, <sup>2</sup>Ewha Womans University, Seoul, KOSOVO, REPUBLIC OF, <sup>3</sup>Choongnam University, Daejeon, KOREA, REPUBLIC OF, <sup>4</sup>Korea Environment Institute, Sejong, KOSOVO, REPUBLIC OF, <sup>5</sup>Ajou University, Suwon, KOSOVO, REPUBLIC OF, <sup>6</sup>Seoul National University College of Medici, Seoul, KOSOVO, REPUBLIC OF, <sup>7</sup>Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF.

**Background:** Long-term exposure to particulate matter less than 2.5  $\mu\text{m}$  ( $\text{PM}_{2.5}$ ) is considered a risk factor for premature death. However, only a few studies have been conducted in areas with moderate  $\text{PM}_{2.5}$  concentrations. Moreover, an aging society may be more susceptible to environmental exposure and future health impacts of  $\text{PM}_{2.5}$ . **Methods:** This study estimates hazard ratios (HRs) for all-cause and cause-specific mortality from long-term exposure to moderate  $\text{PM}_{2.5}$  concentrations in the elderly populations of seven cities in South Korea. We also projected nationwide elderly mortality caused by long-term exposure to  $\text{PM}_{2.5}$ , accounting for population aging until 2045. Mortality in 1,720,230 elderly adults aged 65 years and older in 2008 was monitored across 2009-2016 and linked to modeled  $\text{PM}_{2.5}$  concentrations. **Results:** A total of 421,100 deaths occurred in 2009-2016, and the mean of annual  $\text{PM}_{2.5}$  concentration ranged between 21.1  $\mu\text{g}/\text{m}^3$  and 31.9  $\mu\text{g}/\text{m}^3$  in most regions. The overall HR for a 10  $\mu\text{g}/\text{m}^3$  increase in a 36-month  $\text{PM}_{2.5}$  moving average was 1.024 (95% confidence intervals: 1.009, 1.039). We estimated that 11,833 all-cause nationwide elderly deaths were attributable to  $\text{PM}_{2.5}$  exposure. Annual death tolls may increase to 17,948 by 2045. However, if  $\text{PM}_{2.5}$  is reduced to 5  $\mu\text{g}/\text{m}^3$  by 2045, the tolls may decrease to 3,646. **Conclusions:** The long-term exposure to moderately high levels of  $\text{PM}_{2.5}$  was associated with increased mortality risk among the elderly. Thus,  $\text{PM}_{2.5}$  reduction in response to the projected aging-associated mortality in South Korea is critical.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0980**

**Acute effects of fine and coarse particulate matter on daily mortality in the Metropolitan Area of Monterrey, México.**

**Presenter:** Magali Hurtado-Díaz, Instituto Nacional de Salud Pública, Cuernavaca, Mexico

**Authors:** M. Hurtado-Díaz, J. Cruz, A. Martinez-Muñoz, H. Riojas-Rodriguez;  
Instituto Nacional de Salud Pública, Cuernavaca, MEXICO.

**Background:** The Metropolitan Area of Monterrey (MAM) is the third most populated city in Mexico. Ambient air pollution is a serious environmental problem in this city. Since fine particulate matter (PM<sub>2.5</sub>) measuring started, every year the measurements of particulate matter have more than double the annual mean values recommended by the World Health Organization (WHO) to protect the human health. **Objective:** To estimate the effect of different particle size fractions on total and specific causes of mortality in the MAM, México, between 2004 and 2017. **Materials and Methods:** A retrospective ecological study was conducted, using time-series analysis of daily total and specific causes of mortality, fine (PM<sub>2.5</sub>) and coarse (PM<sub>2.5-10</sub>) particles. The data were analyzing using Poisson Linear Additive Models controlling for trend, seasonality, day of the week and meteorological conditions, on the same day and at lags 1, 3 and 7. **Result:** Daily mean PM<sub>2.5</sub> and PM<sub>2.5-10</sub> concentrations were 26.59 µg/m<sup>3</sup> (SD=11.06) and 48.83 µg/m<sup>3</sup> (SD=21.15) respectively. An increase of 10 µg/m<sup>3</sup> of PM<sub>2.5</sub> was associated with 11.16% (CI<sub>95%</sub>: 1.03-21.39) increased risk of respiratory mortality in children ≤5 years old and 6.6% (CI<sub>95%</sub>: 3.31-9.37) increased risk of pneumonia-influenza in adults ≥65 years old. Weaker mortality associations were observed with PM<sub>10-2.5</sub>. **Conclusions:** Positive and significant associations were observed between exposure to fine and coarse particulate matter and daily mortality in the MAM's population.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0981**

### **Ambient Air pollution and Post-transplant Mortality among US Kidney Transplant Recipients**

**Presenter:** Miranda R. Jones, Johns Hopkins Bloomberg School of Public Health, Baltimore, United States

**Authors:** M. R. Jones<sup>1</sup>, Y. Feng<sup>2</sup>, N. M. Chu<sup>2</sup>, D. L. Segev<sup>2</sup>, M. A. McAdams-DeMarco<sup>1</sup>;

<sup>1</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>2</sup>Johns Hopkins University School of Medicine, Baltimore, MD.

**Background:** Long-term exposure to fine particulate matter (PM<sub>2.5</sub>) has been associated with increased mortality in the general US population and has been shown to negatively affect renal function. Kidney transplant recipients may be especially vulnerable to the effects of air pollution. Our objective was to investigate associations of PM<sub>2.5</sub> concentrations with mortality among US kidney transplant recipients. **Methods:** We studied 96,109 kidney transplant recipients identified from the Scientific Registry of Transplant Recipients who received their transplant between January 1, 2010 and December 31, 2016 and were followed for mortality through June 30, 2019. Annual PM<sub>2.5</sub> concentration at the time of transplant was estimated at each recipient's zip code using derived from National Aeronautics and Space Administration satellite data. Multilevel cox proportional hazards models were used to estimate hazard ratios (HR, 95% confidence intervals [CI]) for post-transplant mortality by zip code PM<sub>2.5</sub> concentration. **Results:** 61% of recipients were male, 48% non-Hispanic (NH) White and the median age at transplant was 53 years. The median zip code PM<sub>2.5</sub> concentration was 9.1µg/m<sup>3</sup>. After a median of 4.0 years of follow-up, there were 14,260 deaths. After multivariable adjustment, recipients living in zip codes in the highest quartile of PM<sub>2.5</sub> exposure (≥10.7µg/m<sup>3</sup>) had 5% higher (HR: 1.05, 95% CI: 1.00, 1.10) risk for post-transplant mortality compared to recipients in zip codes in the lowest quartile of PM<sub>2.5</sub> exposure (<7.6µg/m<sup>3</sup>). These findings were stronger in recipients >65 years of age (HR: 1.09, 95% CI: 1.01, 1.18) and in NH White and NH Black recipients compared to recipients of other race/ethnicities. **Conclusions:** Among US kidney transplant recipients, living in areas with higher exposure to PM<sub>2.5</sub> was associated with increased risk for mortality following transplantation. Additional management of kidney transplant recipients who might be exposed to moderate air pollution may help reduce mortality in this population.

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Theme: **PM and mortality**

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**P-0982**

**Estimating the impacts of fine particulate matter concentration from different sources on the mortality of cardiovascular diseases: a population-based cohort study**

**Presenter:** Li Bai, ICES, Toronto, Canada

**Authors:** L. Bai<sup>1</sup>, R. T. Burnett<sup>2</sup>, J. Meng<sup>3</sup>, R. V. Martin<sup>3</sup>, J. C. Kwong<sup>1</sup>, A. van Donkelaar<sup>3</sup>, H. Chen<sup>2</sup>;  
<sup>1</sup>ICES, Toronto, ON, CANADA, <sup>2</sup>Health Canada, Ottawa, ON, CANADA, <sup>3</sup>Dalhousie University, Halifax, NS, CANADA.

Background: Evidence is limited about the health impacts of fine particulate matter (PM<sub>2.5</sub>) mass originated from different sources. Methods: We assessed the associations of cardiovascular mortality with PM<sub>2.5</sub> mass from ten major sources including residential, transportation, industry, agriculture, wild fire, dust, sea salt, biogenic SOA, power generation, and others. We constructed a cohort that comprised all Ontario adults who, on 1 January 2001, were 35-85 years old (~5.26 million subjects) and were followed up until 31 December 2016. The Ontario Registrar General information on deaths was used to ascertain cardiovascular deaths. We assigned the estimates of PM<sub>2.5</sub> mass from these sources to participants' annual postal-code addresses during follow-up. Using standard Cox proportional hazards models, we calculated hazard ratios (HRs) and 95% confidence intervals (CIs) for source-specific PM<sub>2.5</sub> mass, adjusted for both individual- and neighborhood-level covariates. We considered models for PM<sub>2.5</sub> mass from each source individually and in combination. Results: During follow-up, we identified 305,353 deaths from cardiovascular diseases. Transportation, industry, and residential sectors are three greatest contributors of PM<sub>2.5</sub> mass in Ontario. The residential sector was strongly correlated with the transportation sector ( $r=0.89$ ), moderately with the industry sector ( $r=0.46$ ), and weakly correlated with other sectors. In the single-pollutant models, we found the elevated risk of cardiovascular deaths with each unit increase in exposure to PM<sub>2.5</sub> mass from industry, transportation, agriculture, dust, and power generation sectors with HRs ranging from 1.001 to 1.612. In the multi-pollutant model with all ten sectors included, the strongest positive association was observed with power generation, followed by residential combustion, and wild fire. Conclusion: Our study suggests that PM<sub>2.5</sub> mass from human-made sources might have a greater impact on cardiovascular diseases than that from natural sources. Future investigations are warranted to evaluate the joint health impacts of PM<sub>2.5</sub> and related sources.

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0983**

**Impacts of Long-term Exposure to Fine Particulate Matter on Mortality Among the Elderly**

**Presenter:** Xiao Wu, Harvard University, Boston, United States

**Authors:** X. Wu<sup>1</sup>, D. Braun<sup>2</sup>, J. Schwartz<sup>3</sup>, M. Kioumourtzoglou<sup>4</sup>, F. Dominici<sup>3</sup>;

<sup>1</sup>Harvard University, Boston, MA, <sup>2</sup>Dana-Farber Cancer Institute, Boston, MA, <sup>3</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>4</sup>Columbia Mailman School of Public Health, New York, NY.

Many studies link long-term fine particle (PM<sub>2.5</sub>) exposure to mortality, even at levels below current US air quality standards (12 µg/m<sup>3</sup>). These findings have been disputed citing traditional approaches do not guarantee evidence of causality. We obtained open cohort data for over 68.5 million Medicare enrollees (65 years or older) from 2000-2016. We assigned PM<sub>2.5</sub> zip code concentrations based on an ensemble prediction model. We implemented five statistical approaches to estimate the effect of PM<sub>2.5</sub> exposure on mortality, accounting for potential confounders. The two traditional regression approaches for confounding adjustment: 1) Cox proportional hazards model, and 2) Poisson regression. We also considered three causal inference modeling approaches that rely on the potential outcomes framework and generalized propensity scores (GPS). These approaches adjust for confounding using 1) matching by GPS; 2) weighting by GPS, and 3) including GPS as a covariate in the health outcome model (adjustment by GPS). For the period 2000-2016, we found that all statistical approaches provide consistent results.

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Theme: **PM and mortality**

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**P-0984**

**The Impact of Long-Term PM<sub>2.5</sub> Exposure on sepsis-related death among U.S. Medicare Beneficiaries**

**Presenter:** Fatemeh Kazemiparkouhi, University of Utah, Salt lake City, United States

**Authors:** F. Kazemiparkouhi<sup>1</sup>, T. Henry<sup>1</sup>, T. Honda<sup>1</sup>, H. Suh<sup>2</sup>;

<sup>1</sup>University of Utah, Salt lake City, UT, <sup>2</sup>Tufts University, Medford, MA.

**Background:** The impact of chronic exposure to fine particulate matter (PM<sub>2.5</sub>) on sepsis-related mortality is poorly understood. In a cohort of 53 million Medicare beneficiaries (more than 220,000 sepsis related deaths) living across the conterminous United States between 2000 to 2008, we examined the association of chronic PM<sub>2.5</sub> exposure and sepsis related mortality. **Methods:** For each Medicare beneficiary we estimated the 12-month moving average PM<sub>2.5</sub> concentrations for their zipcode of residence using well validated GIS-based spatio-temporal models. We also estimated warm season average 1-hour maximum ozone exposures for a subset of beneficiaries living in ZIP codes within 24 miles of air quality monitors from the US EPA AQS. The subjects were identified as died from sepsis-related causes if they have ICD-10 code for bacterial or other sepsis. We used Cox proportional hazard models to assess the association of long-term PM<sub>2.5</sub> exposures on sepsis related mortality. Models included strata for age, sex, race, and ZIP code and controlled for neighborhood socio-economic status (SES) in our main analyses, and additionally for warm season average of 1-hour daily maximum ozone exposures in a sensitivity analysis. **Results:** A 10 µg /m<sup>3</sup> increase in 12-month average PM<sub>2.5</sub> was associated with increased risk of sepsis mortality (RR: 1.091; 95% CI: 1.036-1.149) in age, sex, race, ZIP code, and SES-adjusted models. Results remained positive and significant when additionally controlling for ozone exposures. **Conclusions:** Long-term PM<sub>2.5</sub> but not ozone exposure is associated with elevated risks of sepsis-related mortality

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## ABSTRACT E-BOOK

Theme: **PM and mortality**

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**P-0985**

**Exploratory survival models for mortality from chronic diseases associated with exposure to air pollutants (PM<sub>10</sub>, PM<sub>2.5</sub> and ozone) in the population of the Aburra Valley region, Colombia, 2008-2017.**

**Presenter:** Juan Gabriel Pineros-Jimenez, Universidad de Antioquia, Medellin, Colombia

**Authors:** H. Grisales Romero<sup>1</sup>, E. Nieto Lopez<sup>1</sup>, N. Montealegre<sup>1</sup>, F. Villa<sup>2</sup>, A. Orrego<sup>3</sup>, A. Molina<sup>3</sup>, J. Pineros-Jimenez<sup>1</sup>;

<sup>1</sup>Universidad de Antioquia, Medellin, COLOMBIA, <sup>2</sup>Universidad Nacional de Colombia, Medellin, COLOMBIA, <sup>3</sup>Area Metropolitana del Valle de Aburra, Medellin, COLOMBIA.

A greater negative impact of exposure to air pollution on the health of people with greater susceptibility as those with comorbidities is recognized. The aim of this study was to establish the risk of dying at all times of people diagnosed with Chronic Lower Respiratory Tract Disease (CLRTD) (ICD10: J40-J47) and malignant tumors of the respiratory organs (MTRO) (ICD10: C30-C34) associated to PM<sub>10</sub>, PM<sub>2.5</sub> and ozone exposures in each of the 10 municipalities of the Aburrá Valley region. A descriptive study with ecological exposure was developed from the individual service provision records and death records of each of the municipalities. An analysis that prioritized the construction of explanatory models of Cox proportional hazards was carried out. The outcome of interest was the time in years elapsed from the moment the patient was attended in the health system for first time by the chronic event until the time of death for the event or until the follow-up period ended (2008-2017). During the 10 years of the study, 330,171 cases of CLRTD and 9,990 of MTRO were reported, among which there were 13,824 and 8,585 deaths from these causes respectively. Exposure to PM<sub>10</sub> was associated with increases in the risk of dying from CLRTD (14% to 21% for over 65 years old and between 15% and 25% over than 30 years old) and MTRO (between 2% and 8% older than 65 years and between 8% and 26% for people over 30) also, exposure to ozone was associated with the increased risk of dying from COPD (between 20% and 47% for people over 65 and between 16% and 36% for people over 30).

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**P-0986**

**The association between long-term exposure to low-level PM<sub>2.5</sub> and mortality in the State of Queensland, Australia: A modelling study with the difference-in-differences approach**

**Presenter:** Wenhua Yu, Monash University, Melbourne, Australia

**Authors:** W. Yu<sup>1</sup>, Y. Guo<sup>1</sup>, L. Shi<sup>2</sup>, S. Li<sup>1</sup>;

<sup>1</sup>Monash University, Melbourne, AUSTRALIA, <sup>2</sup>Emory University, Atlanta, GA.

**Background:** To date, few studies have investigated the causal relationship between mortality and long-term exposure to low level of fine particulate matter (PM<sub>2.5</sub>) concentrations. **Methods and findings:** We studied 242,320 registered deaths in Queensland between Jan. 1, 1998 to Dec. 31, 2013 with satellite-retrieved annual average PM<sub>2.5</sub> concentrations to each postcode. A variant of difference-in-differences (DID) approach was used to investigate the association of long-term PM<sub>2.5</sub> exposure with total mortality and cause-specific (cardiovascular, respiratory, and non-accidental) mortality. We observed 217,510 non-accidental deaths, 133,661 cardiovascular deaths, and 30,748 respiratory deaths in Queensland during the study period. The annual average PM<sub>2.5</sub> concentrations ranged from 1.6 to 9.0 µg/m<sup>3</sup>, which were well below the current World Health Organization (WHO) annual standard (10 µg/m<sup>3</sup>). Long-term exposure to PM<sub>2.5</sub> was associated with increased total mortality and cause-specific mortality. For each 1 µg/m<sup>3</sup> increase in annual PM<sub>2.5</sub>, we found 2.02% (95% CI: 1.41-2.63%; p < 0.01) increase in total mortality. Higher effect estimates were observed in Brisbane than those in Queensland for all types of mortality. A major limitation of our study is that the DID design is under the assumption that no predictors other than seasonal temperature exhibit different spatial-temporal variations in relation to PM<sub>2.5</sub> exposure. However, if this assumption is violated (e.g., socioeconomic status and outdoor physical activities), the DID design is still subject to confounding. **Conclusions:** Long-term exposure to PM<sub>2.5</sub> was associated with total, non-accidental, cardiovascular, and respiratory mortality in Queensland, Australia, where PM<sub>2.5</sub> levels were measured well below the WHO air-quality standard.

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Theme: **PM and mortality**

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**P-0987**

**Estimating the impact of exposure to multi-pollutant on mortality in an Indian city over middle Indo-Gangetic Plain**

**Presenter:** Nidhi Singh, DST-Mahamana Centre of Excellence in Climate Change Research, Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi, India

**Authors:** N. Singh<sup>1</sup>, A. Mhawish<sup>2</sup>, T. Banerjee<sup>1</sup>, S. Ghosh<sup>3</sup>, R. Singh<sup>4</sup>, R. Mall<sup>1</sup>;

<sup>1</sup>DST-Mahamana Centre of Excellence in Climate Change Research, Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi, INDIA, <sup>2</sup>Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi, INDIA, <sup>3</sup>Department of Biostatistics, St Johns Medical College, Bangalore, INDIA, <sup>4</sup>Department of Chemical Engineering and Technology, Indian Institute of Technology (BHU), Varanasi, INDIA.

**Background:** At a time, individuals are exposed to multi air pollutants which may have independent or synergistic effects on human health. Given the paucity in multi-pollutant based health effect studies, assessment of human health on exposure to multi air pollutant may be more plausible and important than taking under consideration the effects of individual air pollutants. **Objectives:** We examined the association between multiple air pollutants (black carbon; BC, PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub> and O<sub>3</sub>) and non-accidental mortality in an urban pollution hotspot located in middle Indo-Gangetic Plain (IGP). **Method:** Daily mortality data for the years 2009-2016 are taken from office of Municipal Corporation of Varanasi. Meteorological data like temperature and relative humidity were collected from the India Meteorological Department, New Delhi. Semiparametric quasi-Poisson regression model were used to study the relationship between multi air pollutants and daily mortality. **Result:** Among multiple air pollutants, individual impact of BC was highest and significant on mortality. Every 10-unit increase lead to an increase in mortality by 4.95% (95% CI: 2.16-7.74) for BC, followed by 2.38% (95% CI: 0.88-3.87%) for NO<sub>2</sub>, 1.06% (95% CI: 0.45-1.66%) for PM<sub>2.5</sub> and 0.26% (95% CI: 0.13-0.38%) for PM<sub>10</sub>. The multi-pollutant model showed increase in mortality risks for BC aerosols (7.3%) and PM<sub>2.5</sub> (residual PM<sub>2.5</sub>) compared to their individual impact. Effect modification based on sex, age, place of death and season didn't show statistically significant differences except PM<sub>10</sub>. We also found that there exist a lag effect of up to 0-6 days from exposure to mortality. Furthermore, air pollutants displayed mostly but not strictly linear exposure-response association, that shows increase in mortality risk associated with BC exposure >15 µg m<sup>-3</sup> and PM<sub>2.5</sub>>60 µg m<sup>-3</sup>. **Conclusion:** The study concludes with certain confidence that multi pollutant model shows improvement in effect estimates associated with air pollutants in combination than their individual counterpart.

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Theme: **PM and respiratory health**

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**P-0988**

**Perceptions of NO<sub>2</sub> Exposure and Health in a Cohort of Low-Income Adults in Mysore, India**

**Presenter:** Amruta Nori-Sarma, Brown University, Providence, United States

**Authors:** A. Nori-Sarma<sup>1</sup>, R. Thimmulappa<sup>2</sup>, G. Venkataramana<sup>3</sup>, K. Burrows<sup>4</sup>, S. Whittaker<sup>4</sup>, G. Wellenius<sup>5</sup>, M. Rao<sup>2</sup>, M. Bell<sup>4</sup>;

<sup>1</sup>Brown University, Providence, RI, <sup>2</sup>JSS Academy of Higher Education and Research, Mysore, INDIA,

<sup>3</sup>Mysore University, Mysore, INDIA, <sup>4</sup>Yale University, New Haven, CT, <sup>5</sup>Boston University, Boston, MA.

Urban air quality remains a major concern for public health officials and the general public, particularly in low- and middle-income countries (LMICs) where baseline exposures are high. In India, air quality awareness campaigns are major efforts of governments at every level. Yet, our understanding of relationships between ambient air pollution exposure, public perceptions of air quality, and concerns about associated health risks is incomplete. We asked 609 respondents in low-income neighborhoods in Mysore, India, about perceptions of air pollution exposures and self-efficacy, or their ability to act to reduce the health effects of air pollution in their community. Based on lung function tests, we found a 9.3% prevalence (standard error: 0.8%) of chronic obstructive pulmonary disease (COPD) or asthma. An additional 21% of the population reported experiencing chronic cough, phlegm, wheezing, and difficulty walking due to shortness of breath, and 27% of the participants reported visiting a hospital or clinic in the previous 6 months due to chest pain, breathing issues or allergic reaction. On air pollution perception, we found 30% of the respondents believed air pollution in their own neighborhood was worse than pollution in nearby neighborhoods, and 80% of respondents believe air pollution levels in the city of Mysore have been detrimental to their own health. Only 1.5% of respondents prioritized minimizing disruption of their daily routine due to air pollution, and less than 1% of respondents believed they could act individually or collectively within their community to reduce the impacts of their pollution exposure. Public awareness campaigns should be combined with education on ways the public can protect themselves from the adverse impacts of pollution exposure, and should be tailored explicitly for targeting vulnerable populations such as those living in low-income neighborhoods that experience high ambient air pollution levels.

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Theme: **PM and respiratory health**

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**P-0989**

**NO<sub>2</sub> Exposure and Lung Function Decline in a Cohort of Adults in Mysore, India**

**Presenter:** Amruta Nori-Sarma, Brown University School of Public Health, Providence, United States

**Authors:** A. Nori-Sarma<sup>1</sup>, R. K. Thimulappa<sup>2</sup>, G. Venkataramana<sup>3</sup>, J. L. Warren<sup>4</sup>, J. D. Berman<sup>5</sup>, S. D. Whittaker<sup>6</sup>, E. R. Kulick<sup>1</sup>, G. A. Wellenius<sup>7</sup>, M. V. Rao<sup>2</sup>, M. L. Bell<sup>8</sup>;

<sup>1</sup>Brown University School of Public Health, Providence, RI, <sup>2</sup>JSS Academy of Higher Education and Research, Mysore, INDIA, <sup>3</sup>Mysore University, Mysore, INDIA, <sup>4</sup>Yale University School of Public Health, New Haven, CT, <sup>5</sup>University of Minnesota School of Public Health, Minneapolis, MN, <sup>6</sup>Yale University Jackson Institute for Global Affairs, New Haven, CT, <sup>7</sup>Boston University School of Public Health, Boston, MA, <sup>8</sup>Yale University School of the Environment, New Haven, CT.

Previous studies suggest a potentially large burden of respiratory disease attributable to ambient air pollution exposure. Increasingly high air pollution levels in low- and middle-income countries (LMICs) may be contributing to worsening respiratory health. In the course of a 5-year longitudinal study, the influence of annual average ambient nitrogen dioxide (NO<sub>2</sub>) at the home location on lung function decline was investigated in a 485-person cohort of low-income adults in Mysore, Karnataka, India. Health data were gathered in two rounds of qualitative questionnaires (2012-2014 and 2017-2018) using standardized interviews, as well as in-home lung function measurements using field spirometers. We estimated annual average ambient NO<sub>2</sub> in 2017 at the home location from spatial interpolation of seasonal air pollution sampling. Linear mixed effects models with a person-specific random effect were used to estimate NO<sub>2</sub> versus lung function cross-sectionally at baseline as well as longitudinally over time, with models adjusted for potential confounders including age at baseline, sex, smoking status, and month of data collection to control for potential seasonality. Results indicated cross-sectional associations between NO<sub>2</sub> and lung function post-bronchodilation, with a reduction of -28.2 mL (95% CI: -51.2, -5.28) for FEV<sub>1</sub> and -34.3 mL (95% CI: -61.2, -7.47) for FVC post-bronchodilation per 10 ppb increase in NO<sub>2</sub>. We show limited evidence of longitudinal impacts of air pollution on lung function. Future studies would benefit from time-varying air pollution exposure estimates, as well as subsequent rounds of lung function data collection to assess for longer-term trends in lung function decline.

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**P-0990**

**Large-scale agricultural burning and asthma emergency department visits in the U.S. state of Kansas**

**Presenter:** Audrey Flak Pennington, U.S. Centers for Disease Control and Prevention, Atlanta, United States

**Authors:** A. F. Pennington<sup>1</sup>, A. Vaidyanathan<sup>1</sup>, F. S. Ahmed<sup>2</sup>, A. Manangan<sup>1</sup>, M. C. Mirabelli<sup>1</sup>, I. Garrison<sup>2</sup>, K. Sircar<sup>1</sup>, F. Yip<sup>1</sup>, W. D. Flanders<sup>1</sup>;

<sup>1</sup>U.S. Centers for Disease Control and Prevention, Atlanta, GA, <sup>2</sup>Kansas Department of Health and Environment, Topeka, KS.

Background: Prescribed agricultural burning is a common land management practice, but little is known about the respiratory health effects from the resulting smoke exposure. We examined the association between smoke from prescribed burning and asthma in the U.S. state of Kansas. Methods: We analyzed a zip code-level daily time series of primary asthma emergency department (ED) visits and environmental variables for years 2009 - 2011 (n=62,105); analyses were restricted to the months when prescribed burning is common in Kansas (February - May). Given limited monitoring data, we formulated a measure of smoke exposure using non-traditional datasets, including fire radiative power and locational attributes from remote sensing data sources and surface wind characteristics from model-based earth observations. We then assigned a population-weighted potential smoke impact factor (PSIF) to each zip code, based on fire intensity, smoke transport and proximity (to fire) considerations. We used Poisson generalized linear models to estimate the association between PSIF (both as binary and 4-level categorical variables) and asthma ED visits. Results: During the study period, prescribed burning was used to clear approximately 8 million acres in Kansas. Same-day PSIF was associated with a 3% increase in the rate of asthma ED visits when adjusting for month, year, zip code, meteorology, day of week, holidays, and correlation within zip codes (rate ratio [RR]:1.03; 95% confidence interval [CI]:0.97, 1.09). When comparing tertiles of same-day exposure to a reference group of no exposure, adjusted rates of asthma ED visits were elevated for the two lowest tertiles, but did not increase monotonically (RR[CI] from lowest to highest exposure: 1.06[0.95, 1.18], 1.05[0.97, 1.14], 1.00[0.93, 1.08]). Conclusions: Our preliminary results are suggestive of an association between smoke from prescribed burning and asthma ED visits. Elucidating these associations will help guide public health programs that address population-level exposure to smoke from prescribed burning.

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## ABSTRACT E-BOOK

Theme: **PM and respiratory health**

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**P-0991**

**Urban forest characteristics and childhood asthma onset**

**Presenter:** Louise Duquesne, Université de Montréal, Montréal, Canada

**Authors:** L. Duquesne<sup>1</sup>, N. Zhao<sup>2</sup>, C. Plante<sup>3</sup>, E. Anassour Laouan Sidi<sup>4</sup>, R. Sousa Silva<sup>5</sup>, K. Zinszer<sup>6</sup>, D. Kneeshaw<sup>5</sup>, A. Paquette<sup>5</sup>, J. Dupras<sup>5</sup>, D. Kaiser<sup>3</sup>, A. Smargiassi<sup>6</sup>;

<sup>1</sup>Université de Montréal, Montréal, QC, CANADA, <sup>2</sup>Center for Forest Research, Université du Québec à Montréal (UQAM), Montréal, QC, CANADA, <sup>3</sup>Direction de santé publique, CIUSSS Centre-Sud-de-l'Île-de-Montréal, Québec, Canada, Montréal, QC, CANADA, <sup>4</sup>Institut national de la santé publique du Québec, Québec, QC, CANADA, <sup>5</sup>Centre for Forest Research, Université du Québec à Montréal (UQAM), Montréal, QC, CANADA, <sup>6</sup>Public Health Research Center (CRéSP), School of Public Health University of Montreal, Montréal, QC, CANADA.

The influence of the urban forest on asthma onset is unclear as trees reduce air pollution but also emit pollens and biogenic organic compounds. Additionally, rudimentary vegetation data have so far been used to assess risks. We aimed to assess associations between residential urban forest characteristics and the onset of childhood asthma. We used an open cohort of all children born in Montreal (Canada) between 2000 and 2015 and followed up to 12 years, created from linked medico-administrative databases. New cases of asthma were defined with a validated algorithm. Coniferous and deciduous tree crown volumes were estimated with Lidar point cloud data and random forest models. Total volumes of coniferous and deciduous tree canopies for pollen/summer seasons were calculated for buffers around participants' residential postal codes. Cox models (age as the time axis, stratified for sex) for the residential volumes of coniferous and deciduous canopies were developed; splines were used for non-linearity. Models were adjusted for calendar year, and neighborhood social and material deprivation. The cohort included 352,966 children with 30,825 new cases of asthma, and an overall incidence rate of 18 new cases per 1,000 person-years. Volumes of deciduous and coniferous tree canopies in 100 m buffers around postal codes ranged 0 - 465,686 m<sup>3</sup> and 0 - 64,198 m<sup>3</sup> respectively. Volumes of coniferous and deciduous tree canopies had non-linear relationships with asthma onset with null or negative slopes at low levels, becoming positive at higher volumes. Preliminary results suggest complex relationships between urban forest characteristics and childhood asthma onset that deserve investigation to enhance understanding of ecosystem services (i.e. benefits to people) of urban trees.

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**P-0992**

**Long-term impact of PM<sub>2.5</sub> on health in the city of Korhogo (Côte d'Ivoire, West africa)**

**Presenter:** Kouame Kouadio, Pasteur Institute, 01 BP 490, Côte D'Ivoire

**Authors:** K. Kouadio<sup>1</sup>, N. Gnamien<sup>2</sup>, v. Yoboué<sup>2</sup>, C. Liousse<sup>3</sup>;

<sup>1</sup>Pasteur Institute, 01 BP 490, CÔTE D'IVOIRE, <sup>2</sup>Laboratory of atmospheric physics, Felix Houphouet Boigny University, Abidjan, CÔTE D'IVOIRE, <sup>3</sup>Paul Sabatier University, CNRS, Laboratory of aerology, Toulouse, France, FRANCE.

Background/ Aim Air quality and its impacts capture more attention of governments and public opinion. Indeed, air pollution has consequences on the health of populations. Epidemiological studies contributed much to the understanding of the effects. In order to understand this, an epidemiological study was done in the regional hospital of Korhogo in regards to the PM<sub>2.5</sub> concentration levels in the city. The objective of this study was to assess the impact of PM<sub>2.5</sub> concentration on health in Korhogo, with special attention to cardiorespiratory and skin diseases. Methodology All subjects coming to consultation in the regional hospital of Korhogo were selected in relation to the lungs, skin, and heart symptoms for 3 months beginning from December 2018 to March 2019. Patients to include were identified by a Medical Doctor through a questionnaire after their informed consent. The relationship between exposure to air pollution and health was done through time series. The main outcomes of the study were the incidence of cardiorespiratory and skin diseases (95% CI) and the indicator of health impact. An existence of a significant relationship between exposure to air pollution and health outcomes was done. Results The preliminary results showed that 3410 patients consulted a physician during the 3 months visits in the regional hospital of Korhogo. Within those patients, 527 (17.46%) were recruited for pollution issues. More than 95% of the patients had cardiopulmonary diseases in the city of Korhogo. The average of PM<sub>2.5</sub> concentration was higher than the daily recommended by WHO. A strong relationship was seen to be associated to cardiopulmonary disease in that regional hospital Conclusion The average of PM<sub>2.5</sub> concentration was higher than the daily recommended by WHO. A strong relationship was seen to be associated to cardiopulmonary disease in that regional hospital Where a special attention should be taken for patients.

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**P-0993**

**Health risks associated with PM<sub>2.5</sub> concentration in Abidjan hospital, Côte d'Ivoire**

**Presenter:** Kouame Kouadio, Pasteur Institute, 01 BP 490, Côte D'Ivoire

**Authors:** K. Kouadio<sup>1</sup>, C. Konan<sup>1</sup>, V. Yoboue<sup>2</sup>, A. Late<sup>3</sup>, M. Dosso<sup>1</sup>;

<sup>1</sup>Pasteur Institute, 01 BP 490, CÔTE D'IVOIRE, <sup>2</sup>Laboratory of atmospheric physics, Felix Houphouet Boigny University, Abidjan, CÔTE D'IVOIRE, <sup>3</sup>National society for Information technology, Abidjan, CÔTE D'IVOIRE.

Abstract Background/Aim Air pollution has detrimental consequences on the health of populations.. This study was to implement a Health Impact Assessment (HIA) in order to quantify the impacts of air pollution levels on the major health outcomes done in five hospitals in Abidjan with regard to air pollution concentration levels, which will provide new results. Methodology Both exposure concentrations ( $\mu\text{g}/\text{m}^3$ ) and health issues were measured. The relationship between the health outcomes and air pollution concentration were estimated using a Poisson Regression model. Results PM<sub>2.5</sub> Concentrations from the waste burning and traffic sites were comparable with annual averages (28.51  $\mu\text{g}/\text{m}^3$  and 29.69  $\mu\text{g}/\text{m}^3$ ). For domestic fires, the annual average was drastically higher at 155.1  $\mu\text{g}/\text{m}^3$ . For persons living in Cocody, up to 22 emergency room visits could have been avoided for the rainy seasons alone, including 10 deaths. Further, 11 outpatient health center visits could have also been avoided during the rainy seasons. In Yopougon, respiratory visits to the outpatient health center could be reduced more significantly. In considering results for the entire year (26.5 avoided outcomes) and the rainy season (76.7 avoided outcomes), we obtain different results as the HIA for the rainy season was calculated using a different timeframe at a higher risk level. A further 30 outpatient visits for heart and skin problems could also be avoided during the rainy season, given an adherence to WHO recommended levels. Conclusion Using the number of visits to either an outpatient health center or an emergency room as a proxy for adverse health effects, an association was seen between PM<sub>2.5</sub> concentration levels and respiratory, cardiological, dermatological symptoms as well as mortality in the metropolitan area of Abidjan. Overall, we estimate that 143 hospital visits could have been avoided during the rainy seasons of our study period.

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**P-0994**

**Association of personal PM<sub>2.5</sub> exposure with lung function alternation and mediating role of oxidative damage in general urban adults**

**Presenter:** Ge Mu, Huazhong University of Science and Technology, Wuhan, China

**Authors:** G. Mu, M. Zhou, B. Wang, L. Cao, S. Yang, C. Zhu, Y. Zhou, W. Chen;  
Huazhong University of Science and Technology, Wuhan, CHINA.

Background: The association and mechanism of PM<sub>2.5</sub> exposure in personal level with lung function alternation are rarely reported among urban adults in China. Objectives: To evaluate potential effects of personal PM<sub>2.5</sub> exposure on lung function in general urban adults and explore mediating role of oxidative stress in the association. Methods: A total of 7685 measurements were obtained from the Wuhan-Zhuhai cohort. Personal PM<sub>2.5</sub> exposure levels were estimated through an estimated model developed in Wuhan. Mixed linear model with subject-specific random intercept was used to evaluate the association between personal PM<sub>2.5</sub> exposure and lung function, as well as PM<sub>2.5</sub> exposure and oxidative damage biomarkers (urinary 8-isoprostane and 8-hydroxy-2'-deoxyguanosine (8-OHdG)). Mediation analysis was conducted to investigate the role of urinary 8-isoprostane and 8-OHdG in the association between PM<sub>2.5</sub> and lung function. Results: Each 10 µg/m<sup>3</sup> increase of the previous-day personal PM<sub>2.5</sub> was significantly associated with a -2.94 mL, -2.02 mL and -16.14 mL/s change in FVC, FEV<sub>1</sub> and PEF, respectively (all P<0.05). The associations were more obvious among never smokers compared with current smokers. Seven days moving average of PM<sub>2.5</sub> exposure showed the strongest effects on lung function parameters. Non-linear association was observed between 8-isoprostane and lung function. Among participants with low 8-isoprostane level (<73.02 ng/mmol Cr), each 10 µg/m<sup>3</sup> increase of 7 days average PM<sub>2.5</sub> was associated with 1.06% (0.17, 1.96) increase in urinary 8-isoprostane level, and 8-isoprostane mediated 5.24%, 12.05% and 5.21% of the association with FVC, FEV<sub>1</sub> and PEF, respectively. No significant association or mediation effect was observed among participants with high 8-isoprostane level. No significant mediation effect of 8-OHdG was observed. Conclusion: Personal exposure to PM<sub>2.5</sub> is associated with reduced pulmonary ventilation function. PM<sub>2.5</sub>-related declines in both FEV<sub>1</sub> and FVC were stronger among never smokers than those among current smokers. And urinary 8-isoprostane partly mediated the associations.

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**P-0995**

**The effect of particulate matter reduction by indoor air filter use on respiratory symptoms and lung function**

**Presenter:** Sei Won Lee, Asan Medical Center, Seoul, Korea, Republic of

**Authors:** S. Lee<sup>1</sup>, H. Park<sup>1</sup>, H. Lee<sup>1</sup>, C. Suh<sup>1</sup>, H. Kim<sup>1</sup>, H. Kim<sup>2</sup>;

<sup>1</sup>Asan Medical Center, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Inha University, Incheon, KOREA, REPUBLIC OF.

Background: Exposure to particulate matter (PM) is a key public health issue, but effective intervention has not yet been established. A systematic literature review and meta-analysis has been conducted to assess the relationship between the use of air filters, one of the most-studied interventions, and respiratory outcomes in patients with chronic respiratory disease. Methods: Studies that included data on PM level changes and respiratory symptoms or lung function in patients with respiratory diseases were eligible for inclusion. Chronic respiratory diseases included asthma, COPD, bronchiectasis and interstitial lung disease. Effect estimates were quantified separately using the random-effects model. Results: Among 1522 related articles, a total of 18 effect estimates from seven studies were included. Of seven eligible studies, six were randomized controlled trials, and one was a randomized cross-over study. The study population was pediatric asthmatics (n=6) or adult COPD patients (n=1). In all enrolled studies, air filter use reduced indoor PM<sub>2.5</sub> significantly and the model yielded a pooled estimated of absolute difference in PM<sub>2.5</sub> of 11.45 µg/m<sup>3</sup> (95% confidence interval [CI]: 16.01-6.88 µg/m<sup>3</sup>). Air filter use improved predicted forced expiratory volume in one second (FEV<sub>1</sub>) significantly with 3.60% (95% CI: 0.29-6.90%, a random effect model). Air filter use was not associated with a significant change in respiratory symptoms (odds ratio: 0.82; 95% CI: 0.62-1.08). Conclusion: Study evidence indicates a statistically significant association between the use air filters and increased lung function with significant reduction of indoor PM<sub>2.5</sub>.

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## ABSTRACT E-BOOK

Theme: **PM and respiratory health**

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**P-0996**

**Reduced ambient PM<sub>2.5</sub>, better lung function, and decreased risk of chronic obstructive pulmonary disease in adults: a longitudinal cohort study**

**Presenter:** Yacong Bo, Chinese University of Hong Kong, Hong Kong, China

**Authors:** Y. Bo, C. Guo, X. Lao;  
Chinese University of Hong Kong, Hong Kong, CHINA.

Background: Several studies reported that long-term exposure to fine particulate matter (PM<sub>2.5</sub>) was associated with an increased risk of chronic obstructive pulmonary disease (COPD). It remains unclear whether reduced PM<sub>2.5</sub> can decrease the risk of COPD development. We conducted a longitudinal cohort study to investigate the associations of dynamic changes in long-term exposure to ambient PM<sub>2.5</sub> with changes in lung function and the incidence of COPD. Methods: A total of 109,273 adults (aged 18 years or older) were recruited in Taiwan between 2001 and 2014. The change in PM<sub>2.5</sub> ( $\Delta$ PM<sub>2.5</sub>) was defined as the difference between the values measured during follow-up and during the immediately preceding visit. We used a multivariable linear mixed model and time-varying Cox model to investigate the effects of  $\Delta$ PM<sub>2.5</sub> on lung function and the incidence of COPD, respectively. Result: The PM<sub>2.5</sub> concentration in Taiwan increased during 2002-2004 and began to decrease around 2005. Every 5- $\mu$ g/m<sup>3</sup> decrease in the PM<sub>2.5</sub> (i.e.,  $\Delta$ PM<sub>2.5</sub> of 5  $\mu$ g/m<sup>3</sup>) was associated with an increase of 13.67 mL/year (95%CI: 11.96,15.36) in forced expiratory volume in 1 s (FEV<sub>1</sub>), 10.38 mL/year (95%CI: 8.42,12.33) in forced vital capacity (FVC), 35.06 mL/s/year (95%CI: 31.20,38.89) in maximum mid-expiratory flow (MMEF), 0.14%/year (95%CI: 0.01%, 0.17%) in FEV<sub>1</sub>/FVC/year, and a decrease of 11% (95%CI: 5%, 17%) in the risk of COPD development. The stratified and sensitivity analyses generally yielded similar results. Conclusion: An improvement in PM<sub>2.5</sub> air quality is associated with a better level of FEV<sub>1</sub>, FVC, MMEF, and FEV<sub>1</sub>/FVC, and a decreased risk of COPD development.

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**P-0997**

### **Air Pollutants Exposure and the Occurrence of Respiratory Diseases among Residents of Ogbomoso Metropolis**

**Presenter:** Itunu Bisayo Aboderin, Federal University of Agriculture, Abeokuta, Abeokuta, Nigeria

**Authors:** I. B. Aboderin, O. Oguntoke;  
Federal University of Agriculture, Abeokuta, Abeokuta, NIGERIA.

Background/Aim: Air pollution is a major environmental threat and a risk factor for both acute and chronic respiratory diseases. The current surge in the cases of chronic diseases require an investigation of environmental contributors. This study examined the association between air pollutants and respiratory diseases occurrence in Ogbomoso Metropolis, Nigeria. Methods: The concentrations of Carbon dioxide (CO<sub>2</sub>), Sulphur dioxide (SO<sub>2</sub>), Carbon monoxide (CO), Hydrogen sulphide (H<sub>2</sub>S), Volatile organic compounds (VOCs), particulate matter (PM<sub>2.5</sub>, PM<sub>10</sub>) and meteorological parameters (relative humidity, temperature, pressure, wind speed and direction) were measured using Aeroqual gas meter and Windmate respectively at eighty locations in the study area. Information on recorded cases of respiratory health problems were obtained from a State hospital in the study area. Results: The concentrations of CO<sub>2</sub>, SO<sub>2</sub>, CO, H<sub>2</sub>S, VOC, PM<sub>2.5</sub> and PM<sub>10</sub> ranged between 2351±127.1 and 1435±439; 0.7417±0.6554 and 0.1375±0.1245; 45.79±50.48 and 17.67±21.62; 0.7±0.4075 and 0.2833±0.0916; 149±135.1 and 39.83±19.26; 151.5±188.9 and 27.79±5.618; 576.7±943.4 and 109.8±31.98 µg/m<sup>3</sup> respectively. Mean concentrations of CO (17- 45 µg/m<sup>3</sup>), PM<sub>2.5</sub> (27-151 µg/m<sup>3</sup>) and PM<sub>10</sub> (109-576 µg/m<sup>3</sup>) were significantly higher than the WHO permissible limits while others were below the allowable limits. There are significant variations (p<0.05) in the concentrations of all the sampled gases and meteorological parameters in the various locations. Respiratory health problems reported to hospitals between 2015-2019 included upper respiratory tract infection (42.13%), respiratory tract infection (35.56%) and cough (6.25%) among others out of 1600 cases. Conclusion: As demonstrated by the findings of this study, exposure to air pollutants contribute significantly to occurrence of respiratory diseases.

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**P-0998**

### Effects of Fine Particulate Matter on Childhood Asthma Exacerbation in the Philadelphia Metropolitan Region

**Presenter:** Wanyu Huang, Department of Epidemiology and Biostatistics, Dornsife School of Public Health, Drexel University, Philadelphia, United States

**Authors:** W. Huang<sup>1</sup>, L. H. Schinasi<sup>2</sup>, C. Kenyon<sup>3</sup>, K. Moore<sup>4</sup>, S. Melly<sup>4</sup>, Y. Zhao<sup>4</sup>, M. Maltenfort<sup>3</sup>, A. J. De Roos<sup>2</sup>;

<sup>1</sup>Department of Epidemiology and Biostatistics, Dornsife School of Public Health, Drexel University, Philadelphia, PA, <sup>2</sup>Department of Environmental and Occupational Health, Dornsife School of Public Health, Drexel University, Philadelphia, PA, <sup>3</sup>Children's Hospital of Philadelphia, Philadelphia, PA, <sup>4</sup>Urban Health Collaborative, Dornsife School of Public Health, Drexel University, Philadelphia, PA.

**Background:** Fine particulate matter air pollution (PM<sub>2.5</sub>) is a known risk factor for asthma exacerbation. We aimed to describe the local association between PM<sub>2.5</sub> and asthma exacerbation in the Philadelphia region, and to evaluate whether the effect is modified by children's characteristics or other environmental exposures. **Methods:** We conducted a time-stratified case-crossover study of pediatric asthma exacerbation (age ≤18 years) occurring from 2011-2014, identified through electronic health records (EHR) of the Children's Hospital of Philadelphia (CHOP) Care Network. Modeled, census-tract level estimates of daily PM<sub>2.5</sub> concentrations were acquired from the EPA's Downscaler model. We applied conditional logistic regression to estimate the association within warm (Apr-Sep) and cold (Oct-Mar) months, with PM<sub>2.5</sub> level modeled as a natural cubic spline (3 degrees of freedom), and adjusting for temperature, relative humidity, and holidays. We evaluated unlagged effects (i.e., PM<sub>2.5</sub> levels on the same day as the exacerbation) and effects lagged up to 5 days. **Results:** There were 54,632 asthma exacerbation events during the study period, with the majority occurring among male (60.75%) and black, non-Hispanic (58.99%) children. We found a positive association between PM<sub>2.5</sub> and asthma exacerbation in both warm months (odds ratio [OR] comparing 90<sup>th</sup> to 25<sup>th</sup> percentile = 1.09, 95% confidence interval [CI]: 1.01-1.18, lag05) and cold months (OR, 90<sup>th</sup> vs. 25<sup>th</sup> percentile = 1.08, 95% CI: 1.04-1.12, lag0). During cold months, risk increases started from the lowest pollutant concentrations. Results were robust to multi-pollutant modeling and adjustment for additional covariates, and we found no effect modification by children's characteristics (e.g., age, race/ethnicity, allergic rhinitis, eczema). During warm months, the PM<sub>2.5</sub> effect was higher on days with detected tree pollen. **Conclusion:** We found a positive association between PM<sub>2.5</sub> and asthma exacerbation. Our results suggest that even small reductions in fine particulate matter air pollution may reduce clinical visits for asthma exacerbation.

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**P-0999**

**Iron and copper in fine particulate matter, reactive oxygen species concentration in lung epithelial fluid and respiratory health: A population-based cohort study**

**Presenter:** Zilong Zhang, Public Health Ontario, Toronto, Canada

**Authors:** Z. Zhang<sup>1</sup>, S. Weichenthal<sup>2</sup>, J. C. Kwong<sup>3</sup>, R. T. Burnett<sup>4</sup>, M. Hatzopoulou<sup>5</sup>, M. Jerrett<sup>6</sup>, A. van Donkelaar<sup>7</sup>, L. Bai<sup>3</sup>, R. V. Martin<sup>7</sup>, R. Copes<sup>1</sup>, H. Lu<sup>3</sup>, P. Lakey<sup>8</sup>, M. Shiraiwa<sup>9</sup>, H. Chen<sup>1</sup>;

<sup>1</sup>Public Health Ontario, Toronto, ON, CANADA, <sup>2</sup>McGill University, Montreal, QC, CANADA, <sup>3</sup>ICES, Toronto, ON, CANADA, <sup>4</sup>Health Canada, Ottawa, ON, CANADA, <sup>5</sup>University of Toronto, Toronto, ON, CANADA,

<sup>6</sup>University of California Los Angeles, Los Angeles, CA, <sup>7</sup>Dalhousie University, Halifax, NS, CANADA,

<sup>8</sup>University of California, Irvine, CA, <sup>9</sup>University of California Irvine, Irvine, CA.

**Background:** Metal components in fine particulate matter (PM<sub>2.5</sub>) originating from non-tailpipe emissions may play important roles in underlying its adverse effects on respiratory health due to the potential in generating reactive oxygen species (ROS). However, relevant epidemiological evidence is scarce. **Methods:** We investigated the associations of long-term exposure to iron (Fe) and copper (Cu) in PM<sub>2.5</sub> (two metal components mainly originating from non-tailpipe emissions), and their combined impact on the concentration of reactive oxygen species (ROS) with respiratory health in a population-based cohort of ~0.8 million adults in Toronto, Canada. Incidence of asthma, chronic obstructive pulmonary disease (COPD) and respiratory mortality was ascertained using health administrative databases. Exposures to Fe and Cu in PM<sub>2.5</sub> and their combined impact on ROS were estimated using land use regression models. We used mixed-effects Cox regression models to examine the associations between the exposures and health outcomes. **Results:** We found positive associations between long-term exposure to Fe, Cu and ROS, and the risks of all three respiratory outcomes. The associations were more robust for COPD and respiratory disease death than for asthma. In terms of exposures, we observed stronger associations for ROS than for Fe or Cu individually. For example, the hazard ratios (95% confidence interval) for respiratory death associated with an interquartile-range increment in Fe, Cu and ROS were 1.046 (1.034, 1.058), 1.020 (1.008, 1.033) and 1.076 (1.058, 1.094), respectively. In two-pollutant models, adjustment for NO<sub>2</sub> attenuated the associations while PM<sub>2.5</sub> had little influence. **Conclusions:** Long-term exposure to Fe and Cu in PM<sub>2.5</sub> and estimated ROS concentration in lung fluid was associated with increased incidence of respiratory outcomes, particularly COPD and respiratory mortality, suggesting adverse respiratory effects of non-tailpipe emitted air pollution.

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**P-1000**

**Short term effects of air pollution on hospital admission for respiratory diseases among the pediatric and elderly populations, a time-series study**

**Presenter:** Hyun-mook Lim, Department of Preventive Medicine, Seoul National University, College of Medicine, Seoul, Korea, Republic of

**Authors:** H. Lim<sup>1</sup>, D. Lee<sup>2</sup>, J. Oh<sup>3</sup>, H. Bae<sup>4</sup>, Y. Lim<sup>5</sup>, Y. Hong<sup>6</sup>;

<sup>1</sup>Department of Preventive Medicine, Seoul National University, College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Institute of Environmental Medicine, Seoul National University Medical Research Center, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Ewha Womans University College of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>4</sup>Korea Institute for Environmental Policy Evaluation, Seoul, KOREA, REPUBLIC OF, <sup>5</sup>Department of Public Health, Copenhagen University, Seoul, KOREA, REPUBLIC OF, <sup>6</sup>Department of Preventive Medicine, Seoul National University, Seoul, KOREA, REPUBLIC OF.

**Background:** PM<sub>2.5</sub> can cause a variety of diseases, such as respiratory diseases and cardiovascular diseases. Although studies have been conducted between hospital admission due to ultra-fine dust and respiratory diseases in Korea, there are limitations in applying the results to Korea as it was performed limitedly to some regions.

**Methods:** National Health Insurance by Using the Health Insurance Data Sharing Service, among the registered persons to the National Health Insurance in 7 large cities from January 1, 2008 to December 31, 2016, the number of patients hospitalized for COPD, asthma, and total respiratory disease was obtained. The air pollution information was used for PM<sub>2.5</sub> concentrations estimated by chemical transport model. Using the generalized additive model, time series analysis was carried out between hospital admission for air pollutants and respiratory diseases in each of the 7 cities, and the results of each city were analyzed.

**Results:** Ultrafine dust on the day was significantly associated with COPD and total respiratory disease in the pediatric population, and asthma in the elderly population.

**Conclusions:** There is a significant association between ultrafine dust exposure and respiratory disease in the pediatric and elderly populations in seven large cities in Korea. In the future, it is expected that research will be conducted to identify factors that explain the difference in the size of associations between cities.

**Keywords:** pm 2.5; respiratory disease; asthma; chronic obstructive pulmonary disease; National Health Insurance data

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**P-1001**

**Performance Evaluation of a Low Cost Air Quality Sensor over a Wide Concentration Range**

**Presenter:** Darpan Das, Johns Hopkins University, Baltimore, United States

**Authors:** D. Das, G. Ramachandran;  
Johns Hopkins University, Baltimore, MD.

The recent research advancements in the field of chemical sensors, distributed sensing and wireless networking have led to development of several low-cost optical aerosol sensors. These sensors are based on the principle of particle light scattering, and are dependent on several parameters - temperature, relative humidity, particle size, and particle concentration. However, the linearity of the response of these sensors over a wide concentration range has not been well studied. We evaluated a low-cost particulate matter measuring sensor (BlueSky Air Monitor Model 8143 TSI Inc) in different environments. The particulate matter concentration of PM<sub>10</sub>, PM<sub>4</sub>, PM<sub>2.5</sub> and PM<sub>1</sub> were compared with reference measurements using a Dust Trak Model 8534 TSI Inc- a widely used light scattering instrument. Several methodologies were developed to generate wide concentration of aerosols. The concentration ranges for the lower end were created in indoor environmental conditions (0.003-0.004 mg/m<sup>3</sup>) and for the higher end were created in a chamber with e-cigarette vaping (0.006- 30 mg/m<sup>3</sup>). The intermediate concentrations (0.003- 2 mg/m<sup>3</sup>) were obtained using a Concentrated Air Particulate System (CAPS) consisting of a virtual impactor setup that magnifies ambient concentration by an adjustable enrichment factor between 5-20. Results of the present study indicate that the BlueSky low cost sensor compares well with the reference instrument ( $R^2 = 0.92$ ; Intercept  $\sim 0$ ; Slope = 0.75). The novel design of the CAPS including maintaining a uniform temperature and humidity makes it an ideal design for characterizing low cost sensors over a wide range of concentrations. The findings of the present study can be used to design more robust methodologies for laboratory testing for low cost air quality sensors at different concentrations.

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**P-1002**

**Model based ragweed pollen counts predict sleep difficulty in allergy immunotherapy patients in small clinic in Southeastern Michigan, USA**

**Presenter:** Peter S Larson, University of Michigan, Ann Arbor, United States

**Authors:** P. S. Larson, E. Bennion, A. Baptist, M. O'Neill, A. Steiner, C. Gronlund;  
University of Michigan, Ann Arbor, MI.

**Introduction:** Allergic rhino-conjunctivitis impacts up to a quarter of the world's population. Symptoms include sneezing, rhinorrhea, pruritus, and sleep disturbance. Ragweed (*Ambrosia artemisiifolia*) is a plant common to North America and an important allergen. Predicting allergic symptoms associated with ragweed has largely relied on crude and/or expensive methods of measuring airborne pollen counts. We apply a novel model-based raster of predicted pollen counts to test associations with self-reported symptoms of allergic rhino-conjunctivitis among patients receiving immunotherapy for pollen allergies at a University-based allergy clinic in the U.S. **Methods:** Patients receiving immunotherapy injections for seasonal allergies were enrolled in the study on site. Participants filled out a brief intake survey on allergic and symptomatic profiles, sleep quality, housing quality and demographics and then completed a daily sleep quality survey by email for 21 consecutive days. Using the date and GPS location of survey response, ragweed pollen counts were extracted from a model-based raster (25km pixels) of daily predicted pollen counts. Associations between predicted pollen counts and a composite index of sleep quality were estimated using ordinal logistic regression models. **Results:** 50 people were enrolled in the study; 26 (52%) were female. The mean age was 37.9 years. 96% of participants had lived in the area for more than a year. 28 (56%) of respondents were receiving immunotherapy for ragweed pollen. Pollen counts (in 1000s) the previous day was associated with severe sleeping problems (OR 1.83 (1.26, 2.66)), even when controlling for travel to other regions and age of respondent. Impacts on sleep quality were not limited to only persons known to have ragweed allergies. **Conclusion:** Model based predicted ragweed pollen counts can be used to forecast symptoms associated with allergic rhinitis in people with disease severe enough to receive immunotherapy.

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**P-1003**

### **Exposure to Fine Particulate Matter and Lung Function among Response and Cleanup Workers of the Deepwater Horizon Oil Spill**

**Presenter:** Dazhe Chen, Department of Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, United States

**Authors:** D. Chen<sup>1</sup>, K. Lawrence<sup>2</sup>, P. Stewart<sup>3</sup>, G. Pratt<sup>4</sup>, M. Stenzel<sup>5</sup>, R. Kwok<sup>2</sup>, L. Engel<sup>1</sup>, D. Sandler<sup>2</sup>; <sup>1</sup>Department of Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, <sup>2</sup>National Institute of Environmental Health Sciences, Durham, NC, <sup>3</sup>Stewart Exposure Assessments, LLC, Arlington, VA, <sup>4</sup>Division of Environmental Health, University of Minnesota, Minneapolis, MN, <sup>5</sup>Exposure Assessment Applications, LLC, Arlington, VA.

Background Inhalation exposure to fine particulate matter (PM<sub>2.5</sub>) is linked to reduced lung function, but no study has examined the relationship among oil spill workers. During the 2010 Deepwater Horizon (DWH) disaster, controlled burning (flaring at the wellhead and in situ burning offshore) was performed to remove oil from the water. Workers near the sites of combustion were potentially exposed to increased levels of PM<sub>2.5</sub>. We investigated the association between estimated PM<sub>2.5</sub> from burning and lung function measured 1-3 years after the DWH disaster. Methods Data came from the GuLF Study, a prospective cohort study of DWH disaster oil spill workers. We examined workers who participated in response and cleanup activities on water and had their lung function measured via spirometry 1-3 years after the spill (N=1,826). Exposure to PM<sub>2.5</sub> was estimated using AERMOD to develop 1-hour concentrations. Emissions data were linked to workers' detailed work histories collected at enrollment. We evaluated forced expiratory volume in 1 second (FEV<sub>1</sub>; mL), forced vital capacity (FVC; mL), and the ratio (FEV<sub>1</sub>/FVC; %) in relation to PM<sub>2.5</sub> exposure, using multivariable linear regression. Results Compared to the reference group, those with low and high PM<sub>2.5</sub> exposure had reduced FEV<sub>1</sub> (low vs. no exposure: -64 mL, 95% CI: -128, -0.2; high vs. no exposure: -128 mL, 95% CI: -276, -21) and FEV<sub>1</sub>/FVC (low vs. no exposure: -0.6, 95% CI: -1.4, -0.1; high vs. no exposure: -1.1, 95% CI: -2.8, -0.6). The effect on the ratio was stronger among people with pre-existing lung diseases. Conclusions Exposure to PM<sub>2.5</sub>, over a limited number of days, from burning is associated with reduced lung function among oil spill workers, with possibly stronger effects among people with known lung diseases before the spill.

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**P-1004**

**Health impact of environmental pollution and protective effect of masks in Japan**

**Presenter:** Kazunari Onishi, St.Luke's International University, Chuo-ku, Tokyo, Japan

**Authors:** K. Onishi<sup>1</sup>, M. Nojima<sup>2</sup>;

<sup>1</sup>St.Luke's International University, Chuo-ku, Tokyo, JAPAN, <sup>2</sup>The University of Tokyo, Minato-ku Tokyo, JAPAN.

**Background/Aim:** The health effects of cross-border air pollution and Asian dust (AD) originating from drylands, such as the Gobi Desert and Taklamakan Desert, have been a concern in Asia. To overcome the global issue of air pollution, wearing masks is recommended. However, the protective effect of wearing masks are unclear. We assessed the health impact of air pollution and the protective effect of masks. **Methods:** We administered diary-style web-based questionnaires to 48 volunteers who lived in Yonago City in Japan between 2015 and 2016. The results were evaluated using a 4-level subjective symptom score (29 variables include respiratory, nasal, ocular, and skin symptoms), history of the disease, and preventive behaviors (e.g., mask use). Association between the symptom scores and analyzed components for AD, splash sea salt, sulfate aerosol, nitrate aerosol, Organic carbon, Black carbon were assessed using a linear mixed model. Data regarding climate (temperature, humidity, and atmospheric pressure) and environmental factors were used as covariates. Regarding symptom prevention measures, we measured particle leakage rates of participants' masks. **Results:** The association between respiratory symptoms and sulfate aerosol was significant (P trend=0.013, odds ratio [OR] of the highest quartile [Q4] vs. the lowest [Q1]=1.34, 95% CI=1.10 to 1.65). The relationship between symptoms and sulfate aerosol was also significant in the mask-wearing groups. Even with N95 or virus filtration efficiency masks, the leakage rate was high, suggesting that fitting is more important in addition to mask filter quality. **Conclusions:** We found that exposure to air pollution increased the risk of adverse subjective symptoms. We also found that it is essential to wear a mask that fits the facial features without a gap between the face and mask.

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**P-1005**

### **Cross-Shift Changes in Pulmonary Function and Occupational Exposure to Particulate Matter among E-Waste Workers in Ghana**

**Presenter:** Zoey Laskaris, University of Michigan, Ann Arbor, United States

**Authors:** Z. Laskaris<sup>1</sup>, J. Fobil<sup>2</sup>, S. Batterman<sup>1</sup>, M. O'Neill<sup>1</sup>, T. Robins<sup>1</sup>;  
<sup>1</sup>University of Michigan, Ann Arbor, MI, <sup>2</sup>University of Ghana, Accra, GHANA.

**Objectives:** To examine the association between cross-shift changes in pulmonary function (PF) and personal inhalation exposure to particulate matter (PM) among informal electronic-waste (e-waste) recovery workers with substantial occupational exposure to airborne pollutants from burning and other e-waste recovery activities.

**Methods:** Using a cross-shift design, pre- and post-shift spirometry and concomitant personal inhalation exposure to personal PM (sizes <1, < 2.5, and the coarse fraction, 10-2.5  $\mu\text{m}$  in aerodynamic diameter) were measured among e-waste workers (n=142) at the Agbogbloshie e-waste site and a comparison population (n=65) in Accra, Ghana. Linear mixed models measured associations between percent changes in PF and personal PM; self-reported exposures; and (image-based) activities.

**Results:** Following 4 hour (+ 44 min) work-shifts, decelerations in forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) per hour were observed among e-waste workers (2.2% and 1.2%, respectively) and the reference population (1.5% and 0.8%, respectively). Despite significantly higher concentrations of personal PM (all sizes) among e-waste workers, increases in PM (all sizes) were not associated with decelerations in PF in either group. Indicative of a lag-effect, e-waste workers who worked "yesterday" had a larger decrement in FVC (2.4%, 95%CI: -4.04, -0.81) in comparison to those that did not work "yesterday".

**Conclusions:** The acute respiratory-related health effects due to PM exposure among e-waste workers remains unclear. Limitations included potential selection bias due to the "healthy worker" effect and challenges in eliciting valid PF assessments among e-waste workers, short shift duration, the lack of an inception cohort, and inability to measure pre-shift PF among e-waste workers who sleep at the site (89%). Cross-shift studies are useful for generating robust evidence in traditional work settings; however, they need to be adapted to informal settings where workers do not "clock-in" at the start of a shift.

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**P-1006**

**Impact of traffic origin particulate matter and its chemical constituents on oxidative potential**

**Presenter:** Suman Yadav, Indian Institute of Technology Bombay, Mumbai, India

**Authors:** S. Yadav, N. Raparathi, A. Khare, H. C. Phuleria;  
Indian Institute of Technology Bombay, Mumbai, INDIA.

Currently high particulate matter (PM) levels are observed in most of the urban cities of India and one of the major sources of emissions are vehicle plying on roads. Exposure to PM and its components have been linked with various disorders and has been associated with the ability to produce free radicals and reactive oxygen species, known as “oxidative potential” of PM and is proposed to be one of the most relevant indicators of PM toxicity. In the present study we examined the oxidative potential of PM collected at roadside (RS) and urban background (BG) site using dithiothreitol (DTT) assay. PM measurements were carried out simultaneously at both the sites in Mumbai on seven consecutive days, covering both morning (7:00-11:00 AM) and afternoon (12:00-4:00 PM) hours in May 2018 using low volume sampler (Mini vol, Airmetrics, USA flow rate of 5 l min<sup>-1</sup>). The collected samples was analysed for carbonaceous aerosols (OC, EC, and WSOC) and trace elemental components of PM. The average mass concentration at RS and BG during morning rush hours was 80±23 µgm<sup>-3</sup> and 43±10 µgm<sup>-3</sup> while in the afternoon it was 84±14.8 µgm<sup>-3</sup> and 53±13 µgm<sup>-3</sup>, respectively. The average OC, EC levels at RS were 19.8±8.8 µgm<sup>-3</sup>, 16.5±5.1 µgm<sup>-3</sup> (morning), 21.8±9.4, 19.1±13.5 µgm<sup>-3</sup> (afternoon), whereas at BG site it was 16.5±9.9 µgm<sup>-3</sup>, 2.5±2.1 µgm<sup>-3</sup> (morning), 16±13 µgm<sup>-3</sup>, 3.5±3.4 µgm<sup>-3</sup> (afternoon) respectively. The corresponding WSOC levels at RS and BG were 11% and 19% during morning period while during afternoon it was 15% and 27% of OC, respectively. The volume normalised DTT activity (DTTv) was higher at the roadside (1.12±0.54 nmol min<sup>-1</sup> m<sup>-3</sup>) during morning period than at background (0.75±0.6 nmol min<sup>-1</sup> m<sup>-3</sup>). Thus, our first results suggest that exposure to PM from traffic related emissions may pose substantial risk to a large population in urban areas.

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**P-1007**

**Indoor fine particulate matter and stove-use characteristics in homes heated by wood stoves: results from control homes in the KidsAIR randomized trial**

**Presenter:** Ethan S Walker, University of Montana, Missoula, United States

**Authors:** E. S. Walker<sup>1</sup>, C. W. Noonan<sup>1</sup>, B. B. Boyer<sup>2</sup>, E. Erdei<sup>3</sup>, S. E. Hopkins<sup>2</sup>, J. Lewis<sup>3</sup>, E. O. Semmens<sup>1</sup>, P. Smith<sup>1</sup>, D. Ware<sup>1</sup>, T. J. Ward<sup>1</sup>;

<sup>1</sup>University of Montana, Missoula, MT, <sup>2</sup>Oregon Health & Science University, Portland, OR, <sup>3</sup>University of New Mexico, Albuquerque, NM.

**Background/Aim:** Household heating using wood stoves is common practice in many rural areas of the United States (US) and can lead to high concentrations of indoor fine particulate matter (PM<sub>2.5</sub>); yet there is limited research on household and behavioral factors that contribute to PM<sub>2.5</sub> levels in such homes. Our aims were to characterize PM<sub>2.5</sub> concentrations, evaluate household and stove-use characteristics that impact PM<sub>2.5</sub>, and assess the feasibility of interventions to lower PM<sub>2.5</sub> in rural US homes that used wood stoves for heating. **Methods:** KidsAIR was a three-arm post-only randomized trial in wood stove households from three study areas. We measured indoor concentrations of PM<sub>2.5</sub> over a 6-day sampling period during the winter and assessed household and stove-use characteristics. As the two intervention arms (education and air-filtration) were designed to impact PM<sub>2.5</sub> concentrations, we focused these analyses on homes in the control arm (no intervention, n=93).

**Results:** In preliminary analyses, the mean indoor PM<sub>2.5</sub> concentration across all control homes was 28 µg/m<sup>3</sup> (standard deviation [sd]=68), with higher concentrations in Alaska sites (47 µg/m<sup>3</sup>, sd=95, n=10) than Navajo Nation (NN) or Montana sites (29 µg/m<sup>3</sup>, sd=76, n=23; 25 µg/m<sup>3</sup>, sd=59, n=60). Stoves were often over 5 years old (54%) and of poor quality. More participants in NN (35%) reported heavy burning during PM<sub>2.5</sub> measurement than Alaska (10%) or Montana (12%), and more participants in Alaska (70%) and NN (83%) burned wood <3 months after collection than in Montana (25%). Mean wood moisture content was lower in NN (6%) than Alaska (14%) and Montana (13%).

**Conclusions:** We observed poor stove quality, inconsistent burn practices, and moderately high PM<sub>2.5</sub> concentrations inside rural US homes that heated with wood stoves. Our findings highlight the need for, and the complex nature of, culturally- and regionally-appropriate interventions to reduce indoor air pollution in rural wood-burning homes.

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**P-1008**

### **Public Health Applications of Historical Smoke Forecasts: An Evaluation of Archived BlueSky data for the Coterminous United States, 2015**

**Presenter:** Ryan Michael, Centers for Disease Control and Prevention, Atlanta, United States

**Authors:** R. Michael, A. Vaidyanathan;  
Centers for Disease Control and Prevention, Atlanta, GA.

**Background/Aims:** Smoke from wildland fires is a significant public health concern at local, regional, and international scales. Exposure to wildland fire smoke has been linked to adverse health outcomes, including cardiorespiratory illnesses and deaths. Moreover, increases in the severity and frequency of large fires necessitate elucidation of associated effects on air quality and public health to facilitate the development of risk communication tools. We evaluated grid-based North American Mesoscale (NAM) modeled predictions from the BlueSky modeling framework using existing monitor data from the Air Quality System (AQS), and developed surveillance summaries describing population-level smoke exposures. **Methods:** We evaluated NAM 4-km smoke data against AQS-based PM<sub>2.5</sub> measurements for 2015. We analyzed correlations on days above specific smoke thresholds (0, 2, 5, 10, 15, 20, and >20 ug/m<sup>3</sup> PM<sub>2.5</sub>) to benchmark model performance at various concentration levels. We generated population-level smoke measures at the census tract and county scale, summarized total and person-days of smoke exposure, and estimated regional and urban-rural differences in smoke impacts for 2015. **Preliminary Results:** Assessing correlations between the NAM data and the AQS data indicated moderate associations between the datasets, with better model performance observed at higher smoke day thresholds (Kendall's [tau-b] correlation coefficient: 0.47, for smoke days (days with PM<sub>2.5</sub> >20ug/m<sup>3</sup>). During 2015, 2088 (67%) U.S. counties had at least one smoke day, resulting in 803M person-days of exposure. Western states (WA, OR, CA, ID, NV, UT, AZ, MT, WY, CO, and NM) had 310 (74%) counties with at least one major smoke event day over the same period, resulting in 449M person-days of exposure. **Conclusion:** From a public health perspective, wildland fire smoke exposure data are unavailable at consistent spatiotemporal scales. This evaluation demonstrates that archived smoke forecast data can augment existing exposure modeling efforts to identify at-risk areas and populations vulnerable to smoke exposure.

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**P-1009**

### **Outdoor Air Quality Awareness, Perceptions, and Behaviors among U.S. Adolescents**

**Presenter:** Katie M Lynch, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, United States

**Authors:** K. M. Lynch, M. C. Mirabelli;  
National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA.

**Background/Aim:** Ambient air pollution exposure is associated with adverse health effects. Despite the risks to their health, little is known about air pollution-related awareness and behaviors among children and adolescents. We aimed to add to the information on this subject by assessing U.S. adolescents' perceptions and knowledge about air quality and their behaviors intended to reduce air pollution exposure, and whether they vary by demographic characteristics.

**Methods:** We analyzed data from the Porter Novelli Public Services YouthStyles survey, a nationally representative survey of U.S. adolescents aged 12-17 years. In survey years 2015-2018, a total of 3,547 adolescents self-reported awareness, perceptions, and behaviors related to air pollution. We calculated weighted percentages of respondents reporting each aspect of air quality awareness, perception, and behaviors overall and by categories of age, gender, parental education, geographic location, and survey year.

**Results:** Overall, an estimated 81% of U.S. adolescents thought outdoor air pollution could impact health, 52% thought there were things they could do to limit their or their family's exposure, 19% were aware of air quality alerts, 46% of those who thought or were informed air quality was bad did something differently, and 19% always or usually avoided busy roads to reduce air pollution exposure; differences were reported across levels of parent's level of education and by geographic location.

**Conclusions:** Among U.S. adolescents, awareness that air pollution could impact health was relatively high. However, gaps were found in the awareness of the potential impacts and awareness of air quality alerts, the perception that they could limit exposure, and the engagement in behaviors to reduce exposure. Based on the differences found by parental education, disparities may exist by socioeconomic status. These results can be used to inform interventions that increase awareness and behaviors to reduce air pollution exposures among U.S. adolescents.

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**P-1010**

### Using satellite remote sensing to estimate intra-urban disparities in air pollution health impacts in Washington DC

**Presenter:** Maria D Castillo, The George Washington University, Milken Institute School of Public Health, Washington, United States

**Authors:** M. D. Castillo, S. C. Anenberg;  
The George Washington University, Milken Institute School of Public Health, Washington, DC.

**Background:** Ambient air pollution in cities is of growing concern as urbanization and economic development continue, yet many cities lack information on local exposure levels and health impacts, both of which are needed to make evidence-based mitigation decisions. Remote sensing and Earth system models, though widely used for assessing air pollution health impacts globally, could be of particular value for targeted assessment of air pollution exposures and health impacts in cities where there is high population density but sparse ground-based monitoring stations.

**Methods:** We used high resolution data inputs to assess intra-urban heterogeneity in PM<sub>2.5</sub>-attributable health impacts between 2000 and 2015, using Washington DC as a case study. Data inputs included ~1km x 1km satellite-derived global population and PM<sub>2.5</sub> estimates; neighborhood-scale, age-standardized baseline disease rates from the DC Department of Health (DOH) and the CDC 500 Cities project; and PM<sub>2.5</sub> concentration-response functions for chronic obstructive pulmonary disease, lung cancer, stroke and asthma emergency department visits from epidemiological meta-analyses. We also compare the spatial distribution estimated using rates obtained from the DOH versus a modeling approach used by the CDC 500 Cities project

**Results:** Results suggest that although PM<sub>2.5</sub> concentrations have been decreasing in DC over time, the associated health burden continues to be unevenly distributed across the city, affecting mostly the neighborhoods with high proportions of vulnerable populations. These results support the findings from the Health Equity Report for the District of Columbia 2018, which suggests that there is a high degree of environmental and health inequality within the city.

**Conclusions:** Urban-scale health impact assessments could help inform city-specific air pollution mitigation strategies aimed at protecting the public and reducing health disparities within the city. This case study for Washington, DC, can provide a model for estimating intra-urban air pollution-attributable health risks in other cities in the U.S. and worldwide.

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**P-1011**

**Street Vendors in Kampala, Uganda: Traffic-related Air Pollution Exposure and Adverse Health Experiences.**

**Presenter:** Vincent Nsereko, Makerere University, Kampala, Uganda

**Authors:** V. Nsereko;  
Makerere University, Kampala, UGANDA.

**BACKGROUND:** Health effects due to street vending have limited epidemiological research. Street vending is a dominant occupation in developing cities and individuals engaged in this venture are exposed to high levels of traffic related air pollution (TRAP) per mode of operation. **OBJECTIVE:** To establish the TRAP exposure experiences of street vendors in Kampala and associated adverse respiratory, cardiovascular, reproductive and musculoskeletal health effects. **METHODS:** A cross-sectional study was conducted among 418 street vendors operating in commercial areas of Kampala. Exposure to TRAP was categorized as low, moderate and high on the basis of street vending activity levels and self-reported traffic density in vending areas. Low-cost air sensors were used to monitor air quality in the vending areas over a three-day period with levels of PM<sub>2.5</sub> found to exceed the WHO recommended levels. **RESULTS:** Street vendors that reported high traffic density in vending areas had 2.68(95%CI: 1.47, 4.88), 2.91(95%CI: 1.18, 7.14) and 1.79(95%CI: 1.03, 3.11) increased odds of cough and catarrh, compared to their counterparts who reported low traffic density in vending areas. Moderate vending activity levels were associated with 2.25(95%CI: 1.00, 5.05) increased odds of sharp chest pains compared to low vending activity levels. Street vendors who reported moderate and high traffic density in vending areas had 3.00(95%CI: 1.23, 7.36) and 4.24(95%CI: 1.73, 10.38) increased odds of difficulty in walking. Moderate TRAP exposure was associated with 1.76(95%CI: 1.11, 2.79), 1.02(95%CI: 1.02, 2.70) and 2.17(95%CI: 1.09, 4.31) increased odds of catarrh, sneezing and difficulty in kneeling respectively. **CONCLUSION:** street vending and air pollution exposure was found to be associated with various adverse health outcomes in this population. Genome-wide association studies exploring the biological mechanisms of respiratory and cardiovascular injury from exposure to air pollution among street vendors is recommended to help better tailor treatment and preventive strategies.

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**P-1014**

### **Disparities in Growth of Low-Cost Air Pollution Sensor Deployment**

**Presenter:** Chris Lim, Yale University, New Haven, United States

**Authors:** C. Lim, K. Fong, M. Bell;  
Yale University, New Haven, CT.

Background: Low-cost air quality sensors offer the capability to measure and generate a large volume of real-time air pollution data. Two of the most popular low-cost sensors are PurpleAir, a stationary outdoor/indoor monitor; and AirBeam, a portable monitor paired with a smartphone app. Despite the low cost of entry, the popularity and usage of low-cost air quality sensor usage are not yet quantified, and it is unclear where they are being deployed. Methods: Geocoded data from PurpleAirs and AirBeams were downloaded and processed through their respective application programming interfaces. We examined the growth of the numbers of outdoor PurpleAir units and AirBeam mobile sampling sessions over time around the globe. We also evaluated whether there exist disparities in the number of low-cost sensors in the U.S across geographic, racial, and socioeconomic factors at the census tract-level. Results: In 2017 there were approximately 800 outdoor PurpleAir units, and by the end of 2019 this number grew to 5700 units. The total number of AirBeam sampling sessions grew from 1300 in 2013 to more than 80000 by 2019. Most of the sensors were deployed in North America and Europe, although there was significant growth in Africa and Asia in 2019. In the U.S., PurpleAirs were mostly located in the Western states, and within census tracts with high socioeconomic status and majority white populations. AirBeam sessions were mostly carried out in densely populated census tracts and in areas with lower median incomes. Conclusions: The rapid growth of the low-cost sensor deployment across the globe highlights the interest in high-resolution air pollution data. In the U.S., there were noticeable disparities across race, socioeconomic status, and urbanicity for low-cost sensor usage. The observed differences between PurpleAir and AirBeam suggest that their user-profiles and usage purpose are likely to differ.

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**P-1015**

**Imputation methods for addressing missing data in short-term monitoring of air pollutants**

**Presenter:** Steven J Hadeed, The University of Arizona College of Public Health, Tucson, United States

**Authors:** S. J. Hadeed<sup>1</sup>, M. K. O'Rourke<sup>1</sup>, J. L. Burgess<sup>1</sup>, R. B. Harris<sup>1</sup>, R. A. Canales<sup>2</sup>;

<sup>1</sup>The University of Arizona College of Public Health, Tucson, AZ, <sup>2</sup>The University of Arizona, Tucson, AZ.

**Background:** Monitoring of environmental contaminants is a critical part of exposure sciences and epidemiological research. Missing data are often encountered when performing short-term monitoring (<24hr) of air pollutants with real-time monitors, especially in resource-limited areas. Approaches for handling consecutive periods of missing and incomplete data in this context remain unclear. Our aim is to evaluate existing imputation methods for handling missing data for real-time monitors operating for short durations. **Methods:** In a current field-study, real-time particulate monitors were placed outside of 20 households for 24-hours. Missing data was simulated at four consecutive periods of missingness (20%, 40%, 60%, 80%). Univariate (Mean, Median, Last Observation Carried Forward, Kalman Filter, Random, Markov) and multivariate time-series (Predictive Mean Matching, Row Mean Method) methods were used to impute missing concentrations, and performance was evaluated using five error metrics (Absolute Bias, Percent Absolute Error in Means, R<sup>2</sup> Coefficient of Determination, Root Mean Square Error, Mean Absolute Error). **Results:** Univariate methods of Markov, random, and mean imputations performed best, yielding 24-hour mean concentrations with low error and high R<sup>2</sup> values across all levels of missingness. When evaluating error metrics minute-by-minute, Kalman Filters, median, and Markov methods performed well at low levels of missingness (20-40%). However, at higher levels of missingness (60-80%), Markov, random, median, and mean imputation performed best on average. Multivariate imputation methods performed worst across all levels of missingness. **Conclusion:** Epidemiological studies often report pollutant concentration in relationship to their potential health effect by averaging minute or hourly concentrations over 24-hours. However, when more than 25% of data is missing, daily average pollutant concentrations cannot be reliably computed. Univariate imputation may provide a reasonable solution to addressing missing data for short-term monitoring of air pollutants. Further efforts are needed to evaluate imputation methods that are generalizable across a diverse range of study environments.

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**P-1016**

**Measuring and modelling exposure to air pollution with citizen science: the CurieuzeNeuzen project**

**Presenter:** Evi Dons, Hasselt University, Hasselt, Belgium

**Authors:** E. Dons<sup>1</sup>, S. De Craemer<sup>2</sup>, H. Huyse<sup>3</sup>, J. Vercauteren<sup>4</sup>, D. Roet<sup>4</sup>, F. Fierens<sup>4</sup>, W. Lefebvre<sup>5</sup>, C. Stroobants<sup>4</sup>, F. Meysman<sup>2</sup>;

<sup>1</sup>Hasselt University, Hasselt, BELGIUM, <sup>2</sup>University of Antwerp, Antwerp, BELGIUM, <sup>3</sup>KU Leuven, Leuven, BELGIUM, <sup>4</sup>Flanders Environment Agency, Antwerp, BELGIUM, <sup>5</sup>VITO, Mol, BELGIUM.

**Background/Aim:** In May 2018, one of the biggest citizen science projects on air pollution was conducted in the region of Flanders, Belgium: the CurieuzeNeuzen ('Curious Noses') project. In this project, 20,000 people measured NO<sub>2</sub> concentrations at the façade of their residence. The aims of the project were twofold: (1) validation of the air pollution model ATMO-Street on a very high spatial scale, (2) raising awareness on air pollution and have a societal impact. Furthermore, the extensive measurement set can be used for exposure assessment. **Methods:** Residence-based NO<sub>2</sub> can be considered a proxy for personal NO<sub>2</sub> exposure. In a subsample of 5,000 participants, the residence-based NO<sub>2</sub> was combined with the ATMO-Street model (air pollution model combining LUR modelling for background pollution, dispersion modelling for point and line sources, and street canyon effects) for out-of-home exposure to estimate a time-weighted dynamic exposure to NO<sub>2</sub>. **Results:** Residence-based exposure to NO<sub>2</sub> was 22.8±6.5 µg/m<sup>3</sup>. The ATMO-Street model initially underestimated measured concentrations, but after improvements the validation R<sup>2</sup> increased from 0.52 to 0.58. Time-weighted dynamic exposure was 24.1±5.5 µg/m<sup>3</sup>. For 64% of the individuals the dynamic exposure was higher than the residence-based measurement. With increasing travel time or distance, the difference between the residence-based exposure and the dynamic exposure increased: travelling for 3 hours per day resulted in a dynamic exposure that was 5 µg/m<sup>3</sup> higher than the residence-based measurement. **Conclusions:** CurieuzeNeuzen resulted in an unprecedented, unique dataset. Before the project, the ATMO-Street model had to be validated with a few dozens of external measurement sites, now 20,000 sites were available. Time-weighting measurements at home and estimates for out-of-home exposure enables a more accurate estimation of the exposure to NO<sub>2</sub> and its effects on health, allowing to provide better information and recommendations to policy makers.

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**P-1017**

### **NASA's Multi-Angle Imager for Aerosols (MAIA): Applications of NASA Satellite Data to Airborne Particulate Matter Exposure and Human Health**

**Presenter:** Abigail Nastan, Jet Propulsion Laboratory, Pasadena, United States

**Authors:** A. Nastan<sup>1</sup>, D. Diner<sup>1</sup>, M. Garay<sup>1</sup>, K. Whitten<sup>1</sup>, C. Pelayo<sup>2</sup>, Y. Liu<sup>3</sup>, S. Haseminassab<sup>4</sup>, M. Jerrett<sup>5</sup>, B. Ritz<sup>5</sup>, S. Dey<sup>6</sup>, M. Franklin<sup>7</sup>;

<sup>1</sup>Jet Propulsion Laboratory, Pasadena, CA, <sup>2</sup>California State University Los Angeles, Los Angeles, CA,

<sup>3</sup>Emory University, Atlanta, GA, <sup>4</sup>South Coast Air Quality Management District, Diamond Bar, CA, <sup>5</sup>University of California Los Angeles, Los Angeles, CA, <sup>6</sup>Indian Institute of Technology Delhi, New Delhi, INDIA,

<sup>7</sup>University of Southern California, Los Angeles, CA.

The upcoming NASA Multi-Angle Imager for Aerosols (MAIA) investigation seeks to extend NASA's capabilities to study the impact of different size and compositional mixtures of particulate matter (PM) on adverse health outcomes. The MAIA satellite instrument, in development at the Jet Propulsion Laboratory and planned for launch in mid-2022, will collect multiangular, multispectral, and polarimetric measurements over a set of globally distributed target areas. Retrievals of aerosol properties will be combined with ground-based monitor data and chemical transport modeling to produce 1-km gridded data products of daily-averaged PM<sub>10</sub> and PM<sub>2.5</sub> mass, as well as the fractional abundances of sulfate, nitrate, organic carbon, elemental carbon, and dust making up the retrieved PM<sub>2.5</sub> mixtures. Epidemiologists on the MAIA Science Team and their collaborators will use these data in studies aimed at associating health risk with particle types. The MAIA Early Adopters Program is designed to engage the wider air quality and public health communities and assist them in using MAIA data products, which will be publicly available, free of charge, from NASA's Atmospheric Science Data Center. This presentation will cover the plans for operational MAIA data products as well as test data products that will be available prior to launch, and opportunities for Early Adopters to become involved in the program.

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**P-1019**

**The profile of fine particulate matter (PM<sub>2.5</sub>) using Beta Attenuator Monitor (BAM) in Addis Ababa, Ethiopia**

**Presenter:** Abera Kumie, Addis Ababa University, ADDIS ABABA, Ethiopia

**Authors:** A. Kumie;  
Addis Ababa University, ADDIS ABABA, ETHIOPIA.

The profile of fine particulate matter (PM<sub>2.5</sub>) using Beta Attenuator Monitor (BAM) in Addis Ababa, Ethiopia  
Author List: Abera Kumie<sup>1</sup>, Alemayehu Worku<sup>1</sup>, Zelalem Tazu<sup>1</sup>, Worku Tefera<sup>1</sup>, Getu Boja<sup>1</sup>, Molla Mekashaw<sup>1</sup>, Solomon Teferra<sup>2</sup>, Jonathan Patz<sup>3</sup>, Jonathan Samet<sup>4</sup>, Kiros Berhane<sup>5</sup>

<sup>1</sup>Addis Ababa University (Ethiopia); <sup>2</sup>Air Quality Management District (USA), <sup>3</sup>University of Wisconsin–Madison (USA), <sup>4</sup>University of Colorado (USA), <sup>5</sup>University of Southern California (USA).

**Abstract Background:** Ambient air pollution is currently a global agenda. The concentration of fine particulate matter (PM<sub>2.5</sub>) is one of the indicators for the air quality monitoring. The monitoring of air quality indicators is very limited in African countries including Ethiopia. **Objectives:** The objective of this study is to describe the current level of air pollution in Addis Ababa and determine its patterns over time, days of the week and seasons. **Material and Methods:** MetOne® Beta Attenuator Monitor (BAM) instrument for measuring the hourly average level of PM<sub>2.5</sub> was installed at one of the referral hospital in Addis Ababa, capital city of Ethiopia. A two-year data (April 1<sup>st</sup>, 2017 to March 31<sup>st</sup>, 2019) was generated to describe the profile of PM for this study. The raw data from the monitor was periodically downloaded and cleaned using standard operative procedures. R-software was used for data management and analysis. **Results:** The average PM<sub>2.5</sub> concentration over the two years was found to be 43.3 µg/m<sup>3</sup>. There were unusual peaks of PM concentration that greatly exceeded the daily averages. There were differences in levels of PM<sub>2.5</sub> across the days of the week and week days. Sunday's had on average low PM<sub>2.5</sub> concentration relative to other days. We also observed variations in levels of PM<sub>2.5</sub> across the Ethiopian seasons. Generally, wet seasons exhibited high levels of PM<sub>2.5</sub> while low levels of PM<sub>2.5</sub> were during the dry season. These findings highlighted the need of interventions related to public transportation and urban planning in controlling the ambient air pollution. **Keywords:** Ambient air pollution, PM<sub>2.5</sub>, Status, Beta Attenuator Monitor, variation

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**P-1021**

**Exposure to Particulate Air Pollution and the Risk of Progression to End-Stage Renal Disease: An Advanced Chronic Kidney Disease Registry-Based Cohort Study in Taiwan**

**Presenter:** Yu-Ting Lin, China Medical University Hospital, Taichung, Taiwan

**Authors:** Y. Lin<sup>1</sup>, Y. Lo<sup>1</sup>, H. Chiang<sup>1</sup>, C. Jung<sup>2</sup>, C. Wang<sup>3</sup>, T. Chan<sup>4</sup>, C. Kuo<sup>1</sup>, B. Hwang<sup>3</sup>;  
<sup>1</sup>China Medical University Hospital, Taichung, TAIWAN, <sup>2</sup>National Institute for Environmental Studies, Tsukuba, JAPAN, <sup>3</sup>China Medical University, Taichung, TAIWAN, <sup>4</sup>Academia Sinica, Taipei, TAIWAN.

Background: Limited evidence concerns fine particulate matter (PM<sub>2.5</sub>) exposure and the risk of end-stage renal disease (ESRD). This study assessed whether PM<sub>2.5</sub> exposure was associated with progression of chronic kidney disease (CKD) to ESRD. Methods: We conducted a prospective cohort study of 6,628 patients with CKD to assess the effect of long-term exposure to PM<sub>2.5</sub> on the risk of progression to ESRD and all-cause mortality. Satellite-based spatiotemporal models were used to calculate each individual's one-year PM<sub>2.5</sub> exposure prior to the date of enrollment into the Advanced CKD Program. Multivariable proportional hazard regression analysis was used to estimate the association of PM<sub>2.5</sub> with ESRD and all-cause mortality. Restricted cubic splines were used to explore dose-response relationships. Results: A total of 941 events of ESRD and 1,653 deaths occurred during follow-up. The adjusted hazard ratio (HR) for progression to ESRD was 1.19 (95% CI, 1.08 to 1.31) per 7.8 µg/m<sup>3</sup> increase in PM<sub>2.5</sub>, an increase spanning the interquartile range. There was evidence of a dose-response relationship (adjusted HR, 1.16 [95% CI, 0.90 to 1.51] in low PM<sub>2.5</sub> level; 1.19 [95% CI, 0.94 to 1.52] in medium PM<sub>2.5</sub> level; 1.42 [95% CI, 1.12 to 1.80] in high PM<sub>2.5</sub> level). There was no significant association between PM<sub>2.5</sub> and all-cause mortality (adjusted HR, 1.01 [95% CI, 0.95 to 1.08]). Conclusions: Our findings suggest that long-term exposure to PM<sub>2.5</sub> is associated with an increased risk of progression to ESRD in patients with CKD.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

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**P-1024**

**Predictors of Indoor-Outdoor Ratio of Particle Number Concentrations in Israel**

**Presenter:** Raanan Raz, The Hebrew University of Jerusalem, Jerusalem, Israel

**Authors:** S. Zhang<sup>1</sup>, .. Yuval<sup>2</sup>, D. M. Broday<sup>2</sup>, R. Raz<sup>1</sup>;

<sup>1</sup>The Hebrew University of Jerusalem, Jerusalem, ISRAEL, <sup>2</sup>Technion - Israel Institute of Technology, Haifa, ISRAEL.

**Background:** Trends of indoor-outdoor ratios (IOR) of particle number concentrations (PNC) by temporal and meteorological factors can enhance our understanding of this harmful exposure and its sources. **Methods:** PNC data was collected from a one-year field campaign where simultaneous meteorological parameters were measured continuously using Dylos DC500 devices in five locations in Israel, which is one of the high PM area. Generalized linear models were used for estimating the association between the explanatory variables (outdoor PNC, hour of the day, weekend/workday, season, ambient temperature, ambient relative humidity, wind speed) and the IOR. **Results:** The median is 0.830 for fine IOR and is 0.702 for coarse IOR in general, and all IOR medians were  $\leq 1$  in entire locations. Lower IORs were experienced at night, with the daily peak in IOR around noon. The IORs shows a double-hump pattern with higher IOR in spring and autumn, and lower IOR in summer and winter.

**Conclusions:** The outdoor PNC was found to be the most important predictor of indoor PNC at any meteorological conditions, especially for fine particles, but the residents' preferences and activities may dominate the IOR when considerable indoor emissions prevail whereas smoking and cooking tend to elevate the fine PNC, house holding activities effect to a larger extent the coarse fraction.

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Theme: **PM exposure measurement**

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**P-1025**

**Monetized Wellbeing Losses from Air Pollution in China: 2004-2017**

**Presenter:** Miaomiao Liu, Nanjing University, Nanjing, China

**Authors:** M. Liu, J. Bi;  
Nanjing University, Nanjing, CHINA.

Introduction: Benefiting from well-documented epidemiological evidence, the effects on mortality and morbidity are being incorporated into the decision process of pollution control in China. However, the attentions on the costs or benefits of subjective wellbeing (SWB) are still limited by insufficient knowledge on how air pollution affects the subjective dimension of wellbeing. Methods: Based on fortnightly questionnaire surveys in China from July 2014 to June 2016, this study first established the localized associations of SWB with the indicators of both income and air pollution levels. We further calculated the marginal substitution rate (MSR) between PM<sub>2.5</sub> and income to evaluate the monetized SWB losses caused by 1 µg/m<sup>3</sup> PM<sub>2.5</sub> increase in 31 provinces. Finally, the valuation results were applied in assessing the monetized SWB losses attributable to PM<sub>2.5</sub> in China during 2004-2017. Results: Objective air pollution had only indirect effects on SWB through risk perception. This challenged the traditional approaches that usually directly linked objective air pollution and wellbeing. On the national average, 1 µg/m<sup>3</sup> annual PM<sub>2.5</sub> increase was associated with 0.45-1.70 CNY wellbeing losses per capita per day. From 2004 to 2017, the year-by-year newly increased monetized wellbeing losses attributable to PM<sub>2.5</sub> in China increased significantly before 2007 and then showed a slightly decreased trend with some fluctuations. Overall, the accumulated newly increased monetized wellbeing losses attributable to PM<sub>2.5</sub> in China from 2004 to 2017 approximately accounted for 0.02% of accumulated gross domestic productions. The accumulated newly increased monetized wellbeing losses attributable to PM<sub>2.5</sub> exhibited strong spatial variations with the high values in Henan, Shandong and Hebei, which overlapped with the spatial hotspots of PM<sub>2.5</sub> related deaths. We recommended the government paid more attention to those areas. Conclusion: Huge wellbeing losses caused by air pollution shall be incorporated into the cost-benefits analysis framework as a new element.

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**P-1026**

### **Evaluation of a commercial database to estimate residence histories in the Los Angeles Ultrafines Study**

**Presenter:** Danielle N Medgyesi, Occupational and Environmental Epidemiology Branch, Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Rockville, United States

**Authors:** D. N. Medgyesi<sup>1</sup>, J. A. Fisher<sup>1</sup>, A. R. Flory<sup>2</sup>, M. H. Ward<sup>1</sup>, D. T. Silverman<sup>1</sup>, R. R. Jones<sup>1</sup>;  
<sup>1</sup>Occupational and Environmental Epidemiology Branch, Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Rockville, MD, <sup>2</sup>Westat Inc, Rockville, MD.

Background. Completeness of residential histories in epidemiologic studies influence the accuracy of environmental exposures estimated at residential locations. Commercial databases can be useful in locating participants over time; however, the quality of such information is uncertain. Methods. We conducted a commercial database address search (using name and social security numbers) for participants of the NIH-AARP Diet and Health Study cohort (aged 50-71 years) living in Los Angeles (Los Angeles Ultrafines Study; N=50,260). We compared participants with and without commercial addresses(s) at two times (enrollment: 1995-1997 and follow-up: 2004-2005) across strata of participant characteristics. A commercial match to self-reported address was determined by two criteria:  $\leq 250\text{m}$  geocoded distance between addresses and  $\geq 80\%$  string agreement for attributes: street number, street name, city, ZIP code, and state. For both self-reported and commercial addresses at enrollment, we estimated two important predictors of ultrafine particles in a land use regression model, nitrogen dioxide ( $\text{NO}_2$ ;ppm) and high intensity developed land (HIDL;%) within 5km. We compared estimates of  $\text{NO}_2$  and HIDL (Spearman's rho) and changes to exposure classifications (quintiles) between commercial and self-reported addresses. Results. The commercial database identified 69% of participants at enrollment and 95% of those still in California who participated at follow-up (N=23,669). Percentages were similar across sex, race, and education categories and were  $\geq 5\%$  higher for individuals aged 65+ years and never smokers. Most participants had a match to their self-reported addresses, with similar match rates for enrollment (86%) and follow-up (82%). When using commercial versus self-reported addresses, correlations were high for estimated  $\text{NO}_2$  ( $\rho=0.90$ ) and HIDL ( $\rho=0.92$ ). Only 8% of participants were classified into different quintiles for both predictors. Conclusions. Our results demonstrate the potential of commercial databases to provide missing residence information. Future studies should consider how time period, geographic location, and population characteristics may influence the accuracy of information obtained.

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Theme: **PM exposure measurement**

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**P-1027**

### **A New Exposure Metric for the Cumulative Effect of Short-term Peaks of Exposure to Traffic-related Ultrafine Particles**

**Presenter:** Cheng Lin, Tufts University School of Medicine, Boston, United States

**Authors:** C. Lin<sup>1</sup>, K. J. Lane<sup>2</sup>, J. K. Griffiths<sup>1</sup>, D. M. Brugge<sup>3</sup>;

<sup>1</sup>Tufts University School of Medicine, Boston, MA, <sup>2</sup>Boston University School of Public Health, Boston, MA,

<sup>3</sup>University of Connecticut Health Center, Farmington, CT.

**Introduction** Traffic-related ultrafine particles (UFPs) can cause adverse health outcomes through inflammatory reactions. Current epidemiology studies focus on either short-term health outcomes associated with UFP levels averaged over days or weeks, or long-term outcomes associated with a long-term (annual or longer) average exposure to UFP. We hypothesize that frequent and repeated exposure to short-term UFP peaks that last for just one or a few hours could overwhelm human's biological defenses, which may result in long-term health effects. We propose a new exposure metric for measuring the cumulative effect of the peaks. **Method** Our study uses data collected by the Community Assessment of Freeway Exposure and Health (CAFEH) project, which recruited 704 participants from six "near-highway" or "urban background" neighborhoods in the Greater Boston Area between 2009 and 2012. The CAFEH project developed land use regression models to estimate hourly averages of ambient UFP level throughout the study areas, and applied time-activity adjustment to calculate the adjusted hourly estimate. Our alternative metric is the cumulative peak exposure, determined by the intensity (the 99th percentile of an individual's adjusted hourly UFP estimates) and the frequency (the number of hours with the UFP level higher than the 99th percentile of all adjusted hourly UFP estimates of all participants) of UFP peaks. **Results** The cumulative peak exposure does not always correlate well with the annual average, especially in certain near-highway neighborhoods. (Pearson's R between the intensity of UFP peaks and the annual average of hourly UFP estimates ranges from 0.33 to 0.98.) Thus, it appears that there is still sufficient variation within the residents' UFP peak exposure after holding their annual average constant, which suggests they are distinct measurements. **Conclusion** Measuring the cumulative effect of peak exposures may provide a new exposure assessment metric that could be tested for association with long-term health outcomes.

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**P-1028**

**Effects of Personal Exposure to Fine Particulate Matter Air Pollution on Gut microbiota in elderly: The China BAPE study**

**Presenter:** Jiaonan Wang, School of Public Health, Nanjing Medical University, Nanjing, China

**Authors:** J. Wang<sup>1</sup>, T. Li<sup>2</sup>, J. Fang<sup>2</sup>, Y. Wang<sup>2</sup>, H. Du<sup>2</sup>, L. Zhao<sup>2</sup>, Q. Sun<sup>2</sup>, X. Shi<sup>1</sup>;

<sup>1</sup>School of Public Health, Nanjing Medical University, Nanjing, CHINA, <sup>2</sup>National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, Beijing, CHINA.

**Background:** In recent years, it is confirmed that human gut microbiota is critical for human health. Animal studies suggest that air pollutants may alter the composition of the gut microbiota, which may negatively impact health through changes in the composition or function of the gut microbiome. However, Research on the effects of personal exposure to fine particulate matter on gut microbiota is lacking in developing countries, especially in highly polluted areas. **Methods:** Participants (60-69 years, n=76) were enrolled between Sep 10th 2018 and Jan 19th 2019 with a month interval. MicroPEM™ real-time personal measurements was used to monitor the subject's personal PM<sub>2.5</sub> exposure. Faecal samples from 76 healthy elderly were sequenced using 16S rDNA amplification to assess microbial diversity, richness and relative taxa abundance. Operational Units were clustered with 97% similarity cutoff and chimeric sequences were identified and removed. A linear mixed-effect model was applied to estimate the associations of exposure to Fine Particulate Matter with alpha diversity indices and relative abundance of the gut microbiota. **Results:** A total of 516 genus level microbiota were identified in this study. The five most abundant bacteria in the fecal flora of the participants were Bacteroides, Prevotella, Pachyphyte, Faecalibacterium and Roseburia. Exposure to fine particulate matter was associated with the alterations in gut microbiota diversity and relative abundance of 20 genus level microbiota. By analyzing the abundance composition of the KEGG pathway of the intestinal flora of the Participants, the pathways enriched by the intestinal flora mainly include transport, DNA repair and recombinant proteins, ribosomes, and purine metabolism. Involves environmental information processing, genetic information processing, and metabolic mechanisms. **Conclusions:** Exposure to fine particulate matter may alter the relative abundance, and decrease the diversity of the gut microbiota. These findings can extend our understanding of the mechanism of air pollution inducing diseases.

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Theme: **PM exposure measurement**

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**P-1029**

**Effect of housewife's activity pattern on indoor particulate matter concentration: Ko-CHENS Mom study**

**Presenter:** Jongmin Oh, Ewha Woman's University, Seoul, Korea, Republic of

**Authors:** J. Oh<sup>1</sup>, Y. Kwag<sup>1</sup>, S. Ye<sup>2</sup>, D. Lee<sup>3</sup>, J. Park<sup>4</sup>, W. Yang<sup>4</sup>, Y. Kim<sup>5</sup>, E. Ha<sup>1</sup>;

<sup>1</sup>Ewha Woman's University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Occupational Safety and Health Research institute, Korea Occupational Safety and Health Agency, Incheon, KOREA, REPUBLIC OF, <sup>3</sup>Department of Preventive Medicine, Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF,

<sup>4</sup>Department of Occupational Health, Catholic University of Daegu, Daegu, KOREA, REPUBLIC OF,

<sup>5</sup>Department of Occupational and Environmental Medicine, Ulsan University Hospital, University of Ulsan College of Medicine, Seoul, KOREA, REPUBLIC OF.

**Background/Aim** Most housewives spend a lot of time at home and do housework such as cleaning and cooking. Low-cost sensors have advantage of being able to measure indoor particulate matter concentration in real time. Activities such as cooking, eating and cleaning can affect exposure patterns of indoor particulate matter. The purpose of this study was to identify changes in indoor particulate matter concentration according to the time-activity patterns of housewives. **Methods** We enrolled 306 participants in the study for the housewives located in Seoul and Ulsan, Korea. Housewives were measured their indoor exposures by low-cost sensor and completed time-activity diaries for a 7-days monitoring period. PM data is obtained every 5 minutes via Wi-Fi and cloud system connection. Participants self-reported their major activities every hour in their time-activity diary. The time activity diary provides hourly information on participants' activities and locations. Indoor PM concentrations over time were compared with participants' behavior patterns. We also performed the stratified analysis based on weekdays/weekends and seasons. The accuracy of the sensor measurement was evaluated by examining the correlation between the indoor PM measured by the sensor and the indoor PM measured by the GRIMM. **Results** During the study, the indoor occupancy rate of the participants was about 82%. The average age of the participants was 34 years. The time having highest average of indoor PM concentration was 10 am (PM<sub>2.5</sub>: 21.8 µg/m<sup>3</sup>, PM<sub>10</sub>: 26.3 µg/m<sup>3</sup>). Activity patterns related to cooking/eating, and cleaning influenced changes in indoor particulate matter concentrations. There was no difference in indoor PM concentration during weekdays/weekends. The correlation coefficients between concentrations measured by sensor and GRIMM were 0.9. **Conclusion** This study provides a comprehensive assessment of the variation in indoor particulate matter concentration associated with housewives' time-activities. Our results found that indoor PM concentrations increased with indoor cooking /cleaning behavior.

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Theme: **PM exposure measurement**

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**P-1030**

**Land Use Regression Model for Exposure Assessment to Particulate Matter in Rio de Janeiro, Brazil**

**Presenter:** Marcio Sacramento Oliveira, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil

**Authors:** M. S. Oliveira<sup>1</sup>, M. E. Santana<sup>1</sup>, M. C. Marques<sup>1</sup>, R. H. Griep<sup>1</sup>, M. A. Magalhães<sup>1</sup>, M. J. Fonseca<sup>1</sup>, A. B. Moreno<sup>1</sup>, A. Ponce de Leon<sup>2</sup>;

<sup>1</sup>Oswaldo Cruz Foundation, Rio de Janeiro, BRAZIL, <sup>2</sup>Universidade do Estado do Rio de Janeiro, Rio de Janeiro, BRAZIL.

Background: Air pollution is a major public health problem. The latest data from the World Health Organization show that 9 out of 10 people breathe air containing high levels of pollutants and that about 4.2 million deaths were caused by exposure to fine particles in 2016. Therefore, the aim of our study was to elaborate a model for long-term exposure assessment to air pollution. Methods: This study was developed in Rio de Janeiro, The area of the city is 1,200.255 km<sup>2</sup>, it has about 6.7 million residents and is located in the southeastern region of Brazil. The measurements of PM<sub>2.5</sub>, PM<sub>10</sub> and predictor variables were obtained from government agencies. The potential predictor variables that have been used were: temperature, relative humidity, vehicular traffic base, Census, altitude databases, vegetation cover, land use, rock masses, hydrographic and hydrographic sub-basins, urban zoning and road network. For the development of Land Use Regression models, linear regression models were specified using the supervised stepwise procedure. Cook D statistics were used to detect influential observations. The overall model performance was evaluated by leave-one-out cross validation. Results: The annual mean of PM<sub>2.5</sub> and PM<sub>10</sub> was 11.73 (SD = ± 4.84) and 35.57 (SD = ± 8.91) µg·m<sup>-3</sup>, respectively. The R<sup>2</sup> value in the final model for PM<sub>2.5</sub> was 0.3812 (p-value < 0.10). The performance evaluated was also poor: the RMSE was 0.2920, with R<sup>2</sup> = 0.1820. The R<sup>2</sup> value in the final model for PM<sub>10</sub> was 0.73, (p-value < 0.001). The performance evaluated was reassuring: the RMSE was 0.1386, with R<sup>2</sup> = 0.5832. Conclusions: The model could be applied in areas where there is no monitoring of air quality, thus, enabling the evaluation of the health impact of exposed populations, providing support for decision-making and development of public and investments policies, medium impact and long-term.

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Theme: **PM exposure measurement**

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**P-1031**

**Exposure to outdoor PM<sub>2.5</sub> in socioeconomically disadvantaged street vendors in Medellin, Colombia**

**Presenter:** MONICA LUCIA SOTO-VELASQUEZ, Universidad de Antioquia, Medellin, Colombia

**Authors:** C. Segura-T, M. SOTO-VELASQUEZ;  
Universidad de Antioquia, Medellin, COLOMBIA.

Background: Medellin is not only a city of innovation, but also one of the most air polluted cities in Colombia which has faced at least one environmental emergency per year during the last five years. In the middle of the traffic, about 7000 street vendors do their living. Aim: Describe the exposure to PM<sub>2.5</sub> and socio economic conditions of work and living of a sample of street vendors located under the lanes and train station of the elevated metrosystem of transportation in downtown, Medellin. Methods: A survey of socioeconomic conditions was conducted with 74 street vendors. Personal monitoring of PM<sub>2.5</sub> was conducted from Monday to Saturday during 6.69 hours of the workday in the months of September, October or November to a sub-sample of 15 street vendors with a total of 88 personal measurements. Results: 68.9% were men, median age of 54.50 years, 50% studied 5 years or less, 71.6% were migrants. Reason for migration for 35.71% of women was "Displacement due to violence" and for 40.47% of men "Looking for a job opportunity". More than 50% started working at the age of 13. Median years working as street vendors was 13, median work days was 6 and 10 hours a day. 91.67% had no access to insurance for retirement pension or work accident or occupational disease. For 15 street vendors, exposure estimation to PM<sub>2.5</sub> in 24 hours per month was 306.11  $\mu\text{m}^3$ , 249.12  $\mu\text{m}^3$  and 168.89  $\mu\text{m}^3$  and maximum average exposure hours, were 10,31 (sd 14,10), 5,40 (ds 7,26) and 8,6 (ds 9,14) in Sept, Oct and Nov respectively. PM<sub>2.5</sub> in 24 hours was between 65.95 $\mu\text{m}^3$  Tuesdays to 126,39 95 $\mu\text{m}^3$  Saturdays. Conclusions: socioeconomically disadvantaged migrants looking for better conditions of living find that cities perpetuate social injustices through environmental health hazards as pollution of the place of working.

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**P-1032**

**New insights into the association of modeled long-term PM<sub>2.5</sub> with life expectancy compared to measured PM<sub>2.5</sub>**

**Presenter:** Sun-Young Kim, National Cancer Center, Goyang, Korea, Republic of

**Authors:** S. Kim<sup>1</sup>, C. Pope<sup>2</sup>, N. Fann<sup>3</sup>, J. D. Marshall<sup>4</sup>, L. Sheppard<sup>4</sup>;

<sup>1</sup>National Cancer Center, Goyang, KOREA, REPUBLIC OF, <sup>2</sup>Brigham Young University, Provo., UT, <sup>3</sup>US Environmental Protection Agency, RTP, NC, <sup>4</sup>University of Washington, Seattle, WA.

Much of the current evidence of associations between long-term PM<sub>2.5</sub> and health outcomes relies on national or regional analyses using exposures derived directly from regulatory monitoring data. These findings could be affected by limited spatial coverage of monitoring data, particularly for time periods before spatially extensive monitoring began in late 1990s. For instance, Pope et al.(2009) showed that between 1980 and 2000 a 10 µg/m<sup>3</sup> reduction in PM<sub>2.5</sub> was associated with an average 0.61 year (standard error (SE)=0.20) longer life expectancy. That analysis used 1979-1983 averages of PM<sub>2.5</sub> across 51 U.S. Metropolitan Statistical Areas (MSAs) computed from about 100 monitoring sites. Our reanalysis re-examined this association using modeled PM<sub>2.5</sub> that intended to assess population- or geographically-representative exposure.

We used the same life expectancy data, and investigated the same 211 continental U.S. counties, as Pope et al.(2009). For modelled PM<sub>2.5</sub>, using a previously-developed point prediction model based on regulatory monitoring data for 1990-2015 and back-extrapolation. We predicted annual average concentrations at centroids of 70,000 census tracts (CT) and 12,501 25-km national grid cells (NG), to represent population and geography, respectively. We averaged these predictions to the MSA for the two time periods (1979-1983 and 1999-2000) that correspond to the original analysis. Finally, we estimated regression coefficients for PM<sub>2.5</sub> reduction on life expectancy improvement over the two periods, adjusting for area-level confounders. A 10 µg/m<sup>3</sup> decrease in modeled PM<sub>2.5</sub> based on CT and NG predictions was associated with average 0.67 (SE= 0.35) and 0.97 (0.38) year increases in life expectancy, higher than the estimate of Pope et al.(2009). These estimates have larger SEs likely because of smaller variability in predictions. All effect estimates had overlapping confidence intervals. Our approach to estimating population- or geographically-representative PM<sub>2.5</sub> concentrations lends additional support to the evidence that reduced fine particulate matter contributes to extended life expectancy.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

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**P-1033**

**Relationship between chimney emissions and air pollutants near coal-fired power plants**

**Presenter:** XUE HAN, Dankook University, Cheonan, Korea, Republic of

**Authors:** X. HAN<sup>1</sup>, K. Choi<sup>1</sup>, S. Bae<sup>2</sup>, H. Kwon<sup>1</sup>;

<sup>1</sup>Dankook University, Cheonan, KOREA, REPUBLIC OF, <sup>2</sup>The Catholic University of Korea, Seoul, KOREA, REPUBLIC OF.

Relationship between chimney emissions and air pollutants near coal-fired power plants  
Objective: Coal-based energy production is the most utilized method of electricity production worldwide and releases the highest concentration of gaseous, particulate, and metallic pollutants. We aimed to evaluate how the chimney at coal-fired power plants exhaust relates to the outdoor air quality of near coal-fired power plants.  
Methods: We collected per day concentration of ambient air pollution data from the nearest national ambient measurement station, local ambient measurement station and real-time TMS (telemonitoring systems) data of chimney at coal-fired power plants from 2 different regions in Korea. TSP (Total Suspended Particles), NO<sub>x</sub> (Nitrogen Oxides) and SO<sub>x</sub> (Sulfur Oxides) were measured during the same period from 2015 to 2019. Pearson and Time lag correlations were also used to measure the correlation between these data.  
Results: The correlation coefficient of TMS and national station SO<sub>x</sub> was 0.187, 0.093 (1-day lag), 0.106 (2-day lag), 0.092 (3-day lag) in A area, and 0.076, 0.041 (1-day lag), 0.033 (2-day lag), 0.028 (3-day lag) in B area.  
NO<sub>x</sub> was 0.165, 0.137, 0.132, 0.106 lagged by 0-3 days in A area, and 0.039, 0.054, 0.041, 0.032 in B area. TSP was 0.037, 0.029, 0.031, 0.030 in A area and 0.565, 0.522, 0.498, 0.358 in B area.  
Conclusion: The pollutant concentration from chimney at coal-fired power plants exhaust and outdoor shows a moderate amount of correlation depending on the region and requires further analysis considering other indicators related to indoor air pollutants concentration.

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## ABSTRACT E-BOOK

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**P-1034**

**Comparison between national and local land use regression models for NO<sub>2</sub> based on routine monitoring data in Japan**

**Presenter:** Saori Kashima, Graduate School for International Development and Cooperation, Hiroshima University, Higashi-Hiroshima, Japan

**Authors:** S. Kashima<sup>1</sup>, T. Yorifuji<sup>2</sup>;

<sup>1</sup>Graduate School for International Development and Cooperation, Hiroshima University, Higashi-Hiroshima, JAPAN, <sup>2</sup>Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama University, Okayama, JAPAN.

**Background:** To evaluate the health effects of air pollution on a national scale, national land use regression (LUR) models is required. However, the traffic volume, population size, or land usage are different between urban and rural areas. The predictability of the national LUR model for rural areas is still not clear. Thus, we built a national and local LUR model for NO<sub>2</sub> in Japan, and compared the predictability. **Method:** We first, built a national-LUR model based on 1678 routine monitoring data for Nitrogen dioxide (NO<sub>2</sub>). Next, according to the tertile of the prefectural population size, we classified the monitoring sites into three groups. Then we built an urban-LUR (site n=1091), a middle-LUR (n=346), and a rural-LUR model (n=241). We calculated the predictability of each model and compared the predicted concentrations from each model with measured concentrations.

**Results:** The predictability for NO<sub>2</sub> concentrations of the national-LUR model was similar to that of the urban-LUR models: adjusted R<sup>2</sup> = 0.75 and 0.75, respectively, and root mean square error (RMSE)=3.6 and 3.7 ppb, respectively. Adjusted R<sup>2</sup> for the middle-LUR and the rural-LUR models were 0.66 (RMSE=3.2 ppb) and 0.70 (RMSE=2.8 ppb). Although the predictabilities of local LUR models were lower than the national-LUR models, RMSEs of local LUR models were smaller than RMSE in the national-LUR model. Also, the correlation coefficients between predicted and measured concentration in local models were higher than those in the national-LUR model. When concentrations were predicted by national-LUR in the rural area, the correlation coefficient was 0.81. It was 0.84 for the concentrations estimated by the rural-LUR model. **Conclusion:** The local LUR models might be more represented by the local land use conditions comparing with the national scale. Instead of population size, for improving the local model, the similarity might be evaluated by using a machine learning technique.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

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**P-1037**

**Development and Validation of a Crowd-Generated Indicator of Air Pollution Exposures and Health Response using Web Search Log Mining.**

**Presenter:** Zhenjiang Li, Emory University, Atlanta, United States

**Authors:** Z. Li<sup>1</sup>, D. Liang<sup>1</sup>, C. Lin<sup>1</sup>, E. Kahoro<sup>2</sup>, S. Yousefi<sup>1</sup>, E. Agichtein<sup>1</sup>, J. A. Sarnat<sup>1</sup>;  
<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Pomona University, Claremont, CA.

**Background.** Traditional air pollution epidemiologic models use ground-based monitors and/or satellite estimates of ozone and PM<sub>2.5</sub> concentrations as surrogates of exposure. It is possible that crowd-sourced or online data may be more effective at reflecting population exposures than these traditional indicators. Here, we constructed models to “nowcast” observed elevated pollution levels, using online search queries to create a Crowd-Generated Air Pollution (CGAP) metric and compared the output to monitoring data. We then used the CGAP metric to examine short-term associations of ED visits for pediatric asthma. **Methods.** A search term Dictionary Learner-Long-Short Term Memory (DL-LSTM) composite model was developed to combine meteorological data, air pollution measures, and pollution-related search data for Atlanta, and daily CGAP index was generated for ozone and PM<sub>2.5</sub> from 2007 to 2008. Daily counts of ED visits for asthma among children aged 5 to 17 were collected as well. Using quasi-Poisson generalized linear models, we assessed short-term associations of measured ambient concentration and modeled CGAP index with ED visits. **Results.** Both ambient ozone and PM<sub>2.5</sub> levels were associated with asthma ED visits. We observed similar patterns for indices from DL-LSTM model trained by meteorological data, air pollution measures, and search data ( $r = 0.88$ ,  $p < 0.0001$  for ozone;  $r = 0.71$ ,  $p < 0.0001$ ). The quasi-Akaike information criterion (AIC) of the modeled CGAP index was similar to or lower than that of ambient levels (3179.399 vs. 3173.754 for ozone; 3177.887 vs. 3198.606 for PM<sub>2.5</sub>). **Conclusion.** Our findings provided preliminary validation of the CGAP metric, based on a DL-LSTM algorithm. Results using CGAP were comparable to findings using stationary monitoring data for air pollution. The modeled CGAP index showed promise as a means of potentially providing a sensitive, comprehensive predictor of short-term changes in pediatric asthma ED visits due to urban air pollution exposures.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

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**P-1038**

### **Exploring the Spatial Variation Characteristics and Influencing Factors of PM<sub>2.5</sub> Pollution in Nairobi City, Kenya: A preliminary Analysis**

**Presenter:** Nicholas Otienoh Oguge, University of Nairobi, Nairobi, Kenya

**Authors:** N. O. Oguge;  
University of Nairobi, Nairobi, KENYA.

Background Quality of air is an important determinant of health hence of public health importance for a city. If exposure to air pollution varies spatially, this may lead to significant inequality in related health risk. Since air pollution combines with other aspects of the social and physical environment, a likely scenario would be a disproportional disease burden in less affluent parts of society. Previous studies using portable filter-based air samplers carried in backpacks by technicians over two weeks showed that mean daytime concentrations of particulate matter (PM<sub>2.5</sub>) in Nairobi ranged from 10.7 at the rural background site to 98.1 µg/m<sup>3</sup> on a sidewalk in the central business district. Aim Our study aimed at establishing long term exposure of PM<sub>2.5</sub> pollution and factors influencing concentrations.

Methods We examined PM<sub>2.5</sub> pollution in eight Planning Zones in Nairobi between September 2019 and February 2020 using Nephelometers (E-Samplers) calibrated against the Gold Standard reference method, the Beta Attenuation Monitor (BAM) 1022.

Results PM<sub>2.5</sub> pollution was found to vary in different parts of the city being highest 38.01 µg/m<sup>3</sup> around the central business district, and lowest 12.72 µg/m<sup>3</sup> in the southern suburbs of the city. We demonstrate that an order of magnitude rises in the relative humidity (RH) led to a decrease in the level of PM<sub>2.5</sub> concentration by a factor of 0.14 µg/m<sup>3</sup>. An increase in temperature by 1°C conversely led to an additional rise of PM<sub>2.5</sub> concentrations by a factor of 0.49 µg/m<sup>3</sup>.

Conclusions These preliminary findings suggest that meteorological factors had some effects on the diffusion mechanism of PM<sub>2.5</sub> pollution in Nairobi. However, we are analyzing possible contribution of natural environmental conditions and socio-economic factors for a more comprehensive explanation of spatial exposure to PM<sub>2.5</sub> pollutants among Nairobi residents.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

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**P-1039**

**The status of air quality in Kampala city, Uganda 2017-2019: Results from the Eastern Africa GEOHealth Hub using a high-tech reference monitor (Beta Attenuation Monitor 1022)**

**Presenter:** Lynn Atuyambe, Makerere University School of Public Health, Kampala, Uganda

**Authors:** L. Atuyambe<sup>1</sup>, W. Bazeyo<sup>1</sup>, S. Etajak<sup>1</sup>, F. Walyawula<sup>1</sup>, A. Nyabigambo<sup>1</sup>, A. Kumie<sup>2</sup>, K. Dessie<sup>3</sup>, J. Patz<sup>4</sup>, J. M. Samet<sup>5</sup>, K. T. Berhane<sup>6</sup>;

<sup>1</sup>Makerere University School of Public Health, Kampala, UGANDA, <sup>2</sup>Addis Ababa University, Addis Ababa, ETHIOPIA, <sup>3</sup>University of Southern California, CA, <sup>4</sup>University of Wisconsin, Madison, WI, <sup>5</sup>University of Colorado, Colorado, CO, <sup>6</sup>Columbia University, New York, NY.

**Introduction:** Ambient air pollution (AP), particularly from fine particulate matter <2.5 micrometers in aerodynamic diameter (PM<sub>2.5</sub>) is a big public health problem especially in low and middle-income countries. Because of apparent high population growth rate (3%) and economic development in Uganda, ambient AP appears to be rising. As such, we are monitoring ambient PM<sub>2.5</sub> concentrations in Kampala City in a series of studies about the effect of AP on health. This work is part of research and training objectives of the Global Environmental and Occupational Health (GEOHealth) Hub for Eastern Africa. **Methods:** Using a Beta Attenuation Monitor (BAM) 1022, we prospectively measured ambient PM<sub>2.5</sub> concentration for 2 years. This equipment was installed at Makerere University School of Public Health building rooftop (about 15 meters high). The BAM 1022 generated real-time data on PM<sub>2.5</sub>, relative humidity and ambient temperature. **Results:** For the last two years (October 2017 to September 2019), the annual mean of PM<sub>2.5</sub> concentrations were 41.3µg/m<sup>3</sup> and 39.2µg/m<sup>3</sup> respectively. Our two-year data consistently show that dry seasons (January, February, June, July and August) have higher monthly mean PM<sub>2.5</sub> concentrations (46.6µg/m<sup>3</sup>) compared to the wet seasons of March, April, May, September-, October, November and December (35.7µg/m<sup>3</sup>). We observed that for two years the highest PM<sub>2.5</sub> concentration in typical day was between 06.00hrs and 10.00hrs (peak being at 08.00hrs -PM<sub>2.5</sub> 61.3µg/m<sup>3</sup>). However, nights were more polluted between 19.00hrs to 04.00hrs (peak being at 23.00hrs (PM<sub>2.5</sub> 71.2 µg/m<sup>3</sup>). Further, when we divided the day (07.00hrs-18.00hrs) and night (19.00-06.00hrs), the average PM<sub>2.5</sub> concentrations for the two years were 34.5µg/m<sup>3</sup> and 46.9µg/m<sup>3</sup> respectively.

**Conclusion:** Ambient AP is higher in the dry season. Besides, there is more PM<sub>2.5</sub> concentration at night compared to daytime. These results present an opportunity for further studies on AP and its effect on health using hospital mortality and morbidity data.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

**P-1040**

### **Spatial-temporal patterns and influence of land-use and socioeconomic factors on fine particulate matter pollution in Accra, Ghana**

**Presenter:** Abosede Sarah Alli, Department of Environmental Health Sciences, School of Public Health and Health Sciences, University of Massachusetts, Amherst, United States

**Authors:** A. S. Alli<sup>1</sup>, S. Clark<sup>2</sup>, J. Wang<sup>1</sup>, J. Nimo<sup>3</sup>, J. Bedford-Moses<sup>3</sup>, S. Terkpertey<sup>3</sup>, M. Ezzati<sup>2</sup>, M. Brauer<sup>4</sup>, J. Baumgartner<sup>5</sup>, F. Kelly<sup>6</sup>, B. Barratt<sup>6</sup>, A. Beddows<sup>6</sup>, A. Hughes<sup>3</sup>, J. Vallarino<sup>7</sup>, S. Agyei-Mensah<sup>8</sup>, E. Agyemang<sup>8</sup>, R. E. Arku<sup>1</sup>;

<sup>1</sup>Department of Environmental Health Sciences, School of Public Health and Health Sciences, University of Massachusetts, Amherst, MA, <sup>2</sup>Department of Epidemiology and Biostatistics, School of Public Health, Imperial College, London, UNITED KINGDOM, <sup>3</sup>Department of Physics, University of Ghana, Accra, GHANA, <sup>4</sup>School of Population and Public Health, The University of British Columbia, Vancouver, BC, CANADA, <sup>5</sup>Institute for Health and Social Policy, McGill University, Montreal, QC, CANADA, <sup>6</sup>Department of Analytical, Environmental and Forensic Sciences, King's College, London, UNITED KINGDOM, <sup>7</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>8</sup>Department of Geography and Resource Development, University of Ghana, Accra, GHANA.

**Background:** Air pollution levels in cities in Sub-Saharan Africa (SSA), the world's most rapidly urbanizing region, are among the highest globally due to influences from diverse local and regional sources. However, very little is known about within-city disparities at fine spatial-temporal resolution. We examined the space-time patterns of fine particle pollution (PM<sub>2.5</sub>) in relation to land-use variables and socioeconomic factors in Accra, Ghana, and evaluated trends over a decade. **Methods:** We measured and analysed weekly gravimetric and minute-by-minute PM<sub>2.5</sub> (optical sensor) concentrations from 150 unique locations (10 fixed [1-year] and 140 weekly [7-day] sites) covering a range of land-use, socioeconomic features and source influences. **Results:** PM<sub>2.5</sub> concentrations were highest between December - February, during the "Harmattan" when transported dust and changes in regional and local meteorology affect Accra. In this period, levels were as high as 267 µg/m<sup>3</sup> (mean 94.1 µg/m<sup>3</sup>), compared to annual PM<sub>2.5</sub> concentrations ranging from 14.4 to 31.3 µg/m<sup>3</sup> at fixed sites. Across all 150 sites, weekly concentrations ranged from <10 µg/m<sup>3</sup> to >250 µg/m<sup>3</sup>. Sites near roadsides had the highest overall mean PM<sub>2.5</sub> (43 µg/m<sup>3</sup>), followed by high-density (poor) and low-density (affluent) residential sites; peri-urban background sites had the lowest levels. By time of day, daily PM<sub>2.5</sub> at all sites rose at dawn and peaked at daybreak, followed by a gradual decline till afternoon and a modest evening peak. There were indications of decreased PM<sub>2.5</sub> concentrations at residential sites when compared to matching data from a decade ago (39 vs 25 µg/m<sup>3</sup>), suggesting likely reductions in biomass emissions. **Conclusion:** Fine particle pollution in Accra may be decreasing over time but remains 2 to 4-fold higher than the WHO guideline with significant variations in relation to spatial, socioeconomic, and land-use factors. Equitable local policies and interventions are needed to reduce air pollution levels and protect the vulnerable.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

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**P-1042**

### Integration of Low-Cost Sensor Measurements into High-Resolution PM<sub>2.5</sub> Exposure Modeling

**Presenter:** Jianzhao Bi, Emory University, Atlanta, United States

**Authors:** J. Bi, A. Wildani, H. H. Chang, Y. Liu;  
Emory University, Atlanta, GA.

**Background:** Low-cost air quality sensors are promising supplements to regulatory monitors for PM<sub>2.5</sub> exposure assessment. However, little has been done to incorporate the low-cost sensor measurements in large-scale PM<sub>2.5</sub> exposure modeling.

**Objectives:** We conducted spatially varying calibration and developed a down-weighting strategy to optimize the use of low-cost sensor data in PM<sub>2.5</sub> estimation.

**Methods:** In California, PurpleAir low-cost sensors were paired with Air Quality System (AQS) regulatory stations and calibration of the sensors was performed by Geographically Weighted Regression. The calibrated PurpleAir measurements were then given lower weights according to their residual errors and fused with AQS measurements into a Random Forest model to generate 1-km daily PM<sub>2.5</sub> estimates.

**Results:** The calibration reduced PurpleAir's systematic bias to ~0 µg/m<sup>3</sup> and residual errors by 36%. Increased sensor bias was found to be associated with higher temperature and humidity as well as a longer operating time. The weighted prediction model outperformed the AQS-based prediction model with an improved random CV R<sup>2</sup> of 0.86, an improved spatial CV R<sup>2</sup> of 0.81, and a lower prediction error. The temporal CV R<sup>2</sup> did not improve due to the temporal discontinuity of PurpleAir.

**Conclusions:** The inclusion of PurpleAir data allowed the predictions to better reflect PM<sub>2.5</sub> spatial details and hotspots.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

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**P-1044**

**Characterization of particulate matter (PM) species in an area impacted by aggregate mining north of San Antonio, TX**

**Presenter:** Amit Ugamraj Raysoni, The University of Texas Rio Grande Valley, Brownsville, United States

**Authors:** A. U. Raysoni<sup>1</sup>, H. Rodrigo<sup>1</sup>, J. D. Collins<sup>2</sup>;

<sup>1</sup>The University of Texas Rio Grande Valley, Brownsville, TX, <sup>2</sup>Middle Tennessee State University, Murfreesboro, TN.

**Background:** Aggregate and limestone mining in counties - especially Bexar and Comal, north of the city of San Antonio have been a cause of health concern recently. Aggregate mining particularly in residential areas can be problematic due to heavy truck traffic transporting the material resulting in vehicular air pollution as well.

**Methods:** PM species were sampled at four locations north of San Antonio. The data was collected using a TSI Air Quality Sampler that sampled PM<sub>1</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>, wind speed, wind direction, temperature, and relative humidity. Continuous data (1 minute averages) was recorded for the entire study period. The instrument was stationed at every location for a period of 7 days. The four locations were a ranch, open field, residential compound, and an elementary school. The sampling was conducted in August and September 2019.

**Results:** The PM<sub>1</sub> and PM<sub>2.5</sub> levels were low at all the four sites in contrast to the PM<sub>10</sub> levels. This suggests that the PM in Bexar and Comal Counties are impacted by mining activities primarily. For example, the seven day average for PM<sub>2.5</sub> was about 8.6 ug/m<sup>3</sup> at the ranch and PM<sub>10</sub> values were around 15.8 ug/m<sup>3</sup>. PM species were highest at the residential compound due to the close proximity to an active mining area.

**Conclusions:** Mining activities for limestone and aggregates should be limited in areas that are away from residential locations to minimize the respiratory exposure burden of the local population. More sampling needs to be done in other seasons as well.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

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**P-1045**

**Evaluating the utility of high-resolution air pollution data: Comparing the importance of temporal and spatial variability in estimating local air pollution exposures in California from 2015-2018**

**Presenter:** Laura A Gladson, New York University, New York, United States

**Authors:** L. A. Gladson, N. Garcia, K. R. Cromar;  
New York University, New York, NY.

Background: For many years, air quality researchers have focused heavily on improving the spatial resolution of outdoor pollution estimates. This has been accomplished through improved satellite remote sensing technologies combined with complex models, currently producing surface-level estimates down to the kilometer and sub-kilometer scales. However, as resolutions grow increasingly refined, it is important to evaluate how much new information additional resolution provides and compare the relative importance of spatial and temporal variability in assigning pollution exposures to study populations. Methods: Daily PM<sub>2.5</sub> estimates at a 1 km<sup>2</sup> resolution, derived from NASA's MODIS satellite instrument and the MAIAC algorithm, were estimated for 2015-2018 and linked to California ZIP codes using spatial interpolation weighting factors. Within- and between-ZIP code spatial and temporal variations were calculated for all cities with at least three ZIP codes, then aggregated and analyzed using time-series and GIS analyses. Results: Variation of PM<sub>2.5</sub> concentrations within ZIP codes is negligible, with much greater variation observed between ZIP codes in the same city. Within and between ZIP code variation did show strong seasonal influences with greater variation observed during the cooler months of the year, particularly in Northern California which is heavily influenced by local emissions sources. In all cases, temporal variability was much greater than spatial variability at the sub-urban spatial resolutions included in this study. Conclusions: For much of the year, there is little additional information gained by using spatial resolutions more refined than ZIP code level estimates in California during the study period. However, during specific seasons there may be additional value in assigning exposures based on resolutions down to 1 km<sup>2</sup>. As air quality research moves forward, there may be diminishing returns from further improvements in spatial resolution for PM<sub>2.5</sub> and efforts may be better allocated to other areas of exposure assessment.

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## ABSTRACT E-BOOK

Theme: **PM exposure measurement**

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**P-1046**

**Exposure assessment of PM<sub>2.5</sub> for entire population in the region of interest using sensor-based air monitoring system and similar time-activity groups**

**Presenter:** Jinhyeon Park, Daegu Catholic University, Gyeongbuk, Korea, Republic of

**Authors:** J. Park<sup>1</sup>, H. Ryu<sup>1</sup>, E. Kim<sup>1</sup>, Y. Choe<sup>1</sup>, J. Lee<sup>2</sup>, J. Heo<sup>1</sup>, S. Cho<sup>3</sup>, M. Cho<sup>1</sup>, W. Yang<sup>1</sup>;

<sup>1</sup>Daegu Catholic University, Gyeongbuk, KOREA, REPUBLIC OF, <sup>2</sup>Korea Testing & Research Institute, Gwacheon, KOREA, REPUBLIC OF, <sup>3</sup>Research Triangle Institute International, Research Triangle Park, NC.

PM<sub>2.5</sub> is an air pollutant that can cause various adverse health effects. Although the fixed ambient air monitoring stations provides ambient PM<sub>2.5</sub> concentration within a community, it is still weak to assess actual exposure of population account for time-activity patterns. However, the exposure of the entire population in a region of interest may be estimated by classifying the population according to time-activity pattern and modeling their exposure. In this study, we tried to suggest the methodology to assess exposure to PM<sub>2.5</sub> of entire population in a region of interest. The five field technicians representing similar time-activity groups (STG) of preschool children, students, housewives, office workers, and the elderly conducted exposure simulation with PM<sub>2.5</sub> personal exposure monitor in Guro-gu, Seoul, Korea. The PM<sub>2.5</sub> exposure concentrations ( $c_s$ ) were modeled by interpolation (point in polygon, inverse distance weighted and ordinary kriging) and regression model using GPS data and sensor-based air monitoring instruments network and compared with MicroPEM data ( $c_m$ ). The exposure of the entire population to PM<sub>2.5</sub> was estimated by population-weighted average through Monte-Carlo simulation. The elderly had the highest average  $c_m$  follows by office workers, housewives, preschool children, and students. The correlation between  $c_m$  and  $c_s$  was good in order of ordinary kriging ( $R^2=0.822$ ), inverse distance weighted ( $R^2=0.747$ ), and point in polygon method ( $R^2=0.721$ ). The 33.8% of the entire population exposed to PM<sub>2.5</sub> higher than Atmospheric Environmental Standard of PM<sub>2.5</sub> for 24-hour average. In this study, the possibility of assessing the exposure of the entire population for real-time and long-term cumulative exposure was suggested by applying this methodology, and it is expected that the exposure surveillance system can be developed based on these results.

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Theme: **Reproductive**

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**P-1049**

**Exposure to ambient air pollution during pregnancy and inflammatory markers in maternal and umbilical cord blood**

**Presenter:** Chloe Friedman, Colorado School of Public Health, Aurora, United States

**Authors:** C. Friedman<sup>1</sup>, D. Dabelea<sup>2</sup>, D. SK Thomas<sup>3</sup>, J. L. Peel<sup>4</sup>, J. L. Adgate<sup>1</sup>, S. Magzamen<sup>4</sup>, S. E. Martenies<sup>4</sup>, W. B. Allshouse<sup>1</sup>, A. P. Starling<sup>1</sup>;

<sup>1</sup>Colorado School of Public Health, Aurora, CO, <sup>2</sup>University of Colorado, Anschutz Medical Campus, Aurora, CO, <sup>3</sup>University of North Carolina, Charlotte, NC, <sup>4</sup>Colorado State University, Fort Collins, CO.

**Background:** Exposure to ambient air pollution during pregnancy has been associated with adverse pregnancy and birth outcomes. Inflammation has been proposed as a potential mechanistic link to explain this relationship. In a Colorado-based cohort, we estimated associations between air pollution exposure during pregnancy and inflammatory markers in maternal and cord blood. We also estimated associations between maternal inflammatory markers and infant birth and adiposity outcomes. **Methods:** Among 515 mother-infant dyads in the Healthy Start Study (2009-2014), trimester-specific and full pregnancy average concentrations of particulate matter of diameter  $\leq 2.5$  micrometers (PM<sub>2.5</sub>) and ozone (O<sub>3</sub>) were estimated using inverse-distance-weighted interpolation from stationary monitors. Inflammatory markers were measured in mid-pregnancy (median 27 weeks) maternal blood (CRP, IL-6, and TNF $\alpha$ ) and cord blood at delivery (CRP, IL-6, IL-8, IL-10, MCP-1, and TNF $\alpha$ ). Multivariable linear regression models estimated associations between PM<sub>2.5</sub> and O<sub>3</sub> exposure and inflammatory markers, and between maternal inflammatory markers and infant outcomes, including birth weight, gestational age at birth, and adiposity (percent fat mass) assessed via air displacement plethysmography. **Results:** Second trimester PM<sub>2.5</sub> and first trimester O<sub>3</sub> were positively associated with maternal IL-6 concentrations (PM<sub>2.5</sub>: 7.38% per IQR; 95%CI 1.40-13.72; O<sub>3</sub>: 8.09% per IQR, 95%CI 0.00-17.05). PM<sub>2.5</sub> and O<sub>3</sub> were positively associated with maternal TNF $\alpha$  (trimester 1: PM<sub>2.5</sub>: 10.77% per IQR; 95%CI 1.04-21.44; O<sub>3</sub>: 28.05% per IQR, 95%CI; 12.70-45.48; trimester 2: PM<sub>2.5</sub>: 9.19% per IQR; 95%CI 0.00-19.13, O<sub>3</sub>: 25.62% per IQR, 95%CI; 11.08-42.06). Ambient air pollution was not associated with inflammatory markers in cord blood. No consistent associations were found between maternal inflammatory markers and infant outcomes. **Conclusions:** We found evidence of a positive association between ambient air pollution exposure during pregnancy and maternal, but not cord blood, inflammatory markers. Further investigations should examine the health consequences for women of elevated inflammatory markers associated with air pollution exposure during pregnancy.

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## ABSTRACT E-BOOK

Theme: **Reproductive**

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**P-1050**

### **Maternal exposure to plasticizer compounds is inversely associated with gestational weight gain in women with obesity**

**Presenter:** Diana C Pacyga, Department of Food Science and Human Nutrition, Institute for Integrative Toxicology, and Department of Epidemiology and Biostatistics, Michigan State University, East Lansing, United States

**Authors:** D. C. Pacyga<sup>1</sup>, A. M. Calafat<sup>2</sup>, S. L. Schantz<sup>3</sup>, R. S. Strakovsky<sup>4</sup>;

<sup>1</sup>Department of Food Science and Human Nutrition, Institute for Integrative Toxicology, and Department of Epidemiology and Biostatistics, Michigan State University, East Lansing, MI, <sup>2</sup>Division of Laboratory Sciences, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA, <sup>3</sup>Department of Comparative Biosciences and Beckman Institute, University of Illinois, Champaign-Urbana, IL, <sup>4</sup>Department of Food Science and Human Nutrition and Institute for Integrative Toxicology, Michigan State University, East Lansing, MI.

**Background/Aims:** Phthalates are endocrine disruptors with ubiquitous exposure in pregnant women, but their impact on maternal gestational weight gain (GWG) is unclear. We investigated associations of prenatal exposure with GWG and considered whether associations differed by maternal pre-pregnancy BMI (ppBMI). **Methods:** In 444 pregnant women from Champaign-Urbana, Illinois, we calculated GWG (kg) from self-reported pre-pregnancy weight and weight at median (range) 34 (29-38) weeks gestation. We quantified 19 phthalate/alternative metabolites in pools of five first-morning cross-pregnancy urines. These reflect exposures to 10 phthalates/alternatives as individual metabolites or molar sums of metabolites from the same phthalate/alternative [e.g. di(2-ethylhexyl) phthalate (SumDEHP), diisononyl phthalate (SumDiNP), di(2-ethylhexyl) terephthalate (SumDEHTP)]. We categorized ppBMI (kg/m<sup>2</sup>) as under-/normal weight (<25.0), overweight (25.0-29.9), and obese (≥30.0). We used linear regression to assess overall and ppBMI-stratified associations of ln-transformed specific gravity-adjusted biomarker concentrations with GWG, controlling for maternal age, race, ppBMI, parity, smoking status, diet quality, fetal sex, and gestational age at mid-to-late pregnancy weight. **Results:** These predominately Caucasian/White, college-educated women gained on average 12.1kg through mid-to-late pregnancy and >50% had a normal ppBMI. All women were exposed to measured chemicals, with similar concentrations to U.S. women. Overall, only SumDEHP and SumDEHTP were associated with GWG. Specifically, two-fold increases in SumDEHP and SumDEHTP were associated with 0.8kg lower GWG (95%CI: -1.5, -0.7 and -1.4, -0.2), respectively. However, when stratified by ppBMI, associations were strongest in obese women. Only in obese women, two-fold increases in SumDEHP and SumDiNP were associated with 1.9 and 1.3kg lower GWG, respectively. Similarly, in overweight and obese women, a two-fold increase in SumDEHTP was associated with 1.2 and 1.6kg lower GWG. **Conclusions:** In obese women, prenatal exposure to phthalates is associated with reduced GWG. Given the importance of appropriate GWG for fetal growth, especially in obese women, these findings should be corroborated in other populations.

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## ABSTRACT E-BOOK

Theme: **Reproductive**

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**P-1051**

### **Associations between Potential Exposure Sources and Urinary Phthalate Concentrations among Couples Undergoing Infertility Treatment**

**Presenter:** Thoin F Begum, Department of Environmental Health Sciences, School of Public Health, The University at Albany, State University of New York, Rensselaer, United States

**Authors:** T. F. Begum<sup>1</sup>, V. Y. Fujimoto<sup>2</sup>, A. McGough<sup>2</sup>, N. Lenhart<sup>2</sup>, R. Wong<sup>2</sup>, E. Mok-Lin<sup>2</sup>, J. Melamed<sup>2</sup>, R. Gerona<sup>2</sup>, C. D. Butts<sup>1</sup>, B. J. Feingold<sup>1</sup>, X. X. Romeiko<sup>1</sup>, M. S. Bloom<sup>1</sup>;

<sup>1</sup>Department of Environmental Health Sciences, School of Public Health, The University at Albany, State University of New York, Rensselaer, NY, <sup>2</sup>Department of Obstetrics, Gynecology and Reproductive Sciences, University of California at San Francisco, San Francisco, CA.

**Background/Aim:** Phthalates are implicated as reproductive toxicants in experimental and observational studies. We examined associations between potential exposure sources and urinary phthalate concentrations among infertile couples. **Methods:** Women (n=56) and their male partners (n=43) undergoing in vitro fertilization (IVF) were enrolled in a prospective cohort investigation of environmental chemicals and IVF outcomes. On the day of oocyte retrieval, women (fasting) and their male partners provided urine samples and completed questionnaires detailing use of personal care products (PCPs), consumption of medications, and foods/beverages in the preceding 24-hours. Urine was analyzed for monoethyl phthalate (MEP), mono-n-butyl phthalate (MBP), mono-n-pentyl phthalate (MPP), mono-n-hexyl phthalate (MHxP), mono(2-ethylhexyl) phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), mono-(2-ethyl-5-carboxypentyl) phthalate (MECPP), mono-isononyl phthalate (MiNP), mono-isodecyl phthalate (MiDP), monocyclohexyl phthalate (MCHP), and monobenzyl phthalate (MBzP) via liquid chromatography-tandem mass spectrometry (Agilent LC 1260-AB Sciex 5500). We employed principal component analysis (PCA) to summarize questionnaire responses as patterns of exposure and entered factors into linear regression models to evaluate associations with urinary phthalate concentrations, adjusted for specific gravity, age, BMI (for women), history of smoking, and race. **Results:** Among women, recent application of moisturizers, cleansers, and nail polish was associated with greater urinary MBP [ $\beta=0.08$  (95% CI: 0.02-0.14)] and the molar sum of diethylhexyl phthalate (DEHP) metabolites [ $\beta=0.23$  (95% CI: 0.16-0.29)]. Among men, recent supplement and allergy medication intake was positively associated with the sum of DEHP metabolites [ $\beta=0.12$  (95% CI: 0.02-0.21)]. Women with a tubal factor or polycystic ovary syndrome infertility diagnosis had higher urinary phthalate concentrations than women with other infertility diagnoses. **Conclusions:** Among women, recent PCP use predicted urinary phthalate concentrations, whereas in men, supplements/medications were important contributors to phthalate exposure. This difference in exposure sources among couples will be useful for developing strategies to limit phthalate exposure as part of a comprehensive strategy to help improve IVF outcomes.

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**P-1052**

### **Air Pollution Exposure in Relation to the Periconception Serum Metabolome in Women**

**Presenter:** Audrey Jane Gaskins, Rollins School of Public Health, Atlanta, United States

**Authors:** A. J. Gaskins<sup>1</sup>, D. Liang<sup>1</sup>, J. Ford<sup>2</sup>, I. Kloog<sup>3</sup>, J. D. Schwartz<sup>2</sup>, D. Jones<sup>1</sup>, R. Hauser<sup>2</sup>, F. Laden<sup>2</sup>;

<sup>1</sup>Rollins School of Public Health, Atlanta, GA, <sup>2</sup>Harvard T.H. Chan School of Public Health, Boston, MA,

<sup>3</sup>Mount Sinai Hospital, New York City, NY.

**Background/Aim:** Periconception air pollution exposure has been linked with diminished fertility, adverse birth outcomes, and neurodevelopmental disorders. Identifying the metabolic changes induced by air pollution exposure among reproductive-aged women could enhance our understanding of the biological pathways underlying air pollution's reprotoxicity. Thus, our objective was to identify metabolic alterations associated with periconception air pollution exposure in women using a metabolome-wide association study. **Methods:** Our study included 200 women undergoing in vitro fertilization (IVF) at a fertility center in Boston, Massachusetts (2005-2015). Women provided blood samples during controlled ovarian stimulation and untargeted metabolic profiling was conducted on the serum samples using liquid chromatography with ultra-high-resolution mass spectrometry. Spatiotemporal models estimated residence-based daily nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>), and fine particulate (PM<sub>2.5</sub>) concentrations in the 3 months prior to starting IVF. We evaluated associations between each air pollutant and each metabolic feature using linear regression adjusted for age, BMI, education level, smoking status, and average temperature. Pathway analyses were employed to identify biological pathways related to air pollution exposure. **Results:** From the negative and positive ionization modes, 10,803 and 12,968 metabolic features were extracted, respectively. Higher exposure to NO<sub>2</sub>, O<sub>3</sub>, and PM<sub>2.5</sub> was associated with 80, 35, and 246 features, respectively, after controlling for false discovery rate. Across all three pollutants, no common feature was significantly altered; however, higher exposure to NO<sub>2</sub>, O<sub>3</sub>, and PM<sub>2.5</sub> resulted in perturbations in the glycine, serine, alanine and threonine and linoleate pathways and to a lesser extent in the leukotriene, urea cycle/amino group vitamin E, and prostaglandin formation from arachidonate pathways. **Conclusions:** In this cross-sectional study, periconception air pollution exposures were correlated with a variety of metabolic pathways such as amino acid metabolism, inflammation, and oxidative stress. Future studies should determine whether these pathways mediate associations between air pollution and couple fertility.

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**P-1053**

### **Maternal Diet in Pregnancy and Child Blood Pressure: Results from the Conditions Affecting Neurocognitive Development and Learning in Early Childhood (CANDLE) Study**

**Presenter:** Yu Ni, University of Washington, Seattle, United States

**Authors:** Y. Ni<sup>1</sup>, C. Loftus<sup>1</sup>, F. Tyllavsky<sup>2</sup>, A. Szpiro<sup>1</sup>, M. Kratz<sup>3</sup>, A. L. Fitzpatrick<sup>1</sup>, J. Sonney<sup>1</sup>, K. LeWinn<sup>4</sup>, N. Bush<sup>4</sup>, S. Sathyanarayana<sup>5</sup>, R. Davis<sup>2</sup>, C. Karr<sup>1</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>University of Tennessee Health Science Center, Memphis, TN,

<sup>3</sup>University of Washington; Fred Hutchinson Cancer Research Center, Division of Public Health Sciences, Seattle, WA, <sup>4</sup>University of California San Francisco, San Francisco, CA, <sup>5</sup>University of Washington; Seattle Children's Research Institute, Seattle, WA.

**Background:** The intrauterine environment may influence offspring blood pressure, with effects possibly extending into adulthood. The associations of maternal dietary patterns and micronutrient status during pregnancy with offspring blood pressure, alone or in combination with other sociodemographic or behavioral factors, are unclear. **Methods:** The CANDLE study includes a racially and socioeconomically diverse birth cohort in the Mid-South of the U.S.. Mother-child dyads (N=846, 67% Black, 27% White) who completed an age 4-6 visit were included. Child systolic (SBP) and diastolic blood pressure (DBP) percentile incorporating sex, age and height were calculated, and further categorized as high blood pressure (HBP) ( $\geq 90^{\text{th}}$  SBP or DBP) or normal. Maternal dietary patterns were assessed by the Healthy Eating Index (HEI) based on a second trimester Food Frequency, and plasma folate levels were determined during mid to late pregnancy. We fit linear and Poisson (relative risk) regression models adjusted for sociodemographic characteristics, anthropometry, behavioral factors, maternal stress and child diet. Interactions between nutrient indices and child sex, maternal race, maternal smoking, breastfeeding and maternal weight status were explored. **Results:** Mean (standard deviation) HEI and folate were 60.1 (11.3) and 23.2 (11.1) nmol/L respectively. 29% of the children were defined as HBP based on measurements at the age 4-6 visit. Maternal HEI and plasma folate were not associated with child BP percentiles and HBP in the full cohort. Among mothers self-identified as White, each 1-unit increase of HEI was associated with 0.47 lower SBP percentile in the child (95%CI: -0.84, -0.09;  $P_{\text{interaction}}$ : 0.07). We found no evidence of effect modification by child sex, maternal smoking, breastfeeding or maternal weight status. **Conclusion:** Using two measures of prenatal diet, we found little evidence for effects of maternal diet on childhood BP. Optimal maternal dietary patterns were associated with lower child SBP only in mothers self-identified as White.

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**P-1054**

**Ambient fine particulate matter and preterm birth in Temuco, Chile: effect modification by maternal morbidity**

**Presenter:** Estela Blanco, University of Chile, Santiago, Chile

**Authors:** E. Blanco<sup>1</sup>, M. Quinteros<sup>2</sup>, X. Ossa<sup>3</sup>, J. Delgado-Saborit<sup>4</sup>, J. Cárdenas-Ramírez<sup>3</sup>, C. Blázquez<sup>5</sup>, S. Bartington<sup>6</sup>, R. Harrison<sup>6</sup>, P. Ruiz-Rudolph<sup>1</sup>;

<sup>1</sup>University of Chile, Santiago, CHILE, <sup>2</sup>Universidad de Talca, Talca, CHILE, <sup>3</sup>Universidad de la Frontera, Temuco, CHILE, <sup>4</sup>ISGlobal Barcelona Institute for Global Health, Barcelona, SPAIN, <sup>5</sup>Universidad Andrés Bello, Santiago, CHILE, <sup>6</sup>University of Birmingham, Birmingham, UNITED KINGDOM.

Background: Exposure to fine ambient particulate matter (PM<sub>2.5</sub>) during pregnancy has been related to increased risk of preterm birth (PTB), with some evidence for differential vulnerability by maternal morbidity. We evaluated whether selected maternal characteristics modified the effect of PM<sub>2.5</sub> and risk of PTB (gestational age <37 weeks) in Temuco, a city in southern Chile heavily impacted by residential wood-burning for heating. Methods: Between 2009-2015, information on all live births from the regional public hospital in Temuco was collected (n=15,510). Exposure to PM<sub>2.5</sub> in each trimester of pregnancy was estimated using a land-use regression model. Survival analysis was used to estimate the effects of exposure to PM<sub>2.5</sub> in each trimester for risk of PTB adjusting for potential confounders. We tested an interaction between exposure in each trimester and the following maternal characteristics: gestational diabetes, hypertension, heart disease, smoking, preeclampsia, anemia, nutritional status and level of education. Models were stratified when significant interactions were observed. Hazard ratios (HRs) are reported. Results: Median (IQR) of PM<sub>2.5</sub> exposure in the first, second and third trimester was 32.3 (14.3-59.9), 34.5 (15.5-59.6) and 33.6 (13.9-59.9) µg/m<sup>3</sup>, respectively. A 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub> exposure in the first and third trimesters related to increased risks of PTB: HR=1.13 (1.07-1.20) and HR=1.14 (1.07-1.22), respectively. We did not observe significant interactions for: gestational diabetes, hypertension, heart disease, and smoking. Higher HRs of PTB, on the order of 12-38%, were observed for exposures during first and third trimester among women with preeclampsia, chronic anemia, overweight/obesity and lower education. In contrast, underweight women, seemed protected to the effects of PM<sub>2.5</sub>. Conclusions: In a city dominated by residential wood-burning, with PM<sub>2.5</sub> levels exceeding WHO recommendations, we observed that women with comorbidities (preeclampsia, anemia, overweight/obese) and lower education were more vulnerable to present PTB when facing higher PM<sub>2.5</sub> exposures.

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**P-1055**

**Association of urinary concentrations of phthalate metabolites with quinolinic acid among women: a potential link to neurological disorders**

**Presenter:** Feiby L Nassan, Harvard T. H. Chan School of public Health, Boston, United States

**Authors:** F. L. Nassan<sup>1</sup>, J. A. Gunn<sup>2</sup>, M. M. Hill<sup>2</sup>, P. L. Williams<sup>1</sup>, R. Hauser<sup>1</sup>;

<sup>1</sup>Harvard T. H. Chan School of public Health, Boston, MA, <sup>2</sup>Ethos Research & Development, Newport, KY.

**AbstractBackground/Aim:** Quinolinic acid (QA), a neuroactive metabolite produced during tryptophan degradation, is implicated in the pathogenesis of several neurological disorders. Phthalates are structurally similar to QA, and exposure to phthalates has demonstrated increased QA production and excretion in rodent studies. We recently showed that very high exposure to dibutyl phthalate was associated with higher concentrations of urinary QA in men. However, no human studies examined the associations between background (low) phthalate exposures and QA. We examine the associations of urinary phthalate metabolite concentrations with QA. **Methods:** Female participants (N=126) who participated in a prospective cohort study at a Fertility Center in Boston provided 758 urine samples (273 during pregnancy and 485 during non-pregnancy). Concentrations of 11 phthalate metabolites and QA in urine were measured. We used multivariable linear mixed effect models to estimate the percent change in urinary QA concentrations associated with a doubling (100%) of phthalate metabolite concentration, and evaluated whether there was effect modification by pregnancy. **Results:** Women's mean (standard deviation) age was 34.2 (4.0) years with a body mass index of 23.5 (3.7) kg/m<sup>2</sup>. The women were primarily Caucasian (92%), had ≥a college degree (98%), and none were current smokers. In multivariable-adjusted models, the percent change in urinary QA concentrations was significantly higher for each doubling of several urinary phthalate metabolite concentrations. For example, each doubling of DBP metabolites was associated with a 13.7% (95%CI: 10.6, 16.9) higher QA. Associations between the low molecular weight phthalate metabolites and QA were stronger among samples collected during pregnancy as compared to non-pregnancy. **Conclusions:** Urinary concentrations of several phthalate metabolites were positively associated with QA among women. These findings, along with the known neurotoxicity of QA, warrant the need to examine whether QA concentrations may serve as a pathway for the adverse neurodevelopment outcomes found in children's health studies.

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## ABSTRACT E-BOOK

Theme: **Reproductive**

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**P-1056**

### **Residential proximity to major roads and risk of spontaneous abortion**

**Presenter:** Amelia K Wesselink, Boston University School of Public Health, Boston, United States

**Authors:** A. K. Wesselink<sup>1</sup>, L. A. Wise<sup>1</sup>, K. Kirwa<sup>2</sup>, P. Hystad<sup>3</sup>, D. Savitz<sup>4</sup>, A. A. Szpiro<sup>2</sup>, J. D. Kaufman<sup>2</sup>, J. I. Levy<sup>1</sup>, E. M. Mikkelsen<sup>5</sup>, K. J. Rothman<sup>1</sup>, E. E. Hatch<sup>1</sup>;

<sup>1</sup>Boston University School of Public Health, Boston, MA, <sup>2</sup>University of Washington School of Public Health, Seattle, WA, <sup>3</sup>Oregon State University College of Public Health and Human Sciences, Corvallis, OR, <sup>4</sup>Brown University School of Public Health, Providence, RI, <sup>5</sup>Aarhus University Hospital, Aarhus, DENMARK.

**Background:** Spontaneous abortion (SAB), defined as fetal loss before 20 weeks' gestation, affects approximately 30% of pregnancies, yet few modifiable risk factors have been identified. Traffic-related air pollution could plausibly affect SAB risk through several mechanisms, including oxidative stress, systemic and placental inflammation, and DNA damage. Previous epidemiologic studies on SAB and air pollution are generally limited by small size and hospital-based case ascertainment. **Methods:** We examined the association between residential proximity to major roads and SAB risk among pregnancy planners from the United States (n=4,565) and Canada (n=889). From 2013 to 2019, women aged 21-45 years completed an online baseline questionnaire, follow-up questionnaires every 8 weeks, and questionnaires in early and late pregnancy. After geocoding residential addresses, we calculated distance to nearest major roads and length of major roads within buffers of varying sizes around the residence as proxies for traffic-related air pollution. We identified SABs on the follow-up and pregnancy questionnaires. We used Cox proportional hazards regression, with gestational weeks as the time scale, to estimate hazard ratios (HR) and 95% confidence intervals (CI), adjusting for individual- and neighborhood-level characteristics. **Results:** Eighteen percent of pregnancies ended in SAB, at a median time of 6 weeks of gestation (range=4-20). Distance to the closest major road was not meaningfully associated with SAB risk (HRs comparing women who lived <50m with those who lived ≥400m from the closest major road were 1.01 [95% CI: 0.81, 1.27] in the United States and 1.04 [95% CI: 0.56, 1.91] in Canada). Results for other proximity metrics were similarly near null. In a stratified analysis, we found little difference in hazard of SAB by strata of gestational weeks (<8 vs. ≥8).

**Conclusions:** In this large preconception cohort study of North American women, residential proximity to major roads was not appreciably associated with SAB risk.

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**P-1057**

### **Exposures to air pollution and endocrine disruptors and measures of semen quality in a population based cohort of US men**

**Presenter:** Jaime Elizabeth Hart, Brigham and Women's Hospital and Harvard Medical School; Harvard TH Chan School of Public Health, Boston, United States

**Authors:** J. E. Hart<sup>1</sup>, I. Holland<sup>2</sup>, S. Gillooly<sup>3</sup>, G. Adamkiewicz<sup>3</sup>, K. A. Anderson<sup>4</sup>, A. A. Baccarelli<sup>5</sup>, C. L. Bormann<sup>6</sup>, R. Hauser<sup>7</sup>, M. K. Kanakasabapathy<sup>8</sup>, M. N. Kathrins<sup>8</sup>, L. Liang<sup>3</sup>, A. Devi Sivakumar<sup>2</sup>, P. Thirumalaraju<sup>2</sup>, H. Shafiee<sup>8</sup>, J. E. Chavarro<sup>1</sup>;

<sup>1</sup>Brigham and Women's Hospital and Harvard Medical School; Harvard TH Chan School of Public Health, Boston, MA, <sup>2</sup>Brigham and Women's Hospital, Boston, MA, <sup>3</sup>Harvard TH Chan School of Public Health, Boston, MA, <sup>4</sup>Oregon State University, Corvallis, OR, <sup>5</sup>Mailman School of Public Health, Columbia University, New York, NY, <sup>6</sup>Massachusetts General Hospital and Harvard Medical School, Boston, MA, <sup>7</sup>Harvard TH Chan School of Public Health; Massachusetts General Hospital and Harvard Medical School, Boston, MA, <sup>8</sup>Brigham and Women's Hospital and Harvard Medical School, Boston, MA.

**Background:** Multiple studies have identified adverse associations between exposures to air pollution and endocrine disrupting chemicals on semen quality. However, few studies have assessed these associations among men from the general population, as opposed to clinical settings. Our objective was to assess these associations in a subset of participants in the US nationwide Growing Up Today Study (GUTS). **Methods:** We aim to enroll 200 men from GUTS living in the conterminous US, without a vasectomy, are who have not undergone chemotherapy, and are not taking anabolic steroids. For 90 days, participants use a smartphone application to track GPS location, run an air pollution sampler to collect real-time indoor measurements of NO<sub>2</sub>, and wear 3 separate passive wristband samplers each for 30 days. After 90 days of monitoring, participants produce a semen sample, which is analyzed for concentration and morphology at the Massachusetts General Hospital Andrology Laboratory via computer-aided semen analysis. For the first 45 participants, we assessed the interclass correlation (ICC) of exposures and assessed associations between exposures and outcomes using Spearman correlations and linear regressions. **Results:** The average NO<sub>2</sub> concentration was 18.11 (SD=10.2) ppb and 21 chemicals were detected in at least 20% of wristbands measured. The ICC for daily NO<sub>2</sub> was 0.71 (95%CI: 0.61, 0.79), the ICCs for the 21 chemicals varied widely, ranging from 0.04 (0.00, 0.97) for dicyclohexyl phthalate to 0.88 (0.78, 0.94) for galaxolide. Ninety-day average exposures to NO<sub>2</sub> were not associated percent normal morphology, but were associated with decreased sperm concentration (-12.09 M/ml per IQR (14.49 ppb) NO<sub>2</sub>). There were no clear patterns observed between the EDC exposures and semen parameters. **Conclusions:** In an initial subsample of general population men, exposures to NO<sub>2</sub>, but not endocrine disrupting chemicals, were associated with lower sperm concentrations.

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**P-1058**

### **Associations between Exposure to Oil and Gas Extraction and Pregnancy-Related Hypertension: A Difference-in-Differences Analysis**

**Presenter:** Mary D Willis, Oregon State University, Corvallis, United States

**Authors:** M. D. Willis<sup>1</sup>, E. Hill<sup>2</sup>, A. Boslett<sup>2</sup>, M. Kile<sup>1</sup>, S. Carozza<sup>1</sup>, P. Hystad<sup>1</sup>;

<sup>1</sup>Oregon State University, Corvallis, OR, <sup>2</sup>University of Rochester, Rochester, NY.

**Background:** An estimated 17.6 million Americans live within 1.6km of an oil or gas drilling site, and this industry is rapidly expanding. Recent evidence suggests that drilling-related exposures are associated with increased blood pressure. No studies have focused on pregnant women, a population that may be highly susceptible to drilling-related air pollution (e.g. truck traffic, gas flaring.) Using a difference-in-differences design, we examine associations between drilling exposures and pregnancy-related hypertension.

**Methods:** We utilized a population-based retrospective term birth cohort (37-42 weeks gestation) between 1996 and 2009 in Texas, where all mothers reside <10km of an active or future drilling site (n=2,598,025). Using full address data, we linked maternal residences at delivery to the coordinates of active oil and gas extraction sites between 1985 and 2019. We evaluated two markers of pregnancy-related hypertension (gestational hypertension, eclampsia) in a difference-in-differences framework. This design first evaluates hypertension risks among pregnant women residing within 0-3km of 1+ site pre-drilling (unexposed) vs. post-drilling (exposed), and then compares those women to a contemporaneous temporal control group residing 3-10km away in a pre-drilling vs. post-drilling context. We use logistic regression models and control for sociodemographic, behavioral, and clinical information.

**Results:** Among pregnant women residing 0-1km of an active drilling site, we find a 7% increased odds of gestational hypertension (95% CI: 1.02, 1.12) and a 28% increased odds of eclampsia (95% CI: 1.03, 1.58). These associations dissipate for residences 1-2 and 2-3km of 1+ drilling site during pregnancy. In restricted models, we find persistent associations among nulliparous women for gestational hypertension (1.15; 95% CI: 1.07, 1.23) and eclampsia (1.64; 95% CI: 1.23, 2.19).

**Conclusions:** Residential location less than 1km from an oil or gas extraction site, which aligns with hypothesized air pollution gradients from drilling sites, is associated with increased odds of gestational hypertension and eclampsia.

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**P-1060**

**The Relationship of Preconception Urinary Phthalate Levels with Fecundability and Pregnancy Loss**

**Presenter:** Carrie Nobles, NICHD, National Institutes of Health, Bethesda, United States

**Authors:** C. Nobles<sup>1</sup>, P. Mendola<sup>1</sup>, K. Kim<sup>1</sup>, A. Pollack<sup>2</sup>, S. Mumford<sup>1</sup>, N. Perkins<sup>1</sup>, L. Sjaarda<sup>1</sup>, R. Silver<sup>3</sup>, E. Schisterman<sup>1</sup>;

<sup>1</sup>NICHD, National Institutes of Health, Bethesda, MD, <sup>2</sup>George Mason University, Fairfax, VA, <sup>3</sup>University of Utah School of Medicine, Salt Lake City, UT.

**Background/Aim:** Phthalates are endocrine disrupting chemicals widely used as plasticizers and in personal care products. In utero exposure has been linked to pregnancy complications, childhood developmental delay and male reproductive dysfunction; however, studies of impact on establishing pregnancy are limited. **Methods:** The EAGeR trial enrolled 1,228 women attempting pregnancy with 1-2 prior pregnancy losses and followed them for up to 6 menstrual cycles and throughout pregnancy if they became pregnant. Pregnancy was assessed in each cycle using hCG testing and pregnancy loss determined when a positive hCG was followed by an observed loss. Twenty phthalate metabolites, including mono-(2-ethylhexyl) phthalate (mEHP), monobutyl phthalate (mBP) and monobenzyl phthalate (mBzP), were measured in a pooled sample of three consecutive daily spot urines from the beginning of the first menstrual cycle of follow-up to reduce exposure misclassification. Discrete-time survival and log-binomial models evaluated fecundability and pregnancy loss adjusting for creatinine and participant characteristics. **Results:** Phthalate concentrations were similar to other U.S. cohorts (e.g. median 6.6, interquartile range 4.1-12.4 ng/mL for mEHP). Overall, mEHP, mBP and mBzP were associated with lower fecundability (fecundability odds ratio [FOR] 0.90, 95% confidence interval [CI] 0.82-0.98 per log[mEHP]). Effect modification was observed by C-reactive protein (CRP) and body mass index (BMI), with mEHP, mEHP metabolites, mBP and mBzP associated with lower fecundability among those with higher CRP (FOR 0.77, 95% CI 0.65-0.90 for CRP $\geq$ 1.95 mg/L and FOR 0.98, 95% CI 0.88-1.09 for CRP $<$ 1.95 mg/L per log[mEHP]) and higher BMI (FOR 0.69, 95% CI 0.56-0.85 for BMI $\geq$ 30 kg/m<sup>2</sup> and FOR 0.99, 95% CI 0.88-1.11 for BMI $<$ 25 kg/m<sup>2</sup> per log[mEHP]). No relationship was observed between phthalates and pregnancy loss. **Conclusions:** Higher exposure to certain phthalates was associated with lower fecundability. Associations were strongest among women with higher BMI and inflammation, who may represent a key target group for screening and intervention.

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## ABSTRACT E-BOOK

Theme: **Reproductive**

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**P-1061**

### **Prenatal organophosphate flame retardant exposure and the odds of small- and large-for-gestational age births**

**Presenter:** Paige Bommarito, National Institute of Environmental Health Sciences, Durham, United States

**Authors:** P. Bommarito<sup>1</sup>, B. Welch<sup>1</sup>, D. Cantonwine<sup>2</sup>, T. McElrath<sup>2</sup>, K. Ferguson<sup>1</sup>;

<sup>1</sup>National Institute of Environmental Health Sciences, Durham, NC, <sup>2</sup>Brigham and Women's Hospital, Harvard Medical School, Boston, MA.

Background: Deviations in normal fetal growth trajectories may predispose infants to adverse outcomes later in life, such as cardio-metabolic disorders and decreased intellectual performance during childhood. Environmental exposures, including commonly used organophosphate flame retardants (OPFRs), have the ability to disturb normal hormonal and metabolic processes during pregnancy; however, associations with fetal growth have been minimally examined in human populations. Methods: Using a pilot case-control study, we investigated the association between 9 OPFRs and the odds of small-for (SGA) and large-for-gestational age (LGA) births. Concentrations of OPFRs were measured in maternal urine collected from three study visits during pregnancy using high performance liquid chromatography-tandem mass spectrometry. SGA (<10<sup>th</sup> percentile birth weight-for-gestational age, n = 30), LGA (>90<sup>th</sup> percentile, n = 30), and control (10<sup>th</sup> - 90<sup>th</sup> percentile, n = 30) births were selected from the LIFECODES birth cohort study. Odds ratios (OR) and 95% confidence intervals (95% CI) for associations between average OPFR concentrations over pregnancy and SGA and LGA were estimated using multinomial logistic regression. Results: Among the 9 urinary OPFRs measured, only bis(1,3-dichloro-2-propyl) phosphate (BDCPP) and diphenyl phosphate (DPHP) were detected in at least 85% of the participants at each study visit. After adjusting for potential confounders, we observed inverse associations between BDCPP and DPHP concentrations and odds of delivering an LGA baby. For example, a log-unit increase in BDCPP was associated with an OR (95% CI) of 0.37 (0.16, 0.84). All associations between OPFR concentrations and SGA were null. Conclusions: In a pilot study of prenatal OPFR exposure and fetal growth, urinary OPFR concentrations were associated with reduced odds of delivering LGA. While no associations with the SGA group were observed, these findings are consistent with previous observations that OPFRs are associated with lower measures of fetal growth and warrant additional investigation in future work.

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Theme: **Reproductive**

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**P-1062**

### **Relationships between measures of ambient air pollution and markers of inflammation during pregnancy**

**Presenter:** Priyanka Gogna, Queen's University, Kingston, Canada

**Authors:** P. Gogna<sup>1</sup>, W. D. King<sup>1</sup>, M. Johnson<sup>2</sup>, P. Kumarathasan<sup>3</sup>, P. J. Villeneuve<sup>4</sup>, B. Lanphear<sup>5</sup>, T. E. Arbuckle<sup>3</sup>, M. M. Borghese<sup>3</sup>;

<sup>1</sup>Queen's University, Kingston, ON, CANADA, <sup>2</sup>Air Health Science Division, Health Canada, Ottawa, ON, CANADA, <sup>3</sup>Environmental Health Science and Research Bureau, Health Canada, Ottawa, ON, CANADA,

<sup>4</sup>Carleton University, Ottawa, ON, CANADA, <sup>5</sup>Simon Fraser University, Vancouver, BC, CANADA.

**Background** Outdoor air pollution can influence important biological processes such as inflammation, and has been shown to increase the risk of adverse pregnancy and birth outcomes. Pregnancy-specific biological processes, such as increased estrogen production and altered metabolism can impair the body's ability to detoxify air pollution exposures, highlighting the need to study exposures during pregnancy. We examined the relationship between ambient PM<sub>2.5</sub> and NO<sub>2</sub>, with markers of inflammation during pregnancy in a cohort of Canadian women.

**Methods** We analyzed data from 1,397 women enrolled in the Maternal-Infant Research on Environmental Chemicals (MIREC) study, a Canadian pregnancy cohort. Residential PM<sub>2.5</sub> and NO<sub>2</sub> exposures were estimated using satellite-based and land-use regression models to generate overall pregnancy, and trimester specific averages. Inflammatory markers including C-reactive protein (CRP), interleukin-6 (IL-6), interleukin-8 (IL-8), and tumour Necrosis Factor alpha (TNFα) were measured in third-trimester maternal plasma samples. Multivariable linear regression was used to estimate the effects of an inter-quartile (IQR) change in both PM<sub>2.5</sub> and NO<sub>2</sub> on markers of inflammation, while adjusting for relevant individual-level confounders, including maternal behaviours, and established predictors of inflammation.

**Results** An IQR (5.42 µg/m<sup>3</sup>) change in PM<sub>2.5</sub> exposure during pregnancy was associated with higher IL-8 levels in the third trimester (5.13% [95% CI: 0.60% – 10.74%]). Exposure to PM<sub>2.5</sub> and NO<sub>2</sub> (IQR: 19.17ppb) during pregnancy was not significantly associated with other inflammatory makers. Additional analyses examining trimester-specific exposures, non-linear dose-response relationships, and quantitative bias will also be presented.

**Conclusions** We showed that average exposure to PM<sub>2.5</sub> during pregnancy was associated with increased third-trimester IL-8 levels, suggesting a possible mechanism through which air pollution exposures may impact the risk of adverse pregnancy and birth outcomes. This work adds to the limited literature on the impact of air pollution on inflammation during pregnancy in a low-exposure cohort.

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**P-1063**

**Gestational exposure to organophosphate esters (OPEs) and maternal blood pressure during pregnancy: The HOME Study**

**Presenter:** Weili Yang, University of Cincinnati, Cincinnati, United States

**Authors:** W. Yang<sup>1</sup>, J. M. Braun<sup>2</sup>, A. M. Vuong<sup>3</sup>, Z. Percy<sup>1</sup>, Y. Xu<sup>4</sup>, C. Xie<sup>1</sup>, A. M. Calafat<sup>5</sup>, M. Ospina<sup>5</sup>, K. N. Dietrich<sup>1</sup>, K. Yolton<sup>4</sup>, K. M. Cecil<sup>6</sup>, B. P. Lanphear<sup>7</sup>, A. Chen<sup>1</sup>;

<sup>1</sup>University of Cincinnati, Cincinnati, OH, <sup>2</sup>Brown University, Providence, RI, <sup>3</sup>University of Nevada Las Vegas, Las Vegas, NV, <sup>4</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>5</sup>Centers for Disease Control and Prevention, Atlanta, GA, <sup>6</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>7</sup>Simon Fraser University, Burnaby, BC, CANADA.

**Background:** After the phase-out of polybrominated diphenyl ethers, exposure to organophosphate esters (OPEs), which are potential endocrine disruptors, is ubiquitous. No study has examined the associations between gestational exposure to OPEs and blood pressure and the risk of pregnancy-induced hypertensive diseases. **Methods:** We used data from 333 women who had liveborn singletons without congenital abnormalities in the Health Outcomes and Measures of the Environment (HOME) Study, a prospective birth cohort. We quantified maternal urinary OPE metabolites at 16 weeks of gestation. Outcomes included the highest maternal blood pressure measurement at  $\geq 20$  weeks of gestation and pregnancy-induced hypertensive diseases (gestational hypertension, preeclampsia, and eclampsia) from medical chart review. We used linear regression and modified Poisson regression with covariate adjustment to estimate the associations of exposure with blood pressure and the risk of pregnancy-induced hypertensive diseases, respectively. **Results:** Diphenyl phosphate (DPHP) had the highest geometric mean urinary concentrations (1.65  $\mu\text{g/g}$  creatinine), followed by bis(1,3-dichloro-2-propyl) phosphate (BDCIPP; 0.76  $\mu\text{g/g}$  creatinine), bis(2-chloroethyl) phosphate (BCEP; 0.70  $\mu\text{g/g}$  creatinine), and dibutyl phosphate (DBUP; 0.25  $\mu\text{g/g}$  creatinine). There were 29 (8.7%) women diagnosed with pregnancy-induced hypertensive diseases. Average systolic and diastolic blood pressure, measured at an average of 31 weeks gestation (range: 20-41), were  $117 \pm 13$  and  $72 \pm 9$  mmHg, respectively. None of the urinary OPE metabolites were significantly associated with the highest maternal blood pressure at  $\geq 20$  weeks of gestation, nor were they strongly associated with an increased risk of pregnancy-induced hypertensive diseases. The relative risk (RR; 95% confidence interval) of pregnancy-induced hypertensive diseases by a 10-fold increase in exposure was 1.31 (0.66, 2.59) for DPHP, 1.36 (0.51, 3.67) for BDCIPP, 0.63 (0.16, 2.39) for BCEP and 2.13 (0.78, 5.77) for DBUP. **Conclusion:** This study suggests no associations between maternal urinary OPE metabolite concentrations and blood pressure or an increased risk of pregnancy-induced hypertensive diseases during pregnancy.

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**P-1064**

### **Maternal Exposure to Fine and Coarse Particulate Matter and Congenital Malformations in Offspring Among Members of a Primary Health Care Service: A Population-Based Cohort**

**Presenter:** Ronit Nirel, Hebrew University, Jerusalem, Israel

**Authors:** R. Nirel<sup>1</sup>, T. Shoham<sup>1</sup>, W. Abu Ahmad<sup>2</sup>, G. Koren<sup>3</sup>, R. Rotem<sup>4</sup>, I. Kloog<sup>5</sup>, V. Shalev<sup>4</sup>, R. Golan<sup>5</sup>, H. Levine<sup>2</sup>;

<sup>1</sup>Hebrew University, Jerusalem, ISRAEL, <sup>2</sup>Hadassah-Hebrew University, Jerusalem, ISRAEL, <sup>3</sup>Ariel University, Ariel, ISRAEL, <sup>4</sup>Maccabi Institute of Research and Innovation, Tel-Aviv, ISRAEL, <sup>5</sup>Ben-Gurion University of the Negev, Beer-Sheva, ISRAEL.

**Background/Aim:** Studies have suggested an association between particulate matter (PM) air pollution and certain congenital anomalies. However, to date, most studies have been based on anomalies that were ascertained at birth or up to 1 year of age. We investigated associations between exposures to PM during pregnancy and congenital anomalies using birth and childhood follow-up data from a leading health care provider in Israel.

**Methods:** We conducted a retrospective population-based cohort study among 254,756 newborns to members of the Maccabi Health Services, 2004-2015. Malformation follow-up continued into childhood. Daily fine and coarse PM data at pixels of 1X1 km<sup>2</sup> were obtained from prediction models that incorporated satellite data. The geographic coordinates of the mother's residence for each birth were linked to the respective pixel and averaged over weeks 3-8 of each pregnancy. As the relationship between PM and congenital anomalies was non-linear, we used quintiles of exposure to estimate adjusted odds ratios (ORs) with logistic regression models.

**Results:** We captured 31,087 isolated anomalies in the nervous (0.5%), eye-ear-face-neck (1.7%), circulatory (3.0%), digestive (3.1%), genital (3.4%) and urinary (0.5%) systems. For fine PM, positive associations were found across all quintiles when compared to the first quintile for urinary, digestive and circulatory systems. For example, for the urinary systems ORs for the second and fifth quintiles were 1.26 (95%CI: 1.05, 1.51) and 1.14 (95%CI: 0.93, 1.39), respectively, and for the digestive system the respective ORs were 1.09 (95%CI: 1.01, 1.17) and 1.20 (95%CI: 1.11, 1.29). Negative and null associations were found across all quintiles for eye-ear-face-neck and genital anomalies, respectively. Findings for coarse PM were null or negative.

**Conclusions:** Our results suggest supralinear concentration-response relationship between exposure to fine PM and certain congenital anomalies. Information on late diagnosis of children with congenital anomalies is important in evaluating the burden of disease.

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## ABSTRACT E-BOOK

Theme: **Reproductive**

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**P-1065**

### Seasonal Gene Expression in Human Placenta

**Presenter:** Danielle Clarkson-Townsend, Emory University, Atlanta, United States

**Authors:** D. Clarkson-Townsend<sup>1</sup>, E. Kennedy<sup>1</sup>, T. Everson<sup>1</sup>, M. Deyssenroth<sup>2</sup>, A. Burt<sup>1</sup>, K. Hao<sup>3</sup>, J. Chen<sup>3</sup>, M. Pardue<sup>4</sup>, C. Marsit<sup>1</sup>;

<sup>1</sup>Emory University, Atlanta, GA, <sup>2</sup>Columbia University, New York, NY, <sup>3</sup>Icahn School of Medicine at Mt Sinai, New York, NY, <sup>4</sup>Atlanta VA, Center for Visual and Neurocognitive Rehabilitation, Decatur, GA.

**Background:** Seasonal exposures influence human health and development. The placenta, as a mediator of the maternal and fetal systems and a regulator of development, is an ideal tissue to understand the biological pathways underlying relationships between season of birth and later life health outcomes. Rhythmic seasonal gene expression in the placenta could provide a molecular explanation for the associations between season of birth and later life disease.

**Methods:** We investigated whether transcriptome-wide placental gene expression had seasonal or monthly patterns in the Rhode Island Child Health Study (RICHS). We performed a differential expression analysis of season of birth, defined by the solstice and equinox dates to bin by photoperiod. Additionally, we evaluated whether placental gene expression displayed rhythmicity by conducting a cosinor analysis of birth month. Results were adjusted for multiple comparisons using the Benjamini and Hochberg or Bonferroni methods.

**Results:** Of the analyzed transcripts, 583 displayed differential expression between summer and winter births (FDR  $q < 0.05$ ); among these, BHLHE40, MIR210HG, and HILPDA had increased expression among winter births (Bon  $p < 0.05$ ). Enrichment analyses indicated over-representation of transcription factors HIF1A, VDR, and CLOCK, among others, and of GO term pathways related to ribosomal activity and infection between summer and winter births. Additionally, the cosinor analysis found rhythmic expression for approximately 11.9% of all 17,664 analyzed placental transcripts.

**Conclusion:** These results suggest that the placenta responds to seasonal cues and acts as a peripheral clock; results also suggest seasonal changes in placental inflammation and hypoxia, which may provide a molecular explanation for the extensive associations between season of birth and health outcomes. Further study of seasonal and circadian effects on the placenta could shed light on the pathways that influence the associations between season of birth and human health, as well as possible therapeutic targets.

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## ABSTRACT E-BOOK

### Theme: Reproductive

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**P-1066**

#### Testing direct and indirect effects of green space availability on reproductive outcomes

**Presenter:** Asier Anabitarte, Biodonostia Health Research Institute, Group of Environmental Epidemiology and Child Development. Paseo Begiristain s/n, 20014, Donostia - San Sebastián, Spain

**Authors:** A. Anabitarte<sup>1</sup>, M. Subiza-Perez<sup>1</sup>, J. Ibarluzea<sup>2</sup>, K. Azkona<sup>1</sup>, G. Garcia-Baquero<sup>3</sup>, C. Miralles-Guasch<sup>4</sup>, J. Irazusta<sup>5</sup>, K. Whitworth<sup>6</sup>, G. Vich<sup>7</sup>, A. Lertxundi<sup>8</sup>;

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**Background/Aim:** Adverse reproductive effects can lead to cognitive development problems, medical conditions, morbidity and mortality in future stages of lives. Surrounding residential greenness has a positive effect in reproductive health. Different studies have proposed that this effect could be both direct and indirect. Indirect effects of greenness may happen through the reduction of environmental exposure (air pollution, noise and temperature regulation), the promotion of physical activity and the improvement of psychological health. The aim of the study was to analyze the relationship between surrounding residential greenness and reproductive health, studying the possible role of said mediators. **Methods:** 441 pregnant women (mean age 33.52, SD = 4.88) were recruited in Donostialdea, Basque Country, Spain, during the first ultrasound in the Basque Health Service. After signing the informed consent form, participants were given the study questionnaire and one accelerometer (ActiGraph GT3X-BT) which they used it for one week. In the second trimester of pregnancy they repeated the whole process again. Environmental exposures (NO<sub>2</sub> and availability of >5000 m<sup>2</sup> green space in 300m) were assigned to all participants. Moderate to Vigorous Physical Activity (MVPA) was determined with the accelerometer. Psychological health was measured with the General Health Questionnaire (GHQ-12). Birth weight, preterm birth, small and large for gestational age (SGA & LGA) were defined as outcome variables and newborn sex, season, deprivation index and parity as covariates. Natural effects models were used to analyze aforementioned direct and indirect effects. **Results:** Greenness availability had a negative effect on birth weight (-138g; p-value = 0.022). A marginal protective effect of greenness availability on LGA (OR = 0.54; p-value = 0.091) was detected in the model with GHQ as mediator. **Conclusions:** Greenness availability in 300m had limited effects on reproductive outcomes. Using other measures of greenness may help to understand this question better.

## ABSTRACT E-BOOK

Theme: **Reproductive**

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**P-1068**

**Implementation of a community based prospective prenatal cohort in an international setting:  
Reflections on the Proyecto SEMILLA**

**Presenter:** Fadya A Orozco, Universidad San Francisco de Quito, Quito, Ecuador

**Authors:** F. A. Orozco<sup>1</sup>, A. J. Handal<sup>2</sup>, S. M. Montenegro<sup>3</sup>;

<sup>1</sup>Universidad San Francisco de Quito, Quito, ECUADOR, <sup>2</sup>University of Michigan, Ann Arbor, MI, MI, <sup>3</sup>CTT-USFQ, Quito, ECUADOR.

**Background** Once a cohort study is funded, its implementation in international contexts should consider aspects that affect both the methods and the execution time. We reflect on our experience in the implementation of a prenatal community cohort in Ecuador. **Observations** Among the main aspects that have influenced the implementation of the SEMILLA project, some of the most important are the following: 1) Regulatory context and scientific culture: a) Delay in the approval of study protocol by regulatory bodies at national level; b) Limitations due to a scientific culture and social context with little experience in the implementation of cohort studies and their procedures, for example, collection storage of biological samples; c) Delay in the authorization by national authorities to allow health care providers from the Institute of Social Security to participate in the recruitment process at local level. 2) Organization of operative issues at community level: a) Challenges in the adaptation of the physical infrastructure according to the study's implementation requirements, for example, use of freezers and electrical installations; b) Early acquisition of equipment and supplies, as well as rotation of operational personnel influenced implementation costs. 3) Socio-political context: a) Extended period of time between funded studies required time to understand the current social and political context at community level; b) A national strike which resulted in safety concerns and delays in the recruitment process. 4) Research instruments: Delay in recruitment process due to time needed to develop digital instruments and platforms for data collection and to train field staff using new technology. **Conclusions:** In international contexts, aspects related to local regulations, social, political, and cultural environment, can influence the execution of a community-based cohort study and knowing in advance may help reduce the time to manage these studies in early stages. Our community-engaged approaches also help mitigate these challenges.

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## ABSTRACT E-BOOK

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**P-1069**

### **Fine Particulate Matter and Polycystic Ovary Morphology: A Retrospective Investigation of Electronic Medical Records and PM<sub>2.5</sub>**

**Presenter:** Victoria Fruh, Harvard T.H. Chan School of Public Health, Boston, United States

**Authors:** V. Fruh<sup>1</sup>, K. J. Lane<sup>2</sup>, J. Cheng<sup>3</sup>, S. Mahalingaiah<sup>1</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>2</sup>Boston University School of Public Health, Boston, MA, <sup>3</sup>University of Wisconsin–Madison, Madison, WI.

**Background/Aim:** Air pollution is widely known to have adverse cardiopulmonary health impacts, and research has only recently investigated associations between ambient air pollution and women's reproductive health. Still, a dearth of evidence exists on the association between air pollution and polycystic ovary morphology (PCOM).

**Methods:** We conducted a retrospective electronic medical record review of 25,535 reproductive-aged women who underwent pelvic ultrasound examinations to identify PCOM at Boston Medical Center between 2003-2016. Medical report machine learning text algorithms were employed to classify PCOM by ultrasound following the 2003 Rotterdam Consensus Criteria for polycystic ovary syndrome. We used the ambient annual average particulate matter 2.5 (PM<sub>2.5</sub>) model built for the global burden of disease based on the combination of aerosol optical depth measurements and chemical transport model results to yield estimated annual average PM<sub>2.5</sub> concentrations. PM<sub>2.5</sub> estimates were matched by geocoding home addresses and assigning cumulative concentrations over the study period. We evaluated the association between PM<sub>2.5</sub> concentrations and odds of PCOM using logistic regression for complete cases (n=17,902), adjusting for age and race. We additionally modeled these analyses stratified by race/ethnicity. **Results:** PM<sub>2.5</sub> annual average cumulative levels ranged from 5.40 to 17.43 (mean=10.62) µg/m<sup>3</sup>. A total of 6,005 women were confirmed to have PCOM by ultrasound text algorithms. Women had a mean age of 31 years and 47% of the women were Black/African American. PM<sub>2.5</sub> concentrations were not strongly associated with odds of PCOM (odds ratio [OR]: 0.96, 95% CI: 0.93, 1.00). When stratified by race/ethnicity, ORs ranged from 0.96 (95% CI: 0.91, 1.00) among Black/African American women to 1.05 (95% CI: 0.86, 1.28) among Asian women.

**Conclusion:** In this study of reproductive-aged women, we observed little evidence of the association between annual average PM<sub>2.5</sub> and PCOM, and our results found no varying effects of this association by race/ethnicity.

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**P-1070**

### **Maternal Urinary Phthalate Metabolites are Associated with Lipidomic Profiles Among Pregnant Women in Puerto Rico**

**Presenter:** Pahriya Ashrap, University of Michigan, Ann Arbor, United States

**Authors:** P. Ashrap<sup>1</sup>, D. J. Watkins<sup>1</sup>, B. Mukherjee<sup>1</sup>, Z. Rosario<sup>2</sup>, C. M.<sup>3</sup>, A. Alshawabkeh<sup>4</sup>, J. F. Cordero<sup>2</sup>, J. D. Meeker<sup>1</sup>;

<sup>1</sup>University of Michigan, Ann Arbor, MI, <sup>2</sup>University of Georgia, Athens, GA, <sup>3</sup>University of Puerto Rico, San Juan, PR, <sup>4</sup>Northeastern University, Boston, MA.

**Background/Aim:** Endocrine disrupting chemicals (EDCs) such as phthalates have been reported to alter circulating lipid concentrations in animals, however, the relationship has rarely been investigated among humans. We assessed associations between phthalate metabolite biomarkers and lipidomic profiles among pregnant women (n = 99) in the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) birth cohort.

**Methods:** We measured 19 urinary phthalate or phthalate replacement chemical metabolites during 24-28 weeks of pregnancy. Prenatal plasma lipidomic profiles were identified by liquid chromatography-mass spectrometry-based shotgun lipidomics. Multiple statistical strategies were used to assess relationships between phthalates and lipid profiles, including compound-by-compound comparisons using multiple linear regression and various dimension reduction techniques. We derived sums for each lipid class, sums for each lipid sub-class (saturated, monounsaturated, polyunsaturated), and used principal component analysis (PCA) to derive the principal component of each lipid class, which were then regressed on phthalates. Hierarchical clustering and multivariate analyses were also used for further investigation. False discovery rate (FDR) adjusted p-values (q-values) were used to account for multiple comparisons. **Results:** A total of 587 unique lipids from 19 lipid classes were profiled. When controlling for multiple comparisons, 47 phthalate-lipid associations remained highly significant (p-value<0.001, q-value<0.1). Lipid patterns constructed from PCA accounted for 30~57% of the variation for each lipid class. Mono(2-ethyl-5-carboxypentyl) phthalate (MECCP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), and the sum of dibutyl phthalates ( $\Sigma$ DBP) were associated with increased lysophosphatidylcholine (LPC), lysophosphatidylethanolamine (LPE), and phosphatidic acid (PA) lipid groups, particularly those containing saturated and monounsaturated fatty acid chains. This is consistent with the top associations selected from the compound-by-compound analysis. Cyclohexane-1,2-dicarboxylic acid monohydroxy isononyl ester (MHINCH) was also associated with higher polyunsaturated triglyceride (TG). **Conclusion:** Certain phthalate/phthalate replacement biomarkers were associated with lipids integral to cell structure and function. Linking these lipid patterns with health parameters will be an important future step.

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Theme: **Reproductive**

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**P-1071**

### Urinary concentrations of bisphenol analogues and unexplained recurrent spontaneous abortion

**Presenter:** Junjie Ao, Ministry of Education-Shanghai Key Laboratory of Children's Environmental Health, Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

**Authors:** J. Ao<sup>1</sup>, X. Huo<sup>1</sup>, Y. Gan<sup>1</sup>, W. Zhou<sup>2</sup>, F. Luo<sup>1</sup>, K. Luo<sup>1</sup>, S. Bao<sup>3</sup>, J. Zhang<sup>1</sup>;

<sup>1</sup>Ministry of Education-Shanghai Key Laboratory of Children's Environmental Health, Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, CHINA, <sup>2</sup>Center for Reproductive Medicine, Shandong Provincial Hospital Affiliated to Shandong University, Jinan, CHINA, <sup>3</sup>Department of Reproductive Immunology, Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine, Shanghai, CHINA.

**Background:** Under the label of “bisphenol A (BPA)-free”, a group of bisphenol analogues that are structurally similar to BPA have been developed as the alternatives for industrial applications. Bisphenol analogues are endocrine disrupting compounds (EDCs) and lead to growing concerns upon the potential adverse effects on humans, especially for vulnerable groups, such as pregnant women and infants. Unfortunately, evidence on the association between bisphenol analogues and unexplained recurrent spontaneous abortion (URSA) in pregnant women is still scarce. **Objective:** Our goal was to explore the associations between the urinary concentrations of bisphenol analogues in pregnant women and the risk of URSA. **Methods:** A hospital-based case-control study on URSA was carried out in eastern China during 2015 to 2017. The cases were women with unexplained recurrent miscarriage for at least 2 consecutive pregnancies. The controls were women who had normal pregnancy without history of miscarriage. Concentrations of eight bisphenol analogues (A, AF, AP, B, F, P, S, and Z) were measured in the urine samples collected from 775 women (366 URSA cases and 409 controls). A multiple logistic regression was used to evaluate the relationship between urinary bisphenol analogues and URSA. **Results:** Significantly higher urinary levels of BPA, BPAF, BPAP, BPB, and BPP were found in the URSA women than in the controls ( $p < 0.01$ ). Increased risks of URSA were associated with higher urinary levels of BPAF (adjusted odds ratio (OR)=1.76 for the medium tertile, 95% confidence interval (CI): 1.14, 2.72; adjusted OR=1.87 for the highest tertile, 95% CI: 1.19, 2.93), and a test of the trend for the association was statistically significant ( $p_{\text{trend}}=0.0107$ ). **Conclusion:** Our findings suggested that prenatal exposure to bisphenol analogues may be associated with URSA risk in a dose-response pattern.

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## ABSTRACT E-BOOK

Theme: **Reproductive**

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**P-1073**

**Environmental noise and semen quality: a single fertility center cohort study**

**Presenter:** Seung-Ah Choe, CHA University, Seoul, Korea, Republic of

**Authors:** S. Choe<sup>1</sup>, D. Kim<sup>1</sup>, S. Kim<sup>2</sup>, C. Im<sup>3</sup>, S. Kim<sup>4</sup>;

<sup>1</sup>CHA University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Seoul National University, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Korea University, Seoul, KOREA, REPUBLIC OF, <sup>4</sup>National Cancer Center Graduate School of Cancer Science and Policy, Ilsan, Gyeonggi-do, KOREA, REPUBLIC OF.

**Background:** With urbanization and increasing population density, there are growing concerns regarding health impacts of environmental noise. We assessed the relationship between environmental noise and semen quality of men who visited for fertility evaluation. **Methods:** This study is a retrospective cohort study of 1,972 male patient who had undertaken semen test between 2016-2018 at a single fertility center of Seoul, South Korea. We used environmental noise data provided by the National Noise Information System (NNIS) of Korea. We assigned semiannual daytime and nighttime data to individual exposure considering the time of semen sampling. Daytime and nighttime noise exposures at each patient's geocoded address were estimated using empirical Bayesian kriging method. We used multivariable regression and generalized additive models to explore the association of environmental noise with five semen quality parameters and three abnormalities. **Results:** Men with 2<sup>nd</sup> and 3<sup>rd</sup> quartile of daytime noise showed lower sperm concentration (coefficient=-0.27, P=0.045 for 2<sup>nd</sup> quartile) and lower proportion of normal morphology (-0.26, P=0.034 for 2<sup>nd</sup> quartile; -0.33, P=0.013 for 3<sup>rd</sup> quartile) compared to those with the lowest quartile. Estimates for all five semen quality parameters in the 4<sup>th</sup> quartile of daytime noise were not different from those in the lowest quartile. The associations with daytime noise were toward null for semen volume, % of progressive motility and vitality. For nighttime noise, none of the five parameters showed meaningful association. The associations between noise and three semen abnormalities did not reach statistical significance. Sperm concentration and % of normal morphology decreased when the daytime noise was 60-63 L<sub>eq</sub> dB. **Conclusion:** Our study adds an evidence of potentially detrimental impact of environmental noise on semen quality in men living in Seoul. Additional studies with more refined noise measurement will confirm the finding.

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**P-1074**

### **Diet quality during pregnancy predicts maternal concentrations of phthalates and phthalate alternatives**

**Presenter:** Diana K Haggerty, Department of Food Science and Human Nutrition, Michigan State University, East Lansing, United States

**Authors:** D. K. Haggerty<sup>1</sup>, A. M. Calafat<sup>2</sup>, S. L. Schantz<sup>3</sup>, R. S. Strakovsky<sup>4</sup>;

<sup>1</sup>Department of Food Science and Human Nutrition, Michigan State University, East Lansing, MI, <sup>2</sup>Division of Laboratory Sciences, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA, <sup>3</sup>Department of Comparative Biosciences and Beckman Institute, University of Illinois, Champaign-Urbana, IL, <sup>4</sup>Department of Food Science and Human Nutrition, Institute for Integrative Toxicology, Michigan State University, East Lansing, MI.

**Background/Objectives:** Phthalates are endocrine disrupting chemicals that may be particularly disruptive during pregnancy. Pregnancy diet is a vehicle for some phthalate exposures. Therefore, we evaluated whether diet quality predicts urinary phthalate/phthalate alternative biomarkers concentrations in pregnant women. **Methods:** This study includes 427 pregnant women from Champaign-Urbana, Illinois. Alternative Healthy Eating Index (AHEI) scores were estimated from 3-month food frequency questionnaires administered at 34-37 weeks gestation, with higher AHEI scores representing lower chronic diseases risk. We quantified 19 phthalate/phthalate alternative metabolites in cross-pregnancy pools of five first-morning urines in three approximately equal batches based on year of enrollment (2013-2019). In analyses, we used individual metabolites, molar-sums of metabolites of the same parent phthalates (e.g., di(2-ethylhexyl) phthalate (SumDEHP), dibutyl phthalate (SumDBP), di-isononyl phthalate (SumDiNP)) or phthalate replacements (1,2-cyclohexane, dicarboxylic acid diisononyl ester (SumDiNCH), di(2-ethylhexyl) terephthalate (SumDEHTP)). Linear regression models evaluated associations between AHEI and ln-transformed specific-gravity adjusted biomarker concentrations while controlling for demographic/lifestyle characteristics, and stratified by chemical analysis batch.

**Results:** Median AHEI score in these predominantly White, college-educated women was 55.9 (possible 110, range: 24.9-82.4) and varied little across time. Biomarker concentrations were similar to U.S. women and many varied over time: monobenzyl phthalate (MBzP), mono(carboxyisononyl) phthalate (MCNP), mono(3-carboxypropyl) phthalate (MCP), SumDEHP, and SumDiNP decreased from 2013 to 2019, whereas SumDiNCH and SumDEHTP increased. Women with higher AHEI scores had lower SumDEHP, SumDEHTP, and SumDiNP regardless of time, and MBzP, MCNP, MCP, and SumDBP only in the earliest batch. The strongest association was between AHEI and SumDEHTP, which decreased by 2.5% for each unit increase in AHEI (95%CI: -3.8, -1.3). **Conclusions:** In this cohort, pregnant women with high diet quality were the least exposed to plasticizer phthalates/alternatives. While these patterns should be confirmed in other populations, we also noted that associations between diet quality and some phthalates/phthalate alternatives have changed over time.

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**P-1075**

### **Associations between urinary phenol mixtures and gestational diabetes mellitus: A case-control study in Oklahoma**

**Presenter:** Wei-Jen Chen, Department of Biostatistics and Epidemiology, Hudson College of Public Health, University of Oklahoma Health Sciences Center, Oklahoma City, United States

**Authors:** W. Chen<sup>1</sup>, E. Davis<sup>2</sup>, J. Stoner<sup>1</sup>, C. Robledo<sup>3</sup>, J. Goodman<sup>4</sup>, J. Peck<sup>1</sup>;

<sup>1</sup>Department of Biostatistics and Epidemiology, Hudson College of Public Health, University of Oklahoma Health Sciences Center, Oklahoma City, OK, <sup>2</sup>Department of Anatomical Sciences and Neurobiology, University of Louisville, Louisville, KY, <sup>3</sup>UT Health Rio Grande Valley. Population Health and Biostatistics, Harlingen, TX, <sup>4</sup>Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Loyola University Medical Center, Maywood, IL.

**Background:** Previous studies have examined environmental phenol exposures as risk factors for gestational diabetes mellitus (GDM), but have focused on associations with individual chemicals. As methods have emerged to better assess simultaneous exposure to multiple chemicals, the association between phenol mixtures and GDM remains undetermined. In the present study, we utilized Bayesian kernel machine regression (BKMR) to investigate the relationship between phenol mixtures and GDM. **Methods:** A case-control study of 64 GDM cases and 237 controls was conducted among obstetric patients at the University of Oklahoma Medical Center, August 2009 to May 2010. Concentrations of bisphenol A (BPA), benzophenone-3, triclosan, 2,4-dichlorophenol, 2,5-dichlorophenol, butylparaben, methylparaben, and propylparaben were quantified in mid-pregnancy spot urine samples. Multivariable logistic regression was performed to assess associations between continuous measures of individual specific-gravity adjusted phenol concentrations and GDM while controlling for age, race and pre-pregnancy body mass index. Probit implementation of BKMR with hierarchical variable selection was used to evaluate the adjusted mean difference in GDM probability for each component of the phenol mixtures, while taking the correlation among the mixture components into account. **Results:** We observed that benzophenone-3 was positively associated with GDM [adjusted odds ratio (aOR per interquartile range (IQR) = 1.48 (95% Confidence Interval (CI) 1.11, 1.98)] when analyzing individual phenols using logistic regression. In contrast, BPA was negatively associated with GDM (aOR 0.63 (95% CI 0.41, 0.98)). In Probit-BKMR analysis, an IQR increase in Z score-transformed benzophenone-3 was associated with an increase in the probability of GDM (0.19, 95% Credible Interval: -0.09, 0.48), holding other phenols fixed at their medians, but the credible interval crossed zero. The BKMR analyses did not identify associations with the other phenol concentrations while accounting for correlation among the mixture components. **Conclusion:** Our results highlight the importance of addressing chemical mixtures in studies of perinatal environmental exposures.

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Theme: **Reproductive**

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**P-1077**

### **Relationships Between Psychosocial Stressors Among Pregnant Women in San Francisco: a Path Analysis**

**Presenter:** Stephanie M Eick, University of California, San Francisco, San Francisco, United States

**Authors:** S. M. Eick<sup>1</sup>, D. Goin<sup>1</sup>, M. Izano<sup>1</sup>, L. Cushing<sup>2</sup>, E. DeMicco<sup>1</sup>, A. Padula<sup>1</sup>, T. Woodruff<sup>1</sup>, R. Morello-Frosch<sup>3</sup>;

<sup>1</sup>University of California, San Francisco, San Francisco, CA, <sup>2</sup>San Francisco State University, San Francisco, CA, <sup>3</sup>University of California, Berkeley, Berkeley, CA.

Background: Pregnant women who experience psychosocial stressors, such as stressful life events, poor neighborhood quality, and financial hardship, are at an increased risk for adverse pregnancy outcomes. Yet, few studies have examined associations between multiple stressors from different sources, which may be helpful to better inform causal pathways leading to adverse birth outcomes. Methods: Using path analysis, we examined associations between multiple self-reported stressor exposures during and before pregnancy in the Chemicals in Our Bodies-2 study (N=510), a demographically diverse cohort of pregnant women in San Francisco. We examined associations between eight self-reported exposures to stressors and three responses to stress which were assessed via interview questionnaire at the 2<sup>nd</sup> trimester. Stressors included: neighborhood quality, stressful life events, caregiving, discrimination, financial strain, job strain, food insecurity, and unplanned pregnancy. Perceived stress, depression, and perceived community status were included as indicators of self-reported stress response. Results: Our model indicated that women who experienced discrimination and food insecurity had a 3.76 (95% confidence interval [CI]=1.60, 5.85) and 2.67 (95% CI=1.31, 4.04) increase in depression scale scores compared to women who did not experience discrimination and food insecurity, respectively. We additionally identified job strain and caregiving for an ill family member as strong predictors of increased depressive symptoms ( $\beta=1.63$ , 95% CI=0.29, 3.07;  $\beta=1.48$ , 95% CI=0.19, 2.70, respectively). Discrimination, food insecurity, and job strain also influenced depression indirectly through the mediating pathway of increasing perceived stress, although indirect effects were less precise. Conclusions: In our study population, women who experienced discrimination, food insecurity, job strain and caregiving for an ill family member had an increased number of depressive symptoms compared to women who did not experience these stressors. Results from our study highlight the complex relationships between stressors and stress responses and may help to identify possible mediating pathways leading to adverse pregnancy outcomes.

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**P-1078**

### **Polycyclic Aromatic Hydrocarbons and Birth Defects in California**

**Presenter:** Amy Padula, University of California San Francisco, San Francisco, United States

**Authors:** A. Padula<sup>1</sup>, W. Yang<sup>2</sup>, F. Lurmann<sup>3</sup>, S. Hammond<sup>4</sup>, G. Shaw<sup>2</sup>;

<sup>1</sup>University of California San Francisco, San Francisco, CA, <sup>2</sup>Stanford University, Palo Alto, CA, <sup>3</sup>Sonoma Technology Inc., Petaluma, CA, <sup>4</sup>University of California Berkeley, Berkeley, CA.

Background: Ambient air pollution has been associated with several birth defects, though few studies have examined polycyclic aromatic hydrocarbons (PAHs), specifically. Our aim was to assess the relationship between maternal exposure to ambient PAHs in the first two months of pregnancy and risk of several structural birth defects as part of the Berkeley-Stanford Children's Environmental Health Center (Children's Health and Air Pollution Study). Methods: PAHs were assessed through a combination of intermittent monitoring and estimated PAH concentrations based on daily, collected NO and CO measurements in the San Joaquin Valley of California. Daily exposure values were spatially interpolated from the air quality monitoring stations' locations to women's residence locations in early pregnancy using inverse distance-squared weighting with a maximum interpolation radius of 25 km. We used data from 1028 cases and 975 controls from the California center of the National Birth Defects Prevention Study (1997-2011) to examine quartiles of exposure to risk of neural tube defects (N=281), gastroschisis (N=223), and cleft lip with or without cleft palate (N=364) or cleft palate only (N=162). Models were adjusted for maternal race/ethnicity, education and vitamin use in early pregnancy. Results: We found suggestive associations between PAHs and neural tube defects including spina bifida and anencephaly with evidence of an exposure-response across quartiles of PAHs. High ambient PAHs during the first two months of pregnancy were associated with a small increased risk of neural tube defects [odds ratio (OR)=1.23; 95% confidence interval (CI):0.83, 1.82]. We found inverse associations between PAHs and risk of gastroschisis (OR=0.58; 95% CI:0.37, 0.90) and cleft lip with or without cleft palate (OR=0.66; 95% CI:0.46, 0.95). Conclusions: Some results were in the unexpected direction, but results are consistent with our previous observed associations between other traffic-related air pollutants and neural tube defects in the San Joaquin Valley of California.

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Theme: **Reproductive**

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**P-1081**

**Does socioeconomic status modify the effect of air pollution on birth outcomes?**

**Presenter:** Nelson Gouveia, University of Sao Paulo Medical School, Sao Paulo, Brazil

**Authors:** F. P. do Nascimento<sup>1</sup>, M. F. de Almeida<sup>2</sup>, N. Gouveia<sup>1</sup>;

<sup>1</sup>University of Sao Paulo Medical School, Sao Paulo, BRAZIL, <sup>2</sup>University of Sao Paulo School of Public Health, Sao Paulo, BRAZIL.

**BACKGROUND:** Several studies have examined whether air pollution is associated to adverse births outcomes but it is not clear if socioeconomic status (SES) modifies this relationship. **OBJECTIVES:** We investigated if individual and area-level socioeconomic status modified the relationship between ozone, nitrogen dioxide and particulate matter with aerodynamic diameter  $<10\mu\text{m}$  ( $\text{PM}_{10}$ ) and preterm deliveries (gestational age  $<37$  weeks) and term low birth weight (TLBW;  $< 2500\text{g}$ ). **METHODS:** Analyses were based on almost 1 million singleton live births in São Paulo municipality between 2011 and 2016. Exposure to  $\text{PM}_{10}$ ,  $\text{NO}_2$  and  $\text{O}_3$  were estimated by average trimestral and entire gestation based on date of birth and using daily averages of air pollution from the network of monitoring stations. Multilevel logistic regression models were conducted to examine the effect of air pollutants on both birth outcomes and whether it was modified by SES. **RESULTS:** In fully adjusted models, over the entire pregnancy, a  $10\mu\text{g}/\text{m}^3$  increase in  $\text{O}_3$  and  $\text{PM}_{10}$  was associated to PTD (odds ratio; OR = 1.14 CI 1.13,1.16 and 1.08 CI = 1.02,1.15 respectively) and  $\text{PM}_{10}$  was associated to TLBW (OR = 1.08 CI 1.03, 1.14). Associations were modified by individual and area-level SES for both outcomes ( $p<0,001$ ). Mothers with low individual SES had an additional risk for PTD and TLBW associated with  $\text{PM}_{10}$  exposure (OR = 1.04 CI 1.04,1.05 and 1.10 CI 1.08,1.14 respectively). Lower area-level SES also implied in a stronger risk for TLBW (OR = 1.05 CI 1.03,1.06). Similar effect modifications were observed for  $\text{O}_3$  exposure. Trimester specific associations were weaker but followed a similar pattern. **CONCLUSION:** Individual and neighborhood socioeconomic status modifies the effect of air pollution on adverse birth outcomes. Mothers with lower SES may be more susceptible to adverse pregnancy outcomes associated with air pollution exposure.

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Theme: **Reproductive**

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**P-1082**

### **Exposures to residential noise and outdoor light at night and age at natural menopause in the Nurses' Health Study II Cohort**

**Presenter:** Huichu Li, Department of Environmental Health, Harvard T.H.Chan School of Public Health, Boston, United States

**Authors:** H. Li<sup>1</sup>, J. E. Hart<sup>2</sup>, R. C. Nethery<sup>3</sup>, S. Mahalingaiah<sup>1</sup>, P. James<sup>4</sup>, E. Bertone-Johnson<sup>5</sup>, F. Laden<sup>1</sup>;  
<sup>1</sup>Department of Environmental Health, Harvard T.H.Chan School of Public Health, Boston, MA, <sup>2</sup>Channing Division of Network Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, <sup>3</sup>Department of Biostatistics, Harvard T.H.Chan School of Public Health, Boston, MA, <sup>4</sup>Division of Chronic Disease Research Across the Lifecourse (CoRAL), Department of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute, Boston, MA, <sup>5</sup>School of Public Health and Health Sciences, Department of Biostatistics and Epidemiology, University of Massachusetts, Amherst, Amherst, MA.

**Background** Age at natural menopause has implications for women's health and has been suggested to be associated with environmental factors. However, to date no studies have investigated the impact of noise and outdoor light at night on menopausal age. These factors may impact timing of menopause through stress or sleep disruption. **Methods** The Nurses' Health Study II is a prospective cohort of women across the US started in 1989. For this analysis, we followed 105,665 premenopausal participants from age 40 and followed them until 2015. Self-reported menopausal status and age at menopause were obtained from biennial follow-up questionnaires. Women who reported a hysterectomy, oophorectomy, cancer, or death were excluded at baseline or censored during follow-up. Residential exposure to noise was measured as the median nighttime total sound level from a geospatial model predicting sound levels integrated over 2000-2014 at a 270 m spatial resolution, and outdoor light at night was obtained from satellite images. All exposures were examined as time-varying cumulative averages from age 40, from age 40 to 45, or in the previous year to represent exposures in overall, early, and late mid-adulthood. A time-varying Cox proportional hazard model was used to obtain the hazard ratio of natural menopause at any age adjusting for calendar year, region, lifestyle and reproductive factors, neighborhood socioeconomic status, and residential PM<sub>2.5</sub>. **Results** A total of 64,251 participants reported natural menopause during 1,054,109 person years. Exposures to noise and outdoor light at night were not associated with age at natural menopause in single (HR=0.99-1.01 comparing the highest to the lowest quartile) or multi-exposure models (HR=0.99-1.01 comparing the highest to the lowest quartile). **Conclusion** Residential noise and outdoor light at night exposures in mid-adulthood were not associated with the timing of natural menopause.

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Theme: **Reproductive**

**P-1083**

### **Associations between Preconception Phthalate Exposure and Infertility Treatment Outcomes among Couples Undergoing In Vitro Fertilization**

**Presenter:** Thoin F Begum, Department of Environmental Health Sciences, School of Public Health, The University at Albany, State University of New York, Rensselaer, United States

**Authors:** T. F. Begum<sup>1</sup>, V. Y. Fujimoto<sup>2</sup>, A. McGough<sup>2</sup>, N. Lenhart<sup>2</sup>, R. Wong<sup>2</sup>, E. Mok-Lin<sup>2</sup>, R. Gerona<sup>2</sup>, J. Melamed<sup>2</sup>, C. D. Butts<sup>1</sup>, M. S. Bloom<sup>1</sup>;

<sup>1</sup>Department of Environmental Health Sciences, School of Public Health, The University at Albany, State University of New York, Rensselaer, NY, <sup>2</sup>Department of Obstetrics, Gynecology and Reproductive Sciences, University of California at San Francisco, San Francisco, CA.

**Abstract:**Background/Aim: Phthalates are implicated as reproductive toxicants in animal models and human populations. We modeled associations between couples' preconception phthalate exposures and in vitro fertilization (IVF) outcomes. Methods: Women (n=56) and their male partners (n=43) undergoing IVF were enrolled in a prospective cohort investigation of environmental exposures and reproductive outcomes. Participants provided urine samples (fasting for women) on the day of oocyte retrieval. Urine was analyzed for monoethyl phthalate (MEP), mono-n-butyl phthalate (MBP), mono-n-pentyl phthalate (MPP), mono-n-hexyl phthalate (MHxP), mono(2-ethylhexyl) phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), mono-(2-ethyl-5-carboxypentyl) phthalate (MECPP), mono-isononyl phthalate (MiNP), mono-isodecyl phthalate (MiDP), monocyclohexyl phthalate (MCHP), and monobenzyl phthalate (MBzP) via liquid chromatography-tandem mass spectrometry (Agilent LC 1260-AB Sciex 5500). Modified Poisson regression models, were used to assess associations between IVF outcomes and individual urinary phthalates among women and men separately, and simultaneously in couples, adjusted for age, body mass index (for women), and cigarette smoking. Results: Individual partner models showed higher likelihoods of pregnancy and live birth associated with greater concentrations of several urinary phthalates, albeit without statistical significance, with the exception of men's MEHP and pregnancy [RR=0.53 (95%CI: 0.24-1.17)]. However, most urinary phthalates were associated with lower chances of pregnancy and live birth among couples. A doubling in women's MBP was associated with a 43% [RR=0.57 (95%CI: 0.36-0.91)] lower likelihood of a pregnancy and a 46% [RR=0.54 (95%CI: 0.27-1.08)] lower likelihood of a live birth, adjusted for the male partner. Doublings in men's MEHP and MEP were associated with 66% [RR=0.34 (95% CI: 0.16-0.72)] and 28% [RR=0.72 (95% CI: 0.52-1.01)] lower likelihoods of a pregnancy, respectively, adjusted for the female partner. Conclusions: Greater urinary MEP, MBP, and MEHP were associated with lower probabilities of pregnancy and live birth among couples undergoing IVF. The results suggest that greater phthalate exposure in couples may be deleterious to IVF.

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**P-1084**

**Prenatal exposure to specific PM<sub>2.5</sub> constituents and preterm birth in China: a nationwide cohort study**

**Presenter:** Jing Cai, Fudan University, Shanghai, China

**Authors:** J. Cai<sup>1</sup>, Y. Zhao<sup>2</sup>, J. Zhang<sup>3</sup>, R. Martin<sup>4</sup>, A. van Donkelaar<sup>4</sup>, H. Kan<sup>1</sup>, J. Hua<sup>2</sup>;

<sup>1</sup>Fudan University, Shanghai, CHINA, <sup>2</sup>Shanghai First Maternity and Infant Hospital, Shanghai, CHINA,

<sup>3</sup>Xinhua Hospital, Shanghai, CHINA, <sup>4</sup>Dalhousie University, Halifax, NS, CANADA.

**Background:** Prenatal exposure to fine particulate matter (PM<sub>2.5</sub>) has been linked with preterm birth (PTB) in North America and Europe. However, this association remained inconsistent and the roles of specific PM<sub>2.5</sub> chemical constituents behind this association has never been quantified at higher ambient levels. We estimated the odd ratio (OR) for preterm delivery from prenatal exposure to PM<sub>2.5</sub> and its chemical constituents in China. **Methods:** We conducted a cohort study using the China Labor and Delivery Survey data. 62,895 singleton live birth records from 25 (out of 34) provinces of mainland China between March 1<sup>st</sup> 2015 and December 31<sup>st</sup> 2016 were included. Exposures to PM<sub>2.5</sub> total mass and 6 main constituents during the entire pregnancy and each trimester was represented by satellite-based models. Multilevel logistic regression models were used to examine the associations of PTB with PM<sub>2.5</sub> exposure, controlling for seasonality, spatial variation and individual covariates. **Results:** Prenatal exposure to ambient PM<sub>2.5</sub> was associated with increased risk of PTB, with the most significant association during the third trimester [odd ratios (OR) for an interquartile range (IQR) increase = 1.09 (95% confident interval (CI): 1.01-1.18)] which became larger for infants conceived by assisted reproductive technology than ones conceived naturally. For PM<sub>2.5</sub> composition, the strongest association per IQR was estimated for nitrate, ammonium and soil (OR=1.11–1.17), followed by black carbon and sulfate (OR=1.07-1.08). **Conclusion:** Constituents (e.g., ammonium and nitrate) from combustion of fossil fuel have an appreciable influence on the increased risk of PTB.

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**P-1087**

### **Air pollution and anti-Müllerian hormone concentrations in the Sister Study**

**Presenter:** Allyson Gregoire, National Institute of Environmental Health Sciences, Research Triangle Park, United States

**Authors:** A. Gregoire<sup>1</sup>, K. Upson<sup>2</sup>, N. Niehoff<sup>1</sup>, H. Chin<sup>1</sup>, J. Kaufman<sup>3</sup>, C. Weinberg<sup>1</sup>, D. Sandler<sup>1</sup>, H. Nichols<sup>4</sup>, A. White<sup>1</sup>;

<sup>1</sup>National Institute of Environmental Health Sciences, Research Triangle Park, NC, <sup>2</sup>Michigan State University College of Human Medicine, East Lansing, MI, <sup>3</sup>University of Washington School of Public Health, Seattle, WA, <sup>4</sup>University of North Carolina Gillings School of Global Public Health, Chapel Hill, NC.

Background: Anti-Müllerian hormone (AMH) levels are a marker of ovarian reserve and are indicative of a woman's reproductive life span. Although exposure to indoor air pollution has been associated with diminished AMH, little is known about the association between ambient air pollution and ovarian reserve especially in a population not seeking fertility treatments. Methods: For 4,696 Sister Study participants, residential annual average exposure to PM<sub>2.5</sub>, PM<sub>10</sub>, and NO<sub>2</sub> was assessed using land-use regression models and kriging. We estimated distance to the nearest major road for both adult and childhood residences. Serum AMH was measured using ultrasensitive AMH ELISA and picoAMH ELISA kits in 1,322 premenopausal women. We also included postmenopausal women (N = 3,374) in our analyses to address potential selection bias. Inverse probability weighting was used to account for selection into the study. For postmenopausal women or women with AMH values below the limit of detection (LOD), AMH values were imputed as LOD/2. To account for the non-detects, reverse Cox regression modeling with restricted cubic spline adjustment for age was used to estimate hazard ratios (HRs) for the association between ambient air pollution and distance to major roadway and AMH levels. Results: Overall, we saw no consistent association between air pollution exposure or proximity to roadways and AMH levels. An interquartile range (IQR) increase in NO<sub>2</sub> was associated with slightly higher AMH levels (HR = 1.10, 95% CI: 0.99, 1.22). However, among the women not currently using oral contraceptives (which may impact measured AMH levels), an IQR increase in PM<sub>2.5</sub> was associated with lower AMH levels (HR = 0.88, 95% CI: 0.77-0.99). Conclusions: We saw little evidence to support an association between outdoor air pollution and diminished ovarian reserve in women of older reproductive age, except possibly among women who were not current users of hormonal contraceptives.

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**P-1088**

### **Prenatal exposure to ambient air pollution and adverse pregnancy outcomes in Ahvaz, Iran: A Generalized Additive Model**

**Presenter:** Maryam Dastoorpoor, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, Islamic Republic of

**Authors:** M. Dastoorpoor<sup>1</sup>, N. Khanjani<sup>2</sup>;

<sup>1</sup>Ahvaz Jundishapur University of Medical Sciences, Ahvaz, IRAN, ISLAMIC REPUBLIC OF, <sup>2</sup>Kerman University of Medical Sciences, Kerman, IRAN, ISLAMIC REPUBLIC OF.

Prenatal exposure to ambient air pollution and adverse pregnancy outcomes in Ahvaz, Iran: A Generalized Additive Model  
AbstractBackground: There is some evidence about the short-term effects of air pollutants on adverse pregnancy outcomes. The aim of this study was to determine the association between air pollutants and spontaneous abortion, stillbirth, gestational hypertension, preeclampsia, gestational diabetes and macrosomia in Ahvaz, which is one of the most polluted cities in the Middle East. Methods: Data on adverse pregnancy outcomes and air pollutants including Ozone (O<sub>3</sub>), Nitric oxide (NO), Nitrogen Dioxide (NO<sub>2</sub>), Sulfur Dioxide (SO<sub>2</sub>), Carbon Monoxide (CO), Particles with a diameter of less than 10 micrometers (PM<sub>10</sub>) and Particles with a diameter less than 2.5 micrometers (PM<sub>2.5</sub>) were collected over the years 2008-2018. A time-series analysis using the generalized additive model (GAM) with up to 6-day lags was used. Results: The results showed that the SO<sub>2</sub> pollutant on 0, 1, 3, 4, and 6-day lags and PM<sub>10</sub> on lag 0 had direct and significant associations with spontaneous abortion. NO, NO<sub>2</sub> and CO on 0-6-day lags; and O<sub>3</sub> on 6-day lags showed direct and significant associations with preeclampsia. NO and NO<sub>2</sub> pollutants showed significant and direct associations with gestational diabetes, during 0 and 6- day lags. NO on 0, 3 and 4-day lags, CO in all 0-6 day lags and PM<sub>2.5</sub> on 1, 3, 5, and 6-day lags showed direct and significant associations with macrosomia. None of the pollutants showed significant associations with stillbirth or gestational hypertension. Conclusions: Air pollution is apparently causing adverse human reproductive outcomes in Ahvaz. This study further emphasizes the need to control ambient air pollution in Ahvaz.

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**P-1089**

### **A Multi Region Analysis of Shale Drilling Activity and Rates of Sexually Transmitted Infections in the United States**

**Presenter:** Nicholaus P Johnson, Yale School of Public Health, New Haven, United States

**Authors:** N. P. Johnson<sup>1</sup>, J. L. Warren<sup>1</sup>, E. G. Elliott<sup>2</sup>, L. M. Niccolai<sup>1</sup>, N. C. Deziel<sup>1</sup>;

<sup>1</sup>Yale School of Public Health, New Haven, CT, <sup>2</sup>Harvard T.H. Chan School of Public Health, Boston, MA.

**Background:** Fossil fuel extraction from deep shale rock formations using new drilling technologies such as hydraulic fracturing, has rapidly increased in the United States (U.S.) over the past decade. Increases in nonlocal, specialized workers to meet the demands of this complex industry have been suggested to influence rates of sexually transmitted infections (STI) in counties with shale drilling activity; these associations may vary geographically. In this multi-region ecologic analysis, we examine the associations between shale drilling activity and rates of three reportable STI in Colorado, North Dakota, and Texas, states with active shale drilling. **Methods:** We obtained annual reported rates of chlamydia, gonorrhea, and syphilis from the Centers for Disease Control and Prevention (CDC), number of active shale wells from Energen (formerly known as DrillingInfo), and sociodemographic covariates from the U.S. Census Bureau. We used multivariable mixed-effects Poisson regression modeling to estimate rate ratios (RR) with 95% confidence intervals (CIs) adjusted for potential confounders and secular trends. The ecological study design allowed us to study health indicators that may follow from industrial changes at policy-relevant geographical scales. **Results:** In Texas, county-years with high drilling activity had 10% increased rates of chlamydia (RR=1.10; 95% CI=1.04-1.17) and 15% increased rates of gonorrhea (RR=1.15; 95% CI = 1.04-1.28), compared to county-years with no drilling. No statistically significant associations were reported for syphilis or for any STIs in Colorado or North Dakota. **Conclusions:** Associations between shale drilling and chlamydia and gonorrhea in Texas may reflect increased risk in areas with higher drilling activity and a greater number of major metropolitan areas. This ecologic analysis provides an important assessment of community-level health impacts of the UOG industry. Inter-state differences highlight the need for local epidemiology to prioritize community health policies.

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**P-1091**

### **Potential Gains in Reproductive-Aged Life Expectancy if Maternal Mortality were Eradicated from the Kintampo Districts of Central Ghana**

**Presenter:** Sulemana W Abubakari, Kintampo Health Research Centre, Kintampo, Ghana

**Authors:** S. W. Abubakari;  
Kintampo Health Research Centre, Kintampo, GHANA.

**Background:** Almost 99 percent of pregnancy or childbirth-related complications globally is estimated to occur in developing regions. Yet, little is known about the demographic impact of maternal causes of death (COD) in low-and middle-income countries. Assuming that critical interventions were implemented such that maternal mortality is eradicated as a major cause of death, how would it translate to improved longevity for reproductive-aged women in the Kintampo districts of Ghana?

**Methods:** The study used longitudinal health and demographic surveillance data from the Kintampo districts to assess the effect of hypothetically eradicating maternal COD on reproductive-aged life expectancy by applying multiple decrement and associated single decrement life table techniques.

**Results:** According to the results, on the average, women would have lived an additional 4.4 years in their reproductive age if maternal mortality were eradicated as a cause of death, rising from an average of 28.7 years lived during the 2005-2014 period to 33.1 years assuming that maternal mortality was eradicated. The age patterns of maternal-related mortality and all-cause mortality depict that the maternal-related mortality is different from the all-cause mortality for women of reproductive age.

**Conclusion:** This observation suggests that other COD are competing with maternal mortality among the WRA in the study area and during the study period.

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**P-1092**

### **Urinary BPA Concentrations and Postpartum Depressive Symptoms: The HOME Study**

**Presenter:** Serena Rose Russell, Brown University, Providence, United States

**Authors:** S. R. Russell<sup>1</sup>, K. Yolton<sup>2</sup>, B. P. Lanphear<sup>3</sup>, A. Vuong<sup>4</sup>, A. Chen<sup>5</sup>, M. Eliot<sup>1</sup>, J. Braun<sup>1</sup>;  
<sup>1</sup>Brown University, Providence, RI, <sup>2</sup>Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, OH, <sup>3</sup>Simon Fraser University, Vancouver, BC, CANADA, <sup>4</sup>University of Nevada, Las Vegas, Las Vegas, NV, <sup>5</sup>University of Pennsylvania, Philadelphia, PA.

**Background/Aim:** Bisphenol-A (BPA) is a suspected endocrine disrupting compound (EDC) that may adversely affect human health. In rodent studies, prenatal BPA exposure alters maternal behavior, including reduced caregiving behavior towards their pups. These rodent behaviors may be correlates of maternal postpartum depressive symptoms that include feeling withdrawn, numb/disconnected from their offspring, or in doubt of their caregiving ability.

**Methods:** We analyzed data from the Health Outcomes and Measures of the Environment (HOME) Study (n=346), a cohort of pregnant women and their children in Cincinnati, Ohio, enrolled between March 2003 and January 2006. We measured BPA concentrations in urine samples collected at ~16 and 26 weeks gestation. Mothers self-reported depressive symptoms at approximately four weeks post-partum using the Beck Depression Inventory-II (BDI-II). Using linear and logistic regression, we estimated changes in continuous and categorical (>mild vs. minimal symptoms) BDI-II scores, respectively, per interquartile range (IQR) increase in log<sub>10</sub>-transformed urinary BPA concentrations, adjusting for sociodemographic and perinatal factors. **Results:** The mean BDI-II score was 8.3 (25<sup>th</sup> and 75<sup>th</sup> percentiles: 5, 11). A total of 25 (7.2%), 13 (3.8%), and 6 (1.7%) women reported mild (scores: 14-19), moderate (scores: 20-28), and severe (scores: 29-63) depressive symptoms, respectively. Each IQR increase in log<sub>10</sub>-transformed urinary BPA concentration was associated with a 0.85-point increase in BDI-II score (95% CI: 0.2, 1.6). In addition, each IQR increase in BPA concentrations was associated with a 50% increased odds of having > minimal depressive symptoms (95% CI: 1.0, 2.2).

**Conclusion:** Higher maternal urinary BPA concentrations during pregnancy were associated with more postpartum depressive symptoms at four weeks among mothers in this study.

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**P-1093**

**Extreme heat, preterm birth, and stillbirth: a global analysis across low-to-middle-income countries**

**Presenter:** Sara McElroy, University of California, San Diego, La Jolla, United States

**Authors:** S. McElroy;  
University of California, San Diego, La Jolla, CA.

**Background:** Stillbirths and complications from preterm birth (PTB) are two of the leading causes of neonatal deaths across the globe. Low-to-middle-income countries (LMICs) are experiencing some of the highest rates of these adverse birth outcomes. Research has suggested that environmental determinants, such as extreme heat can increase the risk of PTB and stillbirth. In the context of climate change, heat waves are increasing severity, duration, and frequency of heatwaves. Thus, it is imperative to examine how exposure to extreme heat affects adverse birth outcomes, as this trend is likely to continue in the future. Most of the evidence tying extreme heat and adverse birth outcomes has been generated from high-income countries (HICs) because measuring extreme heat in LMICs has proven challenging due to the scarcity of ground monitors. **Methods:** This study will rely on modern techniques such as remote sensing data to overcome this challenge in exposure measurements. Remote sensing data was linked with Demographic Health Surveys data on adverse birth outcomes. A global analysis of 13 LMICs was conducted by exploiting each country's relative extreme heat events via a time-stratified case-crossover design. Conditional multi-level regression with sampling weights was employed to ascertain the relationship between acute exposure to extreme heat and PTB and stillbirths. **Results:** Heatwaves were found to increase the risk of PTB in 81% of the LMICs studied, with the highest increased risk found to be in Malawi (OR of 4.12 (95%CI:2.85-5.96)). Extreme heat events increased the risk of stillbirth in 27% of the LMICs studied. The largest effect of extreme heat and stillbirth was found to be in Angola. **Conclusions:** Results from this study could be used to inform early warning systems (EWS) to target pregnant women by introducing preventative actions that can reduce exposure to extreme heat and ultimately help mitigate the rates of PTB and stillbirth in LMICs.

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**P-1094**

**Moving toward understanding specific pathways of inflammation in pregnancy: prenatal exposure to consumer product chemicals and changes in plasma eicosanoids**

**Presenter:** Barrett M Welch, NIH/NIEHS, Research Triangle Park, United States

**Authors:** B. M. Welch<sup>1</sup>, A. P. Keil<sup>2</sup>, J. Erve<sup>1</sup>, L. J. Deterding<sup>1</sup>, J. G. Williams<sup>1</sup>, F. B. Lih<sup>1</sup>, D. E. Cantonwine<sup>3</sup>, T. F. McElrath<sup>3</sup>, K. K. Ferguson<sup>1</sup>;

<sup>1</sup>NIH/NIEHS, Research Triangle Park, NC, <sup>2</sup>University of North Carolina, Chapel Hill, NC, <sup>3</sup>Brigham and Women's Hospital, Boston, MA.

**Background.** Exposure to consumer product chemicals during pregnancy can influence maternal inflammation, making mothers and infants more susceptible to pregnancy-related disorders. These chemicals can differentially affect inflammatory pathways, but specific pathways during pregnancy are not well characterized. Eicosanoids, an important class of lipid mediators that influence key pathways of inflammation, can now be measured in comprehensive lipid panels. We aimed to determine the association between plasma eicosanoids and urinary biomarkers of three classes of consumer product chemicals among pregnant women. **Methods.** Our data come from a pilot study of 90 pregnant women nested within the LIFECODES birth cohort study. Maternal plasma and urine were collected at up to three prenatal visits. Plasma was analyzed for 61 eicosanoids, which were grouped into biosynthetic pathways defined by the upstream: 1) fatty acid precursor, including linoleic, arachidonic, docosahexaenoic, or eicosapentaenoic acid; and 2) enzyme pathway, including cyclooxygenase, lipoxygenase, or cytochrome P450. Urine was analyzed for three chemical classes, including 12 phthalate metabolites, 12 phenols, and 9 organophosphate flame retardant metabolites (OPFRs). Each eicosanoid-chemical association was examined using repeated measures from generalized additive mixed effects models. Quantile g-computation was used to examine the association between eicosanoids and a simultaneous increase in all chemicals within each class mixture. **Results.** Both single-pollutant and mixture analyses showed positive associations between phthalates and phenols with specific eicosanoid pathways. The most consistent associations were between phthalate metabolites and eicosanoids produced from arachidonic acid by lipoxygenase or cyclooxygenase enzymes. In the mixture analyses, a quartile increase in all di-2(ethylhexyl)-phthalate metabolites were most strongly associated with prostaglandin E2 ( $\beta = 1.61$ , 95% confidence interval: 0.98, 2.24). **Conclusions.** We estimate that higher exposure to phthalates and phenols, but not OPFRs, is associated with elevated inflammation-related eicosanoids, which can provide insight into specific exposure-related pathways of maternal inflammation during pregnancy.

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**P-1095**

### **Exposures to Phthalate Mixtures are Associated with Adverse Birth Outcomes in a Puerto Rico Pregnancy Cohort**

**Presenter:** Amber Cathey, University of Michigan School of Public Health, Ann Arbor, United States

**Authors:** A. Cathey<sup>1</sup>, D. Watkins<sup>1</sup>, Z. Rosario<sup>2</sup>, C. Velez<sup>2</sup>, B. Mukherjee<sup>1</sup>, A. Alshwabkeh<sup>3</sup>, J. Cordero<sup>4</sup>, J. Meeker<sup>1</sup>;

<sup>1</sup>University of Michigan School of Public Health, Ann Arbor, MI, <sup>2</sup>University of Puerto Rico Graduate School of Public Health, San Juan, PR, <sup>3</sup>Northeastern University College of Engineering, Boston, MA, <sup>4</sup>University of Georgia College of Public Health, Athens, GA.

Phthalates are synthetic chemicals used many consumer products. Humans are exposed to complex mixtures of phthalates from diverse sources. Previous studies have reported significant associations between individual phthalate metabolites and adverse birth outcomes such as preterm birth (PTB), but research on how mixtures of phthalates may be related to these outcomes is limited. We utilized data from the PROTECT prospective pregnancy cohort in Puerto Rico, in which 884 women provided up to three urine samples throughout gestation (median 18, 22, and 26 weeks). Samples were analyzed for 13 phthalate metabolites, and birth outcome data (PTB and spontaneous PTB, gestational age, small and large for gestational age (SGA, LGA), and birth weight z-score) were abstracted from medical records. We utilized adaptive elastic net (adENET) to determine which phthalate metabolites in the mixture were most predictive of each birth outcome. We then utilized weights from adENET to construct environmental risk scores (ERS), which represent a weighted sum of each woman's exposure to the phthalate mixture. Birth outcomes were then regressed on quartiles of ERS. We assessed visit-specific and gestational average ERS associations, and explored whether birth outcomes differed by fetal sex. The highest quartile of average ERS was associated with 2.21 times (95% CI: 1.01, 4.81) greater odds of PTB, and 3.13 (95% CI: 1.14, 8.56) times greater odds of spontaneous PTB, relative to the lowest ERS quartile. Exposures at the second study visit were strongest in relation to odds of PTB, while third visit exposures were strongest for spontaneous PTB. Spontaneous PTB results remained significant among male fetuses, while female results were attenuated. The highest quartile of ERS was associated with increased odds of LGA and reduced birth weight z-score among both male and female fetuses. These results highlight the need to study complex mixtures to better understand true health risks.

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**P-1096**

### **Repeated Measures of Polycyclic Aromatic Hydrocarbons are Associated with Reproductive and Thyroid Hormones During Pregnancy**

**Presenter:** Amber Cathey, University of Michigan School of Public Health, Ann Arbor, United States

**Authors:** A. Cathey<sup>1</sup>, D. Watkins<sup>1</sup>, Z. Rosario<sup>2</sup>, C. Velez<sup>2</sup>, A. Alshawabkeh<sup>3</sup>, J. Cordero<sup>4</sup>, J. Meeker<sup>1</sup>;  
<sup>1</sup>University of Michigan School of Public Health, Ann Arbor, MI, <sup>2</sup>University of Puerto Rico Graduate School of Public Health, San Juan, PR, <sup>3</sup>Northeastern University College of Engineering, Boston, MA, <sup>4</sup>University of Georgia College of Public Health, Athens, GA.

Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants produced via incomplete combustion reactions. Human exposure is widespread and occurs via cigarette smoke, charred meats, and automobile exhaust. Recent natural disasters in Puerto Rico have resulted in large numbers of residents relying on gas powered generators for electricity, thus concern about PAH exposures will be heightened in the coming years. Previous studies have demonstrated that PAH exposure may be linked to cardiovascular disease and various cancers, but the mechanisms by which these disease states are affected by PAHs are poorly understood. Therefore, we aimed to investigate the endocrine disrupting potential of PAHs to better understand their physiological impacts. We utilized data from the PROTECT prospective pregnancy cohort in Puerto Rico, in which we had biomarker measurements for 8 urinary PAH metabolites and 9 serum hormones in 1018 pregnant women at two time points (median 18 and 26 weeks) during gestation. Linear mixed models with random intercepts were used to assess longitudinal associations between PAH metabolites and hormone concentrations. Interaction terms were introduced into models to assess differences in observed associations between fetal sexes and between study visits. Significant associations were observed with most PAH metabolites, and some differed by study visit or fetal sex. Notably, an interquartile range (IQR) increase in 2,3-hydroxyphenanthrene was associated with a 19.0% (95% CI: 7.44, 31.7) increase in CRH, and this association was driven by exposure at the first study visit (interaction p-value: 0.027). An IQR increase in 9-hydroxyphenanthrene was associated with a 17.4% (95% CI: 5.18, 28.1) decrease in testosterone among women carrying a female, but not a male, fetus (interaction p-value: 0.006). Our results suggest that exposure to PAHs may disrupt diverse hormonal pathways during pregnancy, and that fetal sex and exposure windows may be important in determining the health effects of PAH exposures.

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**P-1097**

### **Studying Bariatric Surgery Patients to Better Understand Endocrine Disrupting Chemicals Effects on Male Reproduction**

**Presenter:** Danielly Paiva Magalhaes, The George Washington University, Washington, United States

**Authors:** D. P. Magalhaes, L. M. Neumann, M. J. Perry;  
The George Washington University, Washington, DC.

Weight loss promoted by bariatric surgery is generally associated with beneficial health effects. However, the release of lipophilic endocrine-disrupting chemicals (EDCs) accumulated in adipose tissue in a lifetime increases the risk for this population to experience toxic effects. Male patients are exposed to higher levels of EDCs in blood compared to females due to their higher body burden and higher weight loss after surgery. Elevated serum and semen EDCs concentrations have been found to be negatively associated with sperm quality and fertility. The objective of this study is to estimate the serum levels of major EDCs following bariatric surgery and to discuss the potential risk from this exposure to male reproductive health. According to the literature search criteria, nine studies were found that measured the levels of EDCs before and after surgery. Five studies (n=576) were used to calculate the percentage of change in EDCs serum levels per kilogram weight loss. The average weight loss at 6 and 12 months post-surgery for U.S. men are, respectively, 31 and 44 kg, which yielded total serum organochlorines concentrations (p,p'-DDE,  $\Sigma$ PCB,  $\Sigma$ HCH, HCB, and  $\Sigma$ PBDE) in 636.2% (Min-Max 187% - 1052.7%) and 913% (Min-Max 278.3% - 1510.4%) at 6 and 12 months post-surgery, respectively. Only seven small cohorts (n = 3 - 46) studies addressed sperm parameters post-surgery and none of them considered EDCs. Reported negative effects included the lack of improvement in sperm characteristics, a worsening of general sperm quality, azoospermia, and an increase in sperm aneuploidy and infertility after surgery. Occupational and non-occupational populations with similar serum EDCs concentrations as post-bariatric patients were also found to have sperm deterioration and infertility. Bariatric patients prove to be a good model to examine how the reproductive system responds to precipitous and progressive increases in circulating EDCs.

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**P-1098**

**Association between mid pregnancy immune phenotyping and cord blood telomere length: PRISM pregnancy cohort**

**Presenter:** Elena Colicino, -Mount Sinai, , United States

**Authors:** E. Colicino<sup>1</sup>, W. Cowell<sup>1</sup>, N. Foppa Pedretti<sup>1</sup>, A. Joshi<sup>1</sup>, M. Niedzwiecki<sup>1</sup>, V. Bollati<sup>2</sup>, C. Berin<sup>1</sup>, R. Wright<sup>1</sup>, R. Wright<sup>1</sup>;

<sup>1</sup>-Mount Sinai, New York, NY, <sup>2</sup>University of Milan, Milan, ITALY.

**Background:** Environmental exposures including air pollutants, toxic metals, and psychosocial stress have been associated with shorter telomere length (TL) in newborns and adults. These exposures have in turn been linked to an enhanced inflammatory immune response. Taken together, these lines of evidence suggest that increased inflammation during pregnancy may be a central biological pathway linking these environmental factors with reduced TL. Characterizing the prenatal inflammatory milieu through a broader range of cytokine and chemokines, rather than focusing on individual cytokine levels in relation to newborn TL may better elucidate underlying associations **Methods:** Analyses included 129 mother-child dyads enrolled in the PRogramming of Intergenerational Stress Mechanisms pregnancy cohort. Women were racially/ethnically diverse (42% White, 34% African American, 12% Hispanic) and more highly educated (15% reported a high school education or less). We measured 92 inflammation-related proteins in maternal mid-pregnancy serum using the Olink protein array and quantified cord blood relative leukocyte TL (rLTL) via qPCR. We leveraged a tree-based machine learning algorithm to select the most important pro-inflammatory related proteins associated with rLTL. We then evaluated the joint association between the selected proteins with rLTL using Bayesian Weighted Quantile Sum (WQS) Regression. All analyses were adjusted for maternal ethnicity, maternal age, maternal education, fetal sex, and week of serum collection. **Results:** Three proteins were negatively and linearly associated with rLTL (CASP8 Est: -0.22 p=0.008, BNGF Est: -0.43 p=0.033, TRANCE Est: -0.38 p=0.004). Results from Bayesian WQS Regression showed a significant overall decrease in rLTL (-0.26 95%CrI: -0.43, -0.07) per quartile increase of the mixture, with CASP8 contributing the greatest weight (CASP8 50%; BNGF 27%, and TRANCE 23%). **Conclusions:** This proteomics approach identifies novel maternal prenatal inflammatory protein biomarkers associated with shortened rLTL in newborns.

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**P-1099**

### **Antibiotic Use During Pregnancy and the Maternal Epigenome**

**Presenter:** Sahra Mohazzab-Hosseinian, University of Southern California, Los Angeles, United States

**Authors:** S. Mohazzab-Hosseinian, C. V. Breton, C. G. Howe, H. Foley, D. Faham, T. M. Bastain, T. Chavez, D. Weisenberger;  
University of Southern California, Los Angeles, CA.

**Background:** Approximately 40% of women are prescribed an antibiotic during pregnancy. Though completed course of therapy is necessary for treatment of infections, antibiotic use has been associated with several adverse birth outcomes. Biological changes in the prenatal environment affected by antibiotic use are poorly understood. Specifically, examining maternal epigenetic patterns associated with antibiotic use can identify CpG sites that may provide insight into biological pathways associated with adverse birth outcomes. **Objectives:** To evaluate the association of antibiotic use, abstracted from medical records as participants who had ever been prescribed an antibiotic during pregnancy, and maternal peripheral blood DNA methylation patterns during pregnancy in the MADRES (Maternal and Developmental Risks from Environmental and Social Stressors) study, a pregnancy cohort of predominantly lower income Hispanic women in Los Angeles. A paired, longitudinal analysis was used to evaluate changes in methylation between the first and third trimester in women who had ever been prescribed an antibiotic during pregnancy. Exploration of discrete effects at the first and third trimester was also undertaken, as contraindication of antibiotic differs across trimesters of pregnancy. **Methods:** Antibiotic use, indicated by prescription of antibiotic, and its association with differentially methylated positions (DMPs) on the Illumina EPIC array were analyzed using linear mixed and linear regression models. Estimated blood cell type fractions and surrogate variables were used to control for both measured and unmeasured confounding variables in statistical analysis. **Results:** In the third trimester, 15 DMPs were identified (PFDR<0.05) in relation to antibiotic use during pregnancy. Antibiotic use during pregnancy was not associated with first to third trimester methylation changes for any loci on the EPIC array. **Conclusion:** In the MADRES cohort, antibiotic use during pregnancy was not associated with changes in methylation during pregnancy, but was associated with differential methylation at 15 CpGs in third trimester peripheral blood samples.

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**P-1100**

### **Particulate Pollution and Male Reproductive Health: Differential Impacts in Early and Late Spermatogenesis**

**Presenter:** Trenton Henry, University of Utah, Salt Lake City, United States

**Authors:** T. Henry, Trenton J. Honda, Christina A. Porucznik, James A. VanDerslice

**Particulate Pollution and Male Reproductive Health: Differential Impacts in Early and Late Spermatogenesis**  
Background/Aim: Despite increasing evidence that particulate air pollution has adverse effects on human semen quality, few studies examine clinically relevant thresholds typically employed by clinicians to diagnose male fertility problems. Furthermore, exposure is often assessed using average air pollution levels in a geographic area rather than individualized measures. Finally, physiology-driven selection exposure windows are inconsistent.

Methods: We examined a previous cohort of 132 healthy males seeking to become parents, using spermatogenesis-relevant exposure windows of 77-34 days and 37-0 days prior to semen collection. Exposure to PM<sub>2.5</sub> and PM<sub>10</sub> was individualized by selecting multiple air pollution sensors within participants' geographic air basins and employing inverse distance weighting to calculate mean daily exposure levels. We used multiple logistic regression to assess the association between pollution, temperature, and dichotomized World Health Organization semen parameters.

Results: During the early phase of spermatogenesis, air pollution exposure is associated with 1.563 (95% CI, 1.049 to 2.452) times greater odds of <30% normal heads per 1-unit increase in IQR for PM<sub>2.5</sub>. In the late phase of spermatogenesis, air pollution exposure is associated with 0.368 (95% CI, 0.114 to 0.767) times greater odds of semen concentration <15 million/mL per 1-unit increase in IQR for PM<sub>2.5</sub>, and 0.208 (95% CI, 0.042 to 0.653) for PM<sub>10</sub>.

Conclusions: Particulate exposure has a differential and more deleterious impact on early-phase spermatogenesis than late-phase, especially for PM<sub>2.5</sub>. This suggests that smaller particles breathed earlier in the spermatogenic cycle are likelier to affect sperm head formation.

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**P-1101**

**Does preeclampsia mediate the impact of air pollution on reduced birth weight?**

**Presenter:** Lan Jin, Yale University, New Haven, United States

**Authors:** L. Jin<sup>1</sup>, Z. Meng<sup>2</sup>, B. Mao<sup>2</sup>, H. Huang<sup>1</sup>, P. Sun<sup>1</sup>, H. Zhuo<sup>1</sup>, B. Yi<sup>1</sup>, Q. Liu<sup>2</sup>, J. Qiu<sup>2</sup>, Y. Zhang<sup>1</sup>;  
<sup>1</sup>Yale University, New Haven, CT, <sup>2</sup>Gansu Provincial Maternity and Child Care Hospital, Lanzhou, CHINA.

**Background:** Maternal exposure to air pollution has been linked to reduced birth weight and increased risk of preeclampsia. Preeclampsia has been associated with an increased risk of reduced birth weight. We speculate that the impact of air pollution on birth weight could partially attribute to its impact on preeclampsia. **Methods:** We analyzed data from a birth cohort in Lanzhou, China from 2010-2012. We included 8046 mothers, who gave birth (singleton) at Gansu Provincial Maternity and Child Care Hospital, and reported residence at birth in Lanzhou urban area. Maternal exposures to particulate matter with diameter < 10  $\mu\text{m}$  (PM<sub>10</sub>) during the entire pregnancy were estimated using inverse distance weighting based on government monitoring data. We conducted a mediation analysis to investigate the role of preeclampsia in the causal relationship between PM<sub>10</sub> and birth weight. The covariates in the analysis included newborn sex, maternal age, education, income, gestational weeks, C-section, previous preterm birth, body mass index, folate intake, and smoking. **Results:** Maternal exposure to PM<sub>10</sub> during entire pregnancy was significantly associated with reduced birth weight after adjusting for the above covariates [-16 g; 95% CI: -30 g, -2 g; for interquartile range (IQR) increase in PM<sub>10</sub>]. Maternal preeclampsia was significantly associated with reduced birth weight [-384 g; 95% CI: -525 g, -243 g], and PM<sub>10</sub> exposures (OR: 2.2; 95% CI: 1.4, 3.4; for IQR increase in PM<sub>10</sub>). For an IQR increase in PM<sub>10</sub>, preeclampsia explained 4.5% (p: 0.042) of the total effects of elevated PM<sub>10</sub> exposures on reduced birth weight.

**Conclusions:** Preeclampsia mediates the impact of maternal exposure to PM<sub>10</sub> on reduced birth weight, but other pathways through which air pollution impacts birth weight need to be further explored. Preventative measures or proactive management of preeclampsia during pregnancy might help to reduce the adverse impact of air pollution on birth weight.

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**P-1102**

### **Maternal-Fetal Polybrominated Diphenyl Ether (PBDE) Levels and Biomarkers of Placental Development and Disease during Mid-gestation**

**Presenter:** Julia Varshavsky, University of California, San Francisco, Berkeley, United States

**Authors:** J. Varshavsky<sup>1</sup>, J. Robinson<sup>1</sup>, Y. Zhou<sup>1</sup>, K. Puckett<sup>1</sup>, E. Kwan<sup>1</sup>, S. Buarpong<sup>1</sup>, R. Aburajab<sup>1</sup>, S. Gaw<sup>1</sup>, S. Sen<sup>2</sup>, S. Crispo Smith<sup>3</sup>, J. Frankenfield<sup>3</sup>, J. Park<sup>3</sup>, S. Fisher<sup>1</sup>, T. Woodruff<sup>1</sup>;

<sup>1</sup>University of California, San Francisco, Berkeley, CA, <sup>2</sup>University of Tennessee Health Science Center, Department of Preventive Medicine, Memphis, TN, <sup>3</sup>Department of Toxic Substances Control, Berkeley, CA.

While the mechanisms and periods of sensitivity remain undefined, in utero exposures to polybrominated diphenyl ethers (PBDEs) may be linked with placenta-mediated pregnancy complications. To define the relationship between PBDE exposure and placental development, we performed: 1) an evaluation of PBDE exposures in matched samples of maternal serum, placenta, and the fetal liver collected from healthy pregnant women undergoing elective terminations during mid-gestation (n=180; 2014-16); and 2) a semi-qualitative characterization of biomarkers of placental development in relation to placental PBDE levels (n=62). Study protocols were approved by the University of California, San Francisco institutional review board; written and verbal consent were obtained from each study participant. We used censored Kendall's tau correlation and maximum likelihood regression to compare PBDE levels between maternal-fetal tissues and examine their associations with biomarkers of placental development and disease. We profiled placental cytotrophoblast (CTB) expression of integrin alpha 1 (ITGA1) and vascular endothelial-cadherin (CDH5) and metalloproteinase 1 (MMP1). In addition, we evaluated morphological features: leukocyte recruitment (basal plate), fibrinoid deposition (villous, basal plate), and CTB endovascular invasion. PBDEs were detected in all biomatrices. Prior to lipid adjustment, wet-weight PBDE levels were highest in the fetal liver compared to other compartments (p<0.001). In contrast, after lipid adjustment, PBDE levels were higher in maternal serum compared to the fetal liver and placenta (p<0.001). We observed associations between placental PBDE levels and endovascular CTB immunoreactivity of ITGA1 (inverse) and interstitial CTB immunoreactivity of CDH5 (positive), suggesting these markers of CTB invasion and development may be sensitive placental biomarkers of PBDE exposure. Our work suggests that PBDEs are widely detected and differentially distributed in maternal-fetal compartments. Furthermore, we propose specific biomarkers of placental development as potential barometers of PBDE exposure during mid-gestation. This paradigm could be extended to other environmental chemicals and placental biomarkers.

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**P-1103**

**Higher levels of residential radon are associated with higher odds of PIH disorders in Massachusetts, USA**

**Presenter:** Stefania Papatheodorou, Harvard TH Chan School of Public Health, BOSTON, United States

**Authors:** S. Papatheodorou, W. Yao, C. L. Vieira, M. Hacker, B. Wylie, J. Schwartz, P. Koutrakis; Harvard TH Chan School of Public Health, BOSTON, MA.

Background: Exposure to ionizing radiation has been associated with hypertension outside pregnancy, but the association between residential radon and pregnancy-induced hypertensive (PIH) disorders has not been evaluated. Methods: We used the Massachusetts Birth Registry of Vital Records from 2001-2015 to study women with a singleton pregnancy without prior hypertension. The PIH disorders status was obtained from the birth certificates as a binary variable. Median zip code level measurements were used to estimate radon exposure at the lowest livable level of each place under closed-house conditions. We used a mixed-effects model adjusted for sociodemographic covariates, maternal comorbidities, PM<sub>2.5</sub>, temperature, and relative humidity. We examined effect modification by maternal age in two categories at the cutoff of 35 years. Results: Of 990,364 women, 3.7% (37,027) of them developed gestational hypertension. Median zip code level ranged from 0.1 to 19.9 pCi/L. An interquartile range (IQR) increase in median zip code radon level throughout pregnancy was associated with a 3% increase in the odds of PIH disorders (95% CI 2% to 5%) in the full cohort. In women less than 35 years old, an IQR increase in medial residential zip code level, radon was associated with a 4.1% increase in the odds of PIH disorders (95% CI 3% to 6%), while in women more than 35 years old, the association was null. Conclusions: In this cohort, higher levels of residential radon are associated with increased odds of PIH disorders. After stratifying by age, this effect remained significant only in women less than 35 years old. Since the burden of pregnancy-induced hypertensive disorders is high and affects women's future cardiovascular health, the identification of modifiable risk factors is of great importance.

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**P-1104**

### **Association Between PM<sub>2.5</sub> Exposure and Preeclampsia**

**Presenter:** Daphne Miranda Thampy, University of California, Irvine, Irvine, United States

**Authors:** D. M. Thampy<sup>1</sup>, M. Girguis<sup>2</sup>, V. Vieira<sup>1</sup>;

<sup>1</sup>University of California, Irvine, Irvine, CA, <sup>2</sup>University of Southern California, Los Angeles, CA.

**Background:** Previous studies have suggested that traffic-related air pollution can increase risk of pregnancy complications. The purpose of this research is to investigate if PM<sub>2.5</sub> exposure one year prior to conception is associated with preeclampsia. **Methods:** We obtained all live and still births from the Massachusetts state birth registry with an estimated conception date between January 2002 through December 2008. We randomly selected 2,000 infants conceived each year to serve as the study population. Of those 14,000 births, all mothers diagnosed with the main symptoms of preeclampsia, high blood pressure or proteinuria, were identified as cases. Cumulative PM<sub>2.5</sub> exposure was assessed using 4-km spatial satellite remote sensing, meteorological and land use spatiotemporal models at geocoded birth addresses for the year prior to conception. We calculated crude and adjusted preeclampsia odds ratios (ORs) and 95% confidence intervals (CI) per 10 µg/m<sup>3</sup> increase of PM<sub>2.5</sub> exposure. Analyses of complete data were adjusted for demographic, socioeconomic, and reproductive characteristics of the mother. Births missing over 70% of PM<sub>2.5</sub> data were excluded. **Results:** Our final analyses included 576 cases and 11,679 controls. Cumulative PM<sub>2.5</sub> exposure during the year prior to conception was not associated with preeclampsia in the unadjusted analyses (OR: 1.02; 95%CI: 0.97, 1.07). After adjusting for maternal age, race, education, language, insurance status, parity, smoking, drinking, adequacy of care, and year of birth, PM<sub>2.5</sub> exposure remained not significantly associated with preeclampsia (OR: 1.04; 95%CI: 0.98, 1.10). As confirmed by prior literature, Non-Hispanic Black mothers had almost double the risk of being a case compared to the referent group (Non-Hispanic White) (OR: 1.89; 95%CI: 1.44, 2.48). **Discussion:** We did not find evidence to support the relationship between maternal traffic related air pollution exposure and preeclampsia. Future work will assess whether other areas with a higher threshold of air pollution exposure would be associated with preeclampsia.

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**P-1105**

**Arsenic contamination of drinking water in California and risk of spontaneous preterm birth**

**Presenter:** Allison Rabinovitch Sherris, Stanford University, Stanford, United States

**Authors:** A. R. Sherris, M. Baiocchi, S. Fendorf, S. Luby, W. Yang, G. M. Shaw;  
Stanford University, Stanford, CA.

Arsenic is among the most common groundwater contaminants worldwide. Studies have identified elevated risk of adverse birth outcomes, including preterm birth, among populations with high concentrations of arsenic in drinking water. However, the population impact of low-level arsenic exposure on preterm birth remains uncertain. We evaluated the association between arsenic in drinking water and risk of spontaneous preterm birth among nearly one million singleton live births in California from 2000-2011. We used public water system monitoring records to estimate arsenic concentrations in drinking water for each maternal residence during gestation. Our statistical approach emulated a crossover design: We applied mixed effects logistic regression to evaluate preterm birth risk in women who “crossed over” into different arsenic exposure between consecutive pregnancies. We did not observe an association between odds of late preterm birth (32-36 weeks of gestation) and tap water arsenic concentration greater than 5 micrograms per liter during pregnancy. We found a borderline significant increase of approximately 15% in adjusted odds of early preterm birth (20-31 weeks of gestation) associated with the same exposure among women who did not move water systems between consecutive pregnancies. However, this finding was attenuated in several sensitivity analyses. This study does not suggest strong associations between low-level arsenic in drinking water during pregnancy and spontaneous preterm birth, though modest increased risk for gestational length 20-31 weeks was observed with arsenic concentrations above 5 micrograms per liter. Future research will evaluate the cumulative impact of arsenic with other inorganic contaminants in drinking water on preterm birth.

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**P-1106**

### **Environmental Chemical Exposures During Mid-gestation and Biomarkers of Placental Development**

**Presenter:** Julia Varshavsky, University of California, San Francisco, Berkeley, United States

**Authors:** J. Varshavsky<sup>1</sup>, J. Robinson<sup>1</sup>, Y. Zhou<sup>1</sup>, K. Puckett<sup>1</sup>, E. Kwan<sup>1</sup>, S. Buarpong<sup>1</sup>, R. Aburajab<sup>1</sup>, S. Gaw<sup>1</sup>, S. Sen<sup>2</sup>, S. Crispo Smith<sup>3</sup>, J. Frankenfield<sup>3</sup>, J. Park<sup>3</sup>, S. Fisher<sup>1</sup>, T. Woodruff<sup>1</sup>;

<sup>1</sup>University of California, San Francisco, Berkeley, CA, <sup>2</sup>University of Tennessee Health Science Center, Department of Preventive Medicine, Memphis, TN, <sup>3</sup>Department of Toxic Substances Control, Berkeley, CA.

While the mechanisms and periods of sensitivity remain undefined, in utero exposures to environmental chemicals (ECs) are associated with placenta-mediated fetal and maternal health complications. To investigate the relationship between EC exposures and human placental development during mid-gestation, we performed a two-part analysis: 1) an evaluation of polybrominated diphenyl ethers (PBDEs), per- and poly-fluorinated alkyl substances (PFAS), and organophosphate flame retardants (OPFRs) exposures in matched samples of maternal serum, urine, placenta, and/or fetal liver collected from healthy women undergoing elective termination procedures during the 2<sup>nd</sup> trimester (2014-16); and 2) a semi-quantitative characterization of biomarkers of human placental development in relation to EC levels (n=62). We examined chemical levels and their associations with biomarkers of placental development using censored Kendall's tau correlation and maximum likelihood regression. We profiled placental cytotrophoblast (CTB) expression of key molecules involved in CTB differentiation and uterine invasion— ITGA1, CDH5, MMP1—and morphological features: leukocyte recruitment, fibrinoid deposition, and endovascular CTB invasion. Specific ECs were widely detected and differentially distributed across the tested biomatrices. For example, PBDEs were identified in all maternal serum, fetal liver and placental biomatrices, and prior to lipid adjustment, wet-weight levels of PBDE congeners were highest in the fetal liver as compared to the other compartments (p<0.001). Furthermore, we observed significant associations between PBDE (placenta), PFAS (serum), and OPFR (urine) levels and immunoreactivity of ITGA1 (endovascular CTBs; inverse) or CDH5 (interstitial CTBs; positive), suggesting that the localized expression of these molecules in the placenta may be sensitive indicators of chemical exposure. Our results suggest that ECs are widely detected and differentially distributed in maternal-fetal compartments. Furthermore, we propose specific biomarkers of placental development as potential barometers of PBDE, PFAS, and OPFR exposure during mid-gestation. This paradigm could be extended to other environmental chemicals and placental-specific biomarkers.

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**P-1107**

**Local mobility among pregnant women with and without asthma**

**Presenter:** Sandie Ha, University of California, Merced, Merced, United States

**Authors:** S. Ha<sup>1</sup>, J. Kanner<sup>2</sup>, C. Nobles<sup>2</sup>, S. Sherman<sup>3</sup>, D. Stevens<sup>2</sup>, A. Williams<sup>4</sup>, W. Grobman<sup>5</sup>, J. Biggio<sup>6</sup>, A. Subramaniam<sup>7</sup>, M. Ouidir<sup>2</sup>, Z. Chen<sup>2</sup>, P. Mendola<sup>2</sup>;

<sup>1</sup>University of California, Merced, Merced, CA, <sup>2</sup>Epidemiology Branch, Division of Intramural Population Health Research, Eunice Kennedy Shriver National Institute of Child Health and Human Development, Bethesda, MD, <sup>3</sup>The Emmes Company, Rockville, MD, <sup>4</sup>University of North Dakota, Grand Forks, ND, <sup>5</sup>Northwestern University, Chicago, IL, <sup>6</sup>Ochsner Health System, New Orleans, LA, <sup>7</sup>The University of Alabama at Birmingham, Birmingham, AL.

**Background/aim:** Studies evaluating environmental effects on perinatal health often estimate exposures based on residential address assuming pregnant women are stationary. Pregnant women are frequently mobile but their mobility is understudied. We investigate local and residential mobility across pregnancy in a prospective cohort of pregnant women. **Methods.** B-WELL-Mom is a prospective cohort study of 418 pregnant women with and without asthma. This analysis includes 277 women who participated in the local mobility sub-study. Participants carried a GPS-activated device to assess locational changes (i.e., local mobility) throughout pregnancy. They also self-reported residential mobility (i.e., residential relocation) during each trimester and ~4 months post-partum. GPS locations and successive residential addresses throughout pregnancy were geocoded to determine local and residential mobility. **Results.** At enrollment, 69 women (24.9%) had no asthma, 98 (35.4%) had well-controlled asthma, and 110 (39.7%) had poorly-controlled asthma. The proportion of time women spent inside their residential census tract increased from 30.5% during the first trimester to 41.1% during the third trimester. Women without asthma spent less time in their census tract compared to women with asthma especially during later pregnancy (trimester 3: 32% vs. 43%). During postpartum, women without asthma spent 51.9% of their time inside their census tract, whereas women with well-controlled asthma and poorly controlled women spent 56.5% and 76.3% of the time within their census tract, respectively. Approximately 27% of women moved during pregnancy, with 68% of movers relocating to a different census tract. **Conclusions.** Pregnant women are mobile beyond their residential address and local area. Local mobility declined through pregnancy, and women with asthma had less local mobility than women without asthma. Residential relocation was common, and a significant proportion of movers relocate to a different area. Studies assessing environmental effects on perinatal health should pay attention to local and residential mobility to improve exposure assessment.

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**P-1108**

**Hurricane Michael and adverse birth outcomes**

**Presenter:** Ke Pan, Tulane University School of Public Health and Tropical Medicine, New Orleans, US

**Authors:** M. Lichtveld<sup>1</sup>, K. Pan<sup>1</sup>, L. Beitsch<sup>2</sup>, C. Uejio<sup>2</sup>, E. Harville<sup>1</sup>;

<sup>1</sup>Tulane University, New Orleans, LA, <sup>2</sup>Florida State University, Tallahassee, FL.

**Background:** Hurricanes and natural disasters are often associated with increases in adverse birth outcomes, due to associated stress, lack of access to medical care, and exposures to environmental toxicants, including harmful algae, chemical spills, and carbon monoxide. **Methods:** Vital statistics data were used to assess changes in birth outcomes in Florida counties affected by Hurricane Michael (October 2018). Birth outcomes, including low birthweight (LBW; <2500 g) and preterm birth (PTB; <37 weeks' gestation), were compared for one-year periods before and after Michael, and across counties. Paired t-tests and linear regression were used to assess change in number of births. Logistic regression models were used for binary outcomes, and a semi-parametric model and cumulative logistic regression were used for antenatal care (ANC) utilization, adjusting for maternal characteristics. **Results:** Number of births in the affected area was not statistically different before and after Michael. Change in births was not significantly different across counties affected with differing severity by Michael. In counties most affected, proportion of LBW births rose after Michael (8.2% vs. 9.5%,  $p < 0.01$ ), while PTB did not change (13.75% vs. 13.60%,  $p = 0.79$ ). ANC utilization decreased after Michael, including delayed first ANC visit, decreased proportion of women receiving ANC during pregnancy, and decreased Kotelchuck index. Adjusting for covariates, Odds ratio (OR) for LBW was 1.217 (95%CI: 1.082, 1.367,  $p < 0.01$ ), and OR for PTB was 0.994 (95%CI: 0.898, 1.100,  $p = 0.91$ ); first ANC visit was delayed 0.137 month (95%CI: 0.08, 0.19,  $p < 0.01$ ), OR of receiving any ANC was 0.65 (95%CI: 0.50, 0.86,  $p < 0.01$ ), OR of more adequate ANC was 0.79 (95%CI: 0.738, 0.842,  $p < 0.01$ ). **Conclusions:** Hurricane Michael was associated with increased risk of late and inadequate ANC and LBW. Ongoing efforts include characterization of potential Hurricane-associated factors which may have contributed to adverse outcomes, including exposures to chemical stressors including harmful algal blooms and carbon monoxide.

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**P-1109**

**Proximity to inland water and major roadway of residential address and ovarian reserve: a retrospective cohort study**

**Presenter:** Seung-Ah Choe, CHA University, Seoul, Korea, Republic of

**Authors:** S. Choe<sup>1</sup>, S. Kim<sup>2</sup>, C. Im<sup>3</sup>;

<sup>1</sup>CHA University, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Seoul National University, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>Korea University, Seoul, KOREA, REPUBLIC OF.

**Background:** There are growing interests regarding the potential impact of physical environment on reproductive health. This study was to explore the association between neighborhood environment and women's fertility. **Method:** This study is a retrospective cohort study using the data of 7,630 women who have undertaken anti-Mullerian hormone (AMH) test which is a universal indicator for ovarian reserve at a single fertility center in 2016-2018. For indicators of age-adjusted ovarian reserve, we used AMH ratio (defined as  $AMH_{measured} / AMH_{age-appropriate\ reference}$ ). We calculated a distance to nearest inland water (including lake, creek, stream and river) and nearest major roadway for each geocoded address. We used continuous scales for correlation tests and categorized (quartile) scales for multivariable regression analyses. We further analyzed the odds of decreased ovarian reserve (DOR, defined as AMH ratio  $<0.1$ ) with adjustment for covariates. Body mass index, occupation, smoking and regional deprivation index were used as covariates. **Results:** Median age was 39.1 years and mean AMH was 3.5 ng/mL. Mean distance to inland water and major road was 443.7 and 3672.8 m, respectively. Spearman correlation coefficient for the association between AMH ratio and distance to inland water was -0.001 ( $P = 0.934$ ). For the association with distance to major road, the coefficient was -0.023 ( $P = 0.058$ ). In multivariable analyses using quartiles of distance, the associations between proximity to inland water or major road and AMH ratio were toward null. Odds ratios (OR) of DOR was 1.05 (95% confidence intervals (CI): 0.72, 1.53) for the highest quartile of distance to inland water and 1.33 (95% CI: 0.89, 1.98) for the highest quartile of distance to major roadway compared to ORs for the lowest quartile. **Conclusion:** There was no evidence of association of proximity to inland water or major roadway with women's ovarian reserve in our study.

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**P-1111**

### **Placental levels of polycyclic aromatic hydrocarbons and its association with preterm birth and redox status (GSH/MDA)**

**Presenter:** PRIYANKA AGARWAL, Dr.Bhimrao Ambedkar University, Agra-282002, Agra, India

**Authors:** P. AGARWAL, A. TANEJA;  
Dr.Bhimrao Ambedkar University, Agra-282002, Agra, INDIA.

Placental levels of polycyclic aromatic hydrocarbons and its association with preterm birth and redox status (GSH/MDA)Background: Earlier researches have shown association between prenatal environmental exposures specifically to polycyclic aromatic hydrocarbons (PAHs) and adverse health outcomes; however inconsistency lies in reported results and limited focus on women from developing nation India, which is ranked first for preterm birth. Thus, there is a mounting need to assess the presence of PAHs in human tissues and its further impact on adverse pregnancy outcomes. Method: Present study is a part of an ongoing cross-sectional study, collecting 166 placenta tissue samples immediately after delivery from North Indian pregnant women. A well structured questionnaire enclosing socio-demographic characteristics of women and sources of environmental and occupational exposures to PAHs were filled by researchers via face to face interviews. Processing of biochemical parameters (malondialdehyde and reduced glutathione) were done instantly after collection of placenta tissues, followed by extraction of 16 USEPA priority PAHs that were analyzed with the help of GC-MS. Results and conclusion: Benzo(a)pyrene (23.93%) and Chrysene (17.06%) were the most dominant PAHs detected, among all measured PAHs. In addition, high molecular weight PAHs were found to be in more prevalence in placenta tissue samples than low molecular weight congeners. Results of student's t-test indicated that most PAHs (except acenaphthylene) were higher in mothers delivering preterm infants with significantly higher levels of benzo(b)fluoranthene, dibenzo(ah)anthracene and  $\Sigma$ 16PAHs. Concomitantly, significantly enhanced levels of MDA and decreased levels of GSH were recorded among cases (preterm infants, n=80) than controls (fullterm infants, n=86). Multivariable regression analysis showed significant negative association of naphthalene, acenaphthene, benzo(b)fluoranthene with GSH and positive association of benzo(a)anthracene with MDA, explains that PAHs possibly by altering the redox status during pregnancy induce preterm birth. These findings shed light on adverse effect of PAHs on reproductive aged women.

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**P-1112**

### **Correlates of persistent endocrine disrupting chemical mixtures among reproductive-aged Black women**

**Presenter:** Samantha Schildroth, Boston University, Boston, United States

**Authors:** S. Schildroth<sup>1</sup>, L. A. Wise<sup>1</sup>, A. Wesselink<sup>1</sup>, J. Weuve<sup>1</sup>, V. Fruh<sup>2</sup>, D. D. Baird<sup>3</sup>, B. Claus Henn<sup>1</sup>;  
<sup>1</sup>Boston University, Boston, MA, <sup>2</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>3</sup>National Institute of Environmental Health Sciences, Durham, NC.

**Background:** Polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and persistent pesticides are endocrine-disrupting chemicals (EDCs). Demographic and dietary variables have been associated with EDC exposure, but few studies have examined correlates of EDC mixtures. **Methods:** We used cross-sectional data from a Detroit-based prospective cohort of Black women aged 23-35 years. At baseline, we measured PCBs, PBDEs, and pesticides in non-fasting plasma samples of 765 women. Socioeconomic, demographic, and dietary data were collected through self-administered questionnaires, interviews, and clinic visits. We conducted a principal component analysis (PCA) to characterize profiles of exposure to mixtures of log-transformed lipid-adjusted chemicals. Three principal components (PCs) explained >75% of the variance. We used multivariable linear regression to estimate mean differences ( $\beta$ ) in PC scores for each correlate, controlling for confounders determined a priori. **Results:** PC-1 accounted for 50.9%, PC-2 for 15.0% and PC-3 for 9.2% of the variance of chemical concentrations. PC-1 explained the most variance for organochlorine pesticides and PCB Wolff Groups 2B and 3 (PCB 99, 138/158, 146, 153, 156, 170, 180, 183, 187, 194, 196/203, 199, hexachlorobenzene, oxychlorodane, trans-nonachlor, and 2,2-bis(4-chlorophenyl)-1,1-dichloroethene); PC-2 for brominated flame retardants (PBDE 28, 47, 99, 153 and 209); and PC 3 for Wolff Group 2A plus PCB 28 (PCB 28, 66, 74, 105, and 118). Having been breastfed in infancy was positively associated with PC-1 ( $\beta=0.33$ , 95% CI=-0.14,0.53) and negatively associated with PC-2 ( $\beta=-0.13$ , 95% CI=-0.26,-0.13) and PC-3 ( $\beta=-0.12$ , 95% CI=-0.21,-0.02). Age, smoking, fish and alcohol consumption were positively associated with PC-1, suggesting these factors are related to higher concentrations of PC-1 biomarkers. Other findings included a positive association of BMI with PC-2, and an inverse association of lactation with PC-1 and PC-3. **Conclusions:** We characterized distinct profiles of EDC mixtures among Black women in our study, which may help to describe exposure pathways and target interventions.

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## ABSTRACT E-BOOK

Theme: **Reproductive**

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**P-1113**

### **Associations between urinary phthalate metabolite mixtures and oxidative stress biomarkers among male partners of couples undergoing fertility treatments**

**Presenter:** Angel D Davalos, Epidemiology Branch, National Institute of Environmental Health Sciences, Research Triangle Park, United States

**Authors:** A. D. Davalos<sup>1</sup>, T. J. van 't Erve<sup>1</sup>, A. P. Keil<sup>2</sup>, L. Minguéz-Alarcon<sup>3</sup>, P. L. Williams<sup>4</sup>, J. D. Meeker<sup>5</sup>, G. L. Milne<sup>6</sup>, S. Zhao<sup>7</sup>, R. Hauser<sup>3</sup>, K. K. Ferguson<sup>1</sup>;

<sup>1</sup>Epidemiology Branch, National Institute of Environmental Health Sciences, Research Triangle Park, NC, <sup>2</sup>Gillings School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC, <sup>3</sup>Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA, <sup>4</sup>Department of Biostatistics, Harvard T.H. Chan School of Public Health, Boston, MA, <sup>5</sup>Department of Environmental Health Sciences, University of Michigan School of Public Health, Ann Arbor, MI, <sup>6</sup>Division of Clinical Pharmacology, Vanderbilt University School of Medicine, Nashville, TN, <sup>7</sup>Biostatistics and Computational Biology Branch, National Institute of Environmental Health Sciences, Research Triangle Park, NC.

**Background:** Oxidative stress, the imbalance between reactive oxygen species and antioxidants, has been associated with sperm dysfunction in men. Phthalate exposure has been associated with increased oxidative stress; however, few studies have explored the joint association between exposure to multiple phthalate metabolites simultaneously and circulating oxidative stress measures. **Methods:** We addressed this question among men (n=235) in the Environment and Reproductive Health (EARTH) study, in which couples seeking infertility treatment were recruited from a clinic in Boston, MA, USA. For males, one urine sample was collected for each fertility treatment cycle. Samples were analyzed for a panel of 11 phthalate metabolites and 3 oxidative stress biomarkers, including 8-iso-prostaglandin F<sub>2α</sub> [8isoPGF<sub>2α</sub>], its primary metabolite, and prostaglandin F<sub>2α</sub>. All measures were corrected for specific gravity to account for urine dilution, and all estimates were adjusted for potential confounders and accounted for repeated exposure and outcome measures. Single pollutant models for each phthalate metabolite and oxidative stress marker were created using linear mixed effects models. The joint association with the overall mixture was assessed using Bayesian Kernel Machine Regression (BKMR). **Results:** In single pollutant models, most phthalate metabolites were associated with increases in 8isoPGF<sub>2α</sub>, but not other oxidative stress markers. For example, an interquartile range increase (IQR) in summed di-2-ethylhexyl phthalate metabolites was associated with a 7.5% (95% CI: 2.0% – 13.4%) increase in 8isoPGF<sub>2α</sub>. The BKMR model also demonstrated a 20.4% (95% credible interval: 8.8% – 33.2%) increase in the 8isoPGF<sub>2α</sub> concentration per a joint increase in all phthalate metabolites from the 1<sup>st</sup> to the 3<sup>rd</sup> quartile. **Conclusions:** Among men presenting at an infertility clinic, those with higher overall urinary concentrations of phthalate metabolites had elevated urinary 8isoPGF<sub>2α</sub> levels, indicative of oxidative stress or inflammation. This mechanism could be relevant to previously observed associations between phthalate metabolites and fertility measures in men.

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**P-1114**

### **Associations between bisphenols, benzophenones, and chlorophenols with fecundability modified by dietary phenols**

**Presenter:** Keewan Kim, NICHD, Bethesda, United States

**Authors:** K. Kim<sup>1</sup>, C. J. Nobles<sup>1</sup>, A. Z. Pollack<sup>2</sup>, N. J. Perkins<sup>1</sup>, P. Mendola<sup>1</sup>, L. A. Sjaarda<sup>1</sup>, R. M. Silver<sup>3</sup>, E. F. Schisterman<sup>1</sup>, S. L. Mumford<sup>1</sup>;

<sup>1</sup>NICHD, Bethesda, MD, <sup>2</sup>George Mason University, Fairfax, VA, <sup>3</sup>University of Utah, Salt Lake City, UT.

**Background/Aim:** Antioxidant dietary phenols, which are abundant in vegetables, fruits, and herbs, may ameliorate adverse associations between environmental phenols (found in food packaging, UV filters, herbicides, and disinfectants) and reproductive outcomes as they exert protective effects. We therefore evaluated whether dietary phenols modified the relationship between environmental phenols and fecundability. **Methods:** In a prospective cohort study following 1,228 women for up to 6 menstrual cycles while trying to conceive (United States, 2007-2011), concentrations of dietary phenols, bisphenols, benzophenones, and chlorophenols were measured in urine at baseline. Pregnancy was assessed using urine hCG. We used discrete Cox regression to examine how low-to-moderate (<75th percentile) versus high (≥75th percentile) levels of dietary phenols modified associations between environmental phenols and fecundability, adjusting for potential confounders.

**Results:** Bisphenol-S was associated with reduced fecundability (fecundability odds ratio [FOR] 0.95, 95% confidence interval [CI] 0.90, 1.00, per log-unit increase), independent of dietary phenols, though other phenols were not associated with fecundability. Selected environmental phenols were associated with reduced fecundability in women with low-to-moderate dietary phenols but not in women with higher dietary phenols. Specifically, bisphenol-A was associated with reduced fecundability in women with low-to-moderate gallic acid (FOR 0.90, 95% CI 0.81, 1.01). 4-hydroxybenzophenone was associated with reduced fecundability in women with low-to-moderate versus high 3,4-dihydroxyphenylacetic acid (FOR 0.90, 95% CI 0.83, 0.97 versus FOR 0.87, 95% CI 0.69, 1.11, respectively) and caffeic acid (FOR 0.88, 95% CI 0.82, 0.96 versus FOR 1.18, 95% CI 0.94, 1.48, respectively). For pentachlorophenol, reduced fecundability was observed in women with low-to-moderate 3-hydroxybenzoic acid (FOR 0.90, 95% CI 0.81, 1.00) and gallic acid (FOR 0.89, 95% CI 0.81, 0.99).

**Conclusions:** Consumption of dietary phenols may help mitigate the adverse effect of selected environmental phenols on fecundability, highlighting the potential interplay between diet and environmental exposures among women attempting pregnancy.

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**P-1115**

**Intimate partner violence during pregnancy is related to reduced birthweight: cross-sectional study in Kaduna, Northwestern Nigeria**

**Presenter:** Musa Abubakar Kana, National Institute of Environmental Health Sciences, Durham, United States

**Authors:** M. A. Kana<sup>1</sup>, H. Safiyan<sup>2</sup>, H. E. Yusuf<sup>3</sup>, A. M. Musa<sup>4</sup>, Q. E. Harmon<sup>1</sup>, S. J. London<sup>1</sup>;

<sup>1</sup>National Institute of Environmental Health Sciences, Durham, NC, <sup>2</sup>Department of Social Sciences, Kaduna Polytechnic, Kaduna, NIGERIA, <sup>3</sup>Department of Sociology, Kaduna State University, Kaduna, NIGERIA,

<sup>4</sup>CSR Hub Limited, Dhaka, BANGLADESH.

**Abstract** Objective To determine the association of prenatal intimate partner violence (IPV) with birth weight. Methods A cross-sectional study of 320 mother-child pairs recruited shortly after birth at Barau Dikko Teaching Hospital, Kaduna, Nigeria. Emotional, physical, and sexual violence were measured after delivery using the Conflict Tactics Scale. The main outcome measure was birthweight in grams. Linear regression was used to estimate the adjusted associations ( $\beta$  and 95% confidence interval (CI)) between birthweight and 1) exposure to intimate partner violence (relative to no exposure), 2) frequency of prenatal IPV exposure. Results Sixty-nine percent of mothers experienced at least one of the three forms of IPV during pregnancy. Among term births, relative to the 31% of women with no IPV exposure, prenatal exposure to emotional violence was associated with a reduction in birthweight of 99g (95% CI -206,7), 182g (95% CI -285,-80) for physical violence and 139g (95% CI -247,-31) for sexual violence. The combination of all three forms of violence was associated with a 237g reduction in birthweight (95% CI -378,-96). Increasing instances of each of the three types of violence were associated with a greater reduction in birthweight. For physical violence, birthweight was lower by 121g (95% CI -227,-15) with 1-5 instances and 406g (95%CI -570, -240) for >5 instances over the pregnancy, relative to no exposure to IPV. Conclusions Among term newborns, maternal exposure to any form of intimate prenatal violence was associated with reduced birth weight. A dose-response relationship was observed between intimate partner violence and birthweight.

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**P-1116**

### **Bisphenol A exposure and reduced male sex hormone levels in a Norwegian population**

**Presenter:** Randi J Bertelsen, University of Bergen, Bergen, Norway

**Authors:** R. J. Bertelsen<sup>1</sup>, K. Triebner<sup>1</sup>, P. Dadvand<sup>2</sup>, S. S. Hustad<sup>1</sup>, T. Ringel-Kulka<sup>3</sup>, C. Svanes<sup>1</sup>, H. K. Vindenes<sup>1</sup>, F. G. Real<sup>1</sup>;

<sup>1</sup>University of Bergen, Bergen, NORWAY, <sup>2</sup>ISGlobal, Barcelona, SPAIN, <sup>3</sup>University of North Carolina, Chapel Hill, NC.

Background: Bisphenol A (BPA) is used in production of polycarbonate plastics and epoxy resins. Despite endocrine disrupting properties and suspected impact on male reproductive health BPA is still frequently used in a wide variety of consumer products. Few studies have addressed BPA exposure and steroid hormones in a general population sample. We aimed to investigate whether BPA exposure is associated with steroid hormone concentrations (17 $\beta$ -estradiol, estrone, estrone 3-sulfate, progesterone, progesterone 17 $\alpha$ -OH-progesterone, testosterone, androstenedione, dehydroepiandrosterone sulfate (DHEAS), aldosterone, cortisone and cortisol) in a healthy Norwegian population. Methods: The study included 205 women and 232 men aged 18-48 years, participating in the RHINESSA study (2014-15) in Norway. Urine concentration of BPA and steroid hormones in serum were measured using liquid chromatography - mass spectrometry. We applied linear mixed effects random intercept models with sex hormone levels (one at a time) as outcome, BPA concentration as exposure and adjusted for age, sex, BMI, smoking and time of day for urine and blood sampling. Results: Bisphenol A was detected in 96% of the urine samples; and median concentration was 1.32 ng/mL (5<sup>th</sup>-95<sup>th</sup> percentile: 0.50-5.15, max: 21.9 ng/mL). Increasing exposure to BPA (per ng/mL) was associated with decreasing levels of testosterone (-11.72 pmol/cL, 95% Confidence Interval (CI): -22.93, -0.51) and DHEAS (-6.83 nmol/cL, 95% CI: -12.72, -0.94) for men and women combined. Restricting the analyses to men, increasing exposure to BPA was associated with decreasing levels of 17 $\beta$ -estradiol (-0.88 pmol/L, 95% CI: -1.72, -0.04) and with elevated endogenous aldosterone levels (4.32 pmol/L, 95% CI: 0.91, 7.73). Conclusions: The urinary biomarker concentration of BPA is ubiquitous, but relatively low. BPA was associated with an altered hormone profile, in particular with reduced levels of androgens as well as with 17 $\beta$ -estradiol which is synthesized from androgen precursors. Whether the association is of clinical relevance needs to be elucidated.

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**P-1117**

### **Association of Urinary THC Concentrations and Sperm Abnormalities in US Urban Men**

**Presenter:** Hilary McLeland-Wieser, George Washington University, Washington, United States

**Authors:** H. McLeland-Wieser<sup>1</sup>, H. Young<sup>1</sup>, L. Neumann<sup>1</sup>, J. Crites<sup>2</sup>, D. Moody<sup>2</sup>, M. Irwig<sup>3</sup>, D. Frankfurter<sup>3</sup>, M. Perry<sup>1</sup>;

<sup>1</sup>George Washington University, Washington, DC, <sup>2</sup>University of Utah, Salt Lake City, UT, <sup>3</sup>George Washington University Medical Faculty Associates, Washington, DC.

**Background:** The use of marijuana in the US has increased as more states have legalized sales. While smoking marijuana is associated with several negative outcomes, little is known about its effects on the male reproductive system. The endocannabinoid system, a target of  $\Delta^9$ -tetrahydrocannabinol (THC), is known to impact the male reproductive system. However, epidemiological information about the potential risks of THC on sperm are limited. Three human studies have found conflicting evidence of an influence on motility, morphology, and concentration. One study has found evidence of increased aneuploidy. **Aim:** We sought to determine the association between urinary THC concentrations and semen parameters and aneuploidy among urban men living in the United States. **Methods:** Semen and urine samples, from men recruited at an urban health center and in the community, were provided by participants on the same day. Semen were assessed for abnormal sperm concentration, motility, and morphology. Sperm sex chromosomes were identified using fluorescent in situ hybridization. Sex chromosome aneuploidy was determined using a semi-automated scoring method. Gas chromatography tandem mass spectrometry was used to determine COOH-THC (metabolite of THC) concentrations in urine samples. Multivariable logistic regression was used to model the association between COOH-THC concentrations and abnormal concentration, motility and morphology. Multivariable Poisson regression (SAS GENMOD procedure) was used to model the association between COOH-THC and sex chromosome disomy. **Results:** 179 samples were included in the analyses and 15% tested positive for COOH-THC. Mean age was 38.8 years and 55.7% of participants were white. The odds of abnormal semen concentration, morphology, and motility were not significantly associated with increasing concentrations of COOH-THC. A significant inverse association was seen between XX18 disomy and total disomy and increasing COOH-THC concentrations in adjusted models ( $p < 0.0001$ ). **Conclusion:** This study demonstrates a relationship between urinary THC concentrations and sex chromosome disomy in sperm.

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**P-1118**

### **Spatial Analysis of Teen Births to Identify High Risk Neighborhoods**

**Presenter:** Nicole V DeVille, Harvard T.H. Chan School of Public Health and Brigham and Women's Hospital, Boston, United States

**Authors:** N. V. DeVille<sup>1</sup>, J. I. Levy<sup>2</sup>, S. A. Korrick<sup>1</sup>, V. M. Vieira<sup>3</sup>;  
<sup>1</sup>Harvard T.H. Chan School of Public Health and Brigham and Women's Hospital, Boston, MA, <sup>2</sup>Boston University School of Public Health, Boston, MA, <sup>3</sup>University of California, Irvine, Irvine, CA.

**Background:** Although many studies have assessed geographic variation in teen births at national and state levels, few have examined teen births at a high spatial resolution to identify neighborhood-level clusters. The communities in and around New Bedford, Massachusetts (MA), are racially and socioeconomically diverse, with teen birth rates more than twice as high as the state average. Neighborhood environment (e.g., land use patterns, environmental exposure, crime) may influence behavior, including teen sexual activity. Our objectives were to investigate geographic variability in teen births (<20 years of age) in this region over two time periods, and to determine whether sociodemographic characteristics account for any observed geographic variability. **Methods:** Using MA birth records, we examined the association between teen birth status and maternal residence at time of birth in Acushnet, Dartmouth, Fairhaven, and New Bedford from 1992-1998 (n=12,178) and 2002-2008 (n=12,426). We used generalized additive models with a smooth of location to predict teen birth risk, adjusted for maternal race/ancestry, parity, prenatal care, substance use, marital status, parental education, household income, and insurance type. We used permutation tests to assess statistical significance. **Results:** Approximately 15.4% (n=1,874) and 11.7% (n=1,457) of infants were born to teen mothers between 1992-1998 and 2002-2008, respectively. In 1992-1998 analyses, a teen birth cluster was observed, although location was no longer a significant predictor of teen birth after adjustment for education and insurance type (p=0.469). However, a statistically significant area of elevated risk of teen birth remained during the 2002-2008 time period after covariate adjustment (p<0.001). **Conclusions:** Our spatial analyses indicate that available sociodemographic covariates did not appear to explain spatial patterns in teen birth risk during the 2002-2008 period (as they did in the 1992-1998 period), and that other geographically varying risk factors may be contributing to elevated risk of teen birth in this population.

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**P-1119**

### **Associations between quality of water and sanitation and access to maternal and child health services in South Asia**

**Presenter:** Ondine von Ehrenstein, Fielding School of Public Health, University of California Los Angeles, Los Angeles, United States

**Authors:** N. Omidakhsh, O. von Ehrenstein;  
Fielding School of Public Health, University of California Los Angeles, Los Angeles, CA.

**Background/Aim:** Globally unsafe drinking water/sanitation facilities affect women and children who also frequently lack access to appropriate health care. We examined potential associations between unsafe water and sanitation and access to maternal and child health services in South Asia. **Methods:** We utilized representative data from the Demographic and Health Surveys (DHS) for Bangladesh, India, Nepal and Pakistan. Using WHO recommendations for improved/unimproved water sources/sanitation facilities we examined associations with women's access to health-services including adequate antenatal visits, whether a skilled attendant was present at delivery and child's up-to-date immunizations. Logistic regressions were conducted adjusted for country- and individual-level covariates, and stratified by wealth index. **Results:** We included data from 145,262 women ages 15-49 who had a singleton birth with a living child 0-36 months of age. For women in the lower wealth index, access to improved water sources was associated with having a child with up-to-date immunizations (OR: 1.30; 95% CI: 1.20, 1.40) and with having a skilled attendant at delivery (OR: 1.28; 95% CI: 1.19; 1.39). Access to improved sanitation facilities was positively associated with child's up-to-date immunizations (OR: 1.26; 95% CI: 1.18, 1.34 and OR: 1.14; 95% CI: 1.07, 1.22) and adequate ANC visits (OR: 1.59; 95% CI: 1.48, 1.71 and OR: 1.11; 95% CI: 1.04, 1.18) among women in lower and higher wealth indexes, respectively. Among women in the lower wealth index without improved water sources, those without access to water on premises were less likely to have had a skilled attendant at birth. **Conclusion:** Our results indicate that improvements in access and quality of water and sanitation may have positive implications for access to maternal/child health services in South Asia. This may indicate that programs that integrate addressing water/sanitation and maternal/child health services may be beneficial and associations should be further explored.

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**P-1120**

**Urinary parabens and their mixture in relation to fecundability among a cohort of women with prior pregnancy loss**

**Presenter:** Anna Z Pollack, George Mason University, Fairfax, United States

**Authors:** A. Z. Pollack<sup>1</sup>, K. Kim<sup>2</sup>, C. J. Nobles<sup>2</sup>, S. L. Mumford<sup>2</sup>, L. A. Sjaarda<sup>2</sup>, N. J. Perkins<sup>2</sup>, P. Mendola<sup>2</sup>, R. Silver<sup>3</sup>, E. F. Schisterman<sup>2</sup>;

<sup>1</sup>George Mason University, Fairfax, VA, <sup>2</sup>Epidemiology Branch, Division of Intramural Population Health Research, Eunice Kennedy Shriver National Institute of Child Health and Human Development, Bethesda, MD, <sup>3</sup>Department of Obstetrics and Gynecology, School of Medicine, University of Utah, Salt Lake, UT.

**Background/Aim:** Parabens are antimicrobial preservatives with widespread exposure, and may affect endocrine function. Few studies have evaluated their influence on fecundability. Our aim was to determine the association between parabens and fecundability among a cohort of women with one or two prior pregnancy losses who were trying to conceive. **Methods:** The EAGeR trial followed women who were trying to conceive for up to 6 cycles. Six parabens (benzyl, butyl, ethyl, heptyl, methyl, propyl) and four paraben metabolites (OH-methyl, OH-ethyl, 4-hydroxybenzoic acid [4-HB] and 3,4-dihydroxybenzoic acid [3,4-DHB]) were measured as pools combining three consecutive days of spot urine samples, at baseline, from 1185 women. Urinary creatinine was measured on day 1 of the pool. Fecundability, defined as time to pregnancy, was measured as number of menstrual cycles to achieve hCG positive pregnancy. Fecundability odds ratios (FORs) were determined by discrete-time survival analysis to model the association between fecundability and each chemical, adjusting for age, race/ethnicity, body mass index, creatinine, nulliparity and smoking, and accounting for left truncation (time trying prior to study enrollment). Quantile g-computation was used to estimate the effect of increasing all parabens by one quantile, in relation to fecundability. **Results:** Parabens were weakly (ethyl:heptyl rho -0.04) to highly (propyl:methyl rho 0.82) correlated with each other. Results were largely null in single chemical models, for example, butyl paraben FOR=0.99, 95% CI 0.95-1.03, per 1-log unit increase. Propyl paraben was marginally associated with reduced fecundability (FOR=0.96, 95% CI 0.92-1.01) and heptyl paraben with increased fecundability (FOR=1.15, 95% CI 1.00-1.33). Together as a mixture, parabens were not associated with fecundability (FOR=0.91, 95% CI 0.77-1.08). **Conclusion:** In single chemical models and as a mixture, most parabens were not associated with fecundability. While this is reassuring, given the high exposure prevalence, future studies should consider mixtures across endocrine disrupting chemical classes.

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**P-1121**

### **Air Pollution, PFOA, and Preeclampsia in the C8 Studies**

**Presenter:** Ian Wesley Tang, University of California, Irvine, Irvine, United States

**Authors:** I. W. Tang, S. M. Bartell, V. M. Vieira;  
University of California, Irvine, Irvine, CA.

**Background/Aim:** Preeclampsia is a type of pregnancy-induced hypertension that also includes proteinuria. Traffic-related particulate air pollution has been linked to preeclampsia in some previous studies. The C8 Study of perfluorooctanoate (PFOA) and preeclampsia did not consider potential confounding by air pollution. We assessed the association between distance to road (DTR), a marker of traffic related air pollution, and preeclampsia in an area with elevated exposure to PFOA from drinking water contaminated by chemical plant releases. **Methods:** We calculated distance to nearest major road (class A1, A2, or A3) for 5,960 pregnancies occurring between 1990 and 2006 in twelve Ohio and West Virginia counties that were included in previous publications from the C8 Studies. Generalized additive models (GAM) included smoothing for maternal location at birth to assess spatial patterns of preeclampsia risk. We adjusted for estimated annual serum PFOA exposure, exposure year, maternal age at time of pregnancy, parity, education, and smoking status. We then assessed the contribution of DTR to preeclampsia risk with a spatial GAM and a logistic regression without location. **Results:** For our adjusted model with PFOA exposure, the odds ratio (OR) for preeclampsia was 1.01 (95% confidence interval (CI): 0.92, 1.12) per interquartile shift in log-transformed DTR in meters. The ORs for preeclampsia analyses with and without adjustment for DTR were both 1.11 (95% CI: 0.99, 1.25) per interquartile shift in log-transformed PFOA. Residual spatial patterns in preeclampsia risk were present after PFOA adjustment and did not change with inclusion of DTR. **Conclusion:** No associations between DTR and preeclampsia were observed in this large, population-based study with elevated PFOA exposure. We did not find any evidence to suggest DTR confounded the relationship observed with estimated serum PFOA levels. Residual spatial patterns of preeclampsia may be due to other unmeasured confounders or limited adjustment for socioeconomic status.

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**P-1122**

### **Associations of PM<sub>2.5</sub> Exposure with Blood Pressure among Pregnant Women in Rural India: Evidence from the HAPIN Trial**

**Presenter:** Wenlu Ye, Gangarosa Department of Environmental Health, Rollins School of Public Health, Emory University, Atlanta, United States

**Authors:** W. Ye<sup>1</sup>, K. Balakrishnan<sup>2</sup>, G. Thangavel<sup>2</sup>, A. Pillarisetti<sup>1</sup>, L. M. Thompson<sup>3</sup>, K. Steenland<sup>1</sup>, T. Clasen<sup>1</sup>;

<sup>1</sup>Gangarosa Department of Environmental Health, Rollins School of Public Health, Emory University, Atlanta, GA, <sup>2</sup>Department of Environmental Health Engineering, Sri Ramachandra Institute of Higher Education and Research, Chennai, INDIA, <sup>3</sup>Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, GA.

**Background:** The Household Air Pollution Intervention Network (HAPIN) is an ongoing multi-center randomized controlled trial aimed at assessing the impact of a liquified petroleum gas (LPG) cooking stove and fuel intervention on health. Given the potential impacts of household air pollution (HAP) exposure from solid fuel burning on cardiovascular outcomes on pregnancy, we sought to determine whether exposure to PM<sub>2.5</sub> (as an indicator pollutant of HAP) was associated with gestational blood pressure (GBP) among 800 adult women in India, one of the HAPIN trial centers. **Methods:** Mixed-effects models were used to examine the association between PM<sub>2.5</sub> exposure and BP, determined by repeated 24-hour personal exposure and GBP monitoring at baseline (< 20 gestational weeks [GW]), second (24-28 GW) and third (32-36 GW) follow-up visits. Preliminary data from 799 mothers were included in regression analysis. Among these, 220 completed two measurements and 527 completed three measurements. **Results:** We found a significant positive association between nephelometric PM<sub>2.5</sub> exposure and systolic blood pressure (SBP): on average, each IQR  $\mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub> exposure was associated with 0.05 mmHg higher SBP [0.002, 0.1]. A non-significant positive relationship was observed for diastolic blood pressure (DBP). Additionally, we observed a significant difference in SBP and DBP between the two study sites - Villupuram and Nagapattinam. **Conclusion:** This study added new evidence regarding the relationship between HAP exposure and BP among Indian women during pregnancy, a critical window for both mother and child's life-course health. Preliminary results of this longitudinal study suggest that HAP from solid fuel burning is associated with higher blood pressure, particularly SBP, in pregnant women over the second and third trimester, controlling for maternal age, BMI, and gestational age.

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**P-1123**

**Ambient ozone exposure during preconception and gestation periods and birth weight: when is the critical window?**

**Presenter:** Zhongzheng Niu, State University of New York at Buffalo, BUFFALO, United States

**Authors:** Z. Niu<sup>1</sup>, J. Zhang<sup>2</sup>, L. Chu<sup>3</sup>, M. Wang<sup>1</sup>, Y. Guo<sup>4</sup>, L. Qiao<sup>2</sup>, Z. Farhat<sup>1</sup>, A. Grippo<sup>1</sup>, J. Xu<sup>5</sup>, L. Mu<sup>1</sup>;  
<sup>1</sup>State University of New York at Buffalo, BUFFALO, NY, <sup>2</sup>Research Center for Public Health, Tsinghua University, Beijing, CHINA, <sup>3</sup>Beijing Anzhen Hospital, Beijing, CHINA, <sup>4</sup>Aerospace Center Hospital, Beijing, CHINA, <sup>5</sup>State Key Laboratory of Environmental Criteria and Risk Assessment, Chinese Research Academy of Environmental Sciences, Beijing, CHINA.

**Background:** Prenatal exposure to ozone has been associated with lower birth weight. Yet few studies have included the preconception period. Moreover, the critical window of prenatal ozone exposure remains unclear. We aim to examine the association of ambient ozone exposure during preconception and gestation periods with birth weight, and to identify critical exposure windows.

**Methods:** The study included 102 pregnant women at admission for delivery in Anzhen Hospital from July to December 2017 in Beijing, China. We collected information on participants' demographics, health habits, residential address, and living environment. If participants worked before and/or during pregnancy, work addresses and duration at work on typical workdays were asked. Bi-weekly average ambient ozone levels were estimated for home and work addresses using a validated land use regression model. We weighted the time (hours) at home and work to estimate participants' ozone exposure levels from 3 months before conception to the end of pregnancy. Birth weight, gestational age, sex, and maternal prenatal care history were extracted from medical records. We used distributed lag non-linear models to examine the association of monthly average ozone exposure with sex- and gestational age-adjusted birth weight z score and to identify critical exposure windows.

**Results:** After adjusting for maternal age, pre-pregnancy body mass index, ethnicity, family income, and season of birth, two critical windows were identified: Birth weight z score was 0.18 (95% confidence interval [CI]: -0.35, -0.01) lower with each 10 ug/m<sup>3</sup> increases of ozone exposure during 2 months before conception, and 0.12 (95% CI: -0.23, -0.01) lower with exposures during the 5th month of pregnancy. No statistically significant association was observed during other months in the preconception and gestation periods.

**Conclusions:** High levels of ambient ozone exposures during two months before conception and around 5<sup>th</sup> months of gestation may be associated with lower birth weight.

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**P-1124**

**Incidence of low birth weight and proximity to mining in Lubumbashi and Kipushi, DR Congo**

**Presenter:** Tony Kayembe-Kitenge, University of Lubumbashi, Lubumbashi, Congo, Democratic Republic of the

**Authors:** T. Kayembe-Kitenge<sup>1</sup>, P. Musa Obadia<sup>1</sup>, T. Muta Musambo<sup>1</sup>, D. Mfuana Inabanza<sup>1</sup>, V. Manyong<sup>1</sup>, W. Ngandu<sup>2</sup>, C. Banza Lubaba Nkulu<sup>1</sup>, T. S. Nawrot<sup>3</sup>, B. Nemery<sup>3</sup>;

<sup>1</sup>University of Lubumbashi, Lubumbashi, CONGO, DEMOCRATIC REPUBLIC OF THE, <sup>2</sup>Programme National de la Santé de la Reproduction du Haut-Katanga, Lubumbashi, CONGO, DEMOCRATIC REPUBLIC OF THE, <sup>3</sup>KU Leuven, Leuven, BELGIUM.

**Background.** Previous studies have shown high exposure to trace metals in people living close to mining/smelters in Katanga. We determined the incidence of low birth weights (LBW) in Lubumbashi and Kipushi, cities that host zones with different degrees of environmental pollution caused by copper and cobalt mining and smelting.

**Methods.** We used routinely collected birth data in 8 out of 12 existing health zones during one year (1 July 2018 to 30 June 2019). We compared the proportions of neonates with LBW according to the presence of mining/smelting in the health zones. We also looked in more detail into the data of 9 selected maternities where we only considered first-born neonates.

**Results.** Of 202,028 births in Lubumbashi during the observation period, 145,512 (72%) were recorded in the studied health zones, of which 11,448 were LBW neonates (excluding premature births), i.e. 7.87/100 births. The incidence of LBW was 1.80 times higher ( $p<0.001$ ) for the 3 health zones with mining (6,190/57,597 births; 10.75/100) than for the 5 health zones without mining (5,258/87,915 births; 5.98/100). In the 9 selected maternities, LBWs were recorded in 589/7,203 first-born neonates (8.18/100). The incidence was 2.75 times more frequent ( $p<0.001$ ) for the 2 maternities very close (i.e. within sight) to mining (235/1,400 births; 16.78/100) than for the 7 maternities far from mining (354/5,803; 6.10/100).

**Conclusions.** Based on the previous findings of high exposure to trace metals in people living close to mining, it is plausible that mining-related metal pollution plays a role in the spatial association observed in Lubumbashi between proximity to mining and the incidence of low birth weights.

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**P-1125**

**Insight into a first trimester human placental mechanism of fetal endocrine disruption**

**Presenter:** Megan Smith, University of Pittsburgh, Pittsburgh, United States

**Authors:** M. Smith<sup>1</sup>, N. Snyder<sup>2</sup>, R. Birru<sup>3</sup>, J. J. Adibi<sup>3</sup>;

<sup>1</sup>University of Pittsburgh, Pittsburgh, PA, <sup>2</sup>Drexel University, Philadelphia, PA, <sup>3</sup>University of Pittsburgh Graduate School of Public Health, Pittsburgh, PA.

Human chorionic gonadotropin (hCG) is a placental hormone produced during pregnancy which regulates in part the development of fetal reproductive tract. hCG is thought to mediate effects of prenatal phthalates on the fetus. We have shown previously that phthalate-hCG and hCG-neonatal genitalia associations are both sex-specific. The aim was to directly measure, within the relevant critical window in the first trimester, modification of hCG regulation by fetal sex and by phthalate levels. Placental tissue samples (N=96, 45% male) were donated by women undergoing elective pregnancy termination at 2 clinics between gestational weeks 7 - 14. Tissues were dissected, snap frozen and stored at -80 C. mRNAs were measured by qPCR: PPARG, CGA, CGB and 2 housekeeping genes, RN18S and UBP1. PPARG encodes a transcription factor that regulates expression of hCG (encoded by CGA and CGB). Quantitation was done by relative standard curve. Sex was determined by measuring 2 Y-linked genes by PCR. All data were normalized, transformed, and analyzed using linear regression. Placental phthalate levels in the same sample set are being analyzed currently. There was no difference in the means of mRNAs between male and female fetuses. We measured a strong interaction of PPARG and fetal sex in the correlation of PPARG and CGA/CGB (p-interaction<0.005). In male placentas, one log<sub>10</sub> unit in PPARG was associated with a 2.53 (95% CI 1.80, 3.26) log<sub>10</sub> increase in CGA and CGB levels. In female placentas, the same association was null ( $\beta$ = 0.37 log<sub>10</sub> units, 95% CI -0.32, 1.05). Associations with placental phthalate levels are forthcoming. These data offer novel insight into the basis for commonly reported sex-specific associations between prenatal phthalates and child health outcomes. hCG offers promise as a molecular biomarker that can conceptually and quantitatively connect sex-specific effects of prenatal exposures on placental mechanisms, and on fetal outcomes.

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**P-1126**

**Using simulation methods to assess the suitability of the case crossover design in environmental epidemiological studies of preterm birth**

**Presenter:** Daniel Carrión, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** D. Carrión, E. Colicino, A. C. Just;  
Icahn School of Medicine at Mount Sinai, New York, NY.

**Background:** Case crossover (CCO) studies are widely used in environmental epidemiology. CCO studies are case-only within-person comparisons, and therefore not confounded by time invariant characteristics. Proper inference, then, with CCO studies relies on appropriate selection of control time periods, and the time-stratified design serves as a robust method to account for long- and short-term-time trends. However, CCO studies assume stable baseline outcome risks. Since the baseline risk of birth increases secularly over gestation, the CCO should be evaluated for preterm birth. Our study utilizes simulations of extreme ambient temperature exposures to assess the appropriateness of CCO for preterm birth.

**Methods:** We conducted simulations using 2018 data for New York State. Data were acquired from National Weather Service records for LaGuardia Airport (temperature) and the Centers for Disease Control's epidemiologic database (birth data). Baseline birth rates per gestational age served as the basis for baseline risk ( $\beta_0$ ). Baseline risks were then combined with exposure data and simulated effects to create expected counts per day. Relative risks ranged from 0.9 to 1.25 per 10°F increase. We used bootstrapped Poisson random number generation to create 1000 datasets per simulated effect. Counts were disaggregated into individual records for CCO analyses, and estimated via conditional logistic regressions with 2-week and month stratified control period selection.

**Results:** Preliminary results demonstrate upward bias in point estimates of all models. Bias was markedly smaller for 2-week stratified (ranging between 0.18-0.29%) compared to month-stratified (1.18-1.55%) models. Coverage of 95% confidence intervals was higher for 2-week stratified results; between 92.5% and 95.4% of all intervals included the simulated effect. Coverage ranged between 4.9% and 82.6% for month-stratified results.

**Conclusions:** Future analyses will include pooled logistic regression of simulated cohorts and age-varying differences in baseline risk. Characterizing the performance of the CCO under various conditions can improve methodological rigor and innovation.

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**P-1127**

**Placental malaria, air pollution, and birth outcomes in a cohort of infants in Ghana**

**Presenter:** Ashlinn K Quinn, Fogarty International Center, National Institutes of Health, Bethesda, United States

**Authors:** A. K. Quinn<sup>1</sup>, K. Asante<sup>2</sup>, B. J. Wylie<sup>3</sup>, S. Gyasse<sup>2</sup>, A. G. Lee<sup>4</sup>, F. B. Opong<sup>2</sup>, S. N. Chillrud<sup>5</sup>, K. A. Ae-Ngibise<sup>2</sup>, D. Carrión<sup>4</sup>, E. A. Boamah<sup>2</sup>, C. F. Gould<sup>6</sup>, M. Twumasi<sup>2</sup>, D. W. Jack<sup>6</sup>, O. Agyei<sup>2</sup>, P. L. Kinney<sup>7</sup>, S. Owusu-Agyei<sup>2</sup>, -. on behalf of GRAPHS investigators<sup>2</sup>;

<sup>1</sup>Fogarty International Center, National Institutes of Health, Bethesda, MD, <sup>2</sup>Kintampo Health Research Centre, Kintampo, GHANA, <sup>3</sup>Beth Israel Deaconess Medical Center, Boston, MA, <sup>4</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>5</sup>Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY, <sup>6</sup>Mailman School of Public Health, Columbia University, New York, NY, <sup>7</sup>Boston University School of Public Health, Boston, MA.

**Background:** Household air pollution (HAP) exposure and malarial infection during pregnancy have both been associated with adverse birth outcomes. Previous studies on the impact of HAP on birth outcomes have not assessed the potential modifying effect of placental malaria (PMal). **Methods:** Placental tissue from mothers enrolled in the Ghana Randomized Air Pollution and Health Study (GRAPHS) was tested for evidence of malarial infection using histopathology. Associations between carbon monoxide (CO) exposure during pregnancy and birth outcomes were assessed using multivariable regression models with statistical interaction terms to assess effect modification by PMal. **Results:** 286 of 1170 placental samples (23.2%) showed evidence of PMal. CO was not independently associated with PMal (OR 0.94 [95% CI: 0.81, 1.11]) but PMal was associated with reduced birth weight (-175.0g [95% CI: -235.4, -114.6]), birth length (-0.7cm [-1.2, -0.2]), head circumference (-0.6cm [-0.9, -0.2]), and gestational age (-3.2 days [-4.9, -1.5]) in unadjusted analyses. An interaction (p-value 0.03) was observed between CO and PMal on birth weight. In the malaria-negative group, a 1ppm increase in prenatal CO was associated with -62.7g lower infant weight at birth [95% CI: -95.8, -29.6] adjusting for infant sex and maternal characteristics. No significant association was seen among mothers testing positive for PMal (1ppm increase in CO associated with 10.7g [95% CI -48.5, 70.0] difference in birth weight). Similar but non-significant interactions by PMal were observed for birth length, head circumference, and gestational age. **Conclusions:** PMal is a known risk factor for reduced infant size at birth, and demonstrated in our cohort. The negative impact of malaria during pregnancy may overwhelm the effect of HAP on birth weight and other infant anthropometrics at birth. In settings where malaria is endemic, associations between air pollution and birth outcomes may be masked or attenuated if the effect of malaria is not assessed.

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**P-1128**

**Installation of desulfurization equipment at coal-fired power plants in North Carolina and associations with preterm birth among surrounding residents**

**Presenter:** Adrien A Wilkie, UNC-CH, Chapel Hill, United States

**Authors:** A. A. Wilkie, C. G. Woods, M. L. Serre, T. J. Luben, D. B. Richardson, J. L. Daniels; UNC-CH, Chapel Hill, NC.

**Background:** Coal-fired power plants (CFPPs) are major contributors of air pollution globally. In 2002, North Carolina (NC) adopted regulation that required CFPPs to substantially reduce their sulfur dioxide (SO<sub>2</sub>) emissions by 2013. CFPPs complying with this regulation have resulted in measurable decreases of ambient SO<sub>2</sub> across NC. Air pollution research suggests an association between ambient SO<sub>2</sub> and preterm birth (PTB, gestational age < 37 completed weeks). PTB is an important risk factor for neonatal mortality and associated with high healthcare costs. This study aims to evaluate the impact of SO<sub>2</sub> emissions reduction strategies at CFPPs on preterm birth in North Carolina.

**Methods:** The US Environmental Protection Agency's Air Markets Program data were used to determine when the SO<sub>2</sub> emissions reduction strategies were implemented at NC's largest CFPPs (capacity > 150 megawatts). The study population was derived from geocoded NC resident singleton live birth data from 2003-2015 obtained from the NC State Center for Health Statistics. A difference-in-difference analysis using a linear mixed model with random intercepts for the CFPPs will be employed to compare the risk of PTB for mothers living 0-5 miles and 5-10 miles from the CFPPs before and after the intervention, with a control of mothers living 10-15 miles from the CFPPs.

**Results:** During the study period, 7 CFPPs installed desulfurization equipment (i.e. SO<sub>2</sub> scrubbers). The median concentration for reported monthly SO<sub>2</sub> air emissions from the CFPPs in the pre-period and post-period were 4,421 tons and 281 tons, respectively. With the spatial and temporal exposure restrictions applied, there were 42,076 births within 15 miles of the CFPPs.

**Conclusions:** This study comes at a time when the United States government is considering whether to move away from or reinvest in coal for electricity generation.

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**P-1131**

**Understanding the characteristics of a population of working women recruited for participation in a prenatal cohort study and the impact on recruitment strategies: Observations from the SEMILLA Project in Ecuador**

**Presenter:** Stephanie M Montenegro, CTT-USFQ, Quito, Ecuador

**Authors:** S. M. Montenegro<sup>1</sup>, A. J. Handal<sup>2</sup>, F. A. Orozco<sup>3</sup>;

<sup>1</sup>CTT-USFQ, Quito, ECUADOR, <sup>2</sup>University of Michigan, Ann Arbor, MI, MI, <sup>3</sup>Universidad San Francisco de Quito, Quito, ECUADOR.

**BACKGROUND**In the implementation of a community based cohort study, the characteristics of the population can influence recruitment efforts. Understanding these characteristics helps to identify more effective recruitment strategies. We describe some aspects based on our experience during the implementation of the SEMILLA Project.

**OBSERVATIONS**During the initial recruitment efforts of pregnant working women, for 5 months, we have observed the following characteristics, which influence the interest and availability of women to participate in the study:

- 1) Frequency of antenatal visits: Women's perception of participating in a study may be influenced by the frequency of monthly prenatal visits. A woman attends up to four prenatal visits in the same month with different health care providers, belonging to two different government institutions. In addition, women who have had failed pregnancies or abortions seek additional attention with other health care providers, so the number of visits may increase between 8 and 25.
- 2) Work hours: The availability of time to participate in the study is limited for many of these women, especially given their responsibilities at work and home. The range of weekly work hours observed for the women recruited so far is between 20 to 105 hours per week.
- 3) Low decision-making power: Many of the women contacted during recruitment state they must ask for authorization from their partners to participate. In Ecuador, 60% of women have been victims of interpersonal violence (IPV).

**CONCLUSION**The participation of pregnant working women in a community-based cohort study can be influenced by various aspects. A recruitment approach that considers the social, economic, and structural characteristics of a population could help to identify more effective recruitment strategies in these types of studies and similar populations.

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**P-1132**

**A method for comprehensively characterizing chemical exposures of pregnant women in San Francisco using non-targeted analysis**

**Presenter:** Dimitri Abrahamsson, University of California, San Francisco, San Francisco, United States

**Authors:** D. Abrahamsson<sup>1</sup>, A. Wang<sup>1</sup>, T. Jiang<sup>2</sup>, M. Wang<sup>2</sup>, R. Morello-Frosch<sup>3</sup>, J. Park<sup>2</sup>, M. Sirota<sup>1</sup>, T. Woodruff<sup>1</sup>;

<sup>1</sup>University of California, San Francisco, San Francisco, CA, <sup>2</sup>Department of Toxic Substances California, Berkeley, CA, <sup>3</sup>University of California, Berkeley, Berkeley, CA.

Prenatal exposures to environmental chemicals have been associated with preterm birth and low birth weight. However, limited biomonitoring data exist on the majority of the chemicals that are in commerce and are actively used in the United States. Our aim was twofold: i) to characterize exposure profiles of a diverse group of pregnant women to a broad spectrum of chemicals and identify compounds that are currently not biomonitored; ii) to identify chemicals that showed significant correlations with clinical features such as gestational age, birth weight and levels of human metabolites in serum. We analyzed 300 maternal and 300 matched cord serum samples with liquid-chromatography quadrupole time-of-flight mass spectrometry (LC-QTOF/MS) in both positive and negative electrospray ionization modes (ESI+ and ESI-). The data was processed through a non-targeted analysis workflow, which included feature extraction, formula assignment, database screening, feature annotation and finally structure elucidation. Furthermore, for selected features, MS/MS fragmentation was used to confirm structures of certain assigned chemicals. For the statistical analyses, we used the peak areas of the detected features after correcting for batch effect. For the correlations we used the Pearson's r and p-value and we corrected for multiple hypothesis testing using the Benjamini-Hochberg method. After data cleaning and manual curation, we tentatively identified 731 chemical features (mass and retention time) in ESI+ and 824 chemical features in ESI-, for which we were able to assign molecular formulas to. Among them, 22 (3 after multiple hypothesis correction) chemicals showed significant negative correlations with gestational age and 249 (192 after multiple hypothesis correction) chemicals showed positive correlations between measured levels (peak areas) and levels of chenodeoxycholic acid (bile acid) in blood, which has been previously associated with preterm birth and cholestasis. Non-targeted analysis of serum samples elucidates novel chemical exposures and response biomarkers in pregnant women and their newborns.

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**P-1133**

**Arsenic and Atrazine in Drinking Water and the Risk of Gestational Diabetes**

**Presenter:** Zachary V. Bacon, University of Illinois at Chicago, Chicago, United States

**Authors:** Z. V. Bacon, M. Turyk, K. Almborg;  
University of Illinois at Chicago, Chicago, IL.

**Arsenic and atrazine in drinking water and the risk of gestational diabetes** Background There is limited evidence that arsenic and atrazine are associated with an increased risk of gestational diabetes. The objective of this study is to assess the potential association between exposure to arsenic and atrazine in drinking water and the risk of gestational diabetes. Methods Gestational diabetes was ascertained from birth certificate data from the Ohio Department of Health for 428,804 mothers delivering between 2006 – 2008 in the state of Ohio. Exposure data in this study were obtained at the county level from the Safe Drinking Water Information System (SDWIS) and at the community level from the Atrazine Monitoring Program (AMP). Logistic regression models were used to assess the association between both environmental chemicals and gestational diabetes while controlling for year, maternal race/ethnicity, maternal age, maternal education, cigarette use during pregnancy, pre-pregnancy BMI, and socio-economic indicators. Sensitivity analyses were performed to control for gestational hypertension and eclampsia, and by restricting to counties where less than 20% and less than 10% of residents rely on private well water. Results There was no evidence for an association between a one-unit increase in average annual arsenic concentrations ( $\mu\text{g/L}$ ) and the risk of gestational diabetes in fully-adjusted models [Odds Ratio= 0.97, 95%CI=0.96 – 0.98]. The sensitivity analyses yielded similar results to the full models. There was some evidence of an association between average gestational atrazine exposure and the risk of gestational diabetes in fully adjusted models [Odds Ratio= 1.26, 95%CI=0.97 – 1.63]. Conclusions This study provides some evidence of an association between gestational diabetes and atrazine in drinking water. No association between arsenic in drinking water and gestational diabetes was observed. Further research is needed on the role that these and other chemicals may play in gestational diabetes.

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**P-1134**

**Investigating the acute effects of fine particulate matter on stillbirth risk in Ulaanbaatar, Mongolia**

**Presenter:** Temuulen Enebish, University of Southern California, Los Angeles, United States

**Authors:** T. Enebish<sup>1</sup>, R. Habre<sup>1</sup>, C. V. Breton<sup>1</sup>, N. Tuvshindorj<sup>2</sup>, G. Tumor<sup>2</sup>, D. Warburton<sup>3</sup>, M. Franklin<sup>1</sup>;

<sup>1</sup>University of Southern California, Los Angeles, CA, <sup>2</sup>National Center for Maternal and Child Health, Ulaanbaatar, MONGOLIA, <sup>3</sup>Children's Hospital Los Angeles, Los Angeles, CA.

Investigating the acute effects of fine particulate matter on stillbirth risk in Ulaanbaatar, Mongolia  
Temuulen Enebish, Rima Habre, Carrie V. Breton, Nomindelger Tuvshindorj, Gantuya Tumor, David Warburton, Meredith Franklin  
Background: Ulaanbaatar city (UB), the capital and the home to half of Mongolia's total population, has experienced extreme seasonal air pollution in the past two decades with fine particulate matter (PM<sub>2.5</sub>) levels reaching 500 µg/m<sup>3</sup>. We investigated whether short-term increase in daily PM<sub>2.5</sub> shortly before delivery results in stillbirth in UB between 2010 and 2018.  
Methods: We collected individual level data on 1570 stillbirths from hospital records (2010-2013) and surveillance database (2014-2018). Ambient air pollution exposure was estimated at residential area of each case using a Random Forest model. We utilized time-stratified case-crossover design to estimate the relative odds of stillbirth per interquartile range (IQR) increase in PM<sub>2.5</sub> for different exposure windows of individual and cumulative lags of 2-6 days before delivery. Effect estimates were derived from a conditional logistic regression model and individual level characteristics were analyzed for effect modification.  
Results: We observed significantly elevated relative odds of stillbirth per IQR increase in PM<sub>2.5</sub> 3 days (odds ratio [OR]=1.50, 95% confidence interval [CI]=1.06-2.12) and 6 days (OR=1.41, 95% CI=1.00-1.99) before delivery after adjusting for temperature (spline) and PM<sub>10</sub>. These estimates increased (lag day 3: OR=1.93, 95% CI=1.25-2.98, lag day 6: OR=1.73, 95% CI=1.11-2.68) after restricting the analysis to cold season (Oct-Mar). We saw elevated yet not significant effect estimates for cumulative lag day averages of 2-3 and 2-6 days. When only looking at stillbirths in cold season, relative odds of stillbirth for all lag day averages increased with odds ratio for 2-3 lag day averages reaching 2.03 (95% CI=1.20-3.44).  
Conclusion: Acute exposure to PM<sub>2.5</sub> before delivery may trigger stillbirth.

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**P-1136**

**Maternal proximity to petrochemical industrial parks and risk of premature rupture of membranes**

**Presenter:** Ching-chun Huang, National Taiwan University, Taipei, Taiwan

**Authors:** C. Huang<sup>1</sup>, S. Pan<sup>2</sup>, W. Chin<sup>3</sup>, Y. Chen<sup>2</sup>, Y. L. Guo<sup>1</sup>;

<sup>1</sup>National Taiwan University, Taipei, TAIWAN, <sup>2</sup>National Health Research Institutes, Miaoli, TAIWAN, <sup>3</sup>Taipei Medical University, Taipei, TAIWAN.

**Background:** Living near petrochemical industries has been reported to increase the risks of adverse birth outcomes, such as low birth weight and preterm delivery. However, evidence regarding the effect of petrochemical exposure on pregnancy complications remains limited. The study aims to evaluate the association between maternal proximity to petrochemical industrial parks (PIPs) during pregnancy and the occurrence of premature rupture of membranes (PROM).  
**Method:** We conducted a population-based 1:3 case-control study using the 2004-14 Taiwanese Birth Certificate database. Birth records reported as stillbirth or bearing congenital anomalies were excluded. Cases were newborns reported to have PROM, while controls were randomly sampled from those without any pregnancy complications by matching birth year and urbanization index of the residential township. The proximity to PIPs was evaluated by calculating distance to the nearest PIP of the maternal residential township during pregnancy. Furthermore, petrochemical exposure opportunity, accounting for monthly prevailing wind direction, was also quantified during the whole gestational period. We applied conditional logistic regression models to evaluate the associations.  
**Results:** A total of 29371 PROM cases were reported during the study period, with a corresponding 88113 healthy controls sampled. The results revealed that living within 3-km from the PIPs during pregnancy would increase the risk of PROM (OR = 1.76, 95% CI: 1.66-1.87). Furthermore, compared to the lowest exposed group, those with high petrochemical exposure opportunity also had significantly increased risks for RPOM occurrence (OR = 1.69-1.75).  
**Conclusions:** The results of the present work provide evidence that living near PIPs during pregnancy could increase the risks of PROM, and further studies are warranted to confirm our findings.

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## ABSTRACT E-BOOK

Theme: **Reproductive**

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**P-1137**

**Urban PM<sub>2.5</sub> Induces Cellular Toxicity, Hormone Dysregulation, Oxidative Damage, Inflammation, and Mitochondrial Interference**

**Presenter:** Ebba Malmqvist, Lund University, Lund, Sweden

**Authors:** Å. Nääv, L. Erlandsson, C. Isaxon, E. Åsander Frostner, E. Johannes Ehinger, E. Elmer, M. Sporre, A. Kraiss, T. Lundh, B. Strandberg, S. Hansson, E. Malmqvist; Lund University, Lund, SWEDEN.

Epidemiological studies have found air pollution to be a driver of adverse pregnancy outcomes but biological mechanisms are not clear. A first trimester trophoblast cell line (HTR-8/SVneo) was exposed to various concentrations of PM<sub>2.5</sub> in order to elucidate the effect of urban particulate matter (PM) of size <2.5 µm on placental function. PM<sub>2.5</sub> were collected at a site representative of urban traffic and dispersed in cell media by indirect and direct sonication. The HTR-8 cells were grown under standard conditions. Cellular uptake was studied after 24 and 48 h of exposure by transmission electron microscopy (TEM). The secretion of human chorionic gonadotropin (hCG), progesterone, and Interleukin-6 (IL-6) was measured by ELISA. Changes in membrane integrity and H<sub>2</sub>O<sub>2</sub> production were analyzed using the CellTox<sup>TM</sup> Green Cytotoxicity and ROSGlo<sup>TM</sup> assays. Protease activity was evaluated by MitoTox<sup>TM</sup> assay. Mitochondrial function was assessed through high resolution respirometry in an Oroboros O2k-FluoRespirometer, and mitochondrial content was quantified by citrate synthase activity. Results: TEM analysis depicted PM<sub>2.5</sub> cellular uptake and localization of the PM<sub>2.5</sub> to the mitochondria after 24 h. The cells showed aggregated cytoskeleton and generalized necrotic appearance, such as chromatin condensation, organelle swelling and signs of lost membrane integrity. The mitochondria displayed vacuolization and disruption of cristae morphology. At 48 h exposure, a significant drop in hCG secretion and a significant increase in progesterone secretion and IL-6 production occurred. At 48 h exposure, a five-fold increase in protease activity and a significant alteration of H<sub>2</sub>O<sub>2</sub> production was observed. The HTR-8 cells exhibited evidence of increased cytotoxicity with increasing exposure time and dose of PM<sub>2.5</sub>. Conclusion: PM may contribute to the placental dysfunction associated with pregnancy outcomes, such as preeclampsia and intrauterine growth restriction, through their direct and indirect effects on trophoblast protein secretion, hormone regulation, inflammatory response, and mitochondrial interference.

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Theme: **Research to policy**

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**P-1138**

### **Translating Observational Research into Regulatory Science: The Role of U.S. EPA's Office of Pesticide Programs in Evaluating Epidemiologic Evidence**

**Presenter:** Aaron Niman, Environmental Protection Agency, Washington, United States

**Authors:** A. Niman, E. Jones, A. Aldridge;  
Environmental Protection Agency, Washington, DC.

The U.S. Environmental Protection Agency's Office of Pesticide Programs (OPP) is a licensing program that regulates pesticides in the U.S under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA). As part of this program, OPP has a regulatory mandate to evaluate a substantial body of health effect and exposure data in order to assess the effects of pesticides on human health. Through this evaluation, OPP plays a critical role in translating observational research into regulatory science and aims to ensure that pesticide risk assessments incorporate epidemiologic evidence on the potential adverse effects on people that may result from pesticide exposure through dietary, environmental, and occupational exposure pathways. The thematic poster will provide background on OPP's regulatory requirements and then describe the systematic review methodology used to evaluate epidemiologic evidence based on a scientifically robust and transparent approach. This description will emphasize key regulatory considerations and outline elements of OPP's 2016 framework for incorporating epidemiological data into risk assessments for pesticides. The 2016 framework may be of interest to a range of stakeholders in the scientific community and characterizes OPP's "fit-for-purpose" approach to systematic review. OPP uses this approach to define to the scope and complexity of reviews and integrate epidemiologic findings into OPP's overall risk assessment process.

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**P-1139**

**Health Data for New York City (HD4NYC): A collaborative research model to advance policy-relevant environmental health research**

**Presenter:** Perry Sheffield, Icahn SOM at Mt Sinai, New York, United States

**Authors:** P. Sheffield<sup>1</sup>, D. Brahmhatt<sup>2</sup>, S. Khan<sup>3</sup>, S. Bajwa<sup>2</sup>, S. Li<sup>4</sup>, J. Stingone<sup>5</sup>, S. Lovinsky-Desir<sup>6</sup>;  
<sup>1</sup>Icahn SOM at Mt Sinai, New York, NY, <sup>2</sup>NYC Department of Health and Mental Hygiene, New York, NY,  
<sup>3</sup>City University of New York Institute for State and Local Governance, New York, NY, <sup>4</sup>City University of New York, New York, NY, <sup>5</sup>Columbia University, New York, NY, <sup>6</sup>Columbia University Irving Medical Center, New York, NY.

In the spring of 2019, the New York City Department of Health and Mental Hygiene (NYC DOHMH) and the New York Academy of Medicine (NYAM), with Robert Wood Johnson Foundation funding, launched Health Data for NYC (HD4NYC), a multi-institutional research platform focused on improving health equity in NYC. HD4NYC utilizes a working group model to promote data sharing, advance actionable policy-relevant, equity-focused research, and connect a diverse group of early-career academic and Health Department researchers with senior mentorship. The partnership involves over 30 multidisciplinary faculty from nine NYC-area academic institutions. Under the Birth and Childhood Equity working group, the Environmental Health subgroup's initial project utilizes data from NYC KIDS 2017, a DOHMH-led cross-sectional health survey of over 7,500 households with children 0-13 years, to explore the association of socio-environmental and housing factors with child asthma prevalence and outcome disparities. Environmental factors within the NYC KIDS survey include both indoor and outdoor exposures, such as housing quality, prevalence of indoor pests, and perceptions of neighborhood traffic. To explore the influence of large-scale social determinants of health using an equity lens, survey data are merged with neighborhood-level data from the American Community Survey on education, race/ethnicity, income disparities, and gentrification and structural racism metrics. The analysis uses multiple machine learning methods (e.g. random forest) to rank the most salient exposures to inform public health intervention prioritization by neighborhood. All partners benefit from this unique partnership: academics gain facilitated access to robust, local health data; the health department gains access to additional expertise and person-power for innovative research using their data; and all partners receive support and mentorship to enhance productivity. Moreover, this collaboration helps achieve health department priorities for producing actionable policy-relevant research that promotes health equity and might serve as a model for future research endeavors nationally.

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## ABSTRACT E-BOOK

Theme: **Research to policy**

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**P-1140**

**A heat health warning system in Thailand including statistic associations and stakeholders consensus exercise**

**Presenter:** Chuleekorn - Tanathitikorn, Division of Occupational and Environmental Diseases, Bangkok, Thailand

**Authors:** C. -. Tanathitikorn<sup>1</sup>, R. McNally<sup>2</sup>, N. Rousseau<sup>2</sup>, A. Namdeo<sup>3</sup>;

<sup>1</sup>Division of Occupational and Environmental Diseases, Bangkok, THAILAND, <sup>2</sup>Institute of Health and Society, Newcastle, UNITED KINGDOM, <sup>3</sup>School of Engineering, Newcastle, UNITED KINGDOM.

**Background** The aims of this work were to explore the nature of HRIs in Thailand, examine any associations between heat index and heat-related hospitalisations within the general Thai population, and to develop a structure for a HHWS model in Thailand based on the results of statistical analyses and experts' opinion. **Method** This study used a mixed methods approach. In phase 1, a daily tally of HRI hospitalisations from the International Classification of Diseases 10 Revision (ICD10) database with diagnosis T67 (effects of heat and light) were obtained between January 2010 and December 2018. Daily temperature and humidity figures from the same period were obtained. The heat index was calculated. Time series and Poisson regression analysis were used to explore the relationship between HRIs and the heat index controlling for day of the week and holiday indicator, with lag times of 0–7 days. Relative Risk (RR) and 95% confidence intervals were calculated based on a Poisson model from each region of Thailand. Next, an e-Delphi exercise with 16 experts and a focus group with key stakeholders and policy makers were applied to select the suitable threshold level. **Results** Based on expert opinion, the pre-alert level is the level of the heat index below the 75th percentile. The higher level is the level of the heat index from the 75th percentile to the 90th percentile. Lastly, the highest level is the level of the heat index from the 90th percentile. All thresholds were applied depending on the relationship between HRIs and the heat index in each region of Thailand. **Conclusion** This study found the heat index had positive associations with HRI hospitalisations and vary in each region. Importantly, the results of this study support the view that Thailand should have be spoke HHWS which is different from those that has been operated elsewhere.

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Theme: **Research to policy**

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**P-1141**

### **Setting Occupational Health Research Priorities in Europe: the HERA Project**

**Presenter:** Michelle C Turner, Barcelona Institute for Global Health (ISGlobal), Barcelona, Spain

**Authors:** M. C. Turner<sup>1</sup>, N. Pearce<sup>2</sup>, I. S. Mehlum<sup>3</sup>, K. Straif<sup>1</sup>, R. Vermeulen<sup>4</sup>, R. Barouki<sup>5</sup>, M. Kogevinas<sup>1</sup>;  
<sup>1</sup>Barcelona Institute for Global Health (ISGlobal), Barcelona, SPAIN, <sup>2</sup>London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM, <sup>3</sup>National Institute of Occupational Health (STAMI), Oslo, NORWAY, <sup>4</sup>Utrecht University, Utrecht, NETHERLANDS, <sup>5</sup>INSERM, Paris, FRANCE.

Background: Occupation and employment is a major determinant of health. Despite profound changes in working life there has been little coordinated European health research on occupation. We present first results from the Health and Environment Research Agenda (HERA) project, to set priorities for an environment and health research agenda in the European Union for 2020-2030. Methods: We contacted hundreds of researchers in Europe through an online survey. We also identified major policy needs in the health and environment/occupation nexus by contacting national, regional and European stakeholders representing authorities, intergovernmental organisations, civil society and private sector through surveys and regional meetings. We applied a priori defined criteria to examine novelty, public health importance, importance to the environment, impact on policies, and potential for innovation within the sustainable development goals. Results: Main occupational research gaps identified include: (i) Climate change and worker health; (ii) Ageing workers; (iii) New technologies and chemicals; (iv) Working time; (v) Changing employment patterns and precarious employment; (vi) Mixed exposures and biomonitoring; (vii) Work-life-balance; and (viii) Neglected occupational diseases. In addition, priority actions related to occupation were identified such as commuting to work, tools and infrastructure such as the development of big data, biobanks, large population cohorts with occupational information and occupational cohorts, development of exposome type approaches, and approaches examining societal aspects on employment and productivity. Conclusions: We will discuss challenges in the identification of key areas on occupation and health research that will benefit from new scientific evidence and challenges in strategies to ensure the engagement of stakeholders. This large initiative in Europe has systematically evaluated priorities through the engagement of a wide spectrum of stakeholders across the continent. A longer consultation process will continue over the next 2 years to raise additional research gaps and calibrate recommendations.

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Theme: **Research to policy**

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**P-1142**

**Quantifying the health impacts of eliminating air pollution emissions in the City of Boston**

**Presenter:** Matthew Raifman, Boston University, Boston, United States

**Authors:** M. Raifman;  
Boston University, Boston, MA.

**Background.** Cities around the world are taking action to limit greenhouse gas emissions through ambitious climate targets and climate action plans. These strategies are likely to simultaneously improve local air quality, leading to public health and monetary co-benefits. We quantify and value the health impacts of eliminating emissions from the City of Boston, and in doing so, highlight the importance of considering health impacts alongside environmental impacts of local climate action.

**Methods.** We simulated at a 4km resolution how the elimination of anthropogenic emissions from the City of Boston would impact air quality within a 120km by 120km study domain. We then estimate how this change in air quality would impact a number of annual health outcomes and the associated monetary savings.

**Results.** We found that eliminating anthropogenic emissions from Boston would result in a decline in PM<sub>2.5</sub> concentration across the entire study region ranging from 8.5 ug/m<sup>3</sup> in Boston to less than 1 ug/m<sup>3</sup> elsewhere in the domain. In addition, we estimate that summer ozone would increase for the Greater Boston Area and areas west, and decrease elsewhere. The monetary impact of the change in air quality on health is estimated to be a \$2.4 billion per year savings across the full domain and \$1.7 billion within Suffolk County only, about 1.4% of the gross domestic product of the county. These monetary impacts are driven primarily by reduced incidence of mortality. We estimate that 288 deaths would be avoided per year across the study domain, about six deaths avoided, annually, per 100,000 people. Within Suffolk County, we estimate that 47 deaths would be avoided per 100,000 people, around 16% of all-cause premature mortality. We also find a net decrease in cardiovascular and respiratory illness. Across the study domain, these health benefits would be disproportionately conferred upon people of color.

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**P-1143**

**The evolving science of systematic review in environmental health decision making**

**Presenter:** Nicholas Chartres, University of California, San Francisco, San Francisco, United States

**Authors:** N. Chartres;  
University of California, San Francisco, San Francisco, CA.

Systematic review (SR) methods are increasingly being recommended and used to inform environmental health decisions. SR has the potential for long-term effects on public health, due to improved consistency of evidence review with lower bias. SR have been adapted from clinical medicine, where data is largely from randomized, controlled trials. Environmental health SRs often rely on data from human epidemiological studies to inform the relationship between exposures and adverse health outcomes. To bridge between SR in environmental health and the clinical sciences, authoritative bodies, U.S. agencies, and academic scientists developed and implemented validated, peer-reviewed SR methods including the Navigation Guide and the U.S. National Toxicology Program's OHAT Approach. In contrast, US EPA under the Toxic Substances Control Act is using a significantly different approach, with potential implications for regulation of hazardous chemicals and public health. While there has been an increase in SR use, there are divergent approaches to key elements of the SR process, in particular assessing the risk of bias in observational design studies and evaluation of the quality of the body of evidence. Areas of concern for risk of bias include use of quantitative scoring methods and exclusion of studies based on one 'critically deficient' domain. When evaluating the quality of a body of evidence and synthesizing evidence into normative guidance, approaches in environmental health have adopted elements of GRADE (Grading of Recommendations Assessment, Development and Evaluation). However, there is still discussion about accounting for observational human studies and how to assess magnitude of effect. This presentation will highlight the current challenges associated with evaluating human epidemiological evidence, compare current approaches being used by EPA to validated best practice methods, and discuss important future considerations to ensure that the most important and critical types of evidence to inform environmental health decision making are protected.

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Theme: **Research to policy**

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**P-1144**

### **GEOHealth Hub Colombia: achievements and challenges of an environmental and occupational health collaboration initiative**

**Presenter:** Laura Andrea Rodriguez-Villamizar, Universidad Industrial de Santander, Bucaramanga, Colombia

**Authors:** L. A. Rodriguez-Villamizar, A. J. Idrovo Velandia;  
Universidad Industrial de Santander, Bucaramanga, COLOMBIA.

The Global Environmental and Occupational (GEO) Health Hub Colombia is a collaboration initiative between academics and professionals from public and private institutions. The objective of this initiative is to promote high quality research, training, and discussion around fundamental topics of environmental and occupational health in the country, and to provide advice for the formulation of sound policies regarding high-priority environmental and occupational health threats. The GEOHealth Hub Colombia began in 2012 as a bi-national project between Colombia and the United States, funded under the GEOHealth program of the National Health Institute / Fogarty International Center. The project identified environmental and occupational health experts in the country, who contributed to identify research and training needs in this area. Since 2015 the GEOHealth Hub Colombia has been working to promote collaborative research between different regions of the country and internationally. One of the main achievements has been to scale up local problems to the national level and develop multicity research projects, including activities of Colombian peace process related with socioenvironmental topics. Recently, the GEO Health Hub Colombia was awarded the first and only environmental health research program funded by the Colombian Government. The program will be conducted with the collaboration of 10 local universities, regional and national health and environmental authorities, and academic institutions from Brazil, Canada, and Mexico. The main challenge of the research collaboration is the lack of a common platform for exchanging data, ideas, discussions, and to provide information to the different audiences: academics, policy makers, and community.

The GEOHealth Hub Colombia also has generated discussion spaces and position public documents related to environmental threats, such as the use of aerial spray of glyphosate to eliminate illicit crops in rural areas. In this regard, support of international societies is needed to face GEO threats in developing countries.

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**P-1145**

### **NCEH/ATSDR Microplastic Working Group: Identifying and Addressing Data Needs to Evaluate Human Exposures to Microplastics**

**Presenter:** Yulia Iossifova Carroll, CDC, Atlanta, United States

**Authors:** Y. I. Carroll<sup>1</sup>, G. Zarus<sup>2</sup>, C. Hunter<sup>1</sup>, C. Muianga<sup>2</sup>, G. Casillas<sup>1</sup>, M. Zarate-Bermudez<sup>1</sup>;  
<sup>1</sup>CDC, Atlanta, GA, <sup>2</sup>ATSDR, Atlanta, GA.

Microplastics are environmentally persistent pollutants characterized by their diverse composition and small size (<5mm). Microplastics can be manufactured like microbeads, tire crumb, polyester fibers from clothing and carpets, and result from fragmentation processes of plastics disposed in the environment. Microplastics pervade our environment and human exposure is certain. However, exposure-dose and possible health effects have not been established. Some microplastic fibers and particles are small enough to become internalized and transported within our bodies (e.g. respirable particles PM10 and 2.5; particles 0.02-0.05 µm in size can passively drain through lymphatics). However, most of the environmental samples collected have been characterized as larger particles that are unlikely to be absorbed. Other relevant considerations include the composition and physicochemical characteristics of plastics (shape, density, and surface chemistry), and the composition of additives and absorbed or adsorbed contaminants. The array of variables, and uncertainty as to which may be most relevant to health pose challenges for exposure assessment. The CDC National Center for Environmental Health (NCEH) and the Agency for Toxic Substances and Disease registry (ATSDR) developed a microplastics working group with a vision and objectives to: 1. Identify the scientific information and data that are lacking to define health risks; 2. Create constructive partnerships to broaden outreach; 3. Energize communities and institutions to develop initiatives to stop harmful microplastic exposures in our environment. In this poster, we will highlight activities that the NCEH/ATSDR working group has conducted to accomplish the objectives. We will also present an overview of what is known about the fate and transport of microplastics in the environment, and potential human exposures from drinking water, air, and food. Data gaps will be highlighted that may inform policy-relevant research roadmap to address the many uncertainties in this important area.

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**P-1146**

### **Assessing the impact of environmental and occupational cancer hazard assessments on policy decision-making: An analysis of US Federal and state regulations**

**Presenter:** Suril S Mehta, Office of the Report on Carcinogens, Division of the National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, United States

**Authors:** S. S. Mehta<sup>1</sup>, K. Osborn<sup>2</sup>, K. Shannon<sup>2</sup>, M. Kung<sup>2</sup>, C. R. Lemeris (formerly Skuce)<sup>2</sup>, S. Hearn<sup>2</sup>, M. Conti<sup>2</sup>, R. M. Lunn<sup>1</sup>;

<sup>1</sup>Office of the Report on Carcinogens, Division of the National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC, <sup>2</sup>ICF, Fairfax, VA.

Background: After an occupational or environmental carcinogen is identified as a human hazard, years often pass before policy decisions are enacted that will impact public health. Evaluating the informativeness of hazard assessments on science and regulatory policies is critically important but rarely undertaken. Additionally, no clear approaches exist to measure the influence of cancer hazard conclusions on science-based policy. Using the US Report on Carcinogens (RoC) by the National Toxicology Program, we aim to assess the use of cancer hazard assessments in Federal and state policies, public health impacts, and economic impacts associated with the public health impacts. Methods: We conducted a search of any mention of the RoC in the published regulations on the US Federal Register website, as well as state regulations included in Lexis Advance®. For each regulation, we extracted information on the carcinogen(s) regulated, environmental or occupational media, exposure pathways, tumor site, analyzed public health benefits, and metrics reported in the cost-benefit analysis. Results: Of the identified carcinogens in the RoC from 1994-2019, there were 76 regulations from 8 Federal and 6 state or district agencies that cited the RoC in the notice for regulatory action. The most frequently regulated RoC agents were 1,3-butadiene (N=12), acetaldehyde (N=13), formaldehyde (N=16), and benzene (N=14). The most common exposure sources regulated included air pollutants, manufacturing, and transportation. Of the 51 federal regulations identified, 28 were “economically significant” as defined in Executive Order 12866. The largest overall cancer-related economic benefit was a Federal regulation of occupational exposure to hexavalent chromium, a lung carcinogen. Discussion: Over 25 years, RoC cancer hazard assessments directly informed more than 76 health-based regulatory policies. Expansion of our approach to other cancer and noncancer hazard assessments may ultimately improve our understanding of the effectiveness of scientific conclusions on policymaking.

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**P-1147**

### **First National Report of Blood Lead Levels in Mexican Children: An Analysis to Inform Public Health Actions and Policy**

**Presenter:** Martha M Tellez-Rojo, Instituto Nacional de Salud Pública, Cuernavaca, Mexico

**Authors:** M. M. Tellez-Rojo<sup>1</sup>, L. F. Bautista-Arredondo<sup>1</sup>, M. Tamayo-Ortiz<sup>2</sup>, A. Cantoral<sup>3</sup>, D. Estrada-Sanchez<sup>4</sup>, R. Kraiem<sup>5</sup>, I. Pantic<sup>6</sup>, M. Romero<sup>7</sup>, R. Fuller<sup>5</sup>, B. Trejo-Valdivia<sup>1</sup>;

<sup>1</sup>Instituto Nacional de Salud Pública, Cuernavaca, MEXICO, <sup>2</sup>Instituto Nacional de Salud Pública/CONACYT, Mexico City, MEXICO, <sup>3</sup>Instituto Nacional de Salud Pública/CONACYT, Cuernavaca, MEXICO, <sup>4</sup>Pure Earth, Mexico City, MEXICO, <sup>5</sup>Pure Earth, New York, NY, <sup>6</sup>Instituto Nacional de Perinatología, Mexico City, MEXICO, <sup>7</sup>Instituto Nacional de Salud Pública, Mexico City, MEXICO.

**Background.** The toxic effect of lead has been documented in Mexico since 1878. Lead-Glazed Ceramics (LGC) for food consumption has been identified as the main source of exposure; however, it is not clear its contribution to blood lead levels (BLL) at the population level. To date, there is no monitoring system in Mexico. The aim of this study is to estimate the prevalence of high BLL in Mexican children and its association with LGC use, and identify states where prevention efforts should be focused. **Methods.** Capillary BLL was measured in 1-4 year old children from the National Health and Nutrition Survey (ENSANUT) 2018. Logit models were used to estimate the association between high BLL ( $\geq 5\mu\text{g}/\text{dL}$ ) and LGC use, adjusted by sociodemographic characteristics. **Results.** BLL were measured in 4,713 children, representing 7.4 million. The national prevalence of high BLL is 17.3% (CI:14.8,20.0). According to high BLL prevalence and LGC use, we classified the 32 states in four groups: Twelve states with low prevalence (5.0%,CI:3.8,6.3), low frequent-use of LGC (3.9%) and high significant association (OR=8.34,  $p<0.00$ ). Six states with a high prevalence (16.4%,CI:12.9,19.9), the highest frequent-use of LGC (21.4%) and the highest significant association (OR=10.47,  $p<0.00$ ), being LGC the main source of exposure. Ten states with the highest prevalence (26.5%,CI:21.1,31.8), medium frequent-use of LGC (15.2%) and high significant association (OR=2.75,  $p<0.00$ ), suggesting LGC as an important source along with other sources. Four states with high prevalence (13.6%,CI:7.6,19.6), but low frequent-use of LGC (5.0%) and no association (OR=0.33, $p=0.26$ ), discarding LGC and pointing to unknown sources of exposure. **Conclusions.** This study provides evidence of the magnitude and geographic distribution of high BLL in Mexico, confirms LGC use as an important source of exposure, and identifies states with other sources. These findings will be key to design the recently approved National Lead Exposure Control Program.

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Theme: **Research to policy**

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**P-1148**

### **Safeguarding Science from Attack: Data and Trends from the Trump Administration and How to Strengthen the Role of Science-Based Decisionmaking**

**Presenter:** Anita Desikan, Union of Concerned Scientists, Washington, United States

**Authors:** A. Desikan, J. Carter, G. Reed, G. Goldman;  
Union of Concerned Scientists, Washington, DC.

Background/Aim: Protecting the environment and public health often depends on the effective incorporation of science into the federal decisionmaking process. However, the Trump administration has undermined these safeguards such that environmental hazards like air pollution and harmful chemicals are increasingly affecting communities across the US. It is worth analyzing how science is being attacked by the Trump administration and how to strengthen the role of science in the decisionmaking process. Methods: We created a searchable public database to track and analyze attacks on science that have occurred since the inauguration of the Trump administration. A rigorous and systematic set of criteria were used to assess what constitutes an attack on science and how to categorize the attack. Results: Over one hundred attacks on science have been carried out by dozens of federal agencies that follow six trends: anti-science rules, censoring scientists, manipulating studies, making data inaccessible or halting its collection, politicizing funding, sidelining scientific advisory committees, and restricting conference attendance. Conclusions: Our analysis suggests that attacks on science follow a set of patterns that future presidential administrations can guard against. By analyzing data and trends associated with the Trump administration's attacks on science, we offer specific policy recommendations to combat them, including restoring the role of scientific experts in policymaking, bolstering scientific integrity, improving public access to government research, strengthening conflicts of interest policies, restoring protections for government scientists, encouraging public engagement in the rulemaking process, and safeguarding fundamental processes of a healthy democracy.

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**P-1149**

### **Global prevalence of Chronic Kidney Disease of Unknown Etiology (CKDu) and recommendations for developing and strengthening national surveillance systems**

**Presenter:** Agnes Soares da Silva, Pan American Health Organization, PAHO/WHO, Washington, United States

**Authors:** A. Soares da Silva<sup>1</sup>, J. Crowe<sup>2</sup>, M. González-Quiroz<sup>3</sup>, N. Gunawardena<sup>4</sup>, J. A. Escamilla – Cejudo<sup>1</sup>, J. Rodríguez-Guzmán<sup>1</sup>, N. Pearce<sup>5</sup>;

<sup>1</sup>Pan American Health Organization, PAHO/WHO, Washington, DC, <sup>2</sup>Universidad Nacional, San Jose, COSTA RICA, <sup>3</sup>National Autonomous University of Nicaragua, Leon, NICARAGUA, <sup>4</sup>World Health Organization Country Office Sri Lanka, Colombo, SRI LANKA, <sup>5</sup>London School of Hygiene and Tropical Medicine, London, UNITED KINGDOM.

**Background:** Chronic kidney disease of unknown etiology (CKDu) is a disease that is devastating healthcare systems in Central America, Sri Lanka and India, yet population level data about this disease is very sparse. **Methodology:** We reviewed cross-sectional, cross-shift and ecological studies (n=24) published between 2015 and 2019 as well as prevalence data available prior to 2015. Surveillance systems (SS) in affected countries were assessed based on reports from countries participating in an international workshop held in Costa Rica in March 2019. Finally, barriers, solutions and ethical aspects related to CKDu SS were discussed. **Results:** Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Mexico, Panama, Sri Lanka, India and Tanzania have different degrees of certainty about the prevalence of CKDu. Lack of comparability between the studies remains a major challenge. Great progress has been made in collecting and analyzing health service records in many countries, and these developments should be supported and strengthened. However, much work is still needed to obtain comparable population prevalence data. **Discussion and Conclusions:** It remains unclear whether CKDu epidemics represent a global phenomenon or whether there are different regional or national causes for the same outcomes. Compelling evidence supports claims that CKDu is mainly an occupation driven disease, particularly in agricultural communities where informal or temporary contracts create barriers to screening and follow-up. We recommend using the published Disadvantaged Populations eGFR Epidemiology Study (DEGREE) protocol to harmonize data collected. We also make recommendations for SS at three levels: community, healthcare facility, and national (policy) levels. In CKDu endemic areas, we recommend SS at the workplace and strengthening healthcare facilities to allow CKDu screening as part of primary healthcare. Public health SS of CKDu must be associated with guaranteed universal access to healthcare and should be linked to continuous research.

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**P-1150**

### **Small area environmental health data: Challenges and solutions from a surveillance system perspective**

**Presenter:** Angela K Werner, CDC, Atlanta, United States

**Authors:** A. K. Werner, H. Strosnider;  
CDC, Atlanta, GA.

Timely, locally-relevant information is important for conducting environmental epidemiology studies; however, public health data are often lagging, spatially unresolved, or unavailable. The Centers for Disease Control and Prevention's Environmental Public Health Tracking Program (Tracking Program) is building a system of sub-county data to enhance the spatial resolution. This presentation covers the main challenges of increasing spatial resolution. The validity of epidemiologic research depends on positional accuracy of geocodes. Geocoding presents several challenges (e.g., handling special cases like PO Boxes and group quarters, match score thresholds, and how to categorize geocoding quality). The Tracking Program developed geocoding guidelines to transform address-level health data to census tract while addressing these issues. Many health outcomes cannot be displayed at census tract for reasons of confidentiality and stability due to too few cases and/or people in an area. To overcome this, the Tracking Program created standardized sub-county geographies (census tract aggregations) that can be compared over time, space, and dataset to allow data to be displayed at a finer scale while ensuring minimal suppression and instability. Multiple challenges were addressed, including selection of population thresholds and handling group quarters. There are multiple choices of denominator datasets available for public health surveillance (e.g., decennial census). The choice of denominator dataset may or may not have an impact on calculated rates and public health interpretation. To address this and answer the question of which denominator dataset to use, the Tracking Program created a framework to evaluate denominator datasets. The efforts from this project will help meet increasing demand for finer resolution data. These data can inform environmental health studies, where there is often local-level heterogeneity in the environment. Having small area environmental health data can allow for better understanding of local variation within counties, prioritize needs, and advance our understanding of environmental health processes and impacts.

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**P-1151**

### **Assessing Risk of Bias in Human Epidemiologic Studies Using Four Tools: Different Conclusions from Different Tools**

**Presenter:** Stephanie Marie Eick, University of California, San Francisco, San Francisco, United States

**Authors:** S. M. Eick<sup>1</sup>, D. Goin<sup>1</sup>, N. Chartres<sup>1</sup>, J. Lam<sup>2</sup>, T. Woodruff<sup>1</sup>;

<sup>1</sup>University of California, San Francisco, San Francisco, CA, <sup>2</sup>California State University, East Bay, Hayward, CA.

**Background:** Systematic reviews (SR) are increasingly prevalent in environmental health due to their improved ability to synthesize large bodies of evidence, while minimizing bias. Different SR methods have been developed by the U.S. NTP's Office of Health Assessment and Translation (OHAT), U.S. EPA's Integrated Risk Information System (IRIS), and by the U.S. EPA under the Toxic Substances Control Act (TSCA), including how they assess risk of bias (ROB). The objective of this study was to compare the performance of three tools (OHAT, IRIS, TSCA) in assessing ROB, in epidemiology studies in order to identify best practices. **Methods:** Two reviewers independently applied the OHAT, IRIS and TSCA ROB tools to epidemiologic studies used in a previous SR on polybrominated diphenyl ethers and Intelligence Quotient and/or Attention Deficit Hyperactivity Disorder. This SR was chosen because it has been deemed good quality by the National Academy of Sciences. We measured the time to apply each tool and interrater reliability. **Results:** The time to complete the ROB assessments using the different tools varied widely (mean = 20, 32, and 40 minutes per study for the OHAT, IRIS, and TSCA tools, respectively). Interrater reliability was moderate for all tools (Kappa values= 0.56, 0.58, and 0.54, respectively). Based on the ROB assessments the overall quality of the body of evidence was similar for the OHAT and IRIS tools. All studies were rated 'unacceptable' using the TSCA tool because of an 'unacceptable' rating in only one metric not related to ROB, including 'statistical power' and 'study design'. Therefore, no studies were retained to make a judgement about the quality of evidence. **Conclusions:** Using the TSCA tool may significantly reduce the available evidence to assess the harms of hazardous environmental exposures due to only one 'unacceptable' criterion. We recommend using the OHAT method when assessing ROB in SRs.

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**P-1152**

**Use of cancer hazard assessments in Federal and state policy decision-making: Case studies of formaldehyde and trichloroethylene**

**Presenter:** Ruth M. Lunn, NIEHS, Morrisville, United States

**Authors:** R. M. Lunn<sup>1</sup>, I. Morin<sup>2</sup>, A. Belova<sup>2</sup>, K. Osborn<sup>2</sup>, M. Kung<sup>2</sup>, K. Shannon<sup>2</sup>, M. Conti<sup>2</sup>, S. S. Mehta<sup>1</sup>;  
<sup>1</sup>NIEHS, Morrisville, NC, <sup>2</sup>ICF, Fairfax, VA.

**Background:** Every day over 1500 people die from cancer in the United States with estimated cancer-related economic costs reaching over \$170 million. But approximately 42% of all cancers are preventable. Identification of cancer hazards, such as the National Toxicology Program's Report on Carcinogens (RoC), is a first step in public health decision-making; however, the relationship between these activities is unclear. As part of a larger study to address knowledge gaps, we highlight two case studies of known human carcinogens – formaldehyde and trichloroethylene – which are listed in the RoC based on sufficient evidence from epidemiology studies.

**Methods:** We searched U.S. Federal Register and Lexis Advance® for federal and state rulemaking actions citing RoC listings, among other scientific evidence. Relevant qualitative and quantitative data related to health and economic costs were extracted from regulations citing the formaldehyde and trichloroethylene listings. Monetized health benefit estimates were normalized and aggregated across relevant regulations. **Results:** We identified one state and 16 Federal regulations citing RoC's formaldehyde assessment. Most federal rules aimed to reduce multiple air toxins, including formaldehyde, emitted from motor vehicles or other sources. One regulation targeted formaldehyde exposure specifically; the Environmental Protection Agency (EPA) estimated yearly benefits of \$153 million from avoiding 26 to 65 cancer cases as a result of reducing exposure from composite wood products. Three federal rulemaking activities cited the trichloroethylene RoC assessment. According to two EPA proposed rules, prohibiting trichloroethylene use for certain commercial purposes, could save an estimated \$311 million and avoid 22 to 120 cancer cases. The third rule provides health benefits to veterans exposed to trichloroethylene from military service and diagnosed with trichloroethylene-related diseases.

**Discussion:** The case studies of regulatory actions citing two RoC-listed carcinogens illustrate methods that can be used to estimate economic benefits and health impacts, which are informed by hazard identification.

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**P-1153**

**Addressing the environmental burden of asthma through expansion of a public health evidence base, practice, and stewardship: CDC's National Asthma Control Program**

**Presenter:** Josephine Malilay, CDC National Center for Environmental Health, Atlanta, United States

**Authors:** J. Malilay, P. Collins, D. Burrows, S. Damon, K. Sircar, M. Wilce, H. Zahran;  
CDC National Center for Environmental Health, Atlanta, GA.

The National Asthma Control Program (NACP), established by CDC's National Center for Environmental Health in 1999, works with state, territorial, and city health departments and other partners to build community coalitions that develop localized control interventions for asthma, a common chronic disorder with no known cure. The program has reduced the national burden of asthma, helping to cut the number of people with asthma who had asthma attacks from 12.7 million in 2011 to 11.2 million in 2018, reduce deaths linked to asthma, and—in a single year—saving nearly \$4 billion as a result of fewer asthma-related hospitalizations. The NACP uses a multifaceted approach: disease and mortality surveillance, utilizing the Behavioral Risk Factor Surveillance System with Asthma Call-Back Household/Child Surveys; epidemiology to describe disease burden and risk factors for asthma exacerbation; evaluation to assess program effectiveness and return on investment; communication to educate people with asthma and their caregivers and to disseminate findings; and programmatic operations to support surveillance, partnerships, implementation, and evaluation of six evidence-based strategies of the EXHALE technical package. The NACP initially funded four state health department partners to work on asthma in 1999, supported 34 states, District of Columbia, and Puerto Rico at its height during 2010-2014, and currently funds 22 states, city of Houston, and Puerto Rico. It works to solve a complex dynamic equation of large public health disparities, changes in ICD-9 to ICD-10 codes, having inadequate health insurance coverage or none, and a lag in accessing data. Through direct funding and expert support, NACP partners implement evidence-based programs with prescribed measures of performance, including accountability and health outcomes. Using science and practice, NACP and its partners today have moved into a new phase, implementing a five-year initiative to eliminate 500,000 emergency department visits and hospitalizations for asthma among children.

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**P-1154**

**The effects of heat wave warning system on mortality in urban and rural populations in South Korea through 2001-2016**

**Presenter:** Seulkee Heo, Yale University, New Haven, United States

**Authors:** S. Heo<sup>1</sup>, A. Nori-Sarma<sup>2</sup>, K. Lee<sup>3</sup>, F. Dominici<sup>4</sup>, M. Bell<sup>1</sup>;

<sup>1</sup>Yale University, New Haven, CT, <sup>2</sup>Center for Environmental Health and Technology & School of Public Health, Department of Epidemiology, Providence, CT, <sup>3</sup>Department of Statistics, Sungkyunkwan University, Seoul, KOREA, REPUBLIC OF, <sup>4</sup>Harvard T. H. Chan School of Public Health, Harvard University, Boston, MA.

Significant threats to public health are posed as climate change is expected to continuously increase global ambient temperature. Many counties have implemented heat wave warning systems to reduce the health impacts of extreme heat but little is known about whether these systems actually reduce heat-related mortality. We assessed changes in the mortality risk of heat waves over time between 2001-2016 in urban and rural regions in South Korea. Mortality, weather monitoring, and air pollution data were collected for 7 urban cities and 8 rural regions. A difference-in-differences analysis combined with propensity score weighting was applied to estimate changes in mortality risks between before and after the implementation of the heat wave warning system (2001-2007, 2008-2016). Results showed evidence of decreased all-cause mortality (-0.611 deaths / 1,000,000 people, 95% CI: -0.974, -0.248) during heat waves in urban populations after the implementation of the warnings. The reduction in mortality was larger in persons aged 65+ (-6.097 deaths / 1,000,000 people, 95% CI: -9.067, -3.127), compared to persons aged 20-64 (-0.715 deaths / 1,000,000 people, 95% CI: -1.101, -0.328). However, decreased mortality was larger in young adult males (age 20-64) than older males, whereas risk reduction in older females was larger than young adult females. Decreased mortality was found for cardiovascular deaths of persons aged 75+ and for respiratory deaths of all-age males. No evidence was found for decreased all-cause mortality in rural populations although decreased mortality was found for respiratory mortality (age 0-19). In conclusion, we found different effects of the national warning system for reducing heat-related mortality among urban and rural populations, which was more effective in urban regions. Further work needs to examine heterogeneity in social resources or perception of high temperature between urban and rural regions that may explain the different mortality effects of heat wave warning system.

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**P-1155**

**Evaluating the impact of the Clean Heat Program on air pollution levels in New York City**

**Presenter:** Mike Zhongyu He, Columbia University, New York, United States

**Authors:** L. Zhang<sup>1</sup>, M. Z. He<sup>1</sup>, F. P. Perera<sup>1</sup>, G. S. Lovasi<sup>2</sup>, J. Clougherty<sup>2</sup>, D. Carrion<sup>3</sup>, K. Burke<sup>1</sup>, M. Kioumourtzoglou<sup>1</sup>;

<sup>1</sup>Columbia University, New York, NY, <sup>2</sup>Drexel University, Philadelphia, PA, <sup>3</sup>Icahn School of Medicine at Mount Sinai, New York, NY.

**Background:** Residual heating oil combustion has been consistently linked to adverse health effects. In 2012, New York City established a series of policies known as the Clean Heat Program to eliminate the use of residual heating oil and move towards cleaner forms of energy. We aim to evaluate the outcomes of these policies by assessing the association between fuel conversion and reduction in the concentrations of air pollutants from 2012 to 2016, including sulfur dioxide (SO<sub>2</sub>), fine particulate matter (PM<sub>2.5</sub>), and nitrogen dioxide (NO<sub>2</sub>).

**Methods:** We used linear regression models and Lagrange Multiplier (LM) tests to assess spatial autocorrelation and select the appropriate spatial autoregressive (SAR) model. Spatial lag models at the census tract level were used to investigate the association between fuel conversion and changes in the concentration of three air pollutants, adjusting for emissions from on-road vehicles, building age, and median household income. To address the potential equity concerns of the Clean Heat Program, we also evaluated whether household income in quartiles, as a surrogate for neighborhood-level socioeconomic status (SES), modified these relationships.

**Results:** After controlling for spatial autocorrelation and potential confounders, on average, for every 10 buildings that converted from heating oil #6 to cleaner fuels, we observed statistically significant reductions of 0.28 ppb (95%CI: 0.22, 0.34) in SO<sub>2</sub>, 0.12 µg/m<sup>3</sup> (95%CI: 0.09, 0.15) in PM<sub>2.5</sub>, and 0.29 ppb (95%CI: 0.17, 0.41) in NO<sub>2</sub>. Although we did not observe evidence of statistical modification by SES, pollutant decreases were largest for the lowest and highest SES quartiles.

**Conclusions:** Converting heating oil #6 to cleaner fuels was effective in reducing SO<sub>2</sub>, PM<sub>2.5</sub>, and NO<sub>2</sub>. The Clean Heat Program appears to have been effective for individuals at both low- and high-income levels. Future work should continue to evaluate the impact of targeted policies on air pollution.

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**P-1157**

**WHO Europe Heat Health Action Plan guidance: an update of the evidence ten years on.**

**Presenter:** Francesca Katherine de'Donato, Lazio Regional Health Service - ASL Roma 1, ROMA, Italy

**Authors:** F. K. de'Donato<sup>1</sup>, G. Sanchez Martinez<sup>2</sup>, V. Kendrovski<sup>3</sup>;

<sup>1</sup>Lazio Regional Health Service - ASL Roma 1, ROMA, ITALY, <sup>2</sup>Department of Management Engineering, Technical University of Denmark, Copenhagen, DENMARK, <sup>3</sup>European Centre for Environmental Health (ECEH), WHO Regional Office for Europe, Bonn, GERMANY.

Background: Future climate change and the increasing frequency and intensity of heat waves poses a serious health threat to populations worldwide and the need to promote adaptation strategies. The European Centre for Environmental Health - WHO Regional Office for Europe, has carried out an update of the scientific evidence and a survey on European heat health plans currently in place. Our aim is to update the WHO Heat Health Action Plans (HHAP) guidance document. Methods/results. The document includes most relevant evidence from recent epidemiological research and lessons learned from implementation in practice. The evidence update is focused on the eight core components of a HHAP as defined by the WHO: Lead body, warning systems, information plan, reduction in indoor heat exposure, particular care for vulnerable subgroups, preparedness of the health and social services, long-term urban planning, surveillance and evaluation. The survey was disseminated via national focal points and WHO EURO Country Offices, members of the WHO EURO working group and subnational networks. Results from the survey provide an overview of current plans in place among European Member States. Over 80% of HHAPs are either a formal part or mentioned in national Climate Change policy. Most plans identify a lead body, have an information plan and a warning system in place. The latter, helps raise awareness on the health risk during heat waves at population level, while ensuring the timely planning of prevention and emergency measures. Plans acknowledge the need to target vulnerable subgroups, however who these are and what specific measures are adopted is very much heterogeneous. The formal inclusion of long-term policy addressing indoor heat reduction or urban planning has the lowest level of coverage in current HHAPs. Conclusion: The WHO document will help promote the update of HHAPs taking into account the changing climate, shifting demographics and urbanization.

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**P-1158**

### **Restrictions on the Use of Public Health Research at US Government Agencies in the Name of Transparency**

**Presenter:** Gretchen T. Goldman, Union of Concerned Scientists, WASHINGTON, United States

**Authors:** G. Reed, G. T. Goldman, J. Carter, A. Desikan;  
Union of Concerned Scientists, Washington, DC.

Transparency measures at government agencies are essential in order to ensure scientific integrity and public trust in the government's scientific output. Agency scientists, supported by a commitment to a rigorous independent science process, scientific integrity policies, and appropriate transparency measures, should be trusted to analyze available data and issue policies that consider and value the weight of the evidence. We evaluated how recent initiatives at the Environmental Protection Agency (EPA) and the Department of the Interior (DOI) would block the agencies from using many kinds of scientific studies vital to decisionmaking, including studies that rely on personal health data, confidential business information, intellectual property, or older studies for which the authors or data sources may not be accessible. Comparing requirements for industry and all other submissions, we found that these proposals would protect industry data and confidential business information more adequately than public health information. Both directives would allow agencies to use the degree to which the underlying data is public to judge a study's credibility, which would mean many types of studies done in the environmental health field would be discounted. We analyzed how the placement of unnecessary restrictions on the kinds of studies that agencies can consider stands to affect decisionmaking on everything from air pollution standards to water quality issues to chemical regulation in consumer products. The speaker will discuss the difference between genuine transparency needs in government science and these two misguided agency rules. Examples of how these policies could impact the foundation of public environmental and public health protection will be outlined and alternative recommendations for improved government scientific transparency that is protective of public health will be laid out.

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**P-1159**

**Recent Changes to the US Chemical Regulatory Process: Impacts on Public Health**

**Presenter:** Anita Desikan, Union of Concerned Scientists, Washington, United States

**Authors:** G. Reed, G. T. Goldman, A. Desikan, C. Kalman;  
Union of Concerned Scientists, Washington, DC.

The chemical regulatory process at the Environmental Protection Agency (EPA) has historically been vulnerable to pressure from chemical manufacturers and trade organizations. This pressure can be applied directly on the EPA's review of and use of science on a specific chemical or can take the form of influence over the process by which science is used by the agency, including in the development of risk assessments, weight-of-evidence analyses, and hazard determinations or during the peer review process by EPA's advisory committees. We evaluated the way in which process changes at the EPA made since 2017 have or likely will have impacts on the agency's ability to use the best available science to inform policies that keep the public safe from chemical exposure. Examples include delays and suspension of work under the Integrated Risk Information System, restricting the advice that the Science Advisory Committee on Chemicals and the Science Advisory Board can provide to the agency, limiting the scope of assessment for chemicals under implementation of the Toxic Substances Control Act (TSCA), and issuing a TSCA systematic review framework that departs from scientific best practices. We found that these process alterations have resulted in insufficiently health-protective assessments and resulting policy decisions and fewer opportunities for members of the public to provide input. These impacts are felt especially for communities of color, low-income communities, and Indigenous communities who are experience an inequitable burden of chemical exposure. The speaker will lay out solutions that the EPA can put in place to address these challenges with the chemical regulatory process and prevent against undue influence from the regulated industry.

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**P-1160**

### **The Policy Role of National Academy of Medicine and Presumptive Conditions related to Agent Orange**

**Presenter:** Mindy Moore, Milken Institute School of Public Health, Washington, United States

**Authors:** M. Moore;  
Milken Institute School of Public Health, Washington, DC.

#### Background:

The Veterans Administration (VA) is responsible for providing medical and disability support to those who served their country. Deciding if an illness or disability is service related when it manifests years later can bring about much debate and controversy. How the National Academies of Medicine (NAM) came to the forefront and aided the VA in their decision-making process linking illness or disability to service after the Vietnam War has had significant impact on current policies related to military service. The purpose of this paper is to provide an overview on the policy role of NAM and the VA concerning Agent Orange (AO) exposure.

#### Methods:

We conducted a literature review to characterize the history and interaction of the VA, NAM, and the chronic health effects related to AO exposure.

#### Results:

Budgetary allowances for all veteran's compensation benefits are estimated to total \$115.8 billion by 2021. Vietnam veterans comprise 33.5% of the compensation obligation. NAM links AO exposure with the following diseases: ischemic heart disease, lung and trachea cancers, prostate cancer, multiple myeloma, Hodgkin's disease, non-Hodgkin's lymphoma, Parkinson's disease, type 2 diabetes, peripheral neuropathy, porphyria cutanea tarda, soft tissue sarcomas, and chloracne. Epidemiologic evidence suggests that some of these conditions such as, prostate cancer, diabetes, and ischemic heart disease, are linked with aging and thus may not be strongly associated with AO. Failure to properly adjust for such confounding variables by age may undermine the association of exposure to disease. Given the high cost of compensation for Vietnam era service, it may be prudent to re-examine the current policy.

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**P-1162**

**A health impact assessment of lack of air conditioning during extreme heat in a temperate climate**

**Presenter:** Carina J. Gronlund, University of Michigan Institute for Social Research, Ann Arbor, United States

**Authors:** C. J. Gronlund<sup>1</sup>, T. G. Reames<sup>2</sup>, M. Martinez<sup>3</sup>, A. Schulz<sup>4</sup>, R. de Majo<sup>4</sup>, D. Hondula<sup>5</sup>, M. S. O'Neill<sup>4</sup>, B. Stone<sup>6</sup>;

<sup>1</sup>University of Michigan Institute for Social Research, Ann Arbor, MI, <sup>2</sup>University of Michigan School for Environment and Sustainability, Ann Arbor, MI, <sup>3</sup>Michigan Environmental Justice Coalition, Detroit, MI,

<sup>4</sup>University of Michigan School of Public Health, Ann Arbor, MI, <sup>5</sup>Arizona State University, Tempe, AZ,

<sup>6</sup>Georgia Institute of Technology, Atlanta, GA.

**Introduction:** Air conditioning (AC) ownership and use can mitigate the effects of summer heat on health. With increasing temperatures, increasing economic disparities, and the unequal distribution of electricity production harms (e.g., air pollution) and benefits (e.g., AC), heat-related health disparities are of increasing concern. We reviewed the literature on the protective effects of AC and performed a quantitative health impact assessment of AC in Wayne County, Michigan, USA.

**Methods:** We used: 1) a model of central AC prevalence based on American Housing Survey and tax assessor's data; 2) heat-mortality and -hospitalization association estimates; 3) estimates of the AC relative risk ratio (RRR), or relative risk of the health event during vs. not during extreme heat among those without AC vs. the relative risk among those with AC; and 4) mortality, hospitalization, and population estimates to calculate and map extreme-heat attributable health burden and costs (2020 \$USD) by census tract (500-5,000 persons).

**Results:** RRRs ranged widely (1.02-11.5) depending on extreme-heat definitions, health outcomes (e.g., all-cause mortality or heatstroke), and AC geographic resolution (community or individual). Ten-year extreme-heat (defined at the 99th percentile of temperature) associated health rates ranged widely across census tracts (0.6-5.6 deaths/100,000 persons and 2.0-26 hospitalizations/100,000 persons), as did monetized health costs (\$11,000-\$1,640,000 per census tract).

**Conclusions:** Health impacts of lack of AC vary spatially. In future work, we will consider the added effects of low usage among those with AC, the cumulative burden of exposure to power plant emissions and lack of AC, and the impacts of heat during an extended power outage. Quantifying and mapping the cumulative health impacts of energy production can inform neighborhoods of air- and climate-associated risk disparities and inform energy mix and utility rate regulatory decisions.

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**P-1164**

**Citizens' perception, concerns and interests with respect to air pollution and health-related risks: Mapping out a local epidemiological research agenda using results from online surveys and community meetings in Barcelona, Spain**

**Presenter:** Florence Gignac, ISGlobal, Institute for Global Health, Barcelona, Spain

**Authors:** F. Gignac<sup>1</sup>, L. Paz Errandonea<sup>2</sup>, R. Toran<sup>1</sup>, V. Righi<sup>2</sup>, R. Ortiz<sup>1</sup>, G. Maccani<sup>2</sup>, M. Nieuwenhuijsen<sup>1</sup>, J. Creus<sup>2</sup>, X. Basagaña<sup>1</sup>, M. Balestrini<sup>2</sup>;

<sup>1</sup>ISGlobal, Institute for Global Health, Barcelona, SPAIN, <sup>2</sup>Ideas for Change, Barcelona, SPAIN.

**Background:** Health risks of air pollution have attracted considerable attention, both scholarly and within the lay public. However, the latter remains rarely involved in defining the air pollution-related research agenda. We aim to present the results from the first stages of a citizen science epidemiological study in Barcelona within CityS-Health project. The objectives were to shed light on matters of concern, perceptions and interests amongst Barcelona residents regarding air pollution and health, to translate them into a meaningful research question for the community, and to determine with the citizens a type of experimental design for which they would be interested to participate.

**Methods:** An online survey was shared during summer 2019 and 488 Barcelona residents responded. Responses were analyzed using a mixed-method including descriptive statistics, word frequency count and qualitative coding. A total of 557 residents responded to the second survey to choose which question they would like to investigate with scientists. Community meetings were organized to narrow down the research question topics, and to pinpoint the experimental design type that citizens would like to engage.

**Results:** Results show that almost 95% of the sample perceived the air as polluted. Respiratory problems and mental health emerged as the main health preoccupations and priorities of investigation. The most popular research question was "How does air pollution together with noise and green/blue spaces affect mental health?". The preferred study design was an observational study in which citizens provide daily repeated measures of mental health outcomes (cognition, stress and mood) and relate them to the air pollution concentrations.

**Conclusions:** The co-created formulation of a locally-relevant environmental health research question ensures that the epidemiological study will focus on issues of interest to the community. The first version of the study protocol will soon be publicly shared for citizens to incorporate their feedback.

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**P-1165**

**Setting priorities in environment, climate and health research in Europe**

**Presenter:** Manolis Kogevinas, ISGlobal, Barcelona, Spain

**Authors:** M. Kogevinas<sup>1</sup>, A. Huss<sup>2</sup>, F. Matthies-Wiesler<sup>3</sup>, C. Desseille<sup>4</sup>, R. C. Vermeulen<sup>2</sup>, A. Peters<sup>3</sup>, R. Barouki<sup>4</sup>;

<sup>1</sup>ISGlobal, Barcelona, SPAIN, <sup>2</sup>Universiteit Utrecht, Utrecht, NETHERLANDS, <sup>3</sup>Helmholtz Zentrum, Munich, GERMANY, <sup>4</sup>INSERM, Paris, FRANCE.

**Background.** Environmental degradation and pollution, climate change and disruption of ecosystems services damage health and quality of life, and differentially affect socially disadvantaged and vulnerable population groups. The HERA project, funded by the EU Horizon2020 research framework programme, set priorities for an environment and health research agenda in the EU for 2020-2030, closely connected to policy needs. **Methods.** HERA consists of 24 partners from environment, climate and health centres. Following a review of evidence and policies, a methodology was devised to identify and consult scientific communities and relevant stakeholder groups (policy makers, local authorities, NGOs, industry and others) across Europe to identify the knowledge gaps in environment, climate and health research. Web-based surveys were carried out along with online and face-to-face consultation meetings. **Results.** Research priorities relate to environmental exposures, sector-based and holistic approaches, methodologies and infrastructures, and higher-level transformational research. The consultation resulted in 6 main Research Goals and within each goal specific objectives: (i) Reduce the effects of climate change and ecological degradation on health; (ii) Eliminate environmental exposures harmful to health; (iii) Promote healthy lives in sustainable and inclusive societies; (iv) Improve health impact assessment of environmental factors and promote intervention research; (v) Develop infrastructures, technologies and human resources for sustainable research on environmental and health; (vi) Support transformational change approaches in environment and health research. Research goals are closely linked to several SDGS. Europe-wide consultations will be continued to refine the priority assessment and to develop regional research agendas. **Conclusion.** This large systematic initiative involved hundreds of researchers and stakeholders to set priorities for environmental health research for policies in Europe. The inclusion of both researchers and community stakeholders significantly enriched the procedure. Methodologies for defining priorities need to be further developed. Further work will adapt the report to capture research needs at a global scale.

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## ABSTRACT E-BOOK

Theme: **Research to policy**

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**P-1166**

### **Health Benefits Related to the China National Action Plan on Air Pollution Prevention and Control: An Accountability Study in Heavily Polluted Regions in China**

**Presenter:** Tiantian Li, National Institute of Environmental Health, China CDC, Beijing, China

**Authors:** T. Li<sup>1</sup>, C. Chen<sup>1</sup>, Y. Guo<sup>1</sup>, Y. Liu<sup>1</sup>, H. Du<sup>1</sup>, P. L. Kinney<sup>2</sup>, A. J. Cohen<sup>3</sup>, X. Shi<sup>1</sup>;

<sup>1</sup>National Institute of Environmental Health, China CDC, Beijing, CHINA, <sup>2</sup>Boston University School of Public Health, Boston, MA, <sup>3</sup>Health Effects Institute, Boston, MA.

**Background**The National Action Plan on Air Pollution Prevention and Control in China was launched in 2013 and provides a unique opportunity to explore whether the short-term health effects of PM<sub>2.5</sub> might have changed from 2013 to 2018 especially in the Beijing-Tianjin-Hebei (BTH) region where there were major reductions in PM<sub>2.5</sub> concentrations. **Methods**We divided the entire study period (2013-2018) into two subperiods, 2013 to 2015 and 2016 to 2018, to estimate PM<sub>2.5</sub>-mortality effects separately using a quasi-poisson regression model and to observe whether the effects of the two subperiods have changed. We explored a nonlinear effect model, the control comparison analysis and the PM<sub>2.5</sub> components proportion analysis to understand the potential factors to explain the changes in health effects. **Results**The mean daily PM<sub>2.5</sub> levels decreased by above 20 µg/m<sup>3</sup> in the 47 counties included in this study from the second period to the first period. The SO<sub>4</sub><sup>2-</sup> component ratio dramatically decreased from 24% in 2013 to 11% in 2017 in Beijing. A 10 µg/m<sup>3</sup> increase in the PM<sub>2.5</sub> concentration was associated with increases of 0.16% (95% CI: 0.08, 0.24) from 2013 to 2015 and 0.02% (-0.09, 0.13) from 2016 to 2018 in total mortality. The effects of PM<sub>2.5</sub> were significantly decreased for total and circulation mortality. The PM<sub>2.5</sub>-mortality relative risk estimates for 2013-2015 increased monotonically in a roughly linear fashion, whereas the PM<sub>2.5</sub>-mortality relative risk estimates for 2016-2018 were markedly lower and were non-linear. **Conclusions**The air pollution control measures taken in China since 2013 have resulted in reductions in air pollution levels as well as changes in the mix of pollutants to which people are exposed. In addition, trends in behavior may have altered personal exposures to pollution. These actions may have resulted in reduced mortality, but larger studies conducted over longer periods of time are needed to corroborate these results.

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**P-1168**

### **Application of Environmental Epidemiology in Risk Assessment and Public Health Decision-making: A HESI Initiative**

**Presenter:** Sandrine E Deglin, HESI, Washington, United States

**Authors:** S. E. Deglin;  
HESI, Washington, DC.

#### Application of Environmental Epidemiology in Risk Assessment and Public Health Decision-making: A HESI Initiative

In Fall 2017, the Health and Environmental Sciences Institute (HESI) launched a project designed to start a dialogue around the issues that limit the full utilization of environmental epidemiology in risk assessment and regulatory decision-making. The purpose of this project is to identify factors limiting the use of epidemiological data in public health policy and regulatory decision-making, and to design solutions to facilitate that incorporation in risk assessment. The project engages representatives from government, academia, and industry with a wide range of expertise in epidemiology, toxicology, risk assessment, and exposure science. This project aims to improve practices for the collection of human data to meet the standards of the practice of epidemiology and to further contribute to the rigorous characteristics required to provide confidence in science-based assessments for regulatory decision-making. To fulfill this mission, this HESI committee started with an exploratory phase, based on the organization of four focus groups whose goals were to 1) foster dialogue among epidemiologists, risk assessors, exposure scientists, statisticians, and other experts; 2) identify barriers to the optimal integration of epidemiological data into quantitative risk assessment; and 3) propose consensus solutions for a positive impact in this space. Thanks to the active engagement of participants, these interactive meetings identified specific areas of focus, such as funding attribution, data access, insufficient cross-training, and lack of cross-disciplinary communication, where improvements could be made to ultimately increase the use of environmental epidemiology in risk assessment. Salient issues and the lessons learned from these focus groups will be presented, as well as the concrete steps taken by the HESI committee, and their recommendations to increase the relevance of epidemiological data to quantitative risk assessment.

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**P-1169**

**New communication and data collection technologies used in population and patient cohorts**

**Presenter:** Kinga Polanska, Nofer Institute of Occupational Medicine, Lodz, Poland

**Authors:** K. Polanska<sup>1</sup>, B. Ikediashi<sup>2</sup>, T. Torres Moral<sup>3</sup>, A. Weser<sup>4</sup>, D. Derijcke<sup>2</sup>;

<sup>1</sup>Nofer Institute of Occupational Medicine, Lodz, POLAND, <sup>2</sup>The Synergist, Brussels, BELGIUM, <sup>3</sup>Parc Sanitari San Joan de Déu, Barcelona, SPAIN, <sup>4</sup>NTNU / Norwegian University of Science and Technology, Levanger, NORWAY.

Background/Aim: New communication and data collection technologies, including mobile data collection, smart sensors, social media and geospatial technology allow researchers to collect and process data with greater detail and precision, in more natural settings, over longer periods of time and with lower cost and participant burden. The purpose of this study is to map existing population cohorts, patient cohorts and clinical trials using social media and new communication technologies. This is part of a European project - Synergies for Cohorts in Health: Role of all stakeholders (SYNCHROS; <https://synchros.eu/>). The project seeks to establish a sustainable European strategy for the development of the next generation of integrated cohorts. Methods: As part of SYNCHROS project the ascendant (e.g., electronic records, repositories, initiatives) and descendant (e.g., MEDLINE/PUBMED/COCHRANE/EBSCO databases) search approaches were performed to map the main cohorts and clinical trials. The following inclusion criteria were selected: 1) publications/articles/reports published in English from 2012 to date, 2) population-based cohorts, patient cohorts or clinical trials and 3) studies using new communication technologies for communication and data collection. Results: A total of 940 studies were initially selected. Of these, there were 829 original research articles, 32 review papers and 79 initiatives. Finally, 171 studies met inclusion criteria. Most of the studies were conducted in the US and Europe and mobile data and geospatial technologies were the most frequently used new communication and data collection technologies. There were no studies using artificial intelligence. Conclusions: New communication and data collection technologies are increasingly used in cohort studies and clinical trials, thanks to their availability and accessibility. While techniques based on new technologies face a number of challenges, they offer the potential to bring profound, transformative improvements to the study of health in longitudinal and cohort studies.

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**P-1170**

**Data-driven approaches to advance California's Human Right to Water Law: Characterizing inequities in drinking water quality among domestic well communities and public drinking water systems**

**Presenter:** Clare Pace, University of California, Berkeley, Berkeley, United States

**Authors:** C. Pace<sup>1</sup>, L. Cushing<sup>2</sup>, C. Balazs<sup>3</sup>, R. Morello-Frosch<sup>1</sup>;

<sup>1</sup>University of California, Berkeley, Berkeley, CA, <sup>2</sup>San Francisco State University, San Francisco, CA,

<sup>3</sup>Office of Environmental Health Hazard Assessment, Oakland, CA.

In 2012, California became the first state to recognize the Human Right to Water. However, roughly 10% of California's public drinking water systems are currently out of compliance with federal and state drinking water quality standards, and an estimated 6 million Californians are served by systems that have been in violation at some point since 2012. A disproportionate number of water quality violations occur in smaller drinking water systems that serve rural, low income communities color, where a lack of resources make it challenging to treat contaminated water and meet regulatory standards. Additionally, significant data gaps exist regarding the location and water quality of unregulated water sources, such as private domestic wells. The UC Berkeley Water Equity Science Shop sought to characterize demographic differences in water quality for communities reliant upon domestic wells and community water systems. We integrated data from the Department of Water Resources; Tracking California's Drinking Water Systems Geographic Reporting Tool; and the US Census to identify the location of likely domestic well communities across California. Using water quality data from CalEnviroScreen 3.0 and the Groundwater Risk Index Tool, and demographic data from the American Community Survey, we estimate sociodemographic differences in water quality using multivariate analysis.

Results indicate that over 1.3 million Californians rely on private wells for drinking water. We estimate 49,000 and 102,000 people live in domestic well areas where drinking water is likely to exceed regulatory standards for nitrates and arsenic, respectively. Average contaminant concentrations of arsenic and nitrate are over 1.5 times higher in areas served by domestic wells than in community water systems. Multivariate statistical models indicate that area-level measures of race/ethnicity and poverty are associated with increases in drinking water contaminant concentrations in domestic well areas.

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**P-1171**

### **Staff Perception of Tobacco Control and Prevention Policy in a Children's Hospital**

**Presenter:** Yannan Li, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** Y. Li<sup>1</sup>, J. Holstein<sup>2</sup>, S. Ziniel<sup>3</sup>, B. Liu<sup>4</sup>, K. Wilson<sup>4</sup>;

<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Children's Hospital Colorado, Aurora, CO,

<sup>3</sup>University of Colorado/Children's Hospital Colorado, Aurora, CO, <sup>4</sup>Icahn School of Medicine at Mount Sinai, NEW YORK, NY.

**OBJECTIVES:** To assess the knowledge, perception, and comfortableness of hospital TCP policy among staff in a children's hospital. **METHODS:** The study included 2340 staff members who completed a cross-sectional anonymous online survey in a children's hospital. The survey examined employee's knowledge of the effect of tobacco smoking, awareness of hospital TCP policy, and comfortableness of discussing TCP. We compared the responses by respondents' age (18-35, 36-45, and older than 45 years), sex, job types (nurses, social workers, logistical staff, clinicians, and administrative staff), and smoking status using Chi-square tests. P-value < 0.0006 was considered statistically significant after correcting for multiple testing. **RESULTS:** The response rate of the survey is about 41%. A majority (84%) of the respondents were women and 41% aged between 18 and 35 years. The prevalence of ever-smokers and current smokers were 16% and 1.4%, respectively. Nurses represented 47% of the participants, followed by administrative staff (34%). Compared to current smokers, non-current smokers were more supportive of a strict hospital-wide smoke-free policy (85% vs 33%,  $p < 0.0001$ ) and more comfortable in talking to coworkers about the health effects associated with smoking (50% vs 30%,  $p = 0.0004$ ). About 30%-40% of nurses felt comfortable in talking to and educate parents about quitting smoking, compared to less than 20% in other job groups ( $p < 0.0001$ ). Nurses were also more likely to agree or strongly agree than other professionals that the hospital should provide tobacco cessation program for parents ( $\geq 32\%$  vs  $< 16\%$ ,  $p < 0.0001$ ). With increasing age, the comfortableness of talking (31%, 22%, and 21%) and educating (23%, 19%, and 18%) parents about quitting smoking decreased ( $p < 0.0001$ ). **CONCLUSIONS:** Employee's perception of the hospital's TCP policy varied across subgroups by their demographic and job characteristics. The results may help the hospital to improve tailored TCP training among employees.

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**P-1172**

### **Fluoride Developmental Neurotoxicity- Overview of Evidence and Evaluation of Risk at Exposures Due to Artificial Fluoridation**

**Presenter:** Chris Neurath, American Environmental Health Studies Project (AEHSP), Lexington, United States

**Authors:** C. Neurath<sup>1</sup>, P. Connett<sup>2</sup>, M. Connett<sup>3</sup>, J. Hirzy<sup>4</sup>;

<sup>1</sup>American Environmental Health Studies Project (AEHSP), Lexington, MA, <sup>2</sup>AEHSP, Binghamton, NY,

<sup>3</sup>Waters Kraus & Paul, El Segundo, CA, <sup>4</sup>American University Dept. of Chemistry, Washington, DC.

The topic of fluoride developmental neurotoxicity has received great attention recently due to the publication of several high-profile studies and because of the questions these raise about the safety of water fluoridation, a long-established public health measure to reduce tooth decay. The recent studies have found associations between fluoride exposures at levels common in areas with artificial fluoridation and outcomes like reduced IQ and increased risk of ADHD in children. A 2019 draft systematic review by the National Toxicology Program (NTP) identified 149 human studies, including 18 it considered of relatively high quality. The large majority of these studies found adverse neurological effects. The NTP concluded fluoride was a presumed developmental neurotoxin but did not attempt any dose-response analyses. NTP's conclusions about fluoride exposures due to artificially fluoridated water in the USA were equivocal. We give an overview of the human epidemiological evidence from the early studies done in the 1980s in China up to the most recent from Canada and the USA. We evaluated the strength of evidence at exposures relevant to artificial fluoridation. For the strongest studies with suitable data, we conducted dose-response analyses using Benchmark Dose methods with BMR = -1 IQ point. We also compare the quantity and quality of studies on fluoride developmental neurotoxicity to those for lead and other neurotoxins. Conclusions. Multiple high quality studies, conducted in varied populations, consistently find strong associations between loss of IQ or other adverse developmental neurobehavioral outcomes and fluoride exposures commonly occurring from artificial fluoridation. Benchmark Dose analyses consistently find BMDL values well below mean exposure levels of pregnant women and children living in fluoridated areas. Thus, the evidence strongly suggests fluoridation poses an unprecedented neurotoxic risk to a large proportion of the children of the USA and other countries with fluoridation.

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**P-1174**

**Future health impacts of long-term exposure to fine particulate matter under climate change, demographic change and urbanisation in India**

**Presenter:** Asya Dimitrova, Universitat Pompeu Fabra (UPF), Barcelona, Spain

**Authors:** A. Dimitrova<sup>1</sup>, G. Marois<sup>2</sup>, G. Kiesewetter<sup>3</sup>, S. KC<sup>2</sup>, P. Rafaj<sup>3</sup>, C. Tonne<sup>4</sup>;

<sup>1</sup>Universitat Pompeu Fabra (UPF), Barcelona, SPAIN, <sup>2</sup>Asian Demographic Research Institute (ADRI) at Shanghai University, Shanghai, CHINA, <sup>3</sup>International Institute for Applied Systems Analysis (IIASA), Vienna, AUSTRIA, <sup>4</sup>Barcelona Institute for Global Health (ISGlobal), Barcelona, SPAIN.

Background: Rapid socio-economic development in India has been accompanied by gains in life expectancy and improvements in a range of health outcomes. However, it is uncertain how the fast pace of urbanisation, the aging of the population, and climate change will alter this trend in the future. This study estimates dynamically over time the health co-benefits from projected changes in exposure to ambient fine particulate matter (PM<sub>2.5</sub>) in India up to 2050 under alternative climate change mitigation and air pollution abatement scenarios, considering future demographic change, urbanisation trends and changes in disease burdens. Methods: We use outputs from an integrated assessment model and a multi-dimensional cohort-component projection model to explore dynamically over time the range of potential health impacts across urban and rural areas in all states of India. Results: We show that pursuit of the aspirational climate change mitigation targets can bring clear co-benefits from cleaner air by averting up to 7.9 million deaths and adding up to 0.8 years to average life expectancy at birth in 2050 compared to business-as-usual. Combining these targets with policy measures that target air pollution explicitly can double human health benefits. Across the population, the largest health gains from PM<sub>2.5</sub> reduction will occur for those living in rural areas, as well as for males and the elderly. Future health co-benefits differ substantially between states, with the highest potential gains observed in the regions around the Indo-Gangetic Plain, where high population density and low baseline life expectancy coincide with high PM<sub>2.5</sub> levels. Conclusions: Our analysis helps reduce one of the main uncertainties in future health impact assessments (changes in the size, structure, disease burden, and distribution of the population), demonstrates the impact of different PM<sub>2.5</sub> pathways on survival and highlights the important synergies between climate change mitigation and air quality control.

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**P-1175**

### **Environmental and social determinants of health in informal settlements in Mbour, Senegal: challenges and policy directions**

**Presenter:** Sokhna Thiam, Institute for Health Research, Epidemiological Surveillance and Training, Dakar, Senegal

**Authors:** S. Thiam<sup>1</sup>, G. Cissé<sup>2</sup>;

<sup>1</sup>Institute for Health Research, Epidemiological Surveillance and Training, Dakar, SENEGAL, <sup>2</sup>Swiss Tropical and Public Health Institute, Basel, SWITZERLAND.

Rapid urbanization has created many informal settlements around big and secondary cities in Africa, which brings along with specific challenges for global health. In urban informal settlements, residents are often burdened with multiple and overlapping challenges that can undermine the environmental and social determinants of health from poverty to overcrowded, to inadequate infrastructure, all of which can combine to contribute to increased risk of exposures to environmental pathogens that increase infectious like diarrheal diseases in urban poor areas. The purpose of our study was to highlight the most challenges related to environmental and social determinants of health in informal settlements in Mbour, Senegal and to suggest policy directions and interventions to meet these challenges. Geographical and epidemiological surveys using a pre-structured questionnaire with all household heads were carried out to assess the structural and intermediary determinants of health in informal settlements in Mbour. Our results showed that informal settlements residents in Mbour suffer from many challenges like poverty, unemployment, illiteracy, and low education attainments, unhealthy environment, lack of water supply and basic sanitation facilities; high prevalence of infectious diseases, particularly diarrheal diseases among under 5 years old children. Specific policy directions should be developed and implemented by policymakers and local authorities to meet these challenges by prioritizing interventions related to water, sanitation and waste management with a view to reducing the environmental and health risks in informal settlements in Mbour. With the Sustainable Development Goals (SDGs) focused on improving health and wellbeing for billions of city-dwellers, ameliorating the immediate living conditions in informal settlements should be viewed as a key strategy to promote health, equitable development and reduce climate change vulnerabilities in this context of global environmental change.

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**P-1177**

**Individual awareness and response to health messaging related to extreme heat**

**Presenter:** Shubhayu Saha, CDC, Atlanta, United States

**Authors:** S. Saha, M. Mirabelli;  
CDC, Atlanta, GA.

**Objective:** The frequency, intensity, and duration of extreme heat days are increasing across the United States. This study is a nationally representative assessment to (i) identify specific temperature ranges that individuals consider to be a public health risk (ii) document how individuals change behaviors when informed of a heat hazard; and (iii) understand the specific communication channels that individuals rely on for information about extreme heat. **Methods:** The study used data from a nationally representative survey of 3624 adults who responded to the spring wave of the ConsumerStyles survey. The survey responses were linked with information about the annual number of extreme heat days, as recorded by the National Oceanic and Atmospheric Administration (NOAA), and number of heat alerts issued by the National Weather Service in respondents' zip codes. Descriptive analyses were conducted to assess frequencies of responses by census region, age, gender, income, education, race, number of extreme heat days, and number of heat alerts. **Results:** Adults living in the Northeast and Midwest census regions consider health risk from heat at lower temperatures than adults in other regions. On average, men perceive health risk from heat at higher temperature than women. No patterns emerged between observed high temperature days in 2019 and what individuals considered to be a 'hot day'. Individuals reported obtaining information about heat days mainly from the television, followed by radio and the internet. Changing outdoor activity schedule, staying hydrated, and seeking air-conditioned places were the most common responses among individuals who were aware of high ambient heat. **Conclusion:** Variation in perceptions of health risk from extreme heat across different parts of the country reinforce the need to calibrate local heat warnings. Information on how people access and respond to information on extreme heat will help target vulnerable groups during heat days.

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**P-1178**

**Maternal folic acid supplementation mediates the association between maternal socioeconomic status and congenital heart diseases in offspring**

**Presenter:** Yanji Qu, Guangdong Cardiovascular Institute, Guangzhou, China

**Authors:** Y. Qu<sup>1</sup>, S. Lin<sup>2</sup>, M. S. Bloom<sup>2</sup>, X. Wang<sup>1</sup>, B. Ye<sup>2</sup>, Z. Nie<sup>1</sup>, Y. Ou<sup>1</sup>, J. Mai<sup>1</sup>, Y. Wu<sup>1</sup>, X. Gao<sup>1</sup>, H. Tan<sup>3</sup>, X. Liu<sup>1</sup>, J. Zhuang<sup>1</sup>;

<sup>1</sup>Guangdong Cardiovascular Institute, Guangzhou, CHINA, <sup>2</sup>State University of New York at Albany, Albany, NY, <sup>3</sup>Central South University, Changsha, CHINA.

**Background:** It is well known that low maternal socioeconomic status (SES) is associated with a significantly greater risk of congenital heart disease (CHD) in offspring than high maternal SES. However, the pathway underpinning this association is unclear. To help to fill this knowledge gap, we assessed first trimester maternal folic acid supplementation (FAS) as a mediator of the association between maternal SES and CHD in offspring. **Methods:** In this case-control study, we enrolled 8,379 CHD cases and 6,918 CHD-free controls from Guangdong province in southern China. All fetuses were screened for cardiac anomalies using basic ultrasound and CHD cases were confirmed using echocardiogram by two cardiologists in 40 participating centers. We adopted education, income and employment as indicators of SES, and defined education attainment <12 years, household individual income <3000 CNY/person/month and unemployment as low SES. We used causal mediation analysis to estimate the direct, indirect and mediated effects of FAS in the association between maternal SES and CHD, adjusted for maternal demographic characteristics, medication use, lifestyle and environmental factors, reproductive history and paternal exposures. **Results:** Low FAS prevalence mediated 10% (95%CI: 5%-13%) and 3% (95%CI: 1%-5%) of the CHD-maternal low income and the CHD-maternal low education associations, respectively. In addition, FAS mediation effects were strongest when using income as an SES indicator and for the most severe CHDs. Both low maternal income and education were associated with greater odds of CHD among offspring (OR=1.17, 95%CI: 1.09-1.25; OR=1.48, 95%CI: 1.29-1.70, respectively) and a lower prevalence of FAS (OR=0.31, 95%CI: 0.27-0.37; OR=0.44, 95%CI: 0.26-0.75, respectively). **Conclusions:** Maternal FAS partially mediated the association between maternal SES and CHD. Promoting FAS in low SES women of childbearing age may be a low cost and feasible intervention to help prevent CHDs under the conditions as in China.

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**P-1180**

### **Integrating Environmental Medicine into Pre-Clinical Physician Education: Lessons Learned**

**Presenter:** Nicholas Newman, Cincinnati Children's Hospital Medical Center, Cincinnati, United States

**Authors:** N. Newman<sup>1</sup>, J. Kiesler<sup>2</sup>;

<sup>1</sup>Cincinnati Children's Hospital Medical Center, Cincinnati, OH, <sup>2</sup>University of Cincinnati, Cincinnati, OH.

**Background:** Environmental exposures are responsible for approximately 10-12% of morbidity in the United States. Although the Institute of Medicine recommended integration of Environmental Medicine throughout the medical training continuum in 1995, currently medical students and residents in primary care only receive a few hours of Environmental Medicine throughout their 7 years of training. With renewed emphasis on teaching the social determinants of health, this is a venue to integrate environmental medicine into the curriculum. **Objective:** To create and evaluate Environmental Medicine integration in the pre-clinical teaching in an urban medical school in the United States. **Methods:** During two consecutive years (2018 & 2019), 1<sup>st</sup> year medical students (n=355) participated in a 2-hour Environmental Justice session during their "Physician & Society" class. Students were previously assigned to neighborhood-level service-learning groups (n=15) to identify and assist a local organization in addressing social determinants of health in that neighborhood. After a brief introductory lecture, groups were provided with neighborhood-specific US EPA EJSCREEN Lead Index data and childhood lead testing results from the Ohio Department of Health Data Warehouse. Graphical results by neighborhood were created by the students and displayed for the class to understand exposure-outcome associations during a facilitated Q&A session. A panel discussion followed that included representatives of families affected by lead poisoning, community organizations, and health professionals involved in childhood lead poisoning prevention. Students completed an anonymous on-line questionnaire about the session. **Results:** Eighty-two students (23%) completed the questionnaire: 89% reported that the community-level data and 90% reported that the panel discussion helped them achieve the learning objectives. Respondents rated their learning experience on a Likert scale (1=poor, 5=excellent) 3.9+0.8 (Mean+SD). **Discussion:** When integrated into a social determinants of health framework, pre-clinical medical students reacted positively to reviewing local epidemiological data and a panel discussion to teach environmental medicine concepts.

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**P-1181**

**Government actions and incidence of arboviruses :dengue, zika, chikungunya - a comparative analysis from 2015 to 2019**

**Presenter:** Renilda Martins Prestes, Hospital das Clínicas, Faculty of Medicine, University of São Paulo, São Paulo, Brazil

**Authors:** R. M. Prestes, T. Nery;  
Hospital das Clínicas, Faculty of Medicine, University of São Paulo, São Paulo, BRAZIL.

Government actions and incidence of arboviruses(dengue, zika, chikungunya):a comparative analysis from 2015 to 2019  
The increase in the flow of people to Brazil, resulting from events such as the World Cup, Carnival, Olympics and others, culminated in the expansion of communicable diseases such as fever by the vírus zika, chikungunya, dengue, among others according to Ministry of Health ( MS). These exanthematic diseases have common symptoms such as fever, rash and arthralgia lasting up to 10 days, being transmitted by the mosquito of the genus Aedes, where the humans are in an accidental host position. For diagnosis, in Brazil, in addition to clinical considerations, there are laboratory tests funded by the government in units referred by the Unified Health System. Zika, chikungunya, and dengue are arboviruses that do not have a specific vaccination. All of these arboviruses must be compulsorily notified to MS information systems that, through these epidemiological data, plan actions to prevent and control these diseases. Objective: Analyze epidemiological data on arboviruses in the period 2016-2019. Method: Descriptive study with analysis of MS databases and government actions. Results: in the years that more government actions were undertaken, such as in 2016, there was a reduction in the incidence in the following year in the three arboviruses of 84.04% (dengue), 68% (chikungunya) and 66% (zika). In detriment, when there was a decrease in government actions, as in 2019, the incidence increased in relation to the previous year: of Dengue in about 580%, Chikungunya in about 66%. Zika, in 2019, remained unchanged in terms of incidence, with the same number of government actions observed in the previous year. The results demonstrate that entomoepidemiological surveillance must be active to support preventive and mosquito control actions that carry flaviviruses, as well as to prevent outbreaks and the spread of these diseases.

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## ABSTRACT E-BOOK

Theme: **Research to policy**

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**P-1182**

### **The neglected critical contribution of epidemiology to the Strategic Approach to International Chemicals Management**

**Presenter:** Carlos Santos-Burgoa, George Washington University, Washington,

**Authors:** L. Rojas-Bracho<sup>1</sup>, M. Korc<sup>2</sup>, M. Gonzalez<sup>3</sup>, P. Breyse<sup>4</sup>, C. Santos-Burgoa<sup>5</sup>;

<sup>1</sup>Consejo de Salubridad General, Mexico City, MEXICO, <sup>2</sup>PAHO/WHO, Washington, DC, <sup>3</sup>Program Manager, OECD, FRANCE, <sup>4</sup>National Center for Environmental Health / CDC, Atlanta, GA, <sup>5</sup>GWU, Washington, DC.

Background: As knowledge advances in the detail of the toxicology to understand the adverse outcome pathways, the translation from hazard to risk is greatly advanced by the epidemiologic contributions. In SAICM epidemiology is mainly considered in biologic and research surveillance, but somewhat in the risk assessment. Significance: For most of the developing countries, the population distribution of exposures and disease is the key consideration for acting on the management of chemicals; still, the mainstream methods and implementation neglects this area of implementation, directly related to management (regulatory and not), and communication. Content: We will present what is SAICM and where is epidemiology currently considered in the approach, highlighting the contribution to stakeholders understanding of the dimension of the problem especially considering the context of developing countries. Then we review of the contributions of epidemiology to advance chemical regulatory action to protect population's health and assess how it is included in the SAICM. A special emphasis will be done on the contribution of epidemiology to the "risk characterization" that each country must do adequate to their environment and socio-demographic situation of their population when deciding on their acceptable risk and health impact. For this we will touch on the need for monitoring the exposure and health impact from toxicants and regulations in developing countries. We end up with calling for stronger epidemiologic methods contribution to the international management of chemicals.

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**P-1183**

### **The Utility of Systematic Evidence Maps for Data Poor Environmental Chemicals**

**Presenter:** Cynthia J Lin, ICF, Durham, United States

**Authors:** C. J. Lin<sup>1</sup>, A. E. Goldstone<sup>2</sup>, H. Hubbard<sup>1</sup>, C. R. Lemeris<sup>1</sup>, R. B. Blain<sup>1</sup>, N. L. Vetter<sup>1</sup>, K. Thayer<sup>3</sup>, E. G. Radke<sup>4</sup>;

<sup>1</sup>ICF, Durham, NC, <sup>2</sup>ICF, Fairfax, VA, <sup>3</sup>U.S. Environmental Protection Agency, Research Triangle Park, NC,

<sup>4</sup>U.S. Environmental Protection Agency, Washington, DC.

Chemical exposures are an important environmental health concern. The general population can be exposed to chemicals in food and consumer products, cleaning supplies, industrial and manufacturing activities, or agricultural applications on a regular basis. Conducting systematic reviews of these exposures can be challenging due to the sheer number of chemicals as well as the lack of available data in many contexts. Only a small percentage of chemicals will have undergone toxicologic evaluation, human exposure characterization, and epidemiologic analysis. Systematic evidence maps (SEMs) provide a comprehensive summary of the characteristics and availability of data. While the objective is not to synthesize evidence, SEMs can help reveal gaps in the literature and formulate research questions. By using a systematic process to document what is available, SEMs can aid in decision-making in various contexts, both regulatory and non-regulatory. For example, the U.S. Environmental Protection Agency can use SEMs to identify data gaps, understand the resources that would be needed for a full assessment, or prioritize key features for evaluation. This presentation will illustrate how SEM methods were applied to a broad group of over 150 data poor per- and poly-fluoroalkyl substances (PFAS) to narrow search results and identify relevant epidemiology studies that support human health assessment. Starting with a literature search resulting in over 10,000 studies, different levels of screening, including the application of machine learning, were employed to identify approximately 90 epidemiology studies that could then undergo detailed study evaluation and data extraction. In addition, visualization techniques will be demonstrated to show how to effectively explore datasets and how results can be presented to support different research or assessment needs.

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**P-1184**

**Public policies to promote the elimination of polluting fuels for cooking in households: lessons learned from Bolivia, Ecuador and El Salvador**

**Presenter:** Agnes Soares da Silva, Pan American Health Organization, Washington, United States

**Authors:** A. Soares da Silva, K. S. Troncoso;  
Pan American Health Organization, Washington, DC.

The use of solid fuels and kerosene for cooking is one of the main environmental risks to health worldwide, affecting more than 2.8 billion people. In Latin-American and the Caribbean, 90 million people (13% of population) concentrated primarily in nine countries still live in homes using these polluting fuels for cooking. In 2019, the Directing Bodies of the Pan American Health Organization approved an elimination initiative to provide an integrated sustainable approach to orient and guide Member States as they work toward the elimination of a group of priority communicable diseases and related conditions. One of the conditions targeted for elimination is the use of polluting fuels for cooking. This paper analyzes the public policies that have accelerated the access to cleaner energy sources for cooking in Bolivia, Ecuador and El Salvador. These countries implemented different schemes to subsidize the consumption of liquefied petroleum gas (LPG). In Ecuador the price of LPG has remained the same since 2002, and in Bolivia since 2005, with subsidies that have reached 90% in Ecuador and 70% in Bolivia. In El Salvador, a universal subsidy of 65% was removed in 2013 and replaced with a targeted subsidy to the poor that covers almost 70% of the population. As a result, 98%, 86%, and 81% of the population of Ecuador, El Salvador and Bolivia, respectively, now cook with LPG or electricity. These case studies corroborate our previous findings that public policies with economic incentives that promote universal access to cleaner energy sources are important for the transition to clean energy use. Even though most energy subsidies can be regressive, this is not the case for the energy subsidies for cooking as shown in these case studies. This should be taken into consideration when designing the necessary interventions to meet the 2030 Sustainable Development Goals.

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**P-1186**

### **Fish Consumption Advisories for Superfund Site Risk Management**

**Presenter:** Sam Byrne, St. Lawrence University, Canton, United States

**Authors:** S. Byrne;  
St. Lawrence University, Canton, NY.

Background: Polychlorinated biphenyls (PCBs) are a common environmental contaminant within fish species of New York State (NYS). The NYS Department of Health (DOH) issues fish consumption advisories to limit consumption of PCB contaminated fish. Fish consumption advisories may be incorporated into Superfund remedial action plans as “institutional controls” to limit exposure. Within heavily contaminated Superfund sites, the NYS DOH often recommends consuming no fish. There is limited research on the effectiveness of these advisories in preventing consumption of contaminated fish. Methods: We surveyed anglers actively fishing in two PCB contaminated Superfund sites 1) the lower Grass River in Massena, NY and 2) the Upper Hudson River from Glens Falls to Troy, NY. The goal of the survey was assess knowledge of the consumption guidelines, and if the guidelines are effectively preventing exposure to PCBs. Results and Conclusions: Most anglers are aware of and abide by fish consumption guidelines. Some anglers continue to consume fish caught from Superfund sites despite knowledge of the consumption guidelines. Risk assessment and management strategies for Superfund site-associated fisheries should not assume perfect adherence to fish consumption guidelines.

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**P-1187**

### **Improving State Allocations of the Congestion Mitigation and Air Quality Program through Health Research and Updated Pollution Measurements**

**Presenter:** Nicole Porco, New York University, New York, United States

**Authors:** N. Porco<sup>1</sup>, Q. Yuan<sup>2</sup>, K. Cromar<sup>1</sup>;

<sup>1</sup>New York University, New York, NY, <sup>2</sup>New York University, Shanghai, CHINA.

Emissions from mobile sources contribute a sizable fraction of air pollution emissions in most US cities, however due to jurisdictional limitations in the Clean Air Act, there are limited options available to address this problem. One of the primary tools available is approximately \$2.5 billion in annual funds distributed to states through the Congestion Mitigation and Air Quality Improvement (CMAQ) Program; however, it is unclear whether funds are allocated to states in a manner representative of adverse health impacts in the US. The evaluation of the CMAQ program consists of three parts: using the "Health of the Air" report to evaluate how current state allocations compare to health impacts from ambient air quality; conducting policy research to identify the characteristics of the current allocations to determine potential areas for improvements; and, modeling new allocations based on modifications to existing formulations to determine how funds could be best distributed in a way that is reflective of air quality impacts. Current CMAQ allocations are not reflective of air quality burdens in the US. Some states are unfairly benefiting from this inequality while others are not receiving sufficient resources to combat high levels of mobile-source air pollution. This misallocation is primarily attributable to the use of outdated equations (30 years), and outdated pollution and population data (20 years). Newly formulated equations using fine particle pollution instead of carbon monoxide, monitored concentrations rather than attainment/maintenance status, and updated population/pollution data result in dramatic improvements in determining proportional allocations. Improvements need to be incorporated into future allocations of CMAQ funding to remedy the inequalities identified in this study. The findings of this applied research project have already been drafted into an amendment that will be proposed as part of the national highway bill currently being written by the US House Committee on Transportation and Infrastructure.

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**P-1188**

**Epidemiological research contributions to local policies of air quality management in the region of Aburra Valley in Colombia.**

**Presenter:** Juan Gabriel Pineros-Jimenez, Universidad de Antioquia, Medellin, Colombia

**Authors:** J. Pineros-Jimenez<sup>1</sup>, N. Montealegre<sup>1</sup>, F. Villa<sup>2</sup>, A. Orrego<sup>3</sup>, A. Molina<sup>3</sup>;

<sup>1</sup>Universidad de Antioquia, Medellin, COLOMBIA, <sup>2</sup>Universidad Nacional de Colombia, Medellin, COLOMBIA, <sup>3</sup>Area Metropolitana del Valle de Aburra, Medellin, COLOMBIA.

Area Metropolitana del Valle de Aburra- AMVA, environmental authority of ten municipalities in Colombia, has developed the Integrated Management Plan for Air Quality 2017-2030, whose thematic axis 1 proposes strategies such as the design and implementation of an Environmental Health Surveillance System, based on the strengthening of scientific bases and the development of a scientific research agenda. Since 2016, a collaborative process has been set up between AMVA and the public health academic sector in the region. In the first phase (2016-2017), a research of acute events associated to short-term exposure to air pollutants (daily increases of 10  $\mu\text{g}/\text{m}^3$  of  $\text{PM}_{10}$ ,  $\text{PM}_{2.5}$  and  $\text{O}_3$ ) in vulnerable population (under 5 years of age and older adults 65 years old) for each municipality between 2008 and 2015 was developed. This research achieved important methodological developments, such as: 1) the processes of imputation of data of air pollutants not available and the assembly of unique series by municipality; 2) The identification of cases of sentinel events from health care records using data mining techniques and learn machine for traceability of records, 3) the construction of relational databases for big data analysis, 4) the automation of decision-making trees for the construction of explanatory GAM-type models, and 5) the analysis of critical contamination episodes. In its second phase (2017-2018) A prototype of a computational tool was designed in which methodological developments were integrated into data management and analysis. In the third phase (2018-2019), knowledge management processes were developed and epidemiological analyzes for Environmental Health Surveillance were perfected, as well as a web platform - SIVISA was created in order that community actors and decision makers can learn about the phenomenon, manage knowledge, design actions and follow local plans and policies.

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**P-1189**

### **The Impact of Fossil-Fuels and Biomass Combustion on Outdoor PM<sub>2.5</sub> Mass Associations with Respiratory Emergency Department Visits in Dhaka, Bangladesh**

**Presenter:** Mostafijur Rahman, New York University School of Medicine, New York, United States

**Authors:** M. Rahman, G. Thurston;  
New York University School of Medicine, New York, NY.

**Introduction:** Developed world studies report associations between particle air pollution and increased risk of emergency department (ED) visits for respiratory diseases, but few were conducted in the south Asia region, where PM<sub>2.5</sub> composition is different. Differences are from greater biomass and residue crop-burning, which may have differing health impacts from past PM<sub>2.5</sub> studies. Despite that fact, an “equal toxicity” assumption has been made in most global PM<sub>2.5</sub> effect estimates. We evaluated this assumption in Dhaka. **Methods:** The acute effects of PM<sub>2.5</sub> and source component's on 38,233 respiratory ED visits during 2014-2017 were assessed using time-series modeling, adjusted for temporal trend, day of week, holidays, relative humidity, and temperature. Daily counts of respiratory ED visits were obtained from National Institute of Chest Diseases and Hospital. Analyses were conducted to test for seasonal effect modification by including dummy variables for monsoon vs. non-monsoon seasons. **Results:** PM<sub>2.5</sub> yielded statistically significant association with increased respiratory ED visits [Excess Risk, ER=0.88%, 95%CI: 0.37%, 1.39%] per 10 µg/m<sup>3</sup> increase. The effect of PM<sub>2.5</sub> air pollution per 10 µg/m<sup>3</sup> varies with season, with the highest during monsoon season [2.84%, 95%CI: 0.74, 4.91] vs. non-monsoon season [0.77%, 95%CI: 0.23%, 1.31%], suggesting that the effect size per unit mass is much larger when fossil-fuel combustion sources dominated exposures, with effect per unit mass declining when crop-burning and dust sources dominated exposures. A source-specific health effect analysis model using elemental source tracers provided consistent results, with fossil-fuel PM<sub>2.5</sub> having a larger ER per 10 µg/m<sup>3</sup> than biomass-combustion PM<sub>2.5</sub>.

**Conclusion:** This study found that the respiratory health in Dhaka is significantly affected by particle air pollution, with greater impact by fossil-fuel PM<sub>2.5</sub>. This disparity in health impact by PM<sub>2.5</sub> source origin should be considered in PM<sub>2.5</sub> risk assessment, PM<sub>2.5</sub> mitigation measure prioritization, and clinical advice.

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Theme: **Respiratory health**

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**P-1191**

### **Phthalate Exposure and Developmental Delay in Children**

**Presenter:** I-Jen Wang, Taipei Hospital Ministry of Health and Welfare; Taichung Hospital Ministry of Health and Welfare; National Taiwan University; National Yang-Ming University; China Medical University, New Taipei City, Taiwan

**Authors:** I. Wang;

Taipei Hospital Ministry of Health and Welfare; Taichung Hospital Ministry of Health and Welfare; National Taiwan University; National Yang-Ming University; China Medical University, New Taipei City, TAIWAN.

**Abstract:** Background: The role of phthalate exposure at different stages in the nervous system is not well-known. This study aims to evaluate the effects of phthalate exposures on immunoglobulin E (IgE) levels and developmental delay in children by objective biomarkers. Methods: A total of 453 children from Childhood Environment and Allergic Diseases Study cohort with urine samples were recruited in Taiwan. Urine phthalate metabolites (MEP, MBP, MBzP, and 5OH-MEHP) were measured by UPLC-MS/MS at age 3. At age 6, information on the development of developmental delay and serum total IgE were collected. The association between urine phthalate metabolites levels at different stages and serum IgE and developmental delay were evaluated by multivariate linear regression and logistic regression. Results: Urine phthalate metabolites levels were higher at age 3 than those at age 6. 5OH-MEHP levels at age 3 positively correlated with serum IgE levels (per ln-unit:  $\beta=0.191$ ,  $p=0.02$ ). When dividing into quartiles, urine 5OH-MEHP levels at age 3 were associated with the developmental delay at age 6 (adjusted OR=3.65, 95%CI (1.11-11.98)). MEP, MBP, and MBzP levels were also positively associated with the developmental delay, though failed to reach statistically significance. Interestingly, analyses stratified by gender revealed that 5OH-MEHP levels were significantly associated with developmental delay, particularly in boys with OR (95%CI) of 4.40(1.10-17.58). Conclusion: Early life phthalate exposure may increase the risk of developmental delay, particularly in boys.

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**P-1193**

**Prevalence of Hookah smoking and associated factors among male high school students in Iraq**

**Presenter:** Ahmed K Al-Delaimy, Anbar Medical College, University of Anbar, Baghdad, Iraq

**Authors:** A. K. Al-Delaimy, W. Al-Ani;  
Anbar Medical College, University of Anbar, Baghdad, IRAQ.

Prevalence of Hookah smoking and associated factors among male high school students in Iraq. AbstractBackground: The use of the hookah-smoking device is increasing at a large scale in the Eastern Mediterranean region and reaching to Western countries. Hookah smoke users are exposed to a lot of chemical compounds and several chronic diseases. The purpose of this study was to determine the prevalence of hookah use among male high school students and to study different associated factors linked with hookah smoking. Methods: A descriptive cross-sectional study was conducted among students in three high schools (for males only) in the Karkh District, Baghdad. The study period was from Oct. 2017 till Jan. 2019 and included 847 male students. A structured Knowledge Attitude and Practice questionnaire were used to identify their knowledge and use of hookah smoking. Descriptive, chi-square, bivariate, and multivariate logistic regression analysis of data was carried out using the available statistical package of SPSS-25. Results: The overall prevalence of hookah smoking among high school male students was high (46%). More than two-thirds (70.6%) of them think that waterpipe smoking is acceptable socially more than cigarette smoking. More than half of the participants (55%) first heard about hookah smoking from friends and friends constitute close to two-thirds (65.2%) of those who smoke hookah around students. Almost half of the respondents think hookah smoking is not encouraged in the faith of Islam (47.3%) and less than a quarter (20.9%) think it's completely forbidden in Islam. Conclusions: Hookah smoking is increasing among high school students and becoming a socially acceptable behavior that needs preventive strategies targeting this age group.

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**P-1194**

**Associations of air pollution and greenness with all-cause mortality in Greece: an ecological study**

**Presenter:** Evangelia Samoli, Department of Hygiene, Epidemiology and Medical Statistics, Medical School, National and Kapodistrian University of Athens, Athens, Greece

**Authors:** M. I. Kasdagli<sup>1</sup>, K. Katsouyanni<sup>1</sup>, K. de Hoogh<sup>2</sup>, P. Lagiou<sup>1</sup>, E. Samoli<sup>1</sup>;

<sup>1</sup>Department of Hygiene, Epidemiology and Medical Statistics, Medical School, National and Kapodistrian University of Athens, Athens, GREECE, <sup>2</sup>Swiss Tropical and Public Health Institute, Basel, Switzerland; University of Basel, Basel, SWITZERLAND.

Background/Aim: Epidemiological studies have documented the health effects of long-term exposure to fine particulate matter (PM<sub>2.5</sub>), while fewer studies have investigated the effects of exposure to nitrogen dioxide (NO<sub>2</sub>), black carbon (BC) and even less to ozone (O<sub>3</sub>). There is limited evidence for the synergistic effects of exposure to pollutants and proximity to green spaces. We investigated the association of long-term exposure to air pollution and greenness with all-cause mortality in Greece using a geographical ecological study. Methods: Mortality and socioeconomic data were obtained from 1035 municipal units from the 2011 census data. Annual average PM<sub>2.5</sub>, NO<sub>2</sub>, BC and O<sub>3</sub> concentrations for 2010 were derived from 100x100m surfaces predicted by hybrid LUR models developed within the ELAPSE project. The normalized difference vegetation index was used for greenness. We applied generalized additive models on standardized total mortality rates (SMRs) adjusted for socioeconomic indicators and lung cancer rates and accounting for spatial autocorrelation. The analysis was conducted for the whole country and by urban and rural areas. We assessed interactions between pollutants and green space and two-exposure models. Results: PM<sub>2.5</sub>, NO<sub>2</sub> and BC were significantly associated with mortality: an interquartile range (IQR) increase was associated with a Relative Risk (RR) of 1.09, (95% confidence interval (CI): 1.08-1.11), 1.03 (95% CI: 1.03-1.04) and 1.02 (95% CI: 1.02-1.03), respectively. The associations were stronger in urban areas. Greenness was associated with lower mortality (RR: 0.95, 95% CI: 0.94 - 0.96 per IQR). An inverse association with O<sub>3</sub> was found. We did not find any statistically significant interaction between pollution and green spaces, while estimates were mostly robust to co-exposure adjustment. Conclusions: Our findings support independent associations of air pollution exposure and green spaces with total mortality, both in the urban and rural areas in Greece that are of importance for public health policy and urban development.

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**P-1195**

**Alteration in Plant Phenology and Asthma hospitalization in New York State**

**Presenter:** Hyeonjin Song, University of Maryland, College Park, United States

**Authors:** H. Song<sup>1</sup>, L. Li<sup>2</sup>, A. Sapkota<sup>1</sup>;

<sup>1</sup>University of Maryland, College Park, MD, <sup>2</sup>Wuhan University, Wuhan, CHINA.

**Background/Aim.**Recent trend in warming temperature is changing the timing of spring onset for deciduous trees, that are dominant source of springtime pollen. Such changes can alter springtime pollen exposure dynamics and negatively impact burden of allergic disease including asthma hospitalization.**Methods.**We used phenology data from the Landsat series to calculate a cardinal date for start of spring (SOS) for each county within the state of New York for the years 1996–2016. We categorized yearly deviations in SOS for each county (N=62) from their respective long-term averages as: early (>7 days early), average (within 7 days), and late (>7 days late). We linked this changes in SOS to springtime asthma hospitalization counts in the respective 62 counties during 1996 to 2016, obtained from Healthcare Cost and Utilization Project (HCUP). We investigated the association between deviations in SOS and springtime asthma hospitalizations using negative binomial Generalized Estimating Equations.**Results.**We observed that counties in lower latitudes had earlier SOS while counties in higher latitudes had later SOS. There was considerable variability in cardinal date for SOS ranging from 88 to 135 in lower latitudes and 114 to 134 in higher latitudes. During the 20-year period, there was a negative trend in SOS and this change was more pronounced in higher latitudes. During 1996-2016, there were 502,103 asthma inpatient hospitalizations in the New York state. In depth analysis is ongoing to investigate the relationship between changes in timing of spring onset and asthma hospitalization in New York State.**Conclusions.**Our data shows that changes in timing of spring onset is associated with asthma hospitalization rates.

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**P-1196**

### **Understanding workplace exposures and potential health effects of carbon nanotubes and nanofibers in the United States**

**Presenter:** Kaitlin Kelly-Reif, National Institute for Occupational Safety and Health, Cincinnati, United States

**Authors:** K. Kelly-Reif<sup>1</sup>, M. M. Dahm<sup>1</sup>, M. K. Schubauer-Berigan<sup>2</sup>;

<sup>1</sup>National Institute for Occupational Safety and Health, Cincinnati, OH, <sup>2</sup>International Agency for Research on Cancer, Lyon, FRANCE.

Background: Toxicologic and cross-sectional epidemiological studies indicate that inhalation of carbon nanotubes and nanofibers (CNT/F) may cause adverse health effects, but large longitudinal studies are needed to better understand risks associated with handling CNT/F. Researchers at the United States National Institute for Occupational Safety and Health have undertaken a multifaceted approach to characterize and quantify CNT/F workplace exposures and health risks, culminating in the development of an exposure registry and prospective cohort study of CNT/F workers. Methods: Companies in the US that handle CNT/F and operate above the research and development phase are being recruited into the exposure registry. Participating companies are asked to provide complete worker rosters, including demographic information and job tasks for each worker. The exposure registry relies on prior exposure assessments, regression models, and expert opinion to estimate exposures from work history records. After recruitment is complete, records will be used as the basis for a prospective cohort study. Linkage to the National Death Index will be used to assess for mortality outcomes. Additional outcomes will be assessed by questionnaire. Disease rates will be assessed by occupational CNT/F exposure level and compared to disease rates in the US population. Results: The exposure registry is open and continues to recruit companies that handle CNT/F. To date, approximately 600 individual workers with potential exposure to CNT/F at 13 facilities have been included in the exposure registry. By the end of 2022, researchers plan to collect a total of 1,500 worker records. Exposure assessments have demonstrated that CNT/F exposures are occurring in the workplace, and workers who handle CNT/F can experience a wide range of occupational CNT/F exposure. Conclusions: Through the development of an exposure registry and subsequent prospective cohort study, researchers will be able to more quickly identify the development of adverse health conditions, if any exist.

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**P-1197**

**Premature Mortality 30-69 years old of age by Respiratory Disease in Brazil, according to region and sex. Information for construction and adoption preventive measures**

**Presenter:** TELMA NERY, INCOR FMUSP, São Paulo, Brazil

**Authors:** T. NERY<sup>1</sup>, N. Bispo<sup>2</sup>;

<sup>1</sup>INCOR FMUSP, São Paulo, BRAZIL, <sup>2</sup>University Center Sao Camilo, São Paulo, BRAZIL.

According to the World Health Organization chronic respiratory diseases account for 7% of overall mortality. In Brazil they are the third cause of death, with important social impact. Premature mortality generates more important impacts. Knowing this profile by identifying patterns by region and sex, contributes to the adoption of more effective preventive measures. Objectives: To analyze the profile of premature mortality due to respiratory diseases in Brazil by geographic region and sex. Descriptive study, With analysis of the database of the Monitoring Panel by ICD10 (J 30-J98) of the Ministry of Health. Period 2014-2016. Used IBGE data for population calculations. Rates and calculations per 100 thousand. Data analyzed by spss. Respiratory diseases present similar annual increases in all regions. When analyzed by sex, the Southeast region showed an increase of 7.97% for women and 6.03% for men and the southern region showed a greater increase in mortality in women, with an increase of 14.20% in the last period, while men 3,92%. Several factors contribute to the impact of chronic diseases, such as access to medicines, tobacco, physical activity practices. The analysis of premature mortality from 30 to 69 years of age and regions by respiratory diseases contributes to the adoption of specific and differentiated preventive measures, in particular with the rate increase in the female population. The analysis of premature mortality from 30 to 69 years of age and regions by respiratory diseases contributes to the adoption of specific and differentiated preventive measures, in particular with the rate increase in the female population. Clinical Implications: To identify characteristics and phenotypes of patients due to respiratory diseases, contributes to an improved therapeutic and preventive clinical approach

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Theme: **Respiratory health**

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**P-1198**

**Household air pollution (HAP) from solid biomass fuel and lung inflammation: An exposure study in rural high altitude households of Nepal.**

**Presenter:** Binaya KC, Kathmandu University, Dhulikhel, Nepal

**Authors:** B. KC<sup>1</sup>, P. Sarathi Mahapatra<sup>2</sup>, C. Billington<sup>3</sup>, D. Thakker<sup>3</sup>, A. Henry<sup>3</sup>, S. Puppala<sup>2</sup>, B. Shrestha<sup>1</sup>, I. Hall<sup>3</sup>;

<sup>1</sup>Kathmandu University, Dhulikhel, NEPAL, <sup>2</sup>International Centre for Integrated Mountain Development, Kathmandu, NEPAL, <sup>3</sup>University of Nottingham, Nottingham, UNITED KINGDOM.

**Background/Aim** Biomass smoke exposure is the leading cause of morbidity and mortality worldwide, disproportionately affecting low and middle income countries. The domestic smoke exposure pattern and its pulmonary effect have not been explored in high altitude Himalayan regions. This study aimed to (i) monitor the status of HAP in homes using biomass fuel in one rural high altitude (4000 m) Nepalese village and (ii) assess the short term effect of exposure on lung inflammation.

**Methods** Real-time cooking period exposure to particulate matter (PM<sub>2.5</sub>) and carbon monoxide (CO) was monitored in 14 households specifically 9 households with improved cook stove (ICS) and 5 households with traditional cook stove (TCS). Simultaneously with the exposure monitoring, biomass smoke sample was collected in cell and tissue culture media (DMEM). The samples were used to stimulate ex vivo human lung tissue in a short term exposure tissue culture model and pro-inflammatory cytokines were measured in the resulting culture supernatant.

**Results** The cooking period average PM<sub>2.5</sub> and CO concentration were significantly reduced from 746 µg/m<sup>3</sup> (95% CI: 350, 1142) to 91.2 µg/m<sup>3</sup> (95% CI: 37.3, 145.2) and 12.56 ppm (95%CI: 6.7, 18.4) to 2.6 ppm (95% CI: 1.74, 3.6) among household using TCS and ICS respectively. A range of pro-inflammatory cytokines were detected with the fold stimulation of ~2 fold for IL-8 and IL-6, ~2.5 fold for IL-1β and ~3.5 fold for TNF-α. However, no significant variations in the levels of these cytokines were observed among the samples from two stove designs.

**Conclusions** The increased level of inflammatory cytokines from lung tissue revealed short term exposure to high levels of indoor pollutants elicits marked airway inflammation. The people using ICS in this region are exposed to lower concentration of indoor pollutant; however remain likely to be at risk of developing airway inflammation despite ownership of ICS.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1199**

**Temperature as a modifier of the effects of air pollution on respiratory disease hospital admissions in Pretoria, South Africa**

**Presenter:** Adewale Adekunle Adeyemi, University of Pretoria, Pretoria, South Africa

**Authors:** A. A. Adeyemi<sup>1</sup>, P. Molnar<sup>2</sup>, J. Wichmann<sup>1</sup>;

<sup>1</sup>University of Pretoria, Pretoria, SOUTH AFRICA, <sup>2</sup>University of Gothenburg, Gothenburg, SWEDEN.

**Background.** Air pollution is a major threat to industrialised cities across the world, with known detrimental outcomes for human health. We explored if hospital admissions for respiratory disease were associated with PM<sub>10</sub>, NO<sub>2</sub> and SO<sub>2</sub> in Pretoria from 1 January 2011 to 30 November 2014, and if apparent temperature (T<sub>app</sub>) had a modifying effect on any associations. **Aim.** Determine if hospital admissions for respiratory disease were associated with air pollutants (PM<sub>10</sub>, NO<sub>2</sub>, and SO<sub>2</sub>) in Pretoria, South Africa. **Method.** We obtained individual-level respiratory disease hospital admissions data from three hospitals in Pretoria, South Africa, from 1 January 2011 to 30 November 2014. Over four years, 27 480 patients were admitted. We used a time-stratified case-crossover epidemiology study design and conditional logistic regression models to investigate the association between respiratory admissions and PM<sub>10</sub>, NO<sub>2</sub> and SO<sub>2</sub>. **Results.** Over the study period, 17 647 patients were admitted for respiratory disease. Daily PM<sub>10</sub> levels exceeded the daily WHO air quality limit (50 µg/m<sup>3</sup>) on 662 days. The mean apparent temperature (T<sub>app</sub>) was 16.6°C. PM<sub>10</sub>, NO<sub>2</sub>, and SO<sub>2</sub> were negatively correlated with T<sub>app</sub>, temperature and relative humidity. In the study period, a 10 µg/m<sup>3</sup> increase in PM<sub>10</sub> was associated with an increase of 0.2% (-0.7%; 1.2%) in hospital admissions. On warm days, a 10 µg/m<sup>3</sup> increase in NO<sub>2</sub> increased hospital admissions by 19.0% (2.3; 38.4). Respiratory disease admissions were not associated with SO<sub>2</sub>. **Conclusion.** Overall, ambient PM<sub>10</sub> and NO<sub>2</sub> levels in Pretoria are associated with more hospital admission, mostly on warm days, among young children and the elderly.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1200**

**Associations between exposure to biorefineries and respiratory diseases in New York State using two exposure assessment methods**

**Presenter:** Eun Kyung Lee, Case Western Reserve University, Cleveland, United States

**Authors:** E. Lee<sup>1</sup>, X. X. Romeiko<sup>2</sup>, B. J. Feingold<sup>2</sup>, H. A. Khwaja<sup>3</sup>, W. Zhang<sup>2</sup>, X. Zhang<sup>4</sup>, S. Lin<sup>2</sup>;  
<sup>1</sup>Case Western Reserve University, Cleveland, OH, <sup>2</sup>University at Albany, State University of New York, Albany, NY, <sup>3</sup>Wadsworth Center New York Department of Health, Albany, NY, <sup>4</sup>Pacific Northwest National Laboratory & University of Maryland, College Park, MD.

**Background:** The U.S. national energy policies have mandated large volumes of bioenergy production of ~36 billion gallons by 2022. Although previous studies have reported increased risks of respiratory diseases among residents living near industrial areas, little is known about the specific health impacts associated with biofuel production. This study used two exposure assessment methods to examine the associations of residential proximity to biorefineries and biorefinery-emitted air pollutants with respiratory diseases in New York State (NYS).

**Methods:** We conducted a cross-sectional study using two exposure assessment methods: (1) residential proximity (within 10 km) to biorefinery facilities in NYS and (2) residential exposure to American Meteorological Society/EPA Regulatory Model (AERMOD)-predicted air pollutants of fine particulate matter (PM<sub>2.5</sub>), sulfur dioxide (SO<sub>2</sub>) and nitrogen dioxide (NO<sub>2</sub>). Respiratory diseases included emergency department (ED) visits due to asthma, chronic bronchitis, emphysema and chronic obstructive pulmonary disease between 2011 and 2015. After adjusting for age, sex, race, temperature, relative humidity and background air pollutants, we obtained rate ratios (RR) and 95% confidence intervals using Poisson regression.

**Results:** Results derived from the two exposure methods consistently indicated positive and significant associations between respiratory ED visits and residential distance from biorefineries. For residents living within 10 km from the biorefineries, the RR values were between 1.03 and 11.2. We also found that the RR values were much higher for soybean and corn biorefineries (RR: 1.35-3.63) than for wood biorefineries (RR: 1.00-1.66). Furthermore, the associations varied with season, with fall (RR: 2.61-12.3) and spring (RR: 2.39-11.8) stronger than winter and summer.

**Conclusions:** This study suggests that residing within 10 km from biorefineries in NYS leads to significantly higher risks of respiratory diseases. Seasonality analysis shows that the risks are particularly higher in fall and spring. Future measures to control pollution damage should consider residential distance, emissions source and seasons.

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Theme: **Respiratory health**

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**P-1201**

**Associations of pesticide use with allergic and non-allergic wheeze among women in the Agricultural Health Study (2005-2010)**

**Presenter:** Jessica Y Islam, North Carolina State University, CHAPEL HILL, United States

**Authors:** J. Y. Islam<sup>1</sup>, A. S. Mohamed<sup>1</sup>, D. M. Umbach<sup>2</sup>, S. J. London<sup>2</sup>, P. K. Henneberger<sup>3</sup>, L. E. Beane<sup>4</sup>, D. P. Sandler<sup>2</sup>, J. A. Hoppin<sup>1</sup>;

<sup>1</sup>North Carolina State University, CHAPEL HILL, NC, <sup>2</sup>National Institute of Environmental Health Sciences, National Institutes of Health, Research Triangle Park, NC, <sup>3</sup>National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, WV, <sup>4</sup>National Cancer Institute, National Institutes of Health, Rockville, MD.

**Background:** Pesticide use may contribute to respiratory symptoms; allergy may modify this association. Most prior evidence on pesticides and respiratory symptoms comes from studies of men. **Objective:** To study pesticide use and respiratory symptoms in women, we evaluated the association of pesticide use with allergic and non-allergic wheeze among women in the Agricultural Health Study (AHS), a prospective study of farmers in their spouses in North Carolina and Iowa. **Methods:** Using self-reported data for 20,164 women who completed the 2005-2010 AHS interview, we evaluated cross-sectional associations between allergic and non-allergic wheeze with current use of 19 pesticides. We defined allergic wheeze as reporting wheeze and doctor-diagnosed hay fever (7%) and non-allergic wheeze as reporting wheeze but not hay fever (8%) in the past 12 months. Using women without wheeze as the referent, we used polytomous logistic regression to estimate odds ratios (OR) and 95% confidence intervals (CI) adjusted for age, body mass index, state, current asthma, and smoking. **Results:** Current use of any pesticide was reported by 1,425 women (7%) and was associated with both allergic (OR:1.36, 95% CI:1.10-1.67) and non-allergic (OR:1.25, 95% CI=1.04-1.51) wheeze. Glyphosate was the most frequently used pesticide (4%). Glyphosate, carbaryl, and malathion were associated with both allergic and non-allergic wheeze. In addition, diazinon and fly spray were associated with allergic wheeze, whereas dicamba and triclopyr were associated with non-allergic wheeze. Because glyphosate was the most commonly used pesticide, we evaluated whether glyphosate confounded the other pesticide associations. After adjusting for glyphosate use, only diazinon and fly spray remained associated with allergic wheeze and carbaryl with non-allergic wheeze. **Conclusion:** Our findings suggest that specific pesticide use may contribute to allergic and non-allergic wheeze among farm women.

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Theme: **Respiratory health**

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**P-1202**

### **Morbidity, and Mortality of Unintentional Carbon Monoxide Poisoning: United States 2005-2016**

**Presenter:** Mikyong (Meekie) Shin, CDC National Center for Environmental Health, Atlanta, United States

**Authors:** M. Shin, E. Glidden, M. Malone, R. Law, A. Chang, T. Boehmer, H. Strosnider;  
CDC National Center for Environmental Health, Atlanta, GA.

**Background** Carbon monoxide (CO) is a colorless, odorless, nonirritating gas that is produced through the incomplete combustion of carbon-containing substances. CO poisoning is a leading cause of unintentional poisoning deaths in the United States. The Centers for Disease Control and Prevention (CDC) routinely collects surveillance data from different sources to better understand unintentional CO exposures and identify potential environmental risk factors. **Methods** We used four different data sources to track unintentional CO-related exposures and CO poisoning: exposures called to poison control centers (PCCs), emergency department (ED) visits, hospitalizations, and mortality for 2005-2016. We conducted descriptive analyses by cause (fire, non-fire, unknown), month, age, region, and medical outcome (no effect, minor effect, moderate effect, major effect, and death). **Results** Over the 12-year study period, we observed 141,762 PCCS calls (national), 92,390 ED visits (16 states), 14,816 hospitalizations (25 states), and 12,478 deaths (national) due to unintentional CO poisoning. Non-fire unintentional cases comprised more than 70% of all hospitalizations and ED visits and 48% of all deaths compared to other unintentional cases. Across all data sources, CO exposures and poisonings were most commonly reported in January and December. Adults aged 50-59 years were the highest proportions for hospitalizations (19.7%) and deaths (17.0%). For PCC data, CO exposures were most frequently reported among children aged 0-9 years (21.1%) and in Northeastern states (>70 per 100,000 population). Medical outcomes were most often reported as none or minor effect (n=146,067, 72.2%) in PCC data. **Conclusions** This surveillance report provides the most comprehensive review of unintentional CO poisonings in the US. Unintentional CO poisoning remains a public health concern. More standardized and continued public health surveillance of unintentional CO poisoning will be necessary to monitor the public health burden, identify novel exposure pathways, and assess the effectiveness of targeted prevention strategies.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1204**

**Summation of concentration-response shapes by lagged exposure  
Summation of concentration-response shapes by lagged exposure**

**Presenter:** Mieczyslaw Szyszkowicz, Health Canada, Ottawa, Canada

**Authors:** M. Szyszkowicz;  
Health Canada, Ottawa, ON, CANADA.

**Aim:** Air pollutants may negatively affect a large spectrum of human health conditions. Among the statistical methods used to assess the impact of concentrations of ambient air pollutants on health are the time-series and case-crossover methods. Traditionally, both methods estimate risk in linear forms. Recent studies indicate that non-linear representations are more adequate and accurate. **Methods:** We investigate the association between daily emergency department (ED) visits for all respiratory conditions and daily concentration of ambient ozone. We retrieve ED data for Edmonton, Canada, for the period April 1992 - March, 2002, (3,652 days) using the ICD-9 codes 460-519. The case-crossover technique is realized as a conditional Poisson regression. We test lags from 0 to 8 days and determine 9 concentration-response (c-r) shapes. **Results:** 292,285 ED visits were identified and used in the study. Lagged exposures result in positive and statistically significant associations between ozone concentration and ED visits for respiratory conditions. The concentration-response shapes change according to the lags considered. Various forms of c-r shapes are observed, such as an almost linear shape, an S-profile, and others. The amalgamated by used lags c-r function provides a good tool to summarize the risk relating to the concentration of the considered air pollutant. In general, the results are non-linear parametric risk functions of the concentrations. **Conclusion:** The estimated functions allow the identification of concentrations with various intensities of impact on health. In some cases, these functions indicate a potential threshold concentration.

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Theme: **Respiratory health**

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**P-1205**

**Long term exposure to fine particulate matter and development of chronic obstructive pulmonary disease in the elderly**

**Presenter:** Changwoo Han, Chungnam National University College of Medicine, Daejeon, Korea, Republic of

**Authors:** C. Han<sup>1</sup>, J. Oh<sup>2</sup>, Y. Lim<sup>3</sup>, S. Kim<sup>4</sup>, Y. Hong<sup>5</sup>;

<sup>1</sup>Chungnam National University College of Medicine, Daejeon, KOREA, REPUBLIC OF, <sup>2</sup>Ewha Womans University of Medicine, Seoul, KOREA, REPUBLIC OF, <sup>3</sup>University of Copenhagen, Copenhagen, DENMARK, <sup>4</sup>Ajou University, Suwon, KOREA, REPUBLIC OF, <sup>5</sup>Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF.

Background Studies evaluating the role of long-term exposure to fine particulate matter (PM<sub>2.5</sub>) on chronic obstructive pulmonary disease (COPD) development showed inconsistent results and were limited to Western countries. We aimed to determine the association between long-term exposure to PM<sub>2.5</sub> and COPD development in metropolitan cities in Korea, which have higher PM<sub>2.5</sub> levels than those in Western country studies. Methods We constructed a retrospective cohort (elderly aged over 65 years who resided in 7 metropolitan cities in 2008) using Korea health insurance data. A total of 687,940 elderly who had not visited hospitals due to COPD for 3 years (from 2008 to 2010) were followed-up from 2011 to 2016. The first hospital visit due to COPD during the follow-up period was regarded as COPD development. Daily district-level PM<sub>2.5</sub> concentrations were estimated by chemical transport model and 60-month moving average PM<sub>2.5</sub> were assigned to each subject in time-varying Cox proportional hazard model. Results The mean concentration of modelled PM<sub>2.5</sub> in 7 metropolitan cities during the study period (from 2006 to 2016) was 28.0 µg/m<sup>3</sup> and 259,700 subjects newly visited the hospital due to COPD. COPD hospital visit hazard ratio for a 10 µg/m<sup>3</sup> increase in 60-month moving average PM<sub>2.5</sub> concentration was 1.09 (95% confidence interval: 1.07, 1.11). Risks remained unchanged following different PM<sub>2.5</sub> exposure levels (48-month moving average, and average PM<sub>2.5</sub> concentrations for 2008 and 2008-2010) and in subgroup analysis by subject characteristics (sex, age, and income groups). Discussion By following-up 687,940 elderly subjects who resided in metropolitan cities in Korea for 6 years, long-term PM<sub>2.5</sub> exposure showed association with COPD development.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1207**

### **Risk Factors For Respiratory Disorders Among West African Workers In The E-Waste Sector**

**Presenter:** Nonvignon Marius KEDOTE, Department of Health and Environment, Comlan Alfred Quenum Regional Institute of Public Health (IRSP-CAQ), Ecohealth Chair, West Africa GEOHealth Network, University of Abomey-Calavi, Ouidah, Benin

**Authors:** N. KEDOTE<sup>1</sup>, S. SANON LOMPO<sup>2</sup>, H. SANGHO<sup>3</sup>, I. TIEMBRE<sup>4</sup>, L. DJOGBENOU<sup>5</sup>, T. ROBINS<sup>6</sup>, N. BASU<sup>7</sup>, J. FOBIL<sup>8</sup>;

<sup>1</sup>Department of Health and Environment, Comlan Alfred Quenum Regional Institute of Public Health (IRSP-CAQ), Ecohealth Chair, West Africa GEOHealth Network, University of Abomey-Calavi, Ouidah, BENIN,

<sup>2</sup>Laboratory of Public Health, University Pr. Joseph Ki-Zerbo, Ecohealth Chair, West Africa GEOHealth Network, Ouagadougou, BURKINA FASO, <sup>3</sup>Department of Public Health Teaching and Research, West Africa GEOHealth Network, Faculty of Medicine, Bamako, MALI, <sup>4</sup>Public Health Department, Ecohealth Chair, West Africa GEOHealth Network, University Félix Houphouët Boigny, Abidjan, CÔTE D'IVOIRE,

<sup>5</sup>Department of Environmental Health, Comlan Alfred Quenum Regional Institute of Public Health (IRSP-CAQ), Ecohealth Chair, West Africa GEOHealth Network, University of Abomey-Calavi, Ouidah, BENIN,

<sup>6</sup>Department of Environmental Health Sciences, GEOHealth Network, University of Michigan, School of Public Health, Michigan, MI, <sup>7</sup>Canada Research Chair (CRC) in Environmental Health Sciences, GEOHealth Network, McGill University, Montreal, QC, CANADA, <sup>8</sup>Department of Biological, Environmental and Occupational Health Sciences, School of Public Health, West Africa GEOHealth Network, University of Ghana, Legon, GHANA.

**Introduction :** In sub-Saharan Africa, the management of e-waste is increasingly involving workers who may not always be aware of the health risks related. The objective of this study is to determine the prevalence of respiratory diseases and their risk factors among workers in this informal sector in the West African region.

**Methods :** A cross-sectional descriptive and analytical survey was conducted in the economic capitals of Benin, Burkina Faso, Ivory Coast and Mali on e-waste collection, treatment and recycling sites from November 13 to December 9, 2019. A total of 638 reclaimers, repairers and recyclers were selected by stratified sampling taking into account their representativeness by country. The risk factors for respiratory disorders were identified by mixed-effects logistic regression with a random effect on the country variable. **Results :** Among e-workers, the prevalence of respiratory disorders expressed is 47.9%. Their predictive factors were non-participation in e-waste sorting ( $p < 0.001$ ), participation in smelting lead batteries ( $p = 0.001$ ), previous exposure to mining ( $p < 0.001$ ), cooking in the living room ( $p < 0.001$ ), living in an open space ( $p = 0.003$ ) or in the family home ( $p = 0.004$ ), history of respiratory problems ( $p < 0.001$ ), feeling abnormal heartbeats in the last two weeks ( $p = 0.016$ ), occurrence of fever in the last two weeks ( $p < 0.001$ ) and not washing hands with soap ( $p < 0.001$ ).

**Conclusion :** Awareness-raising interventions should be developed for this category of workers to reduce practices that pose a risk to their respiratory health and the adoption of protective measures. **Key words :** risk factor, respiratory disorder, informal sector, e-waste, West Africa.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1208**

**Spatial variation in the joint effect of heat waves and ozone on respiratory hospitalizations in California, 2004 to 2013**

**Presenter:** Lara Schwarz, University of California, San Diego, La Jolla, United States

**Authors:** L. Schwarz<sup>1</sup>, K. Hansen<sup>1</sup>, A. Alari<sup>2</sup>, S. D. Ilango<sup>1</sup>, N. Bernal<sup>3</sup>, R. Basu<sup>4</sup>, A. Gershunov<sup>5</sup>, T. Benmarhnia<sup>1</sup>;

<sup>1</sup>University of California, San Diego, La Jolla, CA, <sup>2</sup>Sorbonne Université, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique, Nemesis research team, Paris, FRANCE, <sup>3</sup>Center for Sustainable Development, University of Brasilia, Brasilia, BRAZIL, <sup>4</sup>Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Oakland, CA, <sup>5</sup>Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA.

Extreme heat and ozone are co-occurring exposures that have been shown to independently and synergistically increase risk of respiratory disease. While some studies have quantified the joint effects of temperature and ozone, none assessed its fine spatial variation. We propose the use of a spatial analysis to examine the potential heterogeneity (on the additive scale) in joint effects between heat and ozone at a small geographical scale. Temperature data was downloaded from the National Ocean and Atmosphere Administration Cooperative Observer stations across the United States and ozone data was estimated at the daily level using 24-hour daily means sampled and analyzed by the US EPA Air Quality System. A spatial extension of the case-crossover design was applied to study this association at the zip code level; spatially varying relative risk due to interaction (RERI) was quantified to consider joint effects. A total of 3,858,196 unscheduled respiratory hospitalizations occurred in California from 2004 to 2013 in the May-September period, and mean thresholds for heat waves ranged from 37.75°C to 39.57°C. For ozone, average concentrations ranged from 61.66 ppb to 79.90 for the different thresholds considered. When considering the overall joint effect in all of California, the RERIs revealed no additive interaction. However, when considering the joint-effects at the zip code level, some areas show a strong joint-effect and other areas indicate negative interaction. Results indicate unspecific patterns of heterogeneity, but by considering spatial differences in these impacts variation in the effect of ozone, heat waves and joint-effects is apparent throughout California. Results indicate the importance of going beyond average measures to consider spatial variation in the health effects of ozone and heat. This information can be used to inform hybrid early warning systems to protect populations from the deleterious effects of both ozone and heat.

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Theme: **Respiratory health**

**P-1211**

**Low-level air pollution exposure and incidence of chronic obstructive pulmonary disease: the ELAPSE project**

**Presenter:** Shuo Liu, University of Copenhagen, Copenhagen, Denmark

**Authors:** S. Liu<sup>1</sup>, P. Ljungman<sup>2</sup>, T. Bellander<sup>2</sup>, U. Hvidtfeldt<sup>3</sup>, O. Raaschou-Nielsen<sup>3</sup>, K. Wolf<sup>4</sup>, B. Hoffmann<sup>5</sup>, B. Brunekreef<sup>6</sup>, M. Strak<sup>7</sup>, J. Chen<sup>6</sup>, O. Hertel<sup>8</sup>, S. Rodopoulou<sup>9</sup>, E. Samoli<sup>9</sup>, T. Sigsgaard<sup>8</sup>, G. Hoek<sup>6</sup>, Z. J. Andersen<sup>1</sup>;

<sup>1</sup>University of Copenhagen, Copenhagen, DENMARK, <sup>2</sup>Karolinska Institute, Stockholm, SWEDEN, <sup>3</sup>Danish Cancer Society Research Center, Copenhagen, DENMARK, <sup>4</sup>Helmholtz Zentrum München, München, GERMANY, <sup>5</sup>Heinrich Heine University of Düsseldorf, Düsseldorf, GERMANY, <sup>6</sup>Utrecht University, Utrecht, NETHERLANDS, <sup>7</sup>National Institute for Public Health and the Environment (RIVM), Bilthoven, NETHERLANDS, <sup>8</sup>Aarhus University, Aarhus, DENMARK, <sup>9</sup>Medical School, National and Kapodistrian University of Athens, Athens, GREECE.

**Background.** Air pollution has been suggested as a risk factor for chronic obstructive pulmonary disease (COPD), but evidence is limited. We examined the association between long-term exposure to low-levels of air pollution and incidence of COPD. **Methods.** Within the multicenter 'Effects of Low-Level Air Pollution: A Study in Europe' (ELAPSE) study, we pooled data from three prospective cohorts, from Denmark and Sweden. Hybrid land use regression models (100m resolution) were used to estimate annual mean concentrations of fine particulate matter (PM<sub>2.5</sub>), nitrogen dioxide (NO<sub>2</sub>), black carbon (BC), and warm season ozone (O<sub>3</sub>) in 2010 based on participants' baseline addresses. Cox proportional hazard models were used to examine the association between air pollution and COPD incidence, defined as first-ever hospital contacts. We also assessed the shape of the concentration-response function with natural cubic splines, and investigated two-pollutant models. **Results.** Among 98,058 participants, 4,928 (5.0%) developed COPD during a mean follow-up period of 16.6 years. Annual average concentrations of PM<sub>2.5</sub>, NO<sub>2</sub>, BC, and O<sub>3</sub> were 12.1 µg/m<sup>3</sup>, 25.1 µg/m<sup>3</sup>, 1.2 10<sup>-5</sup>m<sup>-1</sup>, and 78.1 µg/m<sup>3</sup>, respectively. The fully adjusted hazard ratios (HRs) and 95% confidential intervals for associations between air pollutants and COPD incidence were 1.17 (1.06-1.29) per 5 µg/m<sup>3</sup> for PM<sub>2.5</sub>, 1.11 (1.06-1.16) per 10 µg/m<sup>3</sup> for NO<sub>2</sub>, 1.11 (1.06-1.15) per 0.5 10<sup>-5</sup>m<sup>-1</sup> for BC, and 0.99 (0.93-1.05) per 10 µg/m<sup>3</sup> for O<sub>3</sub>. Associations persisted in the subset of participants with PM<sub>2.5</sub> and NO<sub>2</sub> levels below the European limit values. NO<sub>2</sub> and BC remained unchanged in two-pollutant models with PM<sub>2.5</sub>, whereas PM<sub>2.5</sub> attenuated to unity. The HR for O<sub>3</sub> became positive and significant after adjustment for NO<sub>2</sub> or BC. No significant deviation from linearity was observed for any of the associations. **Conclusion.** Long-term exposure to low-levels of air pollution can lead to the development of COPD, even below current European limit values.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1212**

### **Phthalate Exposure and Respiratory Diseases Among Adults and Children: the US NHANES 2007-2016**

**Presenter:** Nishat Tasnim Hasan, Department of Epidemiology and Biostatistics, School of Public Health, Texas A&M University, College Station, United States

**Authors:** N. T. Hasan, N. C. Shah, T. Roh;  
Department of Epidemiology and Biostatistics, School of Public Health, Texas A&M University, College Station, TX.

**Background/Aim:** Phthalates are used as plasticizers in many consumer products. Although they have associations with multiple adverse health outcomes, studies on phthalate exposure and respiratory outcomes are limited. The objective of our study was to examine the association between phthalate exposure and respiratory diseases in the US population. **Methods:** Using data from the National Health and Nutrition Examination Survey (NHANES) 2007-2016, we analyzed the data on twelve urinary metabolites and current respiratory diseases (asthma, bronchitis, and emphysema) among adults ( $\geq 20$  years of age) and children and adolescents (6-19 years of age). The logistic regression was conducted to estimate the odds ratios (ORs) per one log<sub>10</sub> unit increase in the concentration of urinary phthalate metabolites, and age, gender, race, waist/height ratio, urinary creatinine, serum cotinine level, and poverty index ratio were included in the model for adjustment. Analyses were conducted separately on children and adults to investigate the difference by age. **Results:** In adults, mono-benzyl phthalate (MBzP) was positively associated with asthma and chronic bronchitis (OR 1.34; 95% CI 1.11-1.61 and OR 1.39; 95% CI 1.02-1.91). Mono-(3-carboxypropyl) phthalate and mono-(carboxynonyl) phthalate also showed the significant associations with chronic bronchitis (OR 1.38; 95% CI 1.04-1.84 and OR 1.44; 95% CI 1.03-2.02). Although there was a trend with elevated risk between low-molecular-weight phthalates and emphysema, it was not significant (OR 1.26; 95% CI 0.98-1.62 for mono-ethyl phthalate, and OR 1.28; 95% CI 0.80-2.04 for mono-isobutyl phthalate). In children and adolescents, no evidence of associations between phthalates and asthma was found. **Conclusion:** Our cross-sectional study advocates for the positive associations of high-molecular-weight phthalate metabolites with respiratory diseases among adults. However, in children, the evidence of such association was absent, for which further analysis and research are recommended.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

**P-1214**

**Predictors of Acute respiratory infection among children Under 5 years in Nigeria: imperative for clean, safe household energy practices**

**Presenter:** IBRAHIM ADAMU AHMAD, Department of Community Medicine, Faculty of Clinical Sciences, Kaduna State University, KADUNA, Nigeria

**Authors:** I. A. AHMAD<sup>1</sup>, A. A. ALIYU<sup>2</sup>, S. S. Bashir<sup>2</sup>;

<sup>1</sup>Department of Community Medicine, Faculty of Clinical Sciences, Kaduna State University, KADUNA, NIGERIA, <sup>2</sup>Department of Community Medicine, Faculty of Clinical Sciences, Ahmadu Bello University, ZARIA, NIGERIA.

Predictors of Acute respiratory infection among children Under 5 years in Nigeria: imperative for clean, safe household energy practices

Background

Globally, close to 4 million people die prematurely annually, from illnesses attributable to indoor air pollution (IAP) due to use of solid cooking fuels and kerosene while more than 50% of pneumonia deaths among Under 5 children are linked to IAP. However, in Nigeria, there is dearth of local studies on effect of IAP, despite the high prevalence of Acute Respiratory Infections (ARI).

Aim

This study aims to determine the predictors of Acute respiratory infection among children Under-5 years exposed to smoke from solid cooking fuels in Nigeria. Methods Secondary analysis of data from cross sectional studies from Nigeria Demographic and Health Survey, 2008, 2013 and 2018, was conducted. Data from 28,647 and 28,596 and 30,713 respondents over the three surveys were subjected to bivariate analyses and logistic regression. Results Younger age (0-11months), household use of solid fuel and cooking inside the dwelling were statistically associated with ARI; thus the predictors of ARI in the surveys were household use of solid fuels [AOR: 1.57 (95% C.I: 1.2,1.9), AOR: 4.75 (95% C.I: 2.2, 10.3), AOR: 5.30 (95% C.I: 1.8, 15.9)] and cooking inside the dwelling [AOR: 1.85 (95%.CI: 1.5,2.3), AOR: 1.39 (95% C.I: 1.15,1.67) and AOR: 1.12 (95C.I (0.99,1.2)]; in 2008, 2013 and 2018, respectively. Lastly, younger age (0-11months) was a predictor in 2018 [AOR: 1.6 (95% C.I: 1.4, 1.8) and 2013 AOR: 1.29 (95% C.I:1.04, 1.6)] only. Conclusion The use of solid fuels in households and cooking within the dwelling are predictors of the high prevalence of Acute Respiratory Infections (ARI) in Nigeria. Therefore, use of clean, safe household source of energy, sustainable source of cooking fuel, use of improved cooking stoves, improved air circulation in dwellings are hereby recommended.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1216**

### **Inflammatory responses and gene expression levels to air pollution exposure: A nested case-control panel study on COPD patients**

**Presenter:** Yuan Yao, SKL-ESPC and BIC-ESAT, College of Environmental Sciences and Engineering, Peking University, Beijing, China

**Authors:** Y. Yao<sup>1</sup>, X. Chen<sup>1</sup>, W. Chen<sup>1</sup>, T. Xue<sup>1</sup>, X. Qiu<sup>1</sup>, M. Zheng<sup>1</sup>, C. Que<sup>2</sup>, T. Zhu<sup>1</sup>;

<sup>1</sup>SKL-ESPC and BIC-ESAT, College of Environmental Sciences and Engineering, Peking University, Beijing, CHINA, <sup>2</sup>Peking University First Hospital, Peking University, Beijing, CHINA.

**Background/Aim:** Ambient air pollution is one of the major risk factors for the prevalence and incidence of chronic obstructive pulmonary disease (COPD). However, the biological mechanisms associated with exposure to air pollution in individuals with COPD are not well understood. This study aims to examine whether air pollutant-induced systemic inflammation differs between COPD patients and healthy controls, and provide the underlying biological mechanisms based on transcriptome. **Methods:** Based on a panel study named COPDB (COPD in Beijing), serum interleukin-6 (IL-6) and whole blood transcriptome were repeatedly measured from 53 COPD patients and 82 healthy controls at up to four clinical visits. Hourly concentrations of gaseous pollutants, fine particulate matter (PM<sub>2.5</sub>), metals, temperature, and relative humidity were online monitored 1-14 d prior to clinical visits. Linear mixed-effect models were used to compare the inflammatory responses and gene expression levels to air pollution exposure between COPD patients and healthy controls. Pathway analysis was conducted with MetaCore. **Results:** Short-term exposure to gaseous pollutants, PM<sub>2.5</sub>, and metals were positively associated with increases of IL-6 across different exposure metrics in all subjects. Gaseous pollutants and metals induced IL-6 elevations were consistently higher in COPD patients than in healthy controls. Expression levels of some genes were identified to influence the associations between air pollution exposure and IL-6 levels. Pathway analysis showed that these genes were enriched in immune response and disease related pathways. **Conclusions:** COPD patients are more susceptible to systemic inflammation associated with air pollution exposure than healthy controls. The biological mechanisms may be related to the gene expression levels in some immune and disease related pathways. **Acknowledgment:** This study was funded by the National Basic Research Program (No. 2015CB553401), NSFC (91844000), Beijing Innovation Center for Engineering Science and Advanced Technology. We thank all the volunteers, students and staff involved in COPDB for their contributions.

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Theme: **Respiratory health**

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**P-1218**

### **Genetic susceptibility in air pollution-induced lung function decline**

**Presenter:** Sara Kress, IUF – Leibniz Research Institute for Environmental Medicine, Düsseldorf, Germany

**Authors:** S. Kress<sup>1</sup>, Q. Zhao<sup>1</sup>, A. Hüls<sup>2</sup>, H. Schwender<sup>3</sup>, K. Unfried<sup>1</sup>, T. Schikowski<sup>1</sup>;

<sup>1</sup>IUF – Leibniz Research Institute for Environmental Medicine, Düsseldorf, GERMANY, <sup>2</sup>Departments of Epidemiology and Environmental Health, Rollins School of Public Health, Emory University, Atlanta, GA,

<sup>3</sup>Mathematical Institute, Heinrich Heine University, Düsseldorf, GERMANY.

**Background** Air pollution exposure is linked to reduced lung function. The interaction between genetic susceptibility and air pollution exposures on lung function in elderly women with and without current airflow obstruction was assessed. **Methods** Cross-sectional data from the German SALIA study (Study on the Influence of air pollution on lung function, inflammation and aging) was used to assess 458 women aged 54 years in 1985-94, and 358 women in 2007-10. Weighted genetic risk scores (GRS) (continuous and dichotomized by median) were calculated using 119 lung-related single nucleotide polymorphisms. Air pollution exposures (nitrogen dioxide (NO<sub>2/x</sub>), particulate matter with diameters <2.5, <10 and 2.5-10 µm (PM<sub>2.5/10/coarse</sub>), and PM<sub>2.5</sub> absorbance) were modeled and assigned to residential address. Gene-environment interactions (GxE) were estimated on z-scores of forced expiratory volume in 1 s (FEV<sub>1</sub>), forced vital capacity (FVC), and the ratio of FEV<sub>1</sub> to FVC using adjusted linear regression models. Stratified analysis was performed for women with and without airflow obstruction (FEV<sub>1</sub>/FVC < lower limit of normal, presences of asthma, COPD or bronchitis). **Results** The analysis on all women showed significant interactions between GRS and NO<sub>x</sub> on FVC at follow-up (p= 0.042). Baseline analysis showed no interaction effects. 18.5% of women had a current airflow obstruction at baseline. For women with airflow obstruction, we found significant interactions between GRS and NO<sub>2</sub> on FEV<sub>1</sub>/FVC (p= 0.010), GRS and PM<sub>2.5</sub> on FEV<sub>1</sub>/FVC (p= 0.033), and GRS and PM<sub>2.5</sub> absorbance on FEV<sub>1</sub> (p= 0.017). No other interaction effects were found. **Conclusion** Genetic susceptibility might play a role in air pollution-related obstructive lung disease.

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Theme: **Respiratory health**

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**P-1219**

**Health promotion in the workplace: pneumoconiosis**

**Presenter:** Camila Feijó, Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, São Paulo, Brazil

**Authors:** M. Pustiglione<sup>1</sup>, C. Feijó<sup>1</sup>, A. Martin<sup>2</sup>, S. Quevedo<sup>2</sup>;

<sup>1</sup>Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, São Paulo, BRAZIL,

<sup>2</sup>Secretaria da Saúde do Estado de São Paulo, São Paulo, BRAZIL.

Pneumoconiosis corresponds to a group of diseases that develop with a chronic fibrous reaction of the lungs due to the inhalation of dust. They are especially marked by loss of expandability, fibrosis and pigmentation and can be given several names depending on the dust inhaled. The multiplicity of industrial and extractive activities in Brazil results from a high number of workers exposed to the risk of developing pneumoconiosis. It is a professional disease (technopathy) triggered by the exercise of work peculiar to a certain activity. This category of disease can only be prevented by adopting control measures, especially engineering or environmental measures. In order to understand the magnitude of the problem and trigger surveillance actions, notification of the event to the Notifiable Diseases Information System (SINAN) is essential. In this work, data on pneumoconiosis in Brazil, reported to SINAN, between 2014 and 2018 were collected. An annual average of 161 cases was found, 2017 being the year in which the disease most occurred, representing 77% of the total. Pneumoconiosis usually affects men (94.03%), between 40 and 59 years of age (44.44%), illiterate (90.22%) and who are registered employees (85.90%). The occupation most frequently affected was that of a construction worker (41.63%). However, when the cases were classified according to economic activities, the most found was the manufacture of concrete, cement, fiber cement, plaster and stucco products (85.74%). Regarding the disease itself, 81.43% of cases were reported as pleural plaques, which represent the most frequent manifestation of exposure to asbestos. Asbestosis represented 5.31% of the cases and silicosis 5.14%. 89.39% of the total cases were reported by the Reference Centers in Occupational Health (Cerest). Pneumoconiosis are serious diseases that require intensive treatment and follow-up. Preventive measures and early diagnosis/treatment must be adopted through strict surveillance of workers' health and safety conditions.

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Theme: **Respiratory health**

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**P-1220**

### **Persistent Respiratory Conditions among Coast Guard Responders to the Deepwater Horizon Oil Spill, Five Years of Follow-up**

**Presenter:** Jennifer A. Rusiecki, Department of Preventive Medicine and Biostatistics, Uniformed Services University (USU), Bethesda, United States

**Authors:** J. A. Rusiecki<sup>1</sup>, H. Denic-Roberts<sup>2</sup>, K. Christenbury<sup>3</sup>, J. Barrett<sup>4</sup>, D. L. Thomas<sup>5</sup>, L. S. Engel<sup>6</sup>;  
<sup>1</sup>Department of Preventive Medicine and Biostatistics, Uniformed Services University (USU), Bethesda, MD, <sup>2</sup>Department of Preventive Medicine and Biostatistics, Uniformed Services University; Oak Ridge Institute for Science and Education (ORISE), Bethesda, MD, <sup>3</sup>Social & Scientific Systems, Durham, NC, <sup>4</sup>Department of Preventive Medicine and Biostatistics, Uniformed Services University; War Related Illness & Injury Study Center, Veterans Affairs Medical Center, Washington, D.C., DC, <sup>5</sup>United States Coast Guard Headquarters, Directorate of Health, Safety, and Work Life, Washington, D.C., DC, <sup>6</sup>Department of Epidemiology, Gillings School of Public Health, Chapel Hill, NC.

**Background:** This year marks the 10th anniversary of the Deepwater Horizon oil spill. To date, little is understood about persistent respiratory conditions associated with oil spill response exposures. We conducted a longitudinal study of incident chronic respiratory conditions in a cohort of U.S. Coast Guard (USCG) responders enrolled in an equal access medical system. **Methods:** For all active-duty cohort members (N=45,193) we obtained medical encounter data, 10/01/2007-10/1/2015, representing ~2.5 years pre- and ~5.5 years post-spill. We queried incident respiratory conditions classified by International Classification of Diseases, 9th Edition. We used adjusted Cox Proportional Hazards regressions to compare responders to non-responders, responders reporting any crude oil exposure vs. none, and responders reporting any inhalation of crude oil fumes vs. none for earlier (2010-2012) and later (2013-2015) periods. We also evaluated joint effects of self-reported crude oil and oil dispersant exposures. Within-responder comparisons were adjusted for age, sex, and smoking. **Results:** Responders compared with non-responders were at increased risk in the later period for asthma (HR=1.48), dyspnea (HR=1.23), shortness of breath (HR=1.33), and cough (HR=1.27), in age- and sex-adjusted analyses. Oil exposed responders were at increased risk for asthma in the earlier period (HR=1.60) and for dyspnea (HR=1.52) and shortness of breath (HR=1.88) in the later period. Inhalation exposure was associated with increased risk of many respiratory conditions, including a two-fold elevated risk for shortness of breath in the later period (HR=2.11). Self-reported dispersant exposure further increased this association (HR=2.24). Most HRs were statistically significant. **Conclusions:** Our study, among a population with equal healthcare access, indicates the potential for crude oil exposures during a spill response to increase the risk for longer-term respiratory conditions. **Disclaimer:** The contents, views or opinions expressed here are those of the authors and do not reflect official policy or position of USU, the DoD, or the USCG.

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**P-1221**

**Long-term exposure to Ozone and PM<sub>2.5</sub> in Mexican Cities of the National Urban System: a Health Impact Assessment.**

**Presenter:** José L Texcalac-Sangrador, National Institute of Public Health, Mexico City, Mexico

**Authors:** J. L. Texcalac-Sangrador<sup>1</sup>, H. Riojas-Rodríguez<sup>2</sup>;

<sup>1</sup>National Institute of Public Health, Mexico City, MEXICO, <sup>2</sup>National Institute of Public Health, Cuernavaca, Mor., MEXICO.

Air pollution is a process that introduces diverse pollutants into the atmosphere that cause harm to humans, several studies have documented an association between air pollution exposure and negative effects on human health. Health Impact Assessment (HIA) has been applied in many countries to quantify the impact of interventions on controlling air quality and reducing effects on human health. The National Urban System (SUN for its acronym in Spanish) aggregates the principal urban areas in Mexico where living 92.6 millions of inhabitants that represents 74.2 percent of total population. A HIA to Ozone and PM<sub>2.5</sub> long term exposure was conducted following the method described by WHO using 2015 air pollution data. SOMO35 indicator for ozone and annual mean for PM<sub>2.5</sub> were calculated to assess the impact in terms of the number of attributable deaths. A total of 14 SUN cities (33 millions of inhabitants) were analyzed based in ozone monitor network coverage. For PM<sub>2.5</sub> a total of 15 SUN cities (36 millions of inhabitants) were included considering the monitoring coverage. Approximately 4 700 deaths were attributable to 35 ppm annual ozone excess, almost 50% of them (2 300) occurs in Mexico City. For PM<sub>2.5</sub> about 11 500 deaths could have been avoided if Mexican cities had met the WHO air quality guidelines. To our knowledge this is the first study that analyze avoidable deaths using SOMO35 WHO metric as indicator of long term exposure to ozone in Mexico. This study reveal air pollution impacts in around 35% of the National Urban System and provide information for decision making.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1222**

### **Comparison of LUR, satellite LUR and Bayesian NO<sub>2</sub> exposure measures on effect estimates of respiratory and allergic disease in a children's cohort**

**Presenter:** Christine T Cowie, South West Sydney Clinical School, University of NSW; Ingham Institute of Applied Medical Research; Centre for Air pollution, energy & health Research (CAR); Woolcock Institute of Medical Research, University of Sydney, Liverpool, Australia

**Authors:** C. T. Cowie<sup>1</sup>, Y. Yi<sup>2</sup>, B. G. Toelle<sup>3</sup>, I. C. Hanigan<sup>4</sup>, L. D. Knibbs<sup>5</sup>, E. Jegasothy<sup>6</sup>, G. B. Marks<sup>7</sup>, F. L. Garden<sup>8</sup>;

<sup>1</sup>South West Sydney Clinical School, University of NSW; Ingham Institute of Applied Medical Research; Centre for Air pollution, energy & health Research (CAR); Woolcock Institute of Medical Research, University of Sydney, Liverpool, AUSTRALIA, <sup>2</sup>Nanjing University of Posts and Telecommunications, China; Woolcock Institute of Medical Research, University of Sydney, Nanjing, CHINA, <sup>3</sup>Woolcock Institute of Medical Research, University of Sydney; Sydney Local; Health District, Sydney, Sydney, AUSTRALIA, <sup>4</sup>Sydney Medical School, University of Sydney; Centre for Air pollution, energy & health Research (CAR), Sydney, AUSTRALIA, <sup>5</sup>School of Public Health, University of Queensland; Centre for Air pollution, energy & health Research (CAR), Brisbane, AUSTRALIA, <sup>6</sup>School of Public Health, University of Sydney, Sydney, AUSTRALIA, <sup>7</sup>South West Sydney Clinical School, University of NSW; Ingham Institute of Applied Medical Research; Woolcock Institute of Medical Research (University of Sydney, Centre for Air pollution, energy & health Research (CAR), Liverpool, AUSTRALIA, <sup>8</sup>South West Sydney Clinical School, University of NSW; Ingham Institute of Applied Medical Research, Sydney, Liverpool, AUSTRALIA.

**Background/Aim** Effect estimates in air pollution epidemiology studies can vary depending on the exposure method used, due to error. We aimed to compare estimates for respiratory outcomes in a childhood cohort using three exposure methods. **Methods** We used: an intra-city land use regression (LUR) model; a national satellite-LUR (Sat-LUR) model; and a regional Bayesian blended model (BME); to estimate annual mean NO<sub>2</sub>, a marker of traffic pollution, for 398 children (8 years) from the Childhood Asthma Prevention Study, Sydney. We collected questionnaire information on current asthma, wheeze, eczema, and rhinitis, and measured spirometry (FEV<sub>1</sub>, FVC, airway hyper-responsiveness (AHR)), exhaled nitric oxide (eNO), and atopy. We used logistic and linear regression to analyse binary and continuous variables respectively. Adjusted models included covariates chosen using directed acyclic graphs: sex; father's education; gas cooking; and environmental tobacco smoke. **Results** The annual NO<sub>2</sub> means from LUR, Sat-LUR and BME models were 7.64 (SD 1.82), 8.77 (1.96) and 8.37 (1.81) ppb respectively. We generally found similar and non-significant (NS) effect estimates for most health outcomes across the three exposure methods after adjustment, with a few variations. We found significantly increased OR for any atopy (1.30 (1.02, 1.68)) and house dust mite atopy (1.35 (1.05, 1.74)) for LUR, and increased but NS effects for Sat-LUR and BME. Conversely, ORs were higher for current asthma for BME 1.31 (0.91, 1.69) than for Sat-LUR 1.24 (0.91, 1.68) or LUR 1.08 (0.82, 1.42) (all NS). Estimates for AHR were similarly increased with ORs varying from 24% (LUR) to 27% (BME), although NS. **Conclusions** Use of the three exposure measures resulted in similar effect estimates, albeit with subtle variations, illustrating the importance of exposure derivation. It is unclear which measure is most accurate and choice will depend on geography of models and cohorts and confidence in model inputs.

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**P-1223**

**Impact of traffic-related air pollutants emission reduction policies on hospitalization by asthma, in Seoul and Incheon, Korea**

**Presenter:** Hyomi Kim, Korea University, Seoul, Korea, Republic of

**Authors:** H. Kim, G. Byun, Y. Choi, S. Kim, S. Kim, J. Lee;  
Korea University, Seoul, KOREA, REPUBLIC OF.

Although the goals of most air-quality policies is to reduce direct emissions from the source points, it also aims to reduce health burden due to exacerbated environmental pollution. Therefore, assessing the impact of environmental policies on related health outcomes is important. In Korea, especially in Seoul and Incheon, interventions for reducing traffic-related air pollutants (TRAP) were aggressively implemented since 2007. TRAP is a known risk factor for asthma. In this study, we aimed to investigate whether the interventions had a beneficial impact on hospitalization by asthma. Hospital records for hospitalization by asthma in the study (Seoul and Incheon) and the reference population (Daejeon, Daegu, Busan, and Ulsan) were abstracted from the database in National Health Insurance Service during 2003 to 2011. A controlled interrupted time series design (C-ITS) was adopted to assess the impact of air pollutants emission reduction policies on hospitalization by asthma. Long-term background trends were adjusted using the trends of reference cities. Various sensitivity analyses, including simple-ITS, and C-ITS with false-intervention and with simulated PM10 concentration when there was no intervention, were conducted to give a robustness of our study result. Emissions from traffic-related air pollutants were significantly reduced after 2007. Estimated numbers of prevented hospitalization for asthma in Seoul were 10,377 (14.1%) and 6,011 (8.7%) depending on the reference population (Daejeon and Daegu). For Incheon, estimated numbers of prevented hospitalization for asthma were 3,207 (11.7%) and 2,470 (9.2%) depending on the reference population (Busan and Ulsan). Potential beneficial effects of the interventions on asthma were also found in the sensitivity analysis. Our study provides supportive evidence for potential beneficial effects of interventions for reducing TRAP on hospitalization for asthma in Seoul and Incheon. More studies are needed to determine the impact of such environmental policy implementation on other diseases associated with air pollutants in Korea.

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Theme: **Respiratory health**

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**P-1224**

**Factors associated with chronic airflow limitation among adults in Karachi, Pakistan**

**Presenter:** Shama Razaq, Jinnah Medical and Dental College, Karachi, Pakistan

**Authors:** S. Razaq<sup>1</sup>, U. Rabbani<sup>2</sup>, P. Burney<sup>3</sup>, A. A. Nafees<sup>4</sup>;

<sup>1</sup>Jinnah Medical and Dental College, Karachi, PAKISTAN, <sup>2</sup>Saudi Board Family Medicine, Ministry of Health, Qassim, SAUDI ARABIA, <sup>3</sup>National Heart & Lung Institute, Imperial College, London, UNITED KINGDOM, <sup>4</sup>Aga Khan University, Karachi, PAKISTAN.

**Background:** Using a fixed cut-off for defining airflow limitation might “over” or “under” estimate the diagnosis, hence, “over or under” estimation of risk factors associated with airflow limitation. Using absolute values of the FEV1/FVC ratio without using fixed cut-off has been less investigated in Pakistan. The objective was to determine the risk factors associated with chronic airflow limitation using absolute FEV1/FVC value among adults 18 years and above in the urban area of Karachi.

**Methods:** A multi-stage, community-based survey was conducted in Karachi among adults 18 years and above, recruited from 75 randomly selected clusters. Interview through the American Thoracic Society respiratory questionnaire and spirometry was conducted among 919 participants. The outcome of interest was chronic airflow limitation defined as post-bronchodilator absolute FEV1/FVC ratio. Multivariable linear regression was done to determine factors associated with the post-bronchodilator FEV1/FVC ratio.

**Results:** The mean ( $\pm$  SD) post-bronchodilator absolute FEV1/FVC ratio was 0.79 ( $\pm$  0.07). Chronic airflow limitation was significantly associated with increasing age (Adj.  $\beta$ : -0.06, 95% CI: -0.07 to -0.05), illiteracy (Adj.  $\beta$ : -0.02, 95% CI: -0.03 to -0.004), mosquito coil use (Adj.  $\beta$ : -0.01, 95% CI: -0.02 to -0.002), pack-years of smoking for >20 years (Adj.  $\beta$ : -0.06, 95% CI: -0.08 to -0.03), history of allergy (Adj.  $\beta$ : -0.02, 95% CI: -0.03 to -0.01) and family history of asthma (Adj.  $\beta$ : -0.02, 95% CI: (-0.03 to -0.001). Airflow improved with ventilated kitchen (Adj.  $\beta$ : 0.01, 95% CI: 0.002 to 0.022).

**Conclusion:** Preventive measures should be targeted contextually to reduce smoking habits, enhance health literacy to eliminate indoor air pollutants and efficient environmental conditions with good ventilation inside households.

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**P-1225**

**Short-term joint exposure to air pollution & grass pollen and lung function in French school-age children: the PARIS (Pollution and Asthma Risk: an Infant Study) birth cohort**

**Presenter:** Helene Amazouz, Université de Paris, CRESS - Inserm UMR 1153, HERA research team, Paris, France

**Authors:** H. Amazouz<sup>1</sup>, M. Thibaudon<sup>2</sup>, I. Momas<sup>1</sup>, F. Rancière<sup>1</sup>;

<sup>1</sup>Université de Paris, CRESS - Inserm UMR 1153, HERA research team, Paris, FRANCE, <sup>2</sup>Réseau National de Surveillance Aérobiologique (RNSA), Brussieu, FRANCE.

**Background**As the joint effect of chemical and biological air pollution on respiratory function has been poorly studied, we aimed to investigate these associations at school age in the PARIS birth cohort.**Methods**This study included 1,063 children who participated in the health check-up (including lung function tests) at 8 years. The maximum daily concentrations of grass pollen and the maximum global air quality (ATMO) index based on four ambient air pollutants: PM<sub>10</sub>, NO<sub>2</sub>, O<sub>3</sub> and SO<sub>2</sub> in the Paris area during the four days prior to health check-up were determined using measurements from the Paris air quality monitoring and the French aerobiological surveillance networks. The considered exposure thresholds were  $\geq 10$  grains/m<sup>3</sup> for grass pollen ("intermediate" allergic risk) and  $\geq 6/10$  for the ATMO index ("poor" to "very poor" air quality). Four groups of recent exposure were built by combining these two variables. The associations of these groups with respiratory parameters were studied by linear regression models adjusting for potential confounders.**Results**Among the study population, 51% of the children were in group 1 (grass pollen <10 grains/m<sup>3</sup>, ATMO <6), 25% in group 2 (grass pollen <10 grains/m<sup>3</sup>, ATMO  $\geq 6$ ), 19% in group 3 (grass pollen  $\geq 10$  grains/m<sup>3</sup>, ATMO <6), and 5% in group 4 (grass pollen  $\geq 10$  grains/m<sup>3</sup>, ATMO  $\geq 6$ ). Compared with children in group 1, children in group 4, exposed above the thresholds for both grass pollen and air pollution, had a significant lower FEV1 (adjusted  $\beta = -69.6$ mL, 95% CI: -129.0 to -10.3) and FVC (adjusted  $\beta = -90.2$ mL, 95% CI: -161.5 to -18.8). No associations were found for children in groups 2 and 3.**Conclusion**This study suggested a synergy between chemical and biological air pollutants, with deleterious effect of joint exposure to air pollution and grass pollen on lung function in children from the general population.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1226**

**Short-term effects of rural indoor air pollution on respiratory health and urine biomarkers of college students in the northwestern China**

**Presenter:** Bin Luo, Lanzhou university, Lanzhou, China

**Authors:** B. Luo, J. Niu;  
Lanzhou university, Lanzhou, CHINA.

The purpose of this study is to explore the effect of rural indoor air pollution on respiratory health and urine biomarkers of rural college students during winter vacation. The healthy freshmen of Gansu rural areas were recruited and been questioned for before, during and after winter vacation as well as the spirometry test and urine sample. Urine biomarkers included leukotriene E4 (LTE4), 8-hydroxydeoxyguanosine (8-OHdG), 8-epi-prostaglandin F2 alpha (8-epi-PGF2) and malondialdehyde (MDA). Indoor air pollution index was calculated to indicate the indoor air pollution for each exposure phase, and the outdoor air pollutants were obtained through satellite-based estimation. The subjects in the study lived in villages where coal was widely used for heating (85.70%). We found that IAP exposure index was significantly higher during winter vacation than before and after winter vacation ( $P < 0.05$ ). The PEF was significantly lower before winter vacation than during and after winter vacation ( $P < 0.05$ ), while the FEV1/FVC was significantly lower during winter vacation than before and after winter vacation ( $P < 0.05$ ). In addition, three urine biomarkers comparison showed the LTE4 was significantly higher after winter vacation than during and before winter vacation ( $P < 0.05$ ). However, the 8-epi-PGF2 was significantly higher during winter vacation than before and after winter vacation ( $P < 0.05$ ). After controlling the basic information, each 1 unit increase in the IAP exposure index was significantly correlated with the decrease in FEV1/FVC and the increase in 8-epi-PGF2. In conclusion, short-term exposure to rural indoor air pollution in winter may lead to a decrease in lung ventilation function and increase oxidative stress, indicating the its adverse effects on respiratory system health. Keywords rural area; indoor air pollution; exposure index; urine biomarker; lung function; satellite remote sensing data

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Theme: **Respiratory health**

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**P-1227**

**Using Syndromic Surveillance to Track Pollen Related Allergies Real-time**

**Presenter:** Shubhayu Saha, CDC, Atlanta, United States

**Authors:** S. Saha;  
CDC, Atlanta, GA.

**Objective:** Large parts of the country currently have inadequate monitoring of ambient pollen concentrations. This analysis investigates the association between Emergency Department (ED) syndromic data and pollen measurements to track pollen-related allergies. **Methods:** Daily pollen measurements were obtained from the Atlanta Asthma and Allergy Clinic monitor on the broad pollen taxa of tree and specifically for Oak species from 2017-2018. The start and end of the tree and oak pollen were separately determined based on the days when 1% and 95% of the cumulative pollen load each year were recorded. A syndrome definition was developed to specifically identify 'allergy'-related cases using information contained in chief complaints in the emergency care setting, while avoiding allergies unrelated to pollen exposure (e.g. those associated with food or other exposures). Using the syndrome definition, a daily ratio of allergy-related ED visits to total ED visits was computed for each of the Georgia health districts. For each year, both the log-transformed pollen values and the ED visit ratios were normalized to conform to a specified range that yielded easier inter-annual comparison. Pearson correlation analysis was conducted to estimate the association between the daily pollen measurement and the daily allergy visit ratio for each of the districts. **Results:** Correlation coefficients using the daily tree pollen data and syndromic ED visits ranged from 0.41 to 0.67 in health districts close to the pollen monitoring station. Similar results were obtained when only Oak pollen was considered. As distance from the station increased, the strength of the correlation declined. For sensitivity analysis, correlations using pollen measurements from the same day and average over 3 days preceding the health outcome were robust. **Conclusion:** Robust association between the daily variations in ED syndromic data with the pollen measurements supports the application of the syndromic system to track pollen-related health outcomes.

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**P-1228**

### **Associations between Mediterranean diet and respiratory health or allergy at 8 years in French children from the PARIS cohort**

**Presenter:** Helene Amazouz, Université de Paris, CRESS - Inserm UMR 1153, HERA research team,, Paris, France

**Authors:** H. Amazouz, I. Momas, F. Rancière;  
Université de Paris, CRESS - Inserm UMR 1153, HERA research team,, Paris, FRANCE.

**Background**The Mediterranean diet (MD) has known health benefits but its impact on respiratory health and allergy during childhood is unclear. As part of the PARIS birth cohort follow-up, we aimed to investigate the adherence of children to the MD in association with respiratory and allergic morbidity at school age.  
**Methods**Diet was assessed using food frequency questionnaire filled in by parents at 8 years. The adherence to the MD was evaluated using the KIDMED index (low:  $\leq 3$ , moderate: 4-7, high:  $\geq 8$ ). Current asthma, hay fever and eczema were defined based on symptoms, doctor's diagnosis and medications documented during the health check-up at 8 years. In addition, specific IgE levels were measured, and respiratory tests were performed. Associations of the KIDMED index with respiratory/allergic morbidity were studied using multivariable logistic/linear regression models adjusted for potential confounders, including physical activity.  
**Results**A total of 964 children were included, 36% with low adherence to the MD, 55% with moderate adherence, and 9% had high adherence. Socioeconomic characteristics and feeding/eating habits were identified as determinants of MD adherence. Compared to low MD adherence, a moderate and high MD adherence were associated to a decrease risk of being sensitized at 8 years (adjusted OR [aOR] = 0.71, 95% CI: 0.52-0.97 and aOR=0.50, 95% CI: 0.29-0.88, respectively). High MD adherence was also beneficial regarding FEV1 (adjusted  $\beta$ =+52mL, 95% CI: 5-99), FVC (adjusted  $\beta$ =+61mL, 95% CI: 5-116) and decreased risk of suffering from current asthma (aOR=0.18, 95% CI: 0.04-0.77). No significant association of MD adherence with current eczema, current hay fever, FEV1/FVC ratio and FeNO was found.  
**Conclusions**This study highlights the important role of diet on respiratory and allergic morbidity in children. Higher MD adherence at school age was associated with lower risk of asthma and sensitization and better lung function parameters.

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Theme: **Respiratory health**

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**P-1229**

**Effect of tobacco smoking on atopic disease and asthma as predictors of low awareness**

**Presenter:** Zafar Hussain, Communication University of China, Beijing, China

**Authors:** Z. Hussain<sup>1</sup>, F. Naseem<sup>2</sup>, N. Adnan<sup>3</sup>;

<sup>1</sup>Communication University of China, Beijing, CHINA, <sup>2</sup>Department of Mathematics, Rawalpindi Women University, 6th Road Satellite Town, Rawalpindi, Pakistan, Rawalpindi, PAKISTAN, <sup>3</sup>Department of Geography, F.G. Postgraduate College for Men, Sector H-8, Islamabad, Pakistan, Islamabad, PAKISTAN.

**Abstract:** Effective public health communication is hampered by inaccessibility to use information about health risks. Ineffective public health communication has drastic impact on people's behavior and knowledge. Tobacco smoking is one such example that causes additional disease burden on susceptible populations. We report an analysis of inaccessibility to information about tobacco health risks and health communication effects on people with different socioeconomic status (SES). Our findings comprise of a survey of 306 respondents from adult urban population from Rawalpindi and Islamabad cities. Mean number of smoking health alert subscribers was calculated using mobile phone user as proxy variable to describe access and awareness of population. For one-point increase in poverty, a statistically significant 36.4% decrease ( $p < 0.01$ ), 95% CI (0.33-0.91) in the odds of tobacco risk awareness was observed. Low awareness about tobacco smoke was linked with atopic disease (95% CI; 2.41-5.98) and asthma (95% CI 1.72-6.12). Socioeconomic status has a significant association with obstacles to online information access and health journal, and levels of smoking-related knowledge. Urban population of Islamabad had higher SES, higher news exposure, and higher levels of tobacco-prevention related knowledge than population from Rawalpindi. Respondents from latter group were active in seeking information through television whereas the former prefer to attend seminars and workshops arranged by local health officials to adopt incorrect prevention attitude towards cigarette smoking. Our results suggest that frequent information delivered through media channels will improve the ability of general public to adopt prevention behavior during an outbreak or health emergency condition. We further conclude that prevailing communication inequalities in dealing epidemiological issues can be overcome by extensive use of media, which will not only enhance coordination between organizations disseminating alerts, advisories but also improve the behavior of general public potentially impacting effective response during disease epidemics.

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Theme: **Respiratory health**

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**P-1230**

### **Respiratory Outcomes in an Environmental Justice Community Near Urban Oil Drilling**

**Presenter:** Jill E Johnston, University of Southern California, Los Angeles, United States

**Authors:** J. E. Johnston, T. Enebish, S. P. Eckel;  
University of Southern California, Los Angeles, CA.

**Background/Aim:** Los Angeles, California is the largest urban oil field in the country and home to thousands of active oil wells in very close proximity to homes, schools and parks, yet little is known about potential health impacts. In this study, we used community-driven methodology to assess respiratory health among community residents living within 500 m of either an active or idle oil well in the Las Cienagas oil field in South Los Angeles. **Methods:** A cross-sectional community-based study was conducted between January 2017 and August 2019 near two oil wells in the Las Cienagas oil field. We collected acute health symptoms and measured FEV1 (forced expiratory volume in the first second of exhalation) and FVC (forced vital capacity). We related lung function measures to distance and direction from active or idle oil site using generalized linear models adjusted for covariates. **Results:** A total of 919 residents with valid spirometry measurements living <1000 m from an active or idle oil well were included in this analysis. Adjusting for freeway distance, on average, participants near the active oil site had lower percent predicted FVC (-13.9%,  $p=0.047$ ) and lower percent predicted FEV1 (-11.6%,  $p=0.09$ ) as compared to residents near the idle site. Among only residents near the active site, we observed that residents living downwind and <200m from the active well have significantly lower FEV1 (-.42L,  $p<0.001$ ) compared to residents living upwind after controlling for age, height, race/ethnicity, sex and distance to freeway. Among residents near the idle site, we observed no significant differences based on proximity or direction. **Conclusions:** Living nearby and downwind of active urban oil drilling sites is associated with lower lung function among residents, which may contribute to environmental health disparities.

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Theme: **Respiratory health**

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**P-1231**

**What does calculating impacts of specific morbidity outcomes add to perceptions of air pollution health impact assessment?**

**Presenter:** Heather Anne Walton, Environmental Research Group, and Health Protection Research Unit on Health Impacts of Environmental Hazards, King's College London, London, United Kingdom

**Authors:** D. Evangelopoulos<sup>1</sup>, M. Williams<sup>2</sup>, K. Katsouyanni<sup>3</sup>, H. A. Walton<sup>3</sup>;

<sup>1</sup>Environmental Research Group and Health Protection Research Unit on Health Impacts of Environmental Hazards, King's College London, London, UNITED KINGDOM, <sup>2</sup>Environmental Research Group, King's College London, London, UNITED KINGDOM, <sup>3</sup>Environmental Research Group, and Health Protection Research Unit on Health Impacts of Environmental Hazards, King's College London, London, UNITED KINGDOM.

**Introduction:** Health impact assessments often use broad categories of outcomes, e.g. all respiratory or all cardiovascular admissions. This minimises diagnostic misclassification but does not fully communicate the evidence on associations between air pollution and specific diseases. More specific health impact calculations may resonate with the public more than severe but rarer outcomes.

**Methods:** Literature searches were done for meta-analyses pooling evidence on a variety of pollutants (PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>2</sub> and O<sub>3</sub>) and 40 health outcomes. We investigated the effects of short- and long-term exposure to pollution and did final calculations on 17 morbidity outcomes, rejecting those with weaker evidence, lack of baseline rates, and no priority from focus groups. The selected concentration-response functions were combined with monitoring site, baseline rate/cases and population (e.g. beside roads) data to calculate health impacts in up to 4 scenarios (roadside vs background (daily and annual); 75<sup>th</sup> vs 25<sup>th</sup> percentile daily average and a 20% reduction in annual average) across 9 UK and 4 Polish cities. The largest result per pollutant was given rather than summing across pollutants.

**Results:** The largest change in number of cases was for children with low lung function in London (7927 for a 20% reduction in NO<sub>2</sub>). Changes in cases of acute bronchitis in children in London were also high (3683 for a 20% reduction in PM<sub>10</sub>). Warsaw had greater impacts on cardiovascular than respiratory endpoints compared with London. Other example statements include 'living near busy roads in Oxford may stunt lung growth in children by 14%' and 'in London on higher pollution days, 142 more children with asthma experience symptoms than on lower pollution days'.

**Conclusions:** Health impact statements for a wider variety of outcomes may aid communication of the importance of different health effects to policymakers and the public.

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**P-1233**

**Evaluating the strength of evidence between long-term NO<sub>2</sub> exposure and pediatric asthma incidence for potential inclusion into the Global Burden of Disease Study**

**Presenter:** Katrin G Burkart, University of Washington, Seattle, United States

**Authors:** K. G. Burkart<sup>1</sup>, S. Wozniack<sup>1</sup>, S. C. Anenberg<sup>2</sup>, P. Hystad<sup>3</sup>, D. Goldberg<sup>2</sup>, A. Larkin<sup>3</sup>, A. Moheg<sup>2</sup>, M. Brauer<sup>1</sup>;

<sup>1</sup>University of Washington, Seattle, WA, <sup>2</sup>George Washington University, Washington D.C., DC, <sup>3</sup>Oregon State University, Corvallis, OR.

Several epidemiological studies have highlighted a relationship between NO<sub>2</sub> exposure and increased incidence and prevalence of pediatric asthma. Recently, the Global Burden of Disease (GBD) developed a quantitative evidence scoring approach with the intention to assess the effect and strength of the evidence for exposure-response relationships with consistency across all risk factors. We use this evidence scoring approach to generate a quantitative effect estimate for NO<sub>2</sub> exposure and childhood asthma that can be applied for burden of disease assessments. For the purpose of this work, we systematically compiled existing studies on the relationship between NO<sub>2</sub> and childhood asthma and extracted relative risks (RR). In addition, we extracted a set of study-specific covariates in order to explain between-study heterogeneity in risk estimates. We then applied the GBD's newly developed meta-regression tool MR-BRT (MetaRegression - Bayesian, Regularized, Trimmed) to provide a quantitative estimate of effect and strength of evidence based upon unexplained between-study heterogeneity. Preliminary analyses including 28 sources from 11 countries identified within a systematic literature review conducted by Khreis et al. in 2017 were included in the meta-regression. Overall, we estimated a RR of 1.10 (95% confidence interval [CI]=0.94-1.30) per 5 ppb increase in annual average NO<sub>2</sub> (p-value=0.13) when not accounting for study-specific covariates. A model accounting for all significant study-level covariates ('outcomes self-reported', 'confounding uncontrolled', 'selection bias', and 'subpopulation') revealed an effect estimate of 1.28 (95%CI=1.00-1.63) per 5 ppb (p-value=0.024). Findings provide strong evidence for a relationship between NO<sub>2</sub> exposure and pediatric asthma when adjusting for between-study heterogeneity. In future steps, we will include 27 additional studies that were published after the 2017 systematic review conducted by Khreis et al. (2017). Furthermore, we will apply an automated covariate selection process in which variables are sub-selected by running a set of log-linear models with a range of Lasso penalty parameters.

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## ABSTRACT E-BOOK

Theme: **Respiratory health**

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**P-1234**

### **Pesticide Urinary Metabolite Concentration and Asthma Morbidity in Socially Disadvantaged Children**

**Presenter:** Derek Werthmann, Tulane University, New Orleans, United States

**Authors:** D. Werthmann, F. A. Rabito;  
Tulane University, New Orleans, LA.

**Background:** Little is known about urinary pesticide (UP) concentration in socially disadvantaged children. These children may be at greater exposure risk because low income is associated with more household pest exposure. Urinary pesticide concentration and its association with asthma morbidity was measured in 161 children with asthma (7-12 years) residing in subsidized housing in three U.S. cities (Boston, Cincinnati, New Orleans).

**Methods:** Morning void and convenience spot samples were collected at three time points over one year. Urine samples were analyzed for seven pesticide metabolites; 3 organophosphates (OPs): TCPY, IMPY, PNP; 3 pyrethroids (PYR): 4-F-3-PBA, 3-PBA, trans-DCCA; and 1 herbicide: 2,4-D. Total PYR was calculated as the sum of 4-F-3-PBA, 3-PBA, and trans-DCCA and total OP as the sum of TCPY, IMPY, and PNP. Outcomes were forced expiratory volume in one second (FEV<sub>1</sub>), and respiratory inflammation measured as fractional exhaled nitric oxide (FeNO).

**Results:** A total of eight hundred and ten urine samples were collected. The proportion with detectable metabolites ranged from 35% (trans-DCCA) to 97% (TCPY and PNP). Geomeans of each pesticide were higher in this cohort compared to a national sample (NHANES 2009-2010) of children 6-11 years. In models adjusting for socio-demographic factors, a 1 µg/mL increase in TCPY, IMPY, trans-DCCA, 2,4-D, total OPs and PNP was associated with a reduction in FEV<sub>1</sub> (-0.004 to -0.158) although no model reached statistical significance (p<0.05). An increase in TCPY, total OPs, and 4-F-3-PBA, resulted in a non-statistically significant increase in FeNO (0.0004 to 0.0675).

**Conclusion:** Results demonstrate these low-income children with asthma residing in subsidized housing are exposed to higher concentrations of pesticides compared to a general population sample. Additionally, the evidence suggests negative respiratory outcomes with increasing levels of UPs. Reducing exposure to pesticides is important to mitigate the potential negative health effects for vulnerable populations.

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Theme: **Respiratory health**

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**P-1235**

**Epidemiological Investigation of the Impact of Air Quality on Obstructive Sleep Apnea: What can we learn from CPAP devices?**

**Presenter:** Jay Preston Kitt, University of Utah, Salt Lake City, United States

**Authors:** J. P. Kitt, K. Sundar, R. Gouripeddi, C. Pirozzi, J. Facelli;  
University of Utah, Salt Lake City, UT.

Obstructive sleep apnea (OSA) is a common sleep disorder which affects an estimated 22-million Americans. In patients with OSA, periods of airway closure occur throughout the night resulting in a hypoxic sleep state which contributes increased risk of many conditions including heart disease, depression, stroke, and dementia. Inflammatory events, which occur following acute exposures to irritants lead to an increase in apnea. Exposure to poor air quality or air pollutants has been linked to airway inflammation suggesting that atmospheric pollutants are likely to negatively impact OSA. First-line treatment for OSA is use of a CPAP device which keeps the external air supply at higher pressure to help maintain an open airway. These devices log of apnea events and report daily AHI, a measure of apnea events per hour, for every night of active use. In this epidemiological study, CPAP device data from more than 4000 patients was compared with EPA atmospheric pollutant concentration data from air quality monitoring sites to investigate the impact of air quality on OSA. Machine-learning techniques were utilized to classify “good days,” where no notable apnea changes occurred, and “bad days,” days where more than 10% of patients had an AHI greater than two standard deviations above their mean with 96.7% accuracy. Examining the weighting factors utilized by the algorithm allowed identification of pollutants which drove selection of bad days. Those include PM 2.5, carbon monoxide, and ozone. Through further analysis, it was discovered that pollutant-sensitive sub-populations drive categorization. Overall, some level of pollutant sensitivity impacts ~50% of CPAP patients. Those with sensitivity average a 26% higher AHI and have 46% more clear-airway apneas. These results demonstrate the impact of air pollution on OSA and provide patients and physicians information to make care adjustments for the future.

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Theme: **Respiratory health**

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**P-1236**

### **Urine LTE4 concentrations and organophosphate pesticide exposure in California agricultural communities**

**Presenter:** Sherry WeMott, Colorado State University, Fort Collins, United States

**Authors:** S. WeMott<sup>1</sup>, W. Benka-Coker<sup>1</sup>, G. Erlandson<sup>1</sup>, G. Kuiper<sup>1</sup>, N. Martinez<sup>2</sup>, J. Mendoza<sup>2</sup>, C. Quinn<sup>1</sup>, B. Young<sup>1</sup>, S. Magzamen<sup>1</sup>;

<sup>1</sup>Colorado State University, Fort Collins, CO, <sup>2</sup>Central California Environmental Justice Network, Fresno, CA.

**Background** Exposure to agricultural pesticides, specifically organophosphates (OP) has been linked to adverse respiratory outcomes in agricultural settings. However, these studies have been based on childhood outcomes, with limited information in relation to respiratory endpoints in adults. Urinary leukotriene E4 (uLTE4) is a cysteinyl leukotriene indicative of respiratory inflammation, and is associated with several respiratory diseases, including asthma. Levels of uLTE4 are known to increase during severe asthma attacks. Though OP pesticides are an inhalation hazard, there is little known about their effect on respiratory inflammation in a population without asthma. We evaluated the relation between OP pesticides found in household dust and urinary LTE4 in a cohort of adults residentially exposed to agricultural pesticides. **Methods** Dust and urine samples were collected during the agricultural spraying (June) and non-spraying seasons (January) from 28 households located within 200 feet of agricultural fields in the Central Valley of California. We implemented linear regression models to test the association between uLTE4 and OP concentrations, as well as t-tests comparing mean uLTE4 concentrations by occupational status (agricultural v. non-agricultural).

**Results** A total of 103 urine samples were analyzed for LTE4 and 50 dust samples for OPs. We did not see an association between OP dust concentration (97.4 ppb, sd = 147.0 ppb) and uLTE4 level, nor was there a difference by season. We did observe a difference in mean uLTE4 level by occupational status (non-agriculture = 1067 pg/ml, agriculture = 1345 pg/ml) but it was not statistically significant (p-value = 0.12). **Conclusion** Organophosphates found in house dust were not associated with markers of respiratory inflammation. However, respiratory inflammation may be increased in community members with occupational exposures to pesticides.

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**P-1237**

**Temperature modifies the association between air pollution and respiratory disease mortality in Cape Town, South Africa**

**Presenter:** Janine Wichmann, University of Pretoria, Pretoria, South Africa

**Authors:** J. Shirinde, J. Wichmann;  
University of Pretoria, Pretoria, SOUTH AFRICA.

Background: Due to climate change, an increase of 3-4°C in ambient temperature is projected along the South African coast and 6-7°C inland during the next 80 years. Very few studies in Africa investigated effect modification by a temperature indicator (e.g. apparent temperature, Tapp) on the human health effects of air pollution. Methods: Respiratory disease (RD) mortality data (ICD10 J00-J99) were obtained from Statistics South Africa; after ethics approval. The study period was 1 January 2006 to 31 October 2015. NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub>, temperature and relative humidity data were obtained from the City of Cape Town municipality. A case-crossover epidemiological study design was applied. The present study focused on lag0-1; as most other studies. Models were adjusted for public holidays and Tapp. Days with Tapp below and above/equal the 25<sup>th</sup> (12.6°C) and 75<sup>th</sup> percentiles (20.3°C) were classified as cold and warm days, respectively. Results: Of the 20376 RD deaths, approximately equal numbers were from females, males, 15-64 and 65+ year olds. The daily NO<sub>2</sub>, SO<sub>2</sub>, and PM<sub>10</sub> levels were 16.0, 9.2, and 29.9 µm/m<sup>3</sup>, respectively. Daily air pollutant levels regularly exceeded the WHO guidelines. In general, none of the air pollutants had significant associations with RD mortality on cold days. The younger age group seemed to be more vulnerable to NO<sub>2</sub> and PM<sub>10</sub> on normal days compared to the elderly. On warm days, females were more susceptible to PM<sub>10</sub>, e.g. RR 1.065 95%CI 1.001-1.133 compared to the unstratified analyses RR 1.034 95%CI 0.991-1.078. On warm days, the 15-64 year old group were more vulnerable to NO<sub>2</sub> and SO<sub>2</sub>. Conclusions: These results indicate that the risk of RD deaths due to ambient air pollution exposure is different on cold, normal and warm days in the Vaal Triangle Air Pollution Priority Area.

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Theme: **Susceptible pops**

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**P-1238**

**Smartphone usage patterns and health effects: a case study in university students, Thailand**

**Presenter:** Wachiraporn Wilaiwan, Chulalongkorn University, Bangkok, Thailand

**Authors:** W. Wilaiwan;  
Chulalongkorn University, Bangkok, THAILAND.

Smartphone usage patterns and health effects: a case study in university students, Thailand  
ABSTRACTS  
Smartphones are mobile communication devices that are increasing in the number of users worldwide. The study aims to analyze usage patterns and the health effects related to smartphone usage among university students in Thailand. A cross-sectional descriptive study was conducted in five regions in Thailand. Five hundred thirty-two university students who use smartphones participated in the study. A prepared questionnaire was used for this study. The average age was  $20.34 \pm 1.44$  years old that participated in this study. The averaged time spent using mobile devices were  $6.12 \pm 5.64$  hours/day. The most popular application used was social networking (98.1%). Mostly, the participants used their smartphone in their bedroom (99.1%). The positive health effects of using smartphones were reported to be as follows: an increased feeling warmness with other people (95.3%), increased relaxation (80.6%), and increased happiness (80.1%). The negative health effects consisted of, but not limited to, eye pain (90.2%), misunderstanding with other people (92.5%), shoulder or neck pain (82.3%), and boredom (78.9%). The university students among the five regions in Thailand had significant differences in smartphone use patterns and health effects. Consequently, the intervention to reduce the health effects should be considered. Keywords: health effects; smartphone; university students

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Theme: **Susceptible pops**

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**P-1239**

### **Polygenic Risk Score Approaches for Methylation Data in Multi-Ethnic Populations**

**Presenter:** Anke Huels, Rollins School of Public Health, Emory University, Atlanta, United States

**Authors:** A. Huels<sup>1</sup>, E. Gatev<sup>2</sup>, D. Czamara<sup>3</sup>, K. N. Conneely<sup>4</sup>, N. Koen<sup>5</sup>, H. J. Zar<sup>5</sup>, D. J. Stein<sup>5</sup>, M. P. Epstein<sup>4</sup>, M. S. Kobor<sup>2</sup>;

<sup>1</sup>Rollins School of Public Health, Emory University, Atlanta, GA, <sup>2</sup>University of British Columbia, Vancouver, BC, CANADA, <sup>3</sup>Max Planck Institute of Psychiatry, Munich, GERMANY, <sup>4</sup>School of Medicine, Emory University, Atlanta, GA, <sup>5</sup>University of Cape Town, Cape Town, SOUTH AFRICA.

Polygenic approaches often access more variance of complex traits than is possible by single variant approaches. For genotype data, polygenic risk scores (PRS) are widely used for risk prediction as well as in association and interaction studies. Recently, interest has been growing in transferring PRS approaches to DNA methylation data (methylation risk scores, MRS), which can be used 1) as biomarkers for environmental exposures, 2) in association analyses in which single CpG sites do not achieve significance, 3) as dimension reduction approach in interaction and mediation analyses and 4) to predict individual risks of disease or treatment success. One of the biggest challenges for PRS is its limited applicability across ancestries. We adopted the popular PRS pruning and thresholding approach to methylation data and evaluated its applicability across ancestries by using publicly available data from 1199 samples with African, European and Indian ancestry. First, we used the Co-Methylation with genomic CpG Background (CoMeBack) method to define Co-methylated Regions (CMRs), spanning sets of array probes constructed based on all genomic CpG sites (similar to “LD clusters” in genotype data). Next, we selected one CpG site from each CMR based on its association with the trait of interest in an independent reference dataset (p-value below specific threshold, “pruning and thresholding”). Finally, we calculated a methylation risk score for each sample as a sum of the remaining beta values weighted by the corresponding beta estimates from the independent summary statistics. In contrast to PRS, our preliminary findings suggest that the derived MRS are comparable across different ancestries, which indicates their broad applicability even for ethnically heterogeneous study populations. Finally, we will apply this approach in the multi-ethnic Drakenstein Child Health Study to better understand the biological mechanisms behind the association between prenatal air pollution exposure and infant lung function.

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Theme: **Susceptible pops**

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**P-1240**

**Bias due to selection on live births: A simulation study**

**Presenter:** Michael Leung, Harvard T.H. Chan School of Public Health, Boston, United States

**Authors:** M. Leung<sup>1</sup>, M. Kioumourtzoglou<sup>2</sup>, R. Raz<sup>3</sup>, M. Weisskopf<sup>1</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>2</sup>Columbia University Mailman School of Public Health, New York, NY, <sup>3</sup>The Hebrew University of Jerusalem, Jerusalem, ISRAEL.

**Background:** A recent case-control study found a strong protective association between prenatal exposure to air pollution and risk of autism spectrum disorder (ASD). This unexpected finding can be potentially explained by live-birth bias; that is, the non-exchangeability of exposure groups that arises due to the inevitable restriction of the analytic sample to fetuses that survive. This bias has been suggested to manifest from two separate but related selection mechanisms: 1) collider-stratification, where bias is induced by conditioning on a common consequence (i.e., fetal loss) of air pollution and an independent risk factor for ASD, and 2) the preferential depletion of susceptible fetuses for ASD, which can occur due to the misalignment of exposure assignment and eligibility (i.e., exposure is ascertained at birth, but eligibility begins at conception). **Methods:** We simulated the magnitude of bias under the null from these two hypothetical selection mechanisms, and when they both occur simultaneously. Simulation inputs were based on characteristics of the original case-control study and a range of priors for the prevalence of unmeasured factor U and the odds ratios (ORs) for the selection effects (i.e., the effects of air pollution and U on loss, and U on ASD). Each scenario was simulated 1000 times. **Results:** We found that the magnitude of bias was small for collider-stratification, slightly stronger for depletion of susceptibles, and was strongest when both mechanisms work together. For example, when the OR for each of the selection effects was 3 and the prevalence of U was 0.75, the observed ORs for ASD and air pollution were 0.95, 0.87 and 0.80 for the three mechanisms, respectively. **Conclusion:** Our simulations illustrate that live-birth bias may lead to an underestimation of the effects in studies of prenatal exposures and postnatal outcomes, with the extent of the bias depending on the fetal selection process.

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**P-1242**

### **Assessing Residential Socioeconomic Factors Associated with Pollutant Releases using EPA's Toxic Release Inventory**

**Presenter:** Amanda Charette, SUNY ESF, Syracuse, United States

**Authors:** A. Charette;  
SUNY ESF, Syracuse, NY.

Prior work has shown that when comparing the placement of hazardous waste facilities and the demographic groups in the surrounding areas, there are trends in which demographic groups are disproportionately exposed. Minorities and low-income individuals are often the focus of these studies, which are highly location dependent. Therefore, this study sought to determine whether four comparable counties in Upstate New York (Albany, Erie, Monroe, and Onondaga) display any trend of having higher quantities of polluting facilities and chemical releases located in neighborhoods comprised of certain demographics. Nine population identifiers assessing residential socioeconomic status (R-SES) were obtained from the 2000 US Census at the block group level. The demographics were grouped together based upon their similarities using a hierarchical clustering method which produced seven unique residential clusters. The location of each Toxic Release Inventory (TRI) facility within the four counties was geocoded into the clusters to determine whether a particular cluster had a disproportionate quantity of TRI facilities within it. In addition, we could determine whether particular population characteristics were most highly correlated with the number of facilities present in each cluster. Contrary to the results from prior studies, we found that minorities and low-income individuals were not disproportionately exposed to these polluting facilities in our geographic area. Rather, the largest demographic group found to be located near polluting facilities was workers who were employed in non-managerial positions. The R-SES cluster with one of the highest percentages of laborers in non-managerial positions (78.59% of residents) released over 5 million pounds of chemicals in 2000 alone. In comparison, the next greatest release of chemicals within a cluster was just under 3 million pounds of chemicals. In conclusion, we found that the presence of polluting TRI facilities was highest in locations where the population held non-managerial positions.

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**P-1243**

**Capacity development in environmental epidemiology research in Africa: experience from ISEE sponsored short course in Nigeria**

**Presenter:** Adetoun Mustapha, Nigeria, Lagos, Nigeria

**Authors:** A. Mustapha<sup>1</sup>, M. Kogevinas<sup>2</sup>, K. Berhane<sup>3</sup>;

<sup>1</sup>Nigeria, Lagos, NIGERIA, <sup>2</sup>IS Global, Barcelona, SPAIN, <sup>3</sup>Mailman School of Public Health, Columbia University, New York, NY.

A short course on environmental epidemiology and exposure assessment sponsored by ISEE Capacity and Education committee in 2019 was aimed to strengthen the ability of African researchers to conduct more studies in Africa to fill data gaps. This complements the mission of ISEE Africa chapter. A local institution (University of Ibadan, Nigeria) was sourced to partner with ISEE Africa chapter to host the 3-day introductory training. The course was advertised extensively to all parts of Africa through social media and focus groups. Eligibility criteria for applicants are that they must be African, graduate students and scientists with basic degree in environment, health or a related discipline and ability to meet own transportation and accommodation. Applicants submitted online essay on African environmental issues, research interests and how the training will benefit own career. Training was face-to-face tutorial, videos, group work and hands-on exercises. The course faculty were four experienced tutors from ISEE and partner institution. 213 (39%) out of 545 applications received from 15 African countries, passed the eligibility and screening criteria. Seventy-three (13%) successful applicants were invited but only 59 from Nigeria, Uganda and Guinea attended. Participants comprised 46% female and 54% male with 97% possessing a postgraduate qualification. Participants came from a heterogeneous background and for many, this was their first epidemiology course. Forty-eight participants joined ISEE. Participants feedback was very positive. There was potential for continuation of work locally. For future courses, location selection criteria should include a place that may attract participants from other countries, collaboration with reputable local institution, consideration for post-training sustainability, local organizing committee that can mobilize high number of participants and members for ISEE. Increased knowledge of environmental health risks in Africa is important to improve global public health. Therefore, capacity development in environmental epidemiology in Africa deserves priority in global scientific agenda.

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**P-1244**

### **Acculturation and Personal Care Product Use Among Foreign-Born Chinese Women: Implications for Endocrine-Disrupting Chemical Exposure Disparity**

**Presenter:** Veronica Wang, Harvard T.H. Chan School of Public Health, Boston, United States

**Authors:** V. Wang<sup>1</sup>, M. T. Chu<sup>1</sup>, L. Chie<sup>2</sup>, S. A. Gaston<sup>3</sup>, C. L. Jackson<sup>3</sup>, N. Newendorp<sup>4</sup>, E. Uretsky<sup>5</sup>, R. E. Dodson<sup>6</sup>, G. Adamkiewicz<sup>1</sup>, T. James-Todd<sup>1</sup>;

<sup>1</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>2</sup>Beth Israel Deaconess Medical Center, Boston, MA, <sup>3</sup>National Institute of Environmental Health Sciences, Research Triangle Park, NC, <sup>4</sup>Harvard University, Cambridge, MA, <sup>5</sup>Brandeis University, Waltham, MA, <sup>6</sup>Silent Spring Institute, Newton, MA.

**Background:** EDCs are linked to adverse reproductive health outcomes, with recent work suggesting EDCs vary by acculturation measures. Personal care product (PCP) use is an important source of EDCs. Few studies have evaluated acculturation and EDC-associated PCP use among Asian women. **Methods:** We evaluated these associations among 315 foreign-born Chinese women ages 18-45 years, who were living in the US and seeking obstetrics-gynecology care at community health centers (Boston, MA). English-speaking ability and English language use with friends and at home indicated acculturation. PCP use (e.g. deodorant, perfume/cologne) in the past 48 hours was self-reported. We conducted multivariable logistic and Poisson regressions to determine the cross-sectional associations of acculturation measures and the use of certain types and the total number of PCPs, respectively. Latent class analysis was used to identify usage patterns.

**Results:** Those who used more PCP types, overall and by each PCP type, tended to be more acculturated. Higher acculturation was associated with higher odds of using colored cosmetics, nail polish, and perfume/cologne in the past 48 hours. Women who spoke primarily English used 1.15 (CI: 1.01-1.31) times the number of PCP types than their non-English speaking counterparts.

**Conclusions:** A higher degree of acculturation among Chinese women of reproductive age was associated with greater EDC-associated PCP use. These results have implications for adverse reproductive outcomes linked to EDCs.

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**P-1245**

**When possible, report exact p-values and display informative Fisherian null randomization distributions**

**Presenter:** Marie-Abele Bind, Harvard University, Cambridge, United States

**Authors:** M. Bind<sup>1</sup>, D. Rubin<sup>2</sup>;

<sup>1</sup>Harvard University, Cambridge, MA, <sup>2</sup>Tsinghua University, Beijing, CHINA.

In randomized experiments, Fisherian exact p-values are available and should be used to help evaluate results rather than the more commonly reported asymptotic p-values. The Fisherian statistical framework, proposed in 1925, calculates a p-value in a randomized experiment by using the actual randomization procedure that led to the observed data. Here, we illustrate this Fisherian framework in an epigenomic crossover experiment with only seventeen participants. Each person was randomly exposed on two temporally separated occasions to either clean air or ozone, and their DNA methylation was measured at many CpG sites. First, we consider the initial period of the crossover experiment and analyze its data as a completely randomized experiment. Then, we consider both periods. For each analysis, we focus on eight CpG sites and assess the Fisher sharp null hypothesis of no ozone versus clean air effect on DNA methylation for any participant. For two sites, the traditional asymptotic t-statistic-based p-value substantially subceeds the minimum exact p-value that can be attained. For the other sites, the Fisher null randomization distribution substantially differed from the bell-shaped one assumed by the asymptotic t-statistic based test. When researchers choose to report p-values in randomized experiments, (i) Fisher exact p-values should be used, especially in studies with small sample sizes, and (ii) the shape of the actual null randomization distribution should be examined for the reconditte scientific insights it may reveal.

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**P-1246**

### **Socioeconomic Patterns and Environmental Greenness in Relation to County-Level All-cause and Cause-specific Mortality Rates in Kentucky.**

**Presenter:** Johnnie Deanna Newton, Department of Epidemiology, University of Louisville, School of Public Health and Information Sciences, Louisville, United States

**Authors:** J. D. Newton, L. K. Blair, N. C. DuPre;  
Department of Epidemiology, University of Louisville, School of Public Health and Information Sciences, Louisville, KY.

Background: Kentucky has the fifth highest death rate in the United States. Normalized Difference Vegetation Index (NDVI) is a commonly used measure of natural vegetation, which has been associated with multiple health benefits, including mortality. Complex correlations among socio-economic (SES) determinants that confound associations between mortality and natural vegetation exposure have not been fully considered. We examined the relationship between county-level NDVI and mortality in Kentucky, controlling for SES patterns rather than individual SES markers. Methods: 2010-2014 5-year annual NDVI within 120 Kentucky counties were linked to county-level SES, demographic, and housing factors from the 2010-2014 American Community Survey. Principal components analysis was used to identify patterns of 11 SES variables. Poisson regression was used to estimate relative risks (RR) and 95% confidence intervals (CI) between age-adjusted all-cause and cause-specific mortality rates for a 0.1 unit increase in NDVI, adjusting for SES patterns, sex, smoking and obesity and compared to models with single SES markers (i.e. percent below poverty and income inequality). Results: Three principal components explained 80% of SES variation. NDVI was inversely associated with all-cause mortality adjusting for individual SES variables (RR=0.94 95%CI 0.88, 1.00); however, associations were stronger when adjusted for SES patterns (RR=0.90 95%CI 0.84, 0.96). Associations between NDVI and respiratory mortality were stronger when adjusting for SES patterns (RR=0.77 95%CI 0.68, 0.87) rather than individual SES markers (RR= 0.87 95%CI 0.77, 0.98), and with circulatory mortality (RR adjusted for SES patterns= 0.93 95%CI 0.83, 1.05; RR adjusted for individual SES markers= 0.96 95%CI 0.87, 1.07). Conclusions: We observed greenness benefits for Kentucky mortality rates that became more apparent after adjusting for SES patterns. Future work of greenness and health should consider the complexities of SES confounding analyses of natural vegetation and health. The Jewish Heritage Fund for Excellence (UofL School of Medicine) supported this work.

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**P-1247**

**Exposure to bisphenol A and epigenetic modification in aged population**

**Presenter:** Da Hae Kim, Sejong university, Seoul, Korea, Republic of

**Authors:** D. Kim<sup>1</sup>, Y. Hong<sup>2</sup>, J. Kim<sup>1</sup>;

<sup>1</sup>Sejong university, Seoul, KOREA, REPUBLIC OF, <sup>2</sup>Seoul National University College of Medicine, Seoul, KOREA, REPUBLIC OF.

Background: Bisphenol A (BPA) is an environmental endocrine disrupting chemical affecting public health. So our research aim was to determine whether BPA exposure affects epigenetic mechanisms or not. Methods: We recruited 45 non-smoker females, who were aged 60 years. Participants visited our center 3 times with 1 week interval. On every visit, their urine and blood samples were collected for BPA and epigenome-wide miRNA level measurements, respectively. We evaluated relationships between urinary BPA and miRNA levels. Results: Five miRNAs (miR-1224-3p, miR-138-5p, miR-184, miR-543, and miR-587) were positively associated with BPA exposure ( $p < 0.05$  for all 5 miRNAs). The predicted target genes of 5 miRNAs were found to be related with various disease classes including metabolic, cardiovascular, and chemdependency. Furthermore, KEGG pathways on pathway in cancer (hsa05200), PI3K-Akt signaling pathway (hsa04151), and MAPK signaling pathway (hsa04010) in order of precedence were related with BPA exposure. Conclusions: Our study results suggest a potential that BPA exposure modifies epigenetic mechanisms, resulting in a variety of diseases.

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**P-1248**

**Mitochondria and aging in older individuals: an analysis of DNA methylation age metrics, leukocyte telomere length, and mitochondrial DNA copy number in the VA Normative Aging Study.**

**Presenter:** Jacopo Dolcini, Polytechnic University of Marche/Columbia University, Ancona/New York, Italy

**Authors:** J. Dolcini<sup>1</sup>, H. Wu<sup>2</sup>, J. C.Nwanaji-Enwerem<sup>3</sup>, M. Kioumourtzoglou<sup>2</sup>, A. Cayir<sup>4</sup>, M. Sanchez-Guerra<sup>5</sup>, P. Vokonas<sup>6</sup>, J. Schwarz<sup>3</sup>, A. Baccarelli<sup>7</sup>;

<sup>1</sup>Polytechnic University of Marche/Columbia University, Ancona/New York, ITALY, <sup>2</sup>Department of Environmental Health Sciences, Mailman School of Public Health, Columbia University, New York, NY, USA, New York, NY, <sup>3</sup>Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA, USA, Boston, MA, <sup>4</sup>Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA, USA Vocational Health College, Canakkale Onsekiz Mart University, Canakkale, Turkey, Canakkale, TURKEY, <sup>5</sup>Department of Developmental Neurobiology, National Institute of Perinatology, Montes Urales 800, Lomas Virreyes, Mexico City 11000, Mexico, Mexico City, MEXICO, <sup>6</sup>Veterans Affairs Normative Aging Study, Veterans Affairs Boston Healthcare System, Department of Medicine, Boston University School of Medicine, Boston, MA, USA, Boston, MA, <sup>7</sup>Department of Environmental Health Sciences, Mailman School of Public Health, Columbia University, New York, NY, USA, Ancona, NY.

**AbstractBackground:** Population aging is a looming global health challenge. New biological aging metrics based on DNA methylation levels have been developed in addition to traditional aging biomarkers. The prospective relationships of aging biomarkers with mitochondrial changes are still not well understood. **Aim:** to examine the prospective associations of mitochondrial copy number (mtDNAcn) with several aging biomarkers - DNAm-age, DNAm-PhenoAge, DNAm-GrimAge, and leukocyte telomere length. **Methods:** We analyzed 812 individuals from Veteran Affairs Normative Aging Study (NAS) with available blood samples from 1999-2013. Whole blood mtDNAcn and relative leukocyte telomere length were measured via qPCR. DNA methylation was assessed and used to calculate DNAm-Age, DNAm-GrimAge, and DNAm-PhenoAge. Linear mixed models were used to quantify the associations of mtDNAcn with DNAm-age, DNAm-GrimAge, DNAm-PhenoAge, and leukocyte telomere length. **Results:** In multivariable cross-sectional analyses, mtDNAcn is negatively associated with DNAm-Age, DNAm-PhenoAge, and DNAm-GrimAge. In contrast, mtDNAcn is associated with prospective measures of higher DNAm-PhenoAge and shorter leukocyte telomere length. **Discussion:** Our study shows that higher mtDNAcn is associated with prospective measures of greater DNAm-PhenoAge and shorter leukocyte telomere length independent of chronological age. This indicates a role for mitochondrial in aging-related disease and mortality, but not the departure of biological age from chronological age. Methylation, mtDNA and telomere length are sensible to external environmental stressors like air pollution or temperature and this element could determine an influence of these environmental stressor on epigenetic aging biomarkers like DNAm-age, DNAm-PhenoAge, DNAm-GrimAge and how these metrics interact with mtDNAcn.

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Theme: **Susceptible pops**

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**P-1249**

**Impacts of environmental policies on students' test scores mediating by school attendance rate**

**Presenter:** Bo Ye, Department of Epidemiology and Biostatistics, University at Albany, the State University of New York, Rensselaer, United States

**Authors:** B. Ye<sup>1</sup>, W. Zhang<sup>2</sup>, X. Deng<sup>2</sup>, I. Ryan<sup>2</sup>, Y. Qu<sup>3</sup>, S. Lin<sup>2</sup>;

<sup>1</sup>Department of Epidemiology and Biostatistics, University at Albany, the State University of New York, Rensselaer, NY, <sup>2</sup>Department of Environmental Health Sciences, University at Albany, the State University of New York, Rensselaer, NY, <sup>3</sup>Guangdong Cardiovascular Institute, Guangzhou, CHINA.

Background: Little is known about how different environmental policies improves students' academic performance through enhancing the school attendance rate. This study was aimed to clarify this important policy- attendance- performance pathway by mediation analysis. Methods: We linked the school Building Condition Survey (BCS) data with the school attendance and test score data. The BCS data include 756 building variables and indicators of the implementation of environmental policies or programs (EPA Tools for School (TfS) or other programs). We examined how attendance rate mediated the impact of TfS and other programs on the percent of low-score students in 2956 selected elementary, middle and high schools in New York State. We conducted causal mediation analysis for each subject test while controlling for confounders. Results: We observed that the schools using EPA TfS were directly associated with a lower percent of low-score students in overall scores of math and science, Algebra I, Geometry, Chemistry, Earth Science and Physics tests with regression coefficients ranging from -1.888 to -3.309 (all  $P < 0.05$ ). The impact of this policy significantly mediated by the students' attendance rate for Algebra II/Trigonometry (-1.376,  $P < 0.001$ ) and chemistry (-0.563,  $P < 0.001$ ). We found that other environmental programs were also associated with a lower percent of low-score students in English, Living Environment, overall social studies, Global History and U.S. History with slightly smaller regression coefficients ranging from -0.461 to -1.29 (all  $P < 0.05$ ). Mediation effect of attendance rate was identified in overall science (3.005,  $P < 0.001$ ) and overall social studies (6.56,  $P < 0.001$ ). We noticed that 18% (Ranging 1 % to 47%) of the effect of EPA TfS and other programs on the low score rate was mediated by the attendance rate. Conclusion: Environmental policies in New York schools improve the students' test scores with the effect partially mediated by the attendance rate.

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**P-1250**

### **Adverse Childhood Experiences Modify the Effect of Nature on Stress Recovery Among Males: A Between-Subjects Experiment in Virtual Reality**

**Presenter:** Hector Alfonso Olvera Alvarez, Oregon Health & Science University, Portland, United States

**Authors:** H. A. Olvera Alvarez<sup>1</sup>, J. Yin<sup>2</sup>, G. N. Bratman<sup>3</sup>, J. D. Spengler<sup>2</sup>;

<sup>1</sup>Oregon Health & Science University, Portland, OR, <sup>2</sup>Harvard University, Boston, MA, <sup>3</sup>University of Washington, Seattle, WA.

**Background:** Studies have demonstrated that exposure to nature decreases acute stress responses, and that adverse childhood experiences (ACEs) are linked to physiological hyperreactivity to acute psychosocial stressors. Nature exposure may therefore have potential to act as a protective factor against the heightened stress responses that are associated with high ACEs. We investigated whether ACEs, and other measures of stress vulnerability, modified the effects of virtual nature exposure on physiological responses to an acute psychosocial stressor, and subsequent recovery in contrasting environmental conditions, among 95 healthy adult males.

**Methods:** Baseline assessments included the ACE questionnaire, the Miller-Smith Lifestyle Assessment Inventory (stress vulnerability) and immunological hyperactivity; measured via immune cell interleukin-6 production after lipopolysaccharides (LPS) exposure. We then conducted an experiment in which participants experienced an acute stressor (Trier Social Stress Test), followed by randomly assigned exposure to one of three virtual environments (natural park, natural desert, or control [office]) for 10-min, followed by two 20-min recovery periods. Physiological stress indicators, including systolic and diastolic blood pressure (SBP & DBP), pulse, mean arterial pressure (MAP) and salivary cortisol, were measured repeatedly throughout the experimental sessions.

**Results:** We found that high-ACE, stress-vulnerable and LPS-hyperactive participants exhibited physiological hyperreactivity to the stressor. During the recovery periods, high-ACE and LPS-hyperactive participants in the natural park condition experienced greater drops in blood pressure vs. low-ACE and non-LPS-hyperactive participants. Additionally, high-ACE participants in the desert condition showed greater decreases in DBP vs. low-ACE participants.

**Conclusions:** High-ACE participants responded differently to both the acute stressor and the virtual natural environments than low-ACE participants. This indicates that assessments of ACEs may be a critical consideration when examining the ways in which the stress-buffering effects of nature exposure may vary across individuals and subpopulations, and opens up a new set of questions about why this may be the case.

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**P-1251**

**How to control for confounding by unmeasured genomic variables**

**Presenter:** Brian Knaeble, Utah Valley University, Orem, United States

**Authors:** B. Knaeble;  
Utah Valley University, Orem, UT.

A measured association between an exposure and a disease admits a causal interpretation when the exposure is randomly selected or assigned. However, exposure selection or assignment may be partly determined by genomic variables. This talk shows how to control for confounding by a set of unmeasured genomic variables. It is sufficient to bound three confounding parameters: genetic correlation, heritability of the disease, and the proportion of variation in exposure attributable to the unmeasured set of genomic variables. From these bounds we can compute an interval to capture the adjusted exposure effect. This computation is exact with negligible run time and based on a mathematical solution to a non-convex, constrained, optimization problem.

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**P-1252**

**Temporal trends of associations between short-term exposure to fine particulate matter (PM<sub>2.5</sub>) and risk of hospitalizations in understudied populations, with effect modification by sex and urbanicity in U.S. counties**

**Presenter:** Chen Chen, Yale Univeristy, New Haven, United States

**Authors:** C. Chen<sup>1</sup>, A. Chan<sup>1</sup>, F. Dominici<sup>2</sup>, R. D. Peng<sup>3</sup>, B. Sabath<sup>2</sup>, Q. Di<sup>4</sup>, J. Schwartz<sup>2</sup>, M. L. Bell<sup>1</sup>;  
<sup>1</sup>Yale Univeristy, New Haven, CT, <sup>2</sup>Harvard T.H. Chan School of Public Health, Boston, MA, <sup>3</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, <sup>4</sup>Tsinghua University, Beijing, CHINA.

**Background:** In a previous study, we identified evidence of change in the association between short-term exposure to fine particulate matter (PM<sub>2.5</sub>) and risk of hospitalization over time in U.S. urban counties. Whether this temporal change exists in less densely populated area or varies across individual-level characteristics is unclear. **Methods:** We constructed a daily time-series dataset of 968 continental U.S. counties with cause-specific hospitalization from Medicare fee-for-service data and PM<sub>2.5</sub> estimated concentration from a hybrid model incorporating data from multiple sources for the period 2000 to 2016. Using a modified Bayesian hierarchical model, we evaluated whether disparity exists in the association between PM<sub>2.5</sub> and risk of hospitalizations and its temporal trend across characteristics like sex and urbanicity. Urbanicity was categorized into three levels by county-specific percentage of urban population. **Preliminary results:** We found positive associations between circulatory and respiratory hospitalization and short-term exposure to PM<sub>2.5</sub>, with higher effect estimates towards the end of study period. The association for circulatory hospitalization decreases as urbanicity level decreases but the shape of temporal trend persists across urbanicity. The counties with low urbanicity demonstrated a 0.43%(95% posterior credible interval: 0.27 to 0.59%) increase in risk of circulatory hospitalization per 10µg/m<sup>3</sup> increase in PM<sub>2.5</sub> concentration for the moving average of the same day and previous two days, which is significantly lower than the 0.8%(0.54 to 1.05%) increase in counties with high urbanicity. We did not observe significant patterns in association for respiratory hospitalization or its temporal trend across urbanicity. We found no statistically significant difference in associations or their temporal trends between sexes. **Conclusion:** This study provides evidence of deleterious association between PM<sub>2.5</sub> and hospitalization in understudied areas with less urban population, with different impacts by urbanicity. The association between PM<sub>2.5</sub> and circulatory hospitalizations appears to be increasing over time with similar patterns across urbanicity.

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## ABSTRACT E-BOOK

Theme: **Susceptible pops**

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**P-1253**

**Cold weather injuries among patients at an urban safety net hospital, Boston, MA**

**Presenter:** Miyu Niwa, Boston University School of Public Health, Boston, United States

**Authors:** M. Niwa, J. H. Leibler;  
Boston University School of Public Health, Boston, MA.

**Background:** Disadvantaged urban populations, particularly low-income and homeless individuals, are vulnerable to negative health effects from extreme weather exposure. Cold weather exposures and injury among these populations have received limited attention. We characterized incidence and risk factors for cold weather injuries (CWIs) among patients at Boston Medical Center (BMC), an urban safety-net hospital, over a ten year period. **Methods:** A case-control study was conducted using BMC emergency department (ED) records. Cases included all patients who presented to the ED from November 1, 2005, to March 31, 2015, with ICD-9/10 codes reflecting injury from exposure to extreme cold weather (e.g. hypothermia, trench foot, frostbite, chilblains). Incidence of CWI by month and year were calculated and stratified by sex, age, and race. Conditional multivariable logistic regression was used to identify risk factors for CWI, including race/ethnicity, homelessness, and mental and physical health comorbidities. **Results:** Incidence of CWIs from 2005-2015 was 1.2 cases per 1,000 persons (n=817 cases). January had the highest monthly incidence of cold-weather injuries (n=22±15). Cases were predominantly male (n=614; 75%), and approximately 44% were African American. Twenty-eight percent of cases had ≥2 CWI admissions. In multivariable analyses, non-white Hispanic/Latinos experienced 2.0x the odds of CWI compared to others (OR: 2.0, 1.3, 3.1; p=0.002). Homelessness was associated with reduced odds of CWI (OR: 0.05; 0.03, 0.08; p<0.001.) Comorbid mental health conditions and substance abuse were not associated with increased odds of CWI. **Conclusions:** Increased CWI risk among Hispanic/Latinos may reflect language barriers to accessing prevention. Reduced risk among persons experiencing homelessness may indicate that service providers in Boston are protecting at-risk individuals, or that such injuries are underreported. CWIs should be further assessed among marginalized urban populations.

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**P-1254**

**The Ramapough Lunaape Nation: Facing health impacts associated with proximity to a Superfund site**

**Presenter:** Gabriella Meltzer, New York University School of Global Public Health, New York, United States

**Authors:** G. Meltzer<sup>1</sup>, O. Avenbuan<sup>2</sup>, F. Wu<sup>2</sup>, K. Shah<sup>2</sup>, Y. Chen<sup>2</sup>, V. Mann<sup>3</sup>, J. Zelikoff<sup>2</sup>;

<sup>1</sup>New York University School of Global Public Health, New York, NY, <sup>2</sup>New York University Grossman School of Medicine, New York, NY, <sup>3</sup>Ramapough Lunaape Turtle Clan Nation, Ringwood, NJ.

**Objective:** To evaluate self-reported exposure to the Ringwood Mines/Landfill Superfund Site in relation to chronic health outcomes among members of the Ramapough Lunaape Turtle Clan nation and other local residents of Ringwood, New Jersey.

**Methods:** Community surveys on personal exposure to the nearby Superfund site, self-reported health conditions, and demographics were conducted with 187 members of the Ramapough Lunaape Turtle Clan Nation and non-Native Americans residing in Ringwood, New Jersey from December 2015 to October 2016. Multiple logistic regression was performed to assess the association between ethnicity and a Superfund site exposure score developed for this study, as well as between exposure score and several chronic health conditions.

**Results:** Native Americans were 13.84 times (OR 13.84; 95% CI 4.32, 44.37) more likely to face exposure opportunities to Superfund sites as compared to non-Native Americans in the same New Jersey borough. For the entire surveyed cohort, increased Superfund site exposure routes was significantly associated with bronchitis (OR 4.10; 95% CI 1.18, 14.23). When the analyses were restricted to Native Americans, the association between self-reported Superfund site exposure and bronchitis remained significant (OR 17.42; 95% CI 1.99, 152.45). Moreover, the association between greater exposure score and asthma in this same population also reached statistical significance (OR 6.16; 95% CI 1.38, 27.49).

**Conclusion:** This pilot study demonstrated a significant association between being a Ringwood resident of Native American ethnicity and self-declared opportunities for Superfund site exposure. It also showed a strong association between self-reported Superfund site exposure and the prevalence of bronchitis and asthma.

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**P-1255**

**Estimated prenatal exposure to nitrate in drinking water and body length and head circumference at birth: A population-based prospective cohort study from Denmark, 1991-2011**

**Presenter:** Vanessa Renee Coffman, Division of Epidemiology and Biostatistics, University of Illinois at Chicago, , United States

**Authors:** V. R. Coffman<sup>1</sup>, A. Søndergaard Jensen<sup>2</sup>, B. B. Trabjerg<sup>3</sup>, C. B. Pedersen<sup>4</sup>, T. Sigsgaard<sup>5</sup>, J. Olsen<sup>6</sup>, B. Hansen<sup>7</sup>, J. Schullehner<sup>7</sup>, M. Pedersen<sup>8</sup>, L. Stayner<sup>1</sup>;

<sup>1</sup>Division of Epidemiology and Biostatistics, University of Illinois at Chicago, Chicago, IL, <sup>2</sup>Centre for Integrated Register-based Research (CIRRAU), Aarhus University, Aarhus, DENMARK, <sup>3</sup>Big Data Centre for Environment and Health (BERTHA), Aarhus University, Aarhus, DENMARK, <sup>4</sup>National Centre for Register-Based Research (NCCR), Department of Economics and Business Economics, Aarhus University, Aarhus, DENMARK, <sup>5</sup>Department of Public Health, Aarhus University, Aarhus, DENMARK, <sup>6</sup>Department of Clinical Epidemiology, Aarhus University, Aarhus, DENMARK, <sup>7</sup>Department of Groundwater and Quaternary Geology Mapping, Geological Survey of Denmark and Greenland, Aarhus, DENMARK, <sup>8</sup>Department of Public Health, University of Copenhagen, Copenhagen, DENMARK.

**Background/Aim:** Findings from studies examining the effects of prenatal exposure to nitrate from drinking water on fetal growth have been inconsistent, small, and mostly ecologic in nature and none have explicitly examined infant size as measured by body length (BL) or head circumference (HC) at birth. The aim of this study was to assess maternal exposure to nitrate in drinking water and BL and HC at birth in a large population-based cohort.

**Methods:** Estimates of water contamination by nitrate at each maternal address during pregnancy were linked with individual-level birth registry data to create a cohort of full-term singleton live births in Denmark from Danish parents during 1991-2011, with 848,106 measures of BL and 588,981 of HC. Exposures were modeled both categorically and as log-transformed continuous estimates. Multivariate linear regression with generalized estimating equations was used to assess associations.

**Results:** A negative trend in BL was observed in both categorical ( $p < 0.001$ ) and continuous models ( $p = 0.01$ ) of nitrate exposure. When comparing the European Union action level of 25mg/L to 0mg/L  $\text{NO}_3^-$  exposure, a 0.3mm reduction in BL was estimated. There was no evidence of an exposure-response relationship in either categorical ( $p = 0.52$ ) or continuous ( $p = 0.69$ ) models of nitrate exposure for HC. **Conclusions:** To the best of our knowledge, our study is the first to examine the relationship between nitrate in drinking water and body length and head circumference. Estimated maternal nitrate exposure was associated with decreased BL, but not HC at birth. However, HC was not recorded until 1997 and has less overall variation, making it harder to observe effects of environmental exposures. While the reduction in BL is not clinically relevant at the individual level, it may important from a public health point of view given the widespread exposure to nitrate in drinking water worldwide.

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Theme: **Water quality**

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**P-1256**

**Estimated prenatal exposure to nitrate in drinking water and birth defects: A population-based cohort study of over half a million births in Denmark**

**Presenter:** Vanessa Renee Coffman, Division of Epidemiology and Biostatistics, University of Illinois at Chicago, , United States

**Authors:** V. R. Coffman<sup>1</sup>, B. Dige Semark<sup>2</sup>, B. Trabjerg<sup>3</sup>, C. B. Pedersen<sup>4</sup>, T. Sigsgaard<sup>5</sup>, J. Olsen<sup>6</sup>, B. Hansen<sup>7</sup>, J. Schullehner<sup>7</sup>, M. Pedersen<sup>8</sup>, L. Stayner<sup>1</sup>;

<sup>1</sup>Division of Epidemiology and Biostatistics, University of Illinois at Chicago, Chicago, IL, <sup>2</sup>Centre for Integrated Register-based Research (CIRRAU), Aarhus University, Aarhus, DENMARK, <sup>3</sup>Big Data Centre for Environment and Health (BERTHA), Aarhus University, Aarhus, DENMARK, <sup>4</sup>National Centre for Register-Based Research (NCRR), Department of Economics and Business Economics, Aarhus, DENMARK, <sup>5</sup>Department of Public Health, Aarhus University, Aarhus, DENMARK, <sup>6</sup>Department of Clinical Epidemiology, Aarhus University, Aarhus, DENMARK, <sup>7</sup>Department of Groundwater and Quaternary Geology Mapping, Geological Survey of Denmark and Greenland, Aarhus, DENMARK, <sup>8</sup>Department of Public Health, University of Copenhagen, Copenhagen, DENMARK.

**Background/Aim:** Prior studies have yielded inconsistent evidence from prior studies of an association between nitrate in drinking water and an increased risk of birth defects (BDs). The aim of this study was to assess maternal exposure to nitrate in drinking water and BDs in a large population-based cohort with high-quality individual-level exposure estimates.

**Methods:** A cohort of 564,232 singleton live births that occurred among Danish parents during 1994-2004 was identified from the Danish Birth Registry and information on BDs was obtained from ICD-10 codes within the Danish National Patient Register. Estimates of average nitrate concentrations in drinking water during each pregnancy were linked to these births using data from a national water quality registry. Logistic regression with generalized estimating equations was used to assess the relationship between nitrate exposure and BDs and account for multiple births to the same mother. Nitrate exposure was modeled as both a categorical and continuous variable.

**Preliminary Results:** In total, 31,568 cases of BDs were identified, including 8,101 congenital heart defects, 2,581 urinary defects, 1,986 orofacial clefts, and 1,662 digestive system defects. An elevated risk of any birth defect [adjusted odds ratio: 1.05 (95% confidence interval: 1.01, 1.09)] was observed when comparing the highest quartile of exposure ( $\geq 4.9$  mg/L  $\text{NO}_3^-$ ) to the lowest ( $\leq 1.1$  mg/L  $\text{NO}_3^-$ ). There was also evidence of a positive exposure-response in models using categorical ( $p$  for trend=0.02) and to a lesser extent for continuous ( $p=0.06$ ) nitrate exposure. No clear evidence of an association was observed between nitrate and specific BDs.

**Conclusions:** Our study is the most statistically powerful study to date examining the relationship between nitrate in drinking water and BDs. Maternal nitrate exposure was associated with increased risk of BDs and at levels below current drinking water standards, adding to the evidence that the current standard is not sufficiently protective.

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**P-1258**

### **Antimicrobial Resistance Determinant of *Vibrio* species recovered from selected freshwaters in Southwest Nigeria**

**Presenter:** Ibukun Modupe Adesiyon, Institute of Ecology and Environmental Studies, Ile Ife, Nigeria

**Authors:** I. M. Adesiyon<sup>1</sup>, M. A. Bisi-Johnson<sup>2</sup>;

<sup>1</sup>Institute of Ecology and Environmental Studies, Ile Ife, NIGERIA, <sup>2</sup>Obafemi Awolowo University, Ile Ife, NIGERIA.

Antimicrobial Resistance Determinant of *Vibrio* species recovered from selected freshwaters in South West Nigeria

<sup>1</sup>Ibukun Modupe Adesiyon and <sup>1</sup>Mary Adejumo Bisi-Johnson,<sup>2</sup>Institute of Ecology and Environmental Studies, Obafemi Awolowo University, Ile-Ife, Nigeria <sup>2</sup>Department of Microbiology, Obafemi Awolowo University, Ile-Ife, Nigeria

**BACKGROUND:** Reduction in the burden of infectious diseases has been made possible since the discovery of antimicrobial agent. However, the development of resistance and its quick spread is negating the effectiveness of antibiotics therapy. **METHODS:** A total of 315 *Vibrio* isolates recovered from selected freshwater sources in South West Nigeria were confirmed by simplex polymerase chain reaction technique using *toxR* gene. All confirmed isolates were tested for *In vitro* susceptibility to 18 antibiotics using the standardized agar disc-diffusion assay and the resistant isolates were further profiled for their genotypic antimicrobial resistance determinants by PCR. **RESULTS:** Of the 18 antimicrobials selected from 10 families, resistance among sulphonamides (94%), Macrolides (95%), and tetracyclines (83%), occurred with higher frequency than others. Multi-drug resistance ranged from three to nine antimicrobials. Prevalence and distributions of 11 resistance determinant were obtained as follows; [sulfonamides (*sull* (19%), *sullII* (33%)), [beta-lactams; (*ampC* 39%; *bla<sub>OXA</sub>* (27%), *bla<sub>pse</sub>* (11%)), and [aminoglycosides; (*aacC2* (24%), *aphA1* (14%), *strA* (39%))]. Strong positive correlations between Cd and *bla<sub>pse</sub>*, Cr and *sullII* (*Vibrio* spp.) and As and *aphA2* (*P. shigelloides*) were observed. **CONCLUSION:** This study revealed high prevalence of multidrug resistance *Vibrio* spp. and their resistance determinant in this environment. This indicates that these fresh waters poses health risk to the populace if consumed untreated. Therefore there is need for continuous surveillance and monitoring of water bodies in order to safeguard the health of the populace.

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## ABSTRACT E-BOOK

Theme: **Water quality**

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**P-1259**

**Metals exposure in a community-initiated pilot study of drinking water**

**Presenter:** Alexa Friedman, Boston University School of Public Health, Boston, United States

**Authors:** A. Friedman<sup>1</sup>, J. Bauer<sup>1</sup>, C. Austin<sup>2</sup>, T. Downs<sup>3</sup>, Y. Ogneva-Himmelberger<sup>3</sup>, E. Boselli<sup>4</sup>, I. Papautsky<sup>4</sup>, M. Arora<sup>2</sup>, B. Claus Henn<sup>1</sup>;

<sup>1</sup>Boston University School of Public Health, Boston, MA, <sup>2</sup>Icahn School of Medicine at Mount Sinai, New York City, NY, <sup>3</sup>Clark University, Worcester, MA, <sup>4</sup>University of Illinois at Chicago, Chicago, IL.

**Background/Aims:** Metals are commonly found in drinking water, but the safe level for many metals (e.g. manganese (Mn)), particularly during sensitive developmental periods, is unknown. This study responded directly to community concerns about the safety of the public drinking water supply. We characterized current and past exposure to metals in 28 school-age children who resided in Holliston, Massachusetts since before birth. **Methods:** We collected naturally shed teeth and measured concentrations of 11 metals in dentine using laser ablation ICP-MS to represent exposure in weekly intervals during gestation through 12 months of age. Mn was also measured in residential tap water to estimate current exposure. Questionnaires were used to collect information on sociodemographic factors, past and current drinking water consumption habits and child information. We examined correlates of dentine metals concentrations in linear mixed models and characterized water Mn levels. **Results:** Water Mn levels ranged from 0.07 to 5302 ug/L (median: 2.3 ug/L) with 13% of samples above the lifetime health advisory of 300 ug/L. Tooth metals concentrations decreased over time for some (e.g., Mn) but not all metals (e.g., lead [Pb]). Mn levels were higher in females compared to males (prenatal: 10% [95% CI: -21%, 53%]; postnatal: 72% [7%, 174%]). Formula as predominant source of milk during infancy (compared to breastmilk) was associated with 19% [-55%, 45%] lower postnatal tooth Mn levels. For Pb, females had higher dentine Pb than males in both prenatal (36% [-14%, 113%]) and postnatal (69% [-1%, 186%]) periods. **Conclusions:** Results suggest differences in tooth Mn and Pb concentrations by child sex. Postnatal tooth metals concentrations are more variable than prenatal concentrations, which may suggest varied sources of exposure between time windows. Water Mn levels vary considerably spatially and temporally and sometimes exceed the lifetime health advisory, which warrants further investigation of potential health risks.

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## ABSTRACT E-BOOK

Theme: **Water quality**

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**P-1260**

**Physico-chemical and bacteriological evaluation of hand-dug wells in major markets in south-western Nigeria**

**Presenter:** Temitope Ayodeji LANIYAN, University of Ibadan, IBADAN, Nigeria

**Authors:** T. A. LANIYAN<sup>1</sup>, S. Kenjiru<sup>2</sup>;

<sup>1</sup>University of Ibadan, IBADAN, NIGERIA, <sup>2</sup>Olabisi Onabanjo University, Ago-Iwoye, NIGERIA.

Background: Quality of drinking water has always been a major health concern. Lack of access to safely managed water is responsible for high burden of waterborne diseases which disproportionately impact children and equity of women in Nigeria. This study, therefore, assessed the physico-chemical and bacteriological qualities of hand-dug wells in some major markets in Ibadan Southwestern, Nigeria. Methods: Twenty-two (22) water samples from hand-dug wells, measured sequentially along seven major markets were tested for their physico-chemical and bacteriological characteristics. Following standard sampling procedures, in-situ measurements were taken for total dissolved solute (TDS), pH, electrical conductivity (EC), salinity and temperature. The most probable number – multiple tube technique was used for coliform enumeration in addition to total viable bacteria count (TVBC). Results: Mean pH ( $7.37 \pm 0.47$ ), TDS ( $597.51 \pm 109.06$  mg/L), EC ( $748.79 \pm 110.67$   $\mu$ S/cm), salinity ( $0.05 \pm 0.01$  mg/L), and temperature ( $28.75 \pm 0.58$  °C) for all the markets were within WHO permissible limits except pH. High pH may be due to high organic matter content of the water samples. Bacteria genera comprising *Esherichiacoli* (37.5%), *Staphylococcus aureus* (25%), *Proteus vulgaris* (14.6%), *Baccilus* spp. (12.5%), *Pseudomonas aeruginosa* (8.3%) and *Klebsiella* spp. (2.1%). The mean TVBC of 500 to 192,000 cfu/ml were higher than the stipulated WHO standard of <1 cfu/100ml. The presence of *Esherichiacoli* in hand-dug well water samples revealed human or animal faecal contamination. Conclusions: Water from these sources, intended for human consumption or washing of food items, may compromise food safety and pose severe health risks to consumers. The provision of deep tube wells for safe drinking water, periodically testing of the water quality, and education of the users on improved hygiene practices will help in the provision of safe water to the public consumers.

Keywords: Water quality, Hand-dug well, Bacteriological analysis, Coliforms,

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**P-1261**

**Wastewater released into the Onyasia stream by a sewage treatment plant in Accra, Ghana: what are the bacterial loads and antibiotic resistance profiles?**

**Presenter:** LADY ASANTEWAH BOAMAH ADOMAKO, CSIR-WATER RESEARCH INSTITUTE, ACCRA, Ghana

**Authors:** L. A. BOAMAH ADOMAKO;  
CSIR-WATER RESEARCH INSTITUTE, ACCRA, GHANA.

Antibiotic resistance is currently a major threat to global public health with wastewater treatment plants identified as a major contributor to its spread. Wastewater reuse in urban agriculture is also very common in many cities of Ghana. However despite global strategies towards sustainable reuse of treated wastewater, very little is in place to guide safety levels, regulation and guidelines. This study therefore sought to assess the occurrence of antibiotic resistant *Aeromonas hydrophila* and *Escherichia coli* (*E.coli*) isolates from the Legon wastewater treatment plant and the receiving Onyasia stream using culture dependent methods (Bauer et al., 1966). Antibiotics used for antibiotic susceptibility test were selected based on CLSI recommendations and representing seven different classes of antibiotics including,  $\beta$  lactams (Amoxicillin clavulanate), monobactams (Aztreonam), Carbapenems (Imipenem) 3<sup>rd</sup> generation Cephalosporons (Cefuroxime) and Aminoglycosides (Gentamicin), which are commonly used in Ghana. *E. coli* and *Aeromonas hydrophila* were isolated from the treated water system and showed higher resistance to Amoxicillin clavulanate (57% and 68%), Cefuroxime (52% and 43%), and tetracycline (49% and 31%) respectively. In contrast, they were more susceptible to Imipenem (91% and 78% respectively), Gentamicin (83% and 91%), Aztreonam (74% and 73%) and Ciprofloxacin (71% and 81%) respectively. Significant differences ( $p < 0.05$ ) in resistance patterns in resistance patterns were observed between isolates from upstream and downstream water systems. Results show that the discharge of treated wastewater is potentially a contributor to the dissemination and persistence of antibiotic resistance in the receiving Onyasia stream. This finding has potential human health implications for the use of the stream as an irrigation water source.

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**P-1263**

### **Comparing spatial exposure surrogates with detections and concentrations of unconventional oil and gas-related chemicals in residential drinking water**

**Presenter:** Cassandra J Clark, Yale School of Public Health, Department of Environmental Health Sciences, New Haven, United States

**Authors:** C. J. Clark<sup>1</sup>, B. Xiong<sup>2</sup>, K. Gutchess<sup>3</sup>, E. C. Ryan<sup>4</sup>, H. G. Siegel<sup>3</sup>, K. Cassell<sup>5</sup>, M. A. Soriano, Jr.<sup>3</sup>, E. G. Elliott<sup>6</sup>, Y. Li<sup>2</sup>, R. J. Brenneis<sup>2</sup>, D. L. Plata<sup>2</sup>, J. E. Saiers<sup>3</sup>, N. C. Deziel<sup>1</sup>;

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Channing Division of Network Medicine, Department of Medicine, Brigham and Women's Hospital and

Harvard Medical School, Boston, MA.

Approximately 30 epidemiologic studies of unconventional oil and gas development (UOG) to date have identified associations with adverse health outcomes, such as birth outcomes, asthma, and cancer. These studies used spatial surrogates of exposure, which are feasible approaches for assessing aggregate exposures in large-scale studies. However, exposures and pathways captured by these surrogates (e.g., water contamination, air pollution) are poorly understood. We used logistic and linear regression to assess whether commonly-used spatial surrogates were associated with UOG-related chemicals in residential drinking water, an exposure pathway of public health concern. We compared detections and concentrations of 64 organic and inorganic chemicals from 94 private water wells in Bradford County, Pennsylvania with count of UOG wells within a buffer around the home, distance to nearest UOG well, and inverse distance weighted (IDW) and inverse distance-squared weighted well counts at buffer sizes of 2, 5, and 10km. We also compared chemical concentrations to health-based drinking water standards to understand human health risks from exposure. A total of 28 chemicals were detected in  $\geq 20\%$  of water samples, generally at low concentrations, though seven chemicals exceeded health-based drinking water standards at one or more homes. Of the organics, only benzene and toluene were associated with spatial surrogates. The odds of detecting benzene or toluene decreased by 55% and 50%, respectively, with each increasing kilometer between the residence and nearest UOG well (95%CI: 0.24-0.87 and 0.27-0.94); there were no clear relationships between other chemicals and metrics. Concentrations of iron, manganese, and sulfate were consistently inversely associated with IDW metrics, but the other 14 inorganics were poorly associated with metrics. Preliminary results indicate that spatial surrogates are weakly associated with detections and concentrations of UOG-related chemicals. More complex models incorporating groundwater flow and contaminant fate/transport may be needed to accurately capture drinking water exposure for health studies.

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**P-1264**

### **Association between extreme precipitation, drinking water and acute gastrointestinal illness in the Great Lakes**

**Presenter:** Tim Takaro, Simon Fraser University, Burnaby, Canada

**Authors:** R. Graydon<sup>1</sup>, M. Mezzacapo<sup>2</sup>, J. Boehme<sup>1</sup>, D. Buckeridge<sup>3</sup>, S. Foldy<sup>4</sup>, T. Edge<sup>5</sup>, J. Brubacher<sup>6</sup>, L. Chan<sup>7</sup>, M. Dellinger<sup>8</sup>, E. Faustman<sup>9</sup>, J. Rose<sup>10</sup>, T. Takaro<sup>6</sup>;

<sup>1</sup>International Joint Commission, Windsor, ON, CANADA, <sup>2</sup>University of Hawaii at Manoa, Honolulu, HI, <sup>3</sup>McGill, Montreal, QC, CANADA, <sup>4</sup>Denver Public Health, Denver, CO, <sup>5</sup>McMaster University, Hamilton, ON, CANADA, <sup>6</sup>Simon Fraser University, Burnaby, BC, CANADA, <sup>7</sup>University of Ottawa, Ottawa, ON, CANADA, <sup>8</sup>Medical College of Wisconsin, Milwaukee, WI, <sup>9</sup>University of Washington, Seattle, WA, <sup>10</sup>Michigan State University, East Lansing, MI.

#### Introduction

The burden of waterborne acute gastrointestinal illness (AGI) could increase with climate change. Understanding the relationship between weather, drinking water systems (DWS) and AGI can help increase adaptive capacity for DWS. Here, we present findings about the relationship between two largely waterborne illnesses, extreme precipitation and DWS in four cities relying upon Lake Ontario and Lake Michigan for drinking water.

#### Methods

Weekly sporadic cases of laboratory confirmed cryptosporidiosis and giardiasis from 2009-2014 in Toronto and Hamilton, Ontario and Green Bay and Milwaukee, Wisconsin were analyzed using an ecological time-series design. The associations between weekly reported cases and extreme precipitation (>90<sup>th</sup>tile for the week) were assessed using distributed lag non-linear Poisson regression models adjusted for seasonality, long terms trends, turbidity, and total coliform count. Cases were mapped to 5-digit ZIP code or 3-digit Forward Sortation Area.

#### Results

A total of 3961 cases were included. Green Bay and Hamilton had the least number of AGI cases (259 and 301 respectively). Green Bay had the highest incidence with 10.2 cases/10,000 and Hamilton had the lowest with 5.5. These DWSs use similar technologies for water treatment. Green Bay is the only city without combined sewage drainage water system. Significant associations were detected between extreme precipitation preceded by a dry period and weekly cases reported with 3-6 week lags for the large municipalities of Milwaukee, Toronto and Hamilton, but not for Green Bay. Areas of higher prevalence were identified for each city.

#### Conclusions

Extreme precipitation events have been associated with sporadic waterborne illness in several watersheds. Our findings are the first to report this relationship for the N. American Great Lakes. Such events are predicted to increase with climate change underscoring the need to increase adaptive capacity of DWSs and reduce risk for the approximately 40 million people who rely upon this water supply.

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**P-1265**

**Global assessment of trihalomethanes in drinking water**

**Presenter:** Manolis Kogevinas, ISGlobal, Barcelona, Spain

**Authors:** M. Kogevinas<sup>1</sup>, I. Evlampidou<sup>1</sup>, S. Krasner<sup>2</sup>, S. D. Richardson<sup>3</sup>, C. M. Villanueva<sup>4</sup>;

<sup>1</sup>ISGlobal, Barcelona, SPAIN, <sup>2</sup>Personal, La Verne, CA, <sup>3</sup>University of South Carolina, Columbia, SC,

<sup>4</sup>CIBER Epidemiología y Salud Pública (CIBERESP), Barcelona, SPAIN.

**BACKGROUND.** Chlorination of drinking water is a major public health intervention to avoid water-borne infections. Disinfection generates undesired by-products such as trihalomethanes (THMs), some of which are carcinogenic. Global information on population exposure to disinfection by-products (DBPs) in water is lacking. We developed global country-wide estimates of the concentrations of THMs in drinking water as a marker of DBP exposure. **METHODS.** In this global study we collected information about the regulatory status of DBPs and concentrations of total and specific THMs (chloroform, bromoform, dibromochloromethane, bromodichloromethane) in drinking water from the latest year available. Global THM data were collected using a structured questionnaire and database from key national contacts and experts (national agencies, universities, water utilities). We conducted on-line searches of published reports, research studies, and grey literature. We calculated population-weighted average THM levels in each country. Data quality analysis considered the percentage of population covered, the number of water samples, and the source of information used. **RESULTS.** From the 121 countries included, 90 (74%) regulate THMs in drinking water. In countries with THM regulations, 42 (47%) conduct routine monitoring. Data collection is ongoing. Average THM levels (in µg/L) varied e.g., from 0.02 in Denmark, 0.2 in Netherlands, 24 in UK, 27 in Canada, 34 in USA to 60 in South Africa, and 72 in Australia. Very high levels above 600 were observed in certain areas in India. There were major gaps in global coverage, primarily in Africa, but also in Asia. **DISCUSSION.** This is the first global assessment of THM levels in drinking water. National data were available for most high and several middle income countries. Results will become open access, and are expected to promote research and policy developments, including better estimates of global burden of disease, comparative risk assessment, and will facilitate control of DBPs in drinking water.

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## ABSTRACT E-BOOK

Theme: **Water quality**

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**P-1266**

**Human adenoviruses and hepatitis A viruses in the final effluent of five wastewater treatment plants in the Eastern Cape Province, South Africa**

**Presenter:** Olayinka Osuolale, Elizade University, Ilara Mokin, Nigeria

**Authors:** O. Osuolale;  
Elizade University, Ilara Mokin, NIGERIA.

Background: Large reservoirs of human enteric virus and bacteria have been attributed to municipal effluent. Contemporary monitoring practises rely on indicator bacteria but do not test for viruses. Different viruses including Norwalk-like viruses, hepatitis A virus, adenovirus and rotavirus are important agents of illnesses in human. Methods: The viral detection was done using the real-time PCR and conventional PCR was used for serotyping in final effluents of five wastewater treatment plants in the Eastern Cape, South Africa over a period of 12 months (Sept 2012 – Aug 2013). Results: Adenovirus was detected in all five wastewater treatment plants (WWTPs) effluent samples, while HAV was not detected in any of the effluent samples. At the WWPT-A, samples were collected from the final effluent tank and the discharge point. The viral concentration at the final effluent ranged between  $1.05 \times 10^1$  -  $1.10 \times 10^4$  genome copies/L and at the discharge point it ranged between  $1.2 \times 10^1$  -  $2.8 \times 10^4$  genome copies/L. At WWPT-B, the viral concentration ranged between  $7.92 \times 10^1$  -  $2.37 \times 10^5$  genome copies/L. The HAdV detected at WWPT-C ranged between  $5.32 \times 10^1$  -  $2.20 \times 10^5$  genome copies/L. WWPT-D recorded viral concentration ranged between  $1.23 \times 10^3$  -  $1.05 \times 10^4$  genome copies/L, while at the last WWTP (WWPT-E) viral concentration ranged between  $1.08 \times 10^1$  -  $5.16 \times 10^4$  genome copies/L. The characterizations of adenovirus reveal the presence of HAdV 2 (1.4%) and HAdV 41(7.1%) which is of species C and F respectively. Conclusions: This is the first study to demonstrate the prevalence of HAdV in final effluents of WWTPs in the Eastern Cape, South Africa and the frequency of detection of the virus demonstrates a potential contamination of the environment with adverse public health impact.

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**P-1267**

### **Detection and Molecular Characterization of Norovirus in Wastewater in New Orleans**

**Presenter:** Lauren Marie Ward, Tulane University School of Public Health and Tropical Medicine, New Orleans, United States

**Authors:** L. M. Ward<sup>1</sup>, M. Izawa<sup>2</sup>, D. Motooka<sup>3</sup>, N. Sakon<sup>4</sup>, S. Okabe<sup>2</sup>, M. Kitajima<sup>2</sup>, S. Sherchan<sup>1</sup>;  
<sup>1</sup>Tulane University School of Public Health and Tropical Medicine, New Orleans, LA, <sup>2</sup>Hokkaido University, Hokkaido, JAPAN, <sup>3</sup>Osaka University, Osaka, JAPAN, <sup>4</sup>Osaka Institute of Public Health, Osaka, JAPAN.

Norovirus is a leading cause of nonbacterial acute gastroenteritis worldwide and has significant morbidity and mortality in low- and middle-income, as well as high-income countries. The present study aimed to determine the genotype distribution of human noroviruses in influent and effluent wastewater at a wastewater treatment plant in New Orleans area. A total of fifteen norovirus genotypes belonging to three genogroups (genogroup I [GI], GII, and GIV) were detected. GI.6 and GII.12 were the most commonly detected norovirus genotypes, and were detected primarily in spring and summer. Three GI genotypes and one GII genotype were detected in effluent, with no apparent seasonal pattern. GII genotypes, which are responsible for the largest proportion of human gastroenteritis cases, were most frequently detected (54.29% of detected genotypes). Four genotypes (GI.1, GI.6, GII.12, and GII.4 Sydney) that cause the majority of human norovirus cases in the United States were detected. The results of the present study demonstrate the importance of environmental and molecular surveillance of norovirus in wastewater in order to mitigate human outbreaks from waterborne transmission, as well as other region-specific routes, such as the consumption of contaminated shellfish.

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**P-1270**

**Fluoride exposure and duration and quality of sleep in a Canadian cohort**

**Presenter:** Jasmyn E A Cunningham, Department of Medicine, McMaster University, Hamilton, Canada

**Authors:** J. E. Cunningham<sup>1</sup>, H. McCague<sup>2</sup>, A. Malin<sup>3</sup>, J. Riddell<sup>4</sup>, D. Flora<sup>5</sup>, C. Till<sup>5</sup>;

<sup>1</sup>Department of Medicine, McMaster University, Hamilton, ON, CANADA, <sup>2</sup>Institute for Social Research, York University, Toronto, ON, CANADA, <sup>3</sup>Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, <sup>4</sup>University of Manitoba, Winnipeg, MB, CANADA, <sup>5</sup>Faculty of Health, York University, Toronto, ON, CANADA.

**Background:** Research suggests that fluoride from dietary and environmental sources may concentrate in calcium-containing regions of the body such as the pineal gland. The pineal gland synthesizes melatonin, a hormone that regulates the sleep-wake cycle. We used population-based data from Cycle 3 (2012-2013) of the Canadian Health Measures Survey (CMHS) to examine associations between fluoride exposure and sleep outcomes.

**Methods:** The sample included participants aged 16 to 79 years. Fluoride concentrations were measured in urinary spot samples (n=1303) and household tap water among those who reported drinking tap water (n=1016); urinary fluoride was adjusted for specific gravity (UF<sub>SG</sub>). We used multinomial and ordered logistic regression analyses to examine associations of fluoride exposure with self-reported sleep outcomes, including sleep duration and frequency of sleep problems. Sleep duration was classified as normal, low, or high according to age-based recommendations by the National Sleep Foundation, and frequency of sleep problems were measured on a 5-point scale, ranging from “never” to “all of the time”. Covariates were based on theoretical relevance and included age, sex, ethnicity, body mass index, and household income. **Results:** Median (IQR) UF<sub>SG</sub> and water fluoride concentrations were 0.67 (0.63) and 0.12 (0.38) mg/L, respectively; 32% of participants lived in communities supplied with fluoridated municipal water. A 0.5 mg/L increase in water fluoride level was associated with 34% higher relative risk of reporting sleeping less than the recommended duration [RRR = 1.34, 95% CI: 1.03, 1.73; p = .026]. UF<sub>SG</sub> was not significantly associated with sleep duration. Water fluoride and UF<sub>SG</sub> concentration were not significantly associated with frequency of sleep problems. Including chronic health conditions as a covariate did not substantially change the association between water fluoride and sleep duration.

**Conclusions:** Fluoride exposure may contribute to sleeping less than the recommended duration among older adolescents and adults in Canada.

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**P-1271**

**T for target organ, timing, and fluoride exposure**

**Presenter:** Philippe Grandjean, University of Southern Denmark, Odense, Denmark

**Authors:** P. Grandjean, N. Krishnankutty, F. Nielsen;  
University of Southern Denmark, Odense, DENMARK.

**Background:** The brain is a main target organ for fluoride toxicity during early development. Based on recent epidemiological evidence, an approximate benchmark dose has been calculated for pregnant women at about 0.2 mg/L in water (or urine). This means that current limits for water-fluoride are too high, but tea has been suggested as an additional exposure source. **Methods:** Popular brands of teabags and loose tea were purchased in supermarkets and specialty shops in Denmark. Tea infusions were prepared in a standardized way (1 teabag or 2 g of loose tea per 200 mL cup) in deionized water, and the fluoride concentration was measured by ion-specific electrode. **Results:** Fluoride releases varied substantially. Teabags showed rather uniform and relatively high fluoride concentrations, mostly between 1 and 2.5 mg/L. Green tea and oolong tea showed results between 0.5 and 2 mg/L, and white teas were mostly lower. The concentrations in fruit/herb teas seemed to depend on the content of black tea. Some types of black tea exceeded 4 mg/L. The highest results were obtained for teas from Kenya, the lowest for Nepalese teas. The results suggest that a single cup of tea may well contribute an intake of at least 0.2 mg of fluoride (in addition to the water-fluoride concentration), thereby likely increasing the exposure above the estimated benchmark dose. **Conclusions:** Tea consumption is a main challenge in fluoride exposure assessment. In addition to limiting fluoride concentrations in potable water and in bottled water, information on fluoride concentrations in tea should be made available to allow consumers to choose wisely.

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**P-1272**

**Arsenic in US correctional facility drinking water, 2006-2011**

**Presenter:** Anne Nigra, Columbia University Mailman School of Public Health, New York, United States

**Authors:** A. Nigra, A. Navas-Acien;  
Columbia University Mailman School of Public Health, New York, NY.

**Background:** Very little is known about the quality of drinking water in US correctional facilities (e.g. detention centers, prisons, jails, etc.), which disproportionately detain people of color. The current Environmental Protection Agency's maximum contaminant level (MCL) for arsenic in public drinking water is 10 µg/L. We estimated drinking water arsenic concentrations in US correctional facilities to determine if incarcerated persons remain at risk for chronic, elevated water arsenic exposure relative to the non-incarcerated US population.

**Methods:** We obtained 230,158 arsenic monitoring records for 37,098 community water systems (CWSs) from the Environmental Protection Agency's Third Six Year Review of Contaminant Occurrence dataset (covering 2006-2011). We compared six-year average arsenic concentrations in all CWSs versus CWSs exclusively serving correctional facilities. We separately evaluated the Southwestern US (where groundwater arsenic concentrations are relatively high) versus non-Southwestern US. **Results:** Average six-year water arsenic concentrations were higher for CWSs exclusively serving correctional facilities in the Southwest (6.41 µg/L, 95% CI 3.48, 9.34) compared to all other Southwestern CWSs (3.11 µg/L, 95% CI 2.97, 3.24) and to other CWSs across the rest of the US (1.39 µg/L, 95% CI 1.35, 1.42). Compared to other US CWSs and to other Southwestern CWSs, correctional facility CWSs in the Southwest were more likely to report six-year arsenic averages exceeding 10 µg/L (1.6%, 5.8%, and 26.1% of systems, respectively).

**Conclusions:** CWSs exclusively serving correctional facilities in the Southwestern US reported average water arsenic concentrations twice as high as those reported by all other CWSs in the Southwest, and more than a quarter reported six-year averages exceeding the EPA's regulatory MCL. Strict enforcement of the EPA's drinking water regulations and a comprehensive review of other drinking water contaminants in CWSs serving correctional facilities is necessary to protect the health and human rights of all incarcerated persons in the US.

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**P-1274**

**Arsenic exposure and urinary metabolites during pregnancy and its association with birth outcomes in Tacna, Peru**

**Presenter:** Diego Fano-Sizgorich, Universidad Peruana Cayetano Heredia, Lima, Peru

**Authors:** D. Fano-Sizgorich<sup>1</sup>, C. Vásquez-Velásquez<sup>1</sup>, M. O. Gribble<sup>2</sup>, D. B. Barr<sup>3</sup>, J. K. Wickliffe<sup>4</sup>, M. Y. Lichtveld<sup>4</sup>, K. Steenland<sup>2</sup>, G. F. Gonzales<sup>1</sup>;

<sup>1</sup>Universidad Peruana Cayetano Heredia, Lima, PERU, <sup>2</sup>Rollins School of Public Health, Emory University, Atlanta, GA, <sup>3</sup>LEADER Laboratory, Emory University, Atlanta, GA, <sup>4</sup>School of Public Health & Tropical Medicine, Tulane University, New Orleans, LA.

**Background:** The province of Tacna, Peru, presents arsenic levels in drinking water above the WHO suggested limit of 10µg/L. One of the adverse effects during pregnancy is the increased rate of small for gestational age (SGA). However, comparing to the rest of Peru, SGA in Tacna is lower but large for gestational age (LGA) is the highest in all the country. Here we have evaluated the water and urinary arsenic metabolites in pregnant women and their association with birth outcomes. **Methods:** We estimated the arsenic concentration in drinking water and urine during the second and third trimester of pregnancy in 150 women that live in Tacna from February to July, 2019. Water arsenic was evaluated qualitatively, and urinary arsenic (tAs, As<sup>III</sup>, As<sup>V</sup>, MMA and DMA) was quantified by HPLC-MS. Primary ((MMA+DMA)/tAs) and Secondary (DMA/(MMA+DMA)) methylation-indexes (PMI/SMI) were generated. Reproductive outcomes were assessed as tertiles of exposure. **Results:** We found an almost even distribution of arsenic exposure in drinking water (30.43% to ≤10µg/L; and 34.78% for 25µg/L and 34.78% for ≥50µg/L). Mean total urinary arsenic was higher according to the exposure group (38.08, 51.86 and 65.38ng/mL, respectively). It is appreciated an increase of SGA proportion by tertile of total urinary arsenic (tAs) (2.38%, 7.32% and 8.57%) although not significantly. On the other hand, the proportion of LGA is reduced when increasing the tertile of %As<sup>V</sup>: 38.1%, 35.8% and 28.57%, respectively. **Conclusions:** Although no significant relationship was found between arsenic exposure and births outcomes, there is a tendency of higher risk of SGA with increasing tertile of tAs. On the other, according to recent research, the aymara ethnic population, Tacna's main ethnicity, is characterized by high birthweights for gestational age, and our results show that higher %As<sup>V</sup> might shift this normal pattern, reducing the proportion of LGA; nonetheless, greater sample size is required.

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**P-1275**

### **Trends in Health-Based Drinking Water Violations for Total Coliform Bacteria in the United States**

**Presenter:** Kshipra Sharma, University of North Dakota, Grand Forks, United States

**Authors:** K. Sharma, A. Lyon-Colbert;  
University of North Dakota, Grand Forks, ND.

This research seeks to determine whether health-based drinking water violations for total coliforms have increased since the Revised Total Coliform Bacteria Rule (RTCR) established in 2013 by the Environmental Protection Agency (EPA) under the Safe Drinking Water Act (SDWA); as well as to determine the geographic regions, states and territories with the highest number of health-based Total Coliform Rule (TCR) and RTCR violations. Data was obtained for drinking water violations involving total coliform bacteria from the Safe Drinking Water Information System (SDWIS) for 2000-2019 and trend analysis was performed by state, region, water source, violation type, month, and year. This research seeks to determine whether health-based drinking water violations for total coliforms have increased since the Revised Total Coliform Bacteria Rule (RTCR) established in 2013 by the Environmental Protection Agency (EPA) under the Safe Drinking Water Act (SDWA); as well as to determine the geographic regions, states, and territories with the highest number of health-based Total Coliform Rule (TCR) and RTCR violations. Data were obtained for drinking water violations involving total coliform bacteria from the Safe Drinking Water Information System (SDWIS) for 2000-2019 and trend analysis was performed by state, region, water source, violation type, month, and year. Out of total 587,983 reported TCR and RTCR violations, 124,977 were health-based. EPA Region 5, which is headquartered in Chicago had the highest number of health-based TCR and RTCR violations (n=27,030), followed by EPA Region 1, which is headquartered in Boston (n=17,771). Within EPA Region 5, Wisconsin had the highest number of TCR and RTCR violations (n=7,022). Frequent acute violations occurred in small water systems using primarily groundwater, serving primarily rural populations. Within EPA Region 5, Wisconsin had the highest number of TCR and RTCR violations (n=7,022). Frequent acute violations occurred in small water systems using primarily groundwater, serving primarily rural populations.

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**P-1277**

**Water, Sanitation and Hygiene (WASH) Systems of Selected Schools in Southren Ethiopia**

**Presenter:** Wondwossen Birke, Jimma University, Jimma, Ethiopia

**Authors:** T. Tulu, W. Birke;  
Jimma University, Jimma, ETHIOPIA.

### Background

Although efforts had made to support Universal Primary Education policies implementation in Ethiopia, less consideration was given to the important contribution of clean and healthy school. This study aimed at assessing WaSH systems of primary second cycle schools in Bensa district, Southren Ethiopia, from January 2018-March 2018.

### Methods

A school based cross-sectional study was conducted employing multi-stage sampling method composed of schools, school principals and school children. Accordingly, 8 randomly selected schools & principals for in-depth study, and 422 randomly sampled students from grades 5<sup>th</sup>-8<sup>th</sup>. Data were collected by questionnaire, interview, focus group discussion and observation. For qualitative part, key informants were interviewed using semi structured questionnaire on schools WaSH facilities, utilization and management. Data were processed & analyzed using spreadsheet database developed for this survey.

### Results

The result showed all schools were unable to get water all the times and 37.5% of them got water from unprotected sources. Almost all indicated that their water supply not tested for its quality. On-site observation showed that no schools had hand washing facility near latrine. Latrine student ratios were below the limit of national standard. More than half of them observed to have unclean latrines and feces had seen on the floor. Almost all schools had no maintenance plan for their WSS facilities. The level of attention given by schools and local government for school WaSH was low. Financial capacity, inter-sector and stakeholder cooperation and harmonization were also very weak.

### Conclusions

The study result revealed that school WaSH facilities and its management, and sanitation and hygiene conditions had got various shortcomings. Hence, school WaSH facilities, sanitation and hygiene conditions primarily require due attention and commitment of stakeholders to realize a healthy school environment.

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**P-1278**

**Recreational water exposure is associated with asymptomatic and symptomatic salivary antibody immunoconversions to waterborne pathogens**

**Presenter:** Andrey I Egorov, United States Environmental Protection Agency, Chapel Hill, United States

**Authors:** A. I. Egorov<sup>1</sup>, S. Griffin<sup>2</sup>, R. Converse<sup>1</sup>, L. Wickersham<sup>1</sup>, E. Klein<sup>1</sup>, R. Bonasso<sup>1</sup>, J. Styles<sup>1</sup>, J. Kobylanski<sup>1</sup>, E. Sams<sup>1</sup>, E. Hudgens<sup>1</sup>, A. Dufour<sup>2</sup>, T. Wade<sup>1</sup>;

<sup>1</sup>United States Environmental Protection Agency, Chapel Hill, NC, <sup>2</sup>United States Environmental Protection Agency, Cincinnati, OH.

Non-invasive salivary antibody tests can be used to detect symptomatic and asymptomatic waterborne infections in prospective studies. Immunoconversion as a marker of infection is free of reporting bias potentially affecting self-reported symptoms. Families with children (875 individuals) were recruited at a Lake Michigan beach in Wisconsin in summer 2011. Data on recreational water exposure and baseline saliva samples (S1) were collected at recruitment. Follow-up saliva samples were self-collected at 10-14 days (S2) and 30-40 days post-recruitment (S3). Samples were analyzed for IgG responses to recombinant antigens of six noroviruses and *Cryptosporidium*, and control antigens using an in-house multiplex suspension immunoassay. Immunoconversions were defined as at least four-fold and three-fold increases in antibody responses in S2 and S3 samples compared to S1, with S2 responses to noroviruses and *Cryptosporidium* above the upper 80% or 90% one-sided prediction limits of spline functions of age, respectively. There were 8 (0.9%) immunoconversions including 7 immunoconversions to noroviruses. Among 176 individuals who reported swallowing lake water there were 5 (2.8%) immunoconversions compared to 3 (0.4%) immunoconversions in the remaining 699 individuals: odds ratio 14 (2.4; 80),  $p=0.004$  after adjusting for age. Individuals with norovirus immunoconversion were more likely to experience vomiting or nausea symptoms within four days of the baseline beach visit than non-converters: age-adjusted odds ratios 34 (3.2; 355),  $p=0.003$ , for vomiting, and 8.8 (1.0; 77),  $p=0.05$ , for nausea. This study provided further evidence that recreational water exposure is associated with symptomatic and asymptomatic waterborne infections. This abstract does not represent EPA policy.

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**P-1279**

**Using Electronic Health Record Data to Monitor Trends in Human Illness from Algae Exposure**

**Presenter:** Amy Lavery, Centers for Disease Control and Prevention, Atlanta, United States

**Authors:** A. Lavery, L. Backer, J. Daniel;  
Centers for Disease Control and Prevention, Atlanta, GA.

**Introduction:** Short-term health effects have been associated with Harmful Algal Bloom (HAB) exposure through skin contact, ingestion, or inhalation of the algal toxins. Recorded symptoms include skin, eyes, nose, or throat irritation, headache, neurological symptoms, abdominal pain, vomiting, and diarrhea. Little is known about the prevalence of these and other health symptoms related to HAB exposure in the United States. Electronic health records (EHR) present an opportunity to study the prevalence and geographic distribution of health events related to algae exposure. We evaluated the use of EHR for modeling of HAB health events across the United States. **Methods:** Three EHR databases were searched for use of medical diagnostic codes and key-terms within the medical record related to algae exposure. Records were summarized by demographics, location, and time. A descriptive analysis summarized the health symptoms and procedures listed as part of the clinical encounter. Results from all EHR databases will be presented. Results for the largest EHR database assessed are discussed below. **Results:** The IQVIA database had a total of 13,046 medical records with algae-related exposure from January 2006 to June 2019. Of these, only 290 patients had a direct diagnosis of algae exposure. Patients with algae exposure were mostly female (64%) and non-Hispanic white (87%). The mean age of patients was 38 years (range 1-85). Comparisons of this data to environmental data over space and time are currently underway and will be presented.

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## ABSTRACT E-BOOK

Theme: **Water quality**

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**P-1280**

**Are low fluoride levels in drinking water really detrimental for neuropsychological neurodevelopment in childhood?**

**Presenter:** Jesus Ibarluzea, Department of Health of the Basque Government, Subdirectorate of Public Health of Gipuzkoa, Donostia-San Sebastián, Spain

**Authors:** J. Ibarluzea<sup>1</sup>, M. Gallastegi<sup>2</sup>, M. Lopez Espinosa<sup>3</sup>, C. M. Villanueva<sup>4</sup>, I. Riano<sup>5</sup>, F. Ballester<sup>6</sup>, L. Santa Marina<sup>1</sup>, A. Jiménez Zabala<sup>1</sup>, A. Molinuevo<sup>7</sup>, J. Sunyer<sup>8</sup>, A. Tardon<sup>9</sup>;

<sup>1</sup>Department of Health of the Basque Government, Subdirectorate of Public Health of Gipuzkoa, Donostia-San Sebastián, SPAIN, <sup>2</sup>Biodonostia Health Research Institute, Group of Environmental Epidemiology and Child Development., Donostia-San Sebastián, SPAIN, <sup>3</sup>Nursing School, Universitat de Valencia, Valencia, SPAIN, <sup>4</sup>Spanish Consortium for Research on Epidemiology and Public Health (CIBERESP), Madrid, SPAIN, <sup>5</sup>AGC -Pediatria. HUCA-Oviedo, Oviedo, SPAIN, <sup>6</sup>Foundation for the Promotion of Health and Biomedical Research in the Valencian Region, FISABIO-Public Health, Valencia, SPAIN, <sup>7</sup>Biodonostia Health Research Institute, Group of Environmental Epidemiology and Child Development., Donostia-San Sebastián, SPAIN, <sup>8</sup>. ISGlobal, Centre for Research in Environmental Epidemiology, Barcelona, SPAIN, <sup>9</sup>IUOPA-Departamento de Medicina, Universidad de Oviedo, Oviedo, SPAIN.

**Methods:** Fluoride was measured in drinking water (DW) and in urine (1<sup>st</sup> and 3<sup>rd</sup> trimesters of pregnancy). The 369 mother-children pairs of the Spanish INMA cohort participating in the study reported their drinking water habits (Fluorinated DW, non-Fluorinated DW or bottled water (BW)). Maternal urine fluoride creatinine adjusted (MUFcr) levels at both trimesters were determined and neuropsychological assessment at 1 and 4 years of age was performed. For neuropsychological assessment the Bayley Scales (1 y) and the McCarthy Scales (4-5 years) were used. Multivariate linear regression models were built with the following neuropsychological domains as outcomes: Mental Index (Bayley) and Verbal, Perceptive-Manipulative, Numeric, Memory and General Cognitive (McCarthy)). **Results:** The percentage of mothers drinking FDW, NFDW and BW was 23.9%, 35% and 39.8% respectively. Fluoride mean levels were 0.81, 0.1-0.25 and <0.1-0.48 mg/L in FDW, non-FDW and BW, consecutively. MUFcr mean levels of entire pregnancy (mg F/g creatinine) (mean; 95% CI) were different ( $p < 0.001$ ) for those drinking FDW ((0.91 (0.83, 0.99), NFDW (0.45 (0.41, 0.49)) and BW (0.64 (0.6, 0.69)). No association was detected between MUFcr levels and Mental Index (Bayley). An increase of 1 unit in MUFcr during the entire pregnancy was related to a higher score on the perceptual-manipulative (5.13 (0.52, 9.74)) and the general cognitive (4.8 (0.13, 9.47)) McCarthy scales., MUFcr levels at 32th week of pregnancy were associated with higher verbal, memory and general cognitive scores in boys ( $p$  for interaction  $< 0.05$ ). **Conclusions:** Positive associations between fluoride levels during pregnancy and neuropsychological development at 4 years of age were found. Detrimental effects of fluoride in neurodevelopment were not supported by our data.

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**P-1281**

### **Chemical and Microbial Analysis of Groundwater from Ile-Ife Area of Osun State, Southwestern Nigeria**

**Presenter:** Elishama B. YOMI-AGBAJOR, Federal University of Agriculture, Abeokuta (FUNAAB), Abeokuta, Nigeria

**Authors:** A. M. GBADEBO, E. B. YOMI-AGBAJOR, O. O. OLAIYA;  
Federal University of Agriculture, Abeokuta (FUNAAB), Abeokuta, NIGERIA.

**Background/Aim:** This research examined physical, chemical and heavy metals of groundwater in Ile-Ife-Osu Area of Osun State in order to determine its quality and potability. **Methods:** Twenty (20) groundwater samples (hand dug wells and boreholes) were collected from four (4) different locations in the study area. Hanna 98130 multi-digit meter was used for the determination of pH, Electrical Conductivity (EC), Total Dissolved Solid (TDS) and temperature. Titrimetric method was used for the determination of chloride, total hardness, calcium and magnesium hardness. For the determination of potassium and sodium, the samples were digested and read using flame photometer while the heavy metals were determined using Atomic Absorption Spectrophotometry at Fatlab Nigeria Limited, Ibadan. Microbial load was determined using serial dilution method and the types of bacteria present in the samples were identified. **Results:** The result indicated that the physical parameters of the groundwater samples varied as follows: pH, 4.0-7.4; temperature, 27.0-28.70 °C; EC, 140-1480 µS/cm and TDS, 70-740 mg/L. The mean ranges of Cations such as Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup> are; 11-70 mg/L, 2.0-50 mg/L, 40-272 mg/L and 10-288 mg/L respectively while the mean ranges of anions such as HC03<sup>-</sup> SO<sub>4</sub><sup>2-</sup> NO<sub>3</sub><sup>-</sup> and Cl<sup>-</sup> are 5.0-16.0 mg/L, 12.7-60.0 mg/L, 1.9-27.7 mg/L and 55-210 mg/L. Heavy metals in the samples ranged as follows: Fe, 0.15-2.04 mg/L; Mn, 0.00-0.35 mg/L; Cu, 0.001-0.488 mg/L and Zn, 0.024-0.110. Total bacterial and coliform counts had similar ranges from 1.1 x 10<sup>1</sup>-2.6 x 10<sup>4</sup> cfu/ml. Major bacteria identified in the groundwater samples include Enterobacter aerogenes, Escherichia coli and Klebsiella pneumonia. **Conclusion:** This study revealed that most analysed parameters were within the WHO standard except nitrate and pH which indicated that the groundwater was generally acidic. Microbial analysis affirmed groundwater pollution in the study area.

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## ABSTRACT E-BOOK

Theme: **Water quality**

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**P-1282**

**Association between gastrointestinal diseases in children and wastewater agricultural irrigation in Valle del Mezquital, México.**

**Presenter:** Sandra Rodríguez-Dozal, Instituto Nacional de Salud Publica, Cuernavaca, Mexico

**Authors:** S. Rodríguez-Dozal<sup>1</sup>, E. E. Felix-Arellano<sup>1</sup>, J. D. Contreras<sup>2</sup>, R. Meza<sup>2</sup>, J. N. Eisenberg<sup>2</sup>, H. Riojas-Rodriguez<sup>1</sup>;

<sup>1</sup>Instituto Nacional de Salud Publica, Cuernavaca, MEXICO, <sup>2</sup>University of Michigan, Ann Arbor, MI.

Background. Wastewater reuse for agriculture has intensified over the years partly due to increases in urbanization. In the Valle del Mezquital, wastewater from Mexico City is used for agricultural irrigation. Human and animal pathogens are continuously high in wastewater, potentially putting local residents at risk. The Atotonilco Wastewater Treatment Plant began partially treating wastewater in May 2017, providing treated water to some irrigation districts of the Mezquital. Objective. We compared the risk of gastrointestinal diseases in children under five living in three areas of the Mezquital: zone A where crops are irrigated with treated wastewater after the treatment plant began operation, zone B where crops are irrigated with untreated wastewater, and zone C where crops are irrigated with well water. Methods. We conducted a longitudinal study following 880 children under five with three household visits: recruitment (November 2016-April 2017), follow-up (May-July 2017 and August-November 2017). We administered questionnaires to the primary caregiver about diarrheal disease in children under five, use of water in the household, hygiene practices, and participation in agriculture. We estimated the odds of presenting with diarrhea using multivariate logistic regression models with fixed and random effects. Compared to Zone C, Zone B had 2.3 times the odds of diarrheal disease (95% CI 1.41 - 3.84), followed by zone A (OR = 1.72 times, 95% CI 1.04 - 2.86), after adjusting for age, sex, presence of chickens, and access to sewerage. The odds of diarrhea in children under five increased in the presence of chickens (OR = 1.74, 95% CI 1.18 - 2.57) and decreased with access to sewerage (OR = 0.50, 95% CI 0.27 - 0.93). Conclusion. Our results suggest that exposure to wastewater used for irrigation, with or without treatment, contributes to the presence of diarrheal disease in children under five years of the Mezquital.

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## ABSTRACT E-BOOK

Theme: **Water quality**

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**P-1283**

**Plasma and water fluoride levels and hyperuricemia among US adolescents**

**Presenter:** Yudan Wei, Mercer University School of Medicine, Macon, United States

**Authors:** Y. Wei<sup>1</sup>, J. Zhu<sup>2</sup>, S. Wetzstein<sup>1</sup>;

<sup>1</sup>Mercer University School of Medicine, Macon, GA, <sup>2</sup>Fort Valley State University, Fort Valley, GA.

Background: Evidence obtained thus far on the relationship between exposure to excessive fluoride and serum uric acid levels has been based predominately on experimental animals and the studies have provided mixed results. The present study was to determine a potential relationship between fluoride exposure and uric acid levels in a human population. Methods: A nationally representative subsample of 2018 adolescents, aged 12-19 years, in the 2013-2016 National Health and Nutrition Examination Survey was analyzed for the association of plasma and water fluoride concentrations with serum uric acid levels using multivariate general linear and logistic regression models, adjusting for potential confounders. Hyperuricemia was defined in this study as over the mean plus one standard deviation for each sex and age group of adolescents. Results: Of the study participants, 288 adolescents (weighted prevalence, 16.15%) were having hyperuricemia. A significant and dose-dependent increase in the prevalence of hyperuricemia was seen among the participants cross increasing quartiles of plasma fluoride (p-trend = 0.0015). After adjusting for potential confounders, we found that adolescents in the highest quartiles of plasma fluoride ( $\geq 0.45$   $\mu\text{mol/L}$ ) had significantly increased odds of hyperuricemia (OR: 1.78; 95% CI: 1.04, 3.04) compared with those in the lowest quartile. A 1.86-fold increased odds of hyperuricemia was also observed when analyzing fluoride concentrations as continuous variable. A general linear model revealed that a 1  $\mu\text{mol/L}$  increase in plasma fluoride was associated with a 0.213 mg/dL ( $p < 0.0001$ ) increased serum uric acid level. Furthermore, a positive relationship was observed between water and plasma fluoride concentrations ( $\beta = 0.19$ ;  $p < 0.0001$ ). Conclusion: Our study demonstrates a potential relationship between fluoride exposure and hyperuricemia in adolescents. Additional studies would further explore these interactions and elucidate potential underlying issues of hyperuricemia associated with exposure to high levels of fluoride.

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Theme: **Water quality**

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**P-1284**

### **Geospatial analysis of antibiotic resistance in the aquatic environment of Bangladesh**

**Presenter:** Muhammad Asaduzzaman, icddr,b, Dhaka, Bangladesh

**Authors:** M. Asaduzzaman;  
icddr,b, Dhaka, BANGLADESH.

Background Geographical information systems (GIS) can play a significant role in understanding the distribution and clustering of drug resistant pathogens. Currently, geospatial analysis using GIS is not widely applied to mapping antimicrobial resistance (AMR) in the environment for development of its mitigation strategies. Methods We conducted an observational community prevalence study in rural households, poultry farms and urban markets in Bangladesh. A total of 240 aquatic samples from upstream to downstream surrounding the study settings (drinking water source, waste water and surface water, e.g. rivers and ponds) were collected in summer and winter. Spatial mapping was done (using ArcGIS software) to demonstrate the concentrations of extended-spectrum  $\beta$ -lactamase-producing (ESBL) E. coli count in the aquatic system of each setting. Each data point represents an environmental sample and the data size indicates the concentration of  $\log_{10}$  ESBL E. coli. Results We identified ESBL E. coli in all types of environmental samples. Wastewater had the highest prevalence of ESBL E. coli ranging from 90% in rural households to 98% in urban food markets. River water samples had the next highest prevalence (85% positive) followed by pond water (76% positive in rural households and 68% in farms) respectively. Carbapenem-resistant E. coli were less common than ESBL E. coli but plentiful (30%) in waste water samples adjacent to urban markets. Both ESBL E. coli and Carbapenem-resistant E. coli did not vary by season in waste water and pond water, but Carbapenem resistant E.coli were significantly higher in the summer for river water (50% vs 15% ,  $p < 0.05$  ). Conclusion

Our current study is the first attempt to use spatial mapping in low income settings for assessing the extent of environmental contamination with antibiotic resistant bacteria. Utilization of GIS with microbiological data might be an important monitoring tool for both surveillance and policy context of AMR.

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**P-1285**

**Ingestion of nitrate and nitrite from drinking water and diet and cancers of the gastrointestinal tract in Iowa women**

**Presenter:** Mary H. Ward, National Cancer Institute, Rockville, United States

**Authors:** M. H. Ward<sup>1</sup>, I. Buller<sup>1</sup>, D. M. Patel<sup>1</sup>, R. R. Jones<sup>1</sup>, P. J. Weyer<sup>2</sup>, A. Prizment<sup>3</sup>;  
<sup>1</sup>National Cancer Institute, Rockville, MD, <sup>2</sup>University of Iowa, Iowa City, IA, <sup>3</sup>University of Minnesota, Minneapolis, MN.

Background: Nitrate and nitrite are precursors in the endogenous formation of N-nitroso compounds (NOC), potent animal carcinogens in the gastrointestinal tract. Methods: We evaluated nitrate ingestion from public drinking water supplies (PWS), private well use, and dietary nitrate and nitrite intakes in relation to incidence (through 2014) of cancers of the esophagus (n=37), stomach (97), small intestine (47), liver (56), and gallbladder (66) in the Iowa Women's Health Study (42,000 women ages 50-75 in 1986). Historical nitrate measurements from PWS were linked to the enrollment address by duration. We computed average concentrations and number of years >5 mg/L NO<sub>3</sub>-N (½ the maximum contaminant level [MCL]). Dietary nitrate and nitrite were estimated using a food frequency questionnaire. We used Cox proportional hazards models to compute hazard ratios (HR) and 95% confidence intervals (CI). Results: In adjusted models, liver cancer risk was elevated among private well users (HR=2.5, CI 0.8-8.5) and those with any years >5 mg/L NO<sub>3</sub>-N (HR=2.0, CI 0.8-4.9); there was no association with average concentrations (HR<sub>per1mg/L NO<sub>3</sub>-N</sub> =1.1, CI 0.7-1.7). Private well use and PWS nitrate concentrations were not associated with other cancers. Dietary nitrate and nitrite from plants was inversely associated with small intestine (HR<sub>Q<sub>4</sub>vsQ<sub>1</sub></sub> =0.4, CI 0.1-0.9) and gall bladder cancer (HR<sub>Q<sub>4</sub>vsQ<sub>1</sub></sub> =0.3, CI 0.1-0.8), respectively; there were no associations for the other cancers. Nitrite intake from processed meats was associated with increased risk of stomach (HR<sub>nitriteQ<sub>4</sub>vsQ<sub>1</sub></sub> =1.7, CI 1.0-3.0) and elevated risk of liver cancer (HR<sub>nitriteQ<sub>4</sub>vsQ<sub>1</sub></sub> =1.8, CI 0.8-4.0) but was inversely associated with small intestine cancer (HR<sub>nitriteQ<sub>4</sub>vsQ<sub>1</sub></sub> =0.4, CI 0.1-1.0). Power was limited, but there was no evidence for effect modification by vitamin C and red meat, factors affecting nitrosation. Conclusion: We found novel suggestive evidence that private well use and PWS nitrate may increase liver cancer risk. These associations should be evaluated in studies with larger case numbers.

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## ABSTRACT E-BOOK

Theme: **Water quality**

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**P-1286**

**Human fecal contamination of the domestic environment and child enteric infection in urban Maputo, Mozambique**

**Presenter:** David A Holcomb, University of North Carolina at Chapel Hill, Chapel Hill, United States

**Authors:** D. A. Holcomb<sup>1</sup>, J. Knee<sup>2</sup>, T. Sumner<sup>3</sup>, R. Nalá<sup>4</sup>, O. Cumming<sup>2</sup>, J. Brown<sup>3</sup>, J. R. Stewart<sup>1</sup>;

<sup>1</sup>University of North Carolina at Chapel Hill, Chapel Hill, NC, <sup>2</sup>London School of Hygiene and Tropical Medicine, London, UNITED KINGDOM, <sup>3</sup>Georgia Institute of Technology, Atlanta, GA, <sup>4</sup>Instituto Nacional de Saúde, Ministério da Saúde, Maputo, MOZAMBIQUE.

**Background:** Children living in settings with poor sanitation infrastructure are commonly infected by a range of enteric pathogens that can be transmitted through multiple pathways in the domestic environment. Host-associated microbial source tracking (MST) markers are increasingly used to identify fecal contamination, but the relationship between MST markers and infection risk remains poorly characterized. **Methods:** We assessed fecal contamination in samples of water, soil, and food preparation surfaces from household clusters (compounds) in low-income neighborhoods of urban Maputo, Mozambique through two cross-sectional surveys conducted approximately 12 months apart. Child stool was analyzed for 23 enteric pathogens from four classes: nine bacteria, three viruses, and three protozoan parasites by multiplex reverse-transcription polymerase chain reaction (RT-PCR) and eight soil transmitted helminths (STH) by Kato-Katz. Human fecal contamination was determined by real-time PCR (qPCR) targeting two human-associated MST markers, HF183/BacR287 and Mnif, and *Escherichia coli* was assessed by culture and qPCR to indicate non-specific fecal contamination. We estimated associations between fecal indicators in each sample type and infection by pathogen class and number of co-infections using multilevel logistic and negative binomial regression, respectively, with compound-varying intercepts. **Results:** Samples were collected from 193 children and 71 compounds, with 112 children contributing stool in both survey rounds. Prevalence of enteric infection was high, with 86-92% of children in each survey round shedding at least 1 pathogen, but most were asymptomatic with 8-12% reporting diarrhea in the preceding 7 days. Contamination of drinking water source demonstrated weak associations with bacterial (aOR: 2.2; 95% CI: 1.0-4.4) and viral (aOR: 1.9; 95% CI: 1.0-3.6) infections for increasing *E. coli* density, while detection of human-associated HF183 in latrine soil was weakly associated with reduced odds of protozoan infection (aOR: 0.7; 95% CI: 0.4-1.0). **Conclusions:** Measures of fecal contamination were largely unassociated with enteric infection prevalence or number of co-infections.

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## ABSTRACT E-BOOK

Theme: **Water quality**

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**P-1288**

**Determination of hand-dug well conditions and groundwater quality in Ifo area of Ogun State, Nigeria**

**Presenter:** AYOBAMI MARY KUYOORO, FEDERAL UNIVERSITY OF AGRICULTURE ABEOKUTA, ABEOKUTA, Nigeria

**Authors:** A. M. KUYOORO, O. OGUNTOKE, M. AGBAJE;  
FEDERAL UNIVERSITY OF AGRICULTURE ABEOKUTA, ABEOKUTA, NIGERIA.

Background/Aim: Inadequate provision of public water for domestic uses has led to private house-owner to explore shallow water-well in Nigeria. While many of these wells are not constructed following standard procedure, the water quality is hardly determined in the laboratory. This research assessed the condition and water quality of hand-dug wells of a semi-urban area in Ogun State, Nigeria. Methods: Eleven sites were selected using stratified-random sampling method and a total of 110 wells were subjected to a standard checklist modified from swoveland. Ten water samples each from wells with high and low risk scores were collected in triplicates. Sixty samples in total were analysed for chemical parameters using flame photometer and UV/Visible Spectrophotometer while Total Bacteria and Coliform count were estimated using pour-plate technique. Results: The checklist evaluation of well characteristics showed that between 10 and 69 % of sampled wells were sited less than 2, 5 and 15 m from dwelling units, outdoor premises and sewer pipes/septic tanks respectively. It also revealed that well casing was present in about 62 % of the wells. Mean concentrations of Total Dissolved Solids ( $35.00 \pm 2.00 - 975.00 \pm 15.00$  mg/L) and Total Hardness ( $3.20 \pm 0.45 - 399.05 \pm 383.41$  mg/L) exceeded the permissible limits of WHO while  $K^+$  ( $50.24 \pm 30.11 - 0.05 \pm 0.05$  mg/L),  $Na^+$  ( $2.87 \pm 0.14 - 152.56 \pm 12.51$  mg/L),  $Cl^-$  ( $28.80 \pm 0.00 - 244.80 \pm 7.20$  mg/L),  $SO_4^{2-}$  ( $1.00 \pm 1.00 - 1.33 \pm 0.58$  mg/L) and  $NO_3^-$  ( $0.11 \pm 0.04 - 13.07 \pm 5.72$  mg/L) were within the limits. The microbial load in the water samples ranged from  $3.2 \times 10^6 - 12.3 \times 10^6$  CFU/ml for bacteria count and  $1.7 \times 10^6 - 12.5 \times 10^6$  CFU/ml for coliform count. Conclusion: There were significant correlations between the well risk scores and water parameters. Well owner's knowledge about standards for well constitute an intense factor in the determination of well-water quality. Therefore, the area of the wells should be protected in order to minimize contamination from sources of pollution.

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## ABSTRACT E-BOOK

Theme: **Water quality**

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**P-1289**

**Fluoride in diet, drinking water and urine in relation to bone mineral density and incidence of fractures**

**Presenter:** Emilie Helte, Karolinska Institutet, Stockholm, Sweden

**Authors:** E. Helte<sup>1</sup>, C. Donat Vargas<sup>2</sup>, M. Kippler<sup>1</sup>, A. Wolk<sup>1</sup>, K. Michaëlsson<sup>3</sup>, A. Åkesson<sup>1</sup>;  
<sup>1</sup>Karolinska Institutet, Stockholm, SWEDEN, <sup>2</sup>Universidad Autónoma de Madrid, Madrid, SPAIN, <sup>3</sup>Uppsala University, Uppsala, SWEDEN.

**Background:** Randomized controlled trials have shown that high fluoride doses increases both bone mineral density and skeletal fragility. The consequences of long-term low dose exposure to fluoride, primarily via drinking water, on bone health among the general public is however not clear. In the present study, we assessed associations of fluoride in urine or in beverages and diet with bone health in postmenopausal women. **Methods:** We used the population-based prospective Swedish Mammography Cohort- Clinical, encompassing 4306 postmenopausal women (aged 56-85), residing in Uppsala county, Sweden, with drinking water fluoride  $\leq 1$  mg/L. Fluoride was measured in urine (mg/g creatinine), and estimated from diet and drinking water (mg/day) at baseline. Hip and spine bone mineral density was measured at baseline using dual-energy X-ray absorptiometry. Incident cases of fractures were ascertained through linkage to the Swedish National Patient Register during 9.3 years of follow-up. Associations of exposures (comparing tertiles) with outcomes were assessed using regression analyses. **Results:** The mean urinary fluoride was 1.2 mg/g creatinine (+/- standard deviation 1.9) and the mean dietary fluoride was 2.2 mg/day (+/-0.9). 78% of the dietary intake originated from water-based beverages. During 40,200 person-years of follow-up, 850, 353 and 187 cases of any fractures, osteoporotic fractures and hip fractures were ascertained, respectively. In the cross-sectional assessment, dietary fluoride, but not urinary fluoride, was associated with a 1-2% higher baseline bone mass at the hip and spine. Both dietary and urinary fluoride was prospectively associated with increased risk of hip fractures, hazard ratios for highest vs lowest tertile 1.59 (95% confidence interval, CI 1.10-2.31) and 1.50 (95% CI 1.04-2.15), respectively. **Conclusion:** A high consumption of water and water-based beverages with a fluoride concentration around 1 mg/L, may increase the risk of hip fracture in older women.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1290**

**Exposure to household air pollution from wood-burning cookstoves and C-reactive protein among women in rural Honduras**

**Presenter:** Megan L. Benka-Coker, Gettysburg College, Gettysburg, United States

**Authors:** M. L. Benka-Coker<sup>1</sup>, M. Clark<sup>2</sup>, S. Rajkumar<sup>2</sup>, B. Young<sup>2</sup>, A. Bachand<sup>2</sup>, D. Diaz-Sanchez<sup>3</sup>, L. Neas<sup>3</sup>, R. Brook<sup>4</sup>, T. Nelson<sup>2</sup>, J. Volckens<sup>2</sup>, S. Reynolds<sup>2</sup>, A. Wilson<sup>2</sup>, C. L'Orange<sup>2</sup>, N. Good<sup>2</sup>, C. Quinn<sup>2</sup>, K. Koehler<sup>5</sup>, S. Africano<sup>6</sup>, A. Osorto Pinel<sup>7</sup>, J. Peel<sup>2</sup>;

<sup>1</sup>Gettysburg College, Gettysburg, PA, <sup>2</sup>Colorado State University, Fort Collins, CO, <sup>3</sup>U.S. Environmental Protection Agency, Chapel Hill, NC, <sup>4</sup>University of Michigan, Ann Arbor, MI, <sup>5</sup>Johns Hopkins University, Baltimore, MD, <sup>6</sup>Tress, Water, People, Fort Collins, CO, <sup>7</sup>Asociación Hondureña para el Desarrollo, Tegucigalpa, HONDURAS.

Household air pollution from the burning of solid fuels is estimated to cause 1.6 million deaths annually and is an important risk factor for cardiovascular disease. Cardiovascular disease risk can be assessed by C-reactive protein (CRP) levels via dried blood spots in resource-limited settings. We evaluated the cross-sectional association of household air pollution and CRP among 106 female primary cooks in rural Honduras using wood-burning traditional or Justa stoves. We measured 24-hour gravimetric kitchen and personal fine particulate matter (PM<sub>2.5</sub>) and black carbon concentrations. Finger-stick blood samples were collected on filter paper for CRP analysis. Associations were evaluated using linear regression, adjusted for age, body mass index (BMI), education, and number of household assets. We assessed effect modification by risk factors age, BMI, glycated hemoglobin, and blood pressure. The median (25<sup>th</sup>-75<sup>th</sup> percentile) 24-hour average personal PM<sub>2.5</sub> concentrations among traditional stove users and Justa stove users were: 115 µg/m<sup>3</sup> (65-154 µg/m<sup>3</sup>); 52 µg/m<sup>3</sup> (39-81 µg/m<sup>3</sup>), respectively. Kitchen PM<sub>2.5</sub> and kitchen and personal black carbon were also higher among traditional stove users. In adjusted analyses, higher concentrations of 24-hour average kitchen and personal PM<sub>2.5</sub> and black carbon were associated with higher levels of CRP (e.g., a 25% increase in personal PM<sub>2.5</sub> exposure was associated with a 10.5% increase in CRP [95% confidence interval: 1.2-20.6]). We only observed evidence of effect modification by levels of glycated hemoglobin. The association between personal PM<sub>2.5</sub> and CRP was stronger among women with normal glycated hemoglobin levels compared to women with elevated glycated hemoglobin levels (p-interaction=0.01). Our results indicate that higher exposure to household air pollution is associated with higher levels of CRP among women in rural Honduras. The effect modification results only among women with normal blood sugar is contrary to our hypothesis and requires additional investigation. This does not necessarily reflect the policies of EPA.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1291**

**Measuring air pollution in wildfire conditions using PurpleAir monitors**

**Presenter:** Elgin Avila, University of Minnesota, Minneapolis, United States

**Authors:** E. Avila;  
University of Minnesota, Minneapolis, MN.

In November 2018, California experienced one of the most financially costly wildfires in history. Some PurpleAir monitors were available and collecting data in nearby cities like San Francisco, recording real-time measurements of particulate matter concentrations. Using this data, air quality data was assessed to determine how frequently the PM 2.5 concentrations were exceeding the National Ambient Air Quality standards. For approximately twelve days, the air concentrations for PM 2.5 exceeded the 24-hour limit of 35 ug/m<sup>3</sup>. Throughout this period, the sensors recorded data that was remarkably comparable between each sensor with an exception of one sensor (LPH). Compared to EPA data, the PurpleAir monitors typically had noticeably higher mass concentrations prior to the 16th of November. One of the potential issues with this data is that there are not an equal number of EPA monitors solely in the city of San Francisco. Many of the sensors are spread out throughout the Bay area. Depending upon the path of the air currents, particulates could be more concentrated in one area of the metropolitan area versus another area. An additional potential issue is that the exact location of the PurpleAir monitors are unknown, therefore it would be inappropriate to speculate whether these sensors were placed correctly to ensure accurate concentrations. Further investigation should take place to see how reliable these sensors are in extreme conditions to ensure the validity of this data as it could be a useful tool for communities' advocating for clean air while using low-cost sensors.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1292**

### **Explaining social acceptance of a municipal waste incineration plant through sociodemographic and psychoenvironmental variables**

**Presenter:** Mikel Subiza-Perez, Biodonostia Health Research Institute, Group of Environmental Epidemiology and Child Development. Paseo Begiristain s/n, 20014, Donostia - San Sebastián, Spain

**Authors:** M. Subiza-Perez<sup>1</sup>, L. Santa-Marina<sup>2</sup>, A. Irizar<sup>1</sup>, M. Gallastegi<sup>1</sup>, A. Anabitarte<sup>1</sup>, N. Urbieta<sup>1</sup>, I. Babarro<sup>1</sup>, A. Molinuevo<sup>1</sup>, L. Vozmediano<sup>3</sup>, J. Ibarluzea<sup>4</sup>;

<sup>1</sup>Biodonostia Health Research Institute, Group of Environmental Epidemiology and Child Development. Paseo Begiristain s/n, 20014, Donostia - San Sebastián, SPAIN, <sup>2</sup>Department of Health of the Basque Government, Subdirectorate of Public Health of Gipuzkoa, Avenida Navarra 4, 20013, Donostia - San Sebastián, SPAIN, <sup>3</sup>Faculty of Psychology, University of the Basque Country UPV/EHU, Av. Tolosa 70 20018, Donostia - San Sebastián, SPAIN, <sup>4</sup>Spanish Consortium for Research on Epidemiology and Public Health (CIBERESP), Instituto de Salud Carlos III, C/Monforte de Lemos 3-5, 28029, Madrid, SPAIN.

**Background/aim:** Municipal waste incineration plants (MWIPs) are a source of emission of diverse pollutants that have been associated with environmental and health effects, mainly in relation to premises that are old and not well equipped or maintained. As a result, the general public usually holds a negative view of such plants and tends to react adversely to construction of new plants. Understanding a population's perceptions is key to ensuring the correct development of such infrastructure and managing population health concerns and behaviours. **Methods:** In this study, we surveyed 173 residents living close (10 km) to an MWIP being built in San Sebastian (Gipuzkoa, Spain) and 164 living further away (>10 km). The questionnaire included sociodemographic and psycho-environmental measures. **Results:** We found a fairly low acceptance rate and the perception of a high risk for human health and the environment (average scores of 0.57, 3.07 and 2.89 respectively in a 0 to 4 scale), with no statistically significant differences between people living nearby and further afield. A hierarchical regression model built to explore the public's acceptance of the MWIP explained 59% of the variance. Dominance and relative weight analyses revealed that the most important predictors of acceptance were trust in the information provided by the local government and perceived health for human health, which accounted for the 33.7% and 27.4% of the variance explained by the model. Preference for landfilling and MWIP acceptance in another location made a less relevant role (contribution to explained variance around 15%). **Conclusions:** Our results shed some light on variables significantly linked to public acceptance. Public institutions and companies responsible for waste incineration infrastructures need to take into account public perceptions and deploy campaigns and interventions aiming at assuring the correct development of such projects and avoid unadjusted aversive social reactions and over magnified risk perceptions.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1293**

**Monitoring for clean air spaces during wildfire events**

**Presenter:** Curtis Noonan, University of Montana, Missoula, United States

**Authors:** G. Hagler<sup>1</sup>, H. Vreeland<sup>1</sup>, A. Holder<sup>1</sup>, B. Hassett-Sipple<sup>1</sup>, S. Coefield<sup>2</sup>, B. Schmidt<sup>2</sup>, E. Walker<sup>3</sup>, B. McCaughey<sup>4</sup>, C. Berg<sup>1</sup>, L. Kashef-Hamadani<sup>1</sup>, S. Katz<sup>1</sup>, G. Robarge<sup>1</sup>, C. Noonan<sup>3</sup>;

<sup>1</sup>US Environmental Protection Agency, Washington, DC, <sup>2</sup>Missoula City-County Health Department, Missoula, MT, <sup>3</sup>University of Montana, Missoula, MT, <sup>4</sup>Hoopa Valley Tribe, Hoopa, CA.

**Background:** Many communities are exposed to extended periods of smoke from wildland fires. A common recommendation to reduce exposure during smoke events is to go indoors. However, building characteristics that translate to clean air spaces during such events are poorly understood. The purpose of this study was to compare outdoor and indoor fine particulate (PM<sub>2.5</sub>) at commercial buildings during smoke events. **Methods:** Purple Air Sensors (PA-II-SD) were co-located with regulatory grade reference monitors to generate individual sensor correction equations. Outdoor and indoor sensors were co-located at 18 buildings in Missoula, MT from July to September 2019. Outdoor to indoor daily PM<sub>2.5</sub> averages were compared for assessment of building air handling systems. Spikes in indoor PM<sub>2.5</sub>, identified as any hour where the standard deviation of the 2-minute data was over 10% of the hourly average, were flagged and removed from the comparisons.

**Results:** Individual correction equations and strength of agreement were similar across the set of sensors (slope: 0.36 -0.47 and R<sup>2</sup>: 0.91 to 0.95). Censoring of data flagged as indoor generated PM<sub>2.5</sub> accounted for <5% to 14% of observations across buildings. Fourteen buildings had MERV8 filter systems, two buildings had higher MERV rating filters, and two buildings had no air handling systems. All buildings with air handling systems had reductions in indoor PM<sub>2.5</sub> compared to outdoor concentrations but building-to-building observations were highly variable (6% to 44% reduction for MERV8 buildings). Outdoor-to-indoor reductions were similar during smoke impacted periods compared to non-smoke periods. **Conclusions:** This study demonstrates the utility of low-cost PM<sub>2.5</sub> sensors for identifying poor indoor air quality. The variable findings for buildings with similar air handling filter ratings indicate that other building features and operation behaviors are important factors and need to be understood to inform exposure mitigation strategies during smoke events.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1294**

**Wildfire smoke impacts respiratory health more than fine particles from other sources: observational evidence from Southern California**

**Presenter:** Rosana Aguilera, University of California San Diego, La Jolla, United States

**Authors:** R. Aguilera, T. Corringham, A. Gershunov, T. Benmarhnia;  
University of California San Diego, La Jolla, CA.

The Western U.S. and regions worldwide are experiencing more frequent and destructive wildfires in a changing climate. Fine particulate matter,  $PM_{2.5}$ , is the main component of wildfire smoke that adversely impacts human health. Wildfires account for 29% of total  $PM_{2.5}$  emissions in the US, 50% in California, and this proportion is expected to increase in the coming years. Recent animal toxicological studies suggest that wildfire particulate matter may be more toxic than equal doses of  $PM_{2.5}$  from other sources. Current air quality regulations in the US however assume that the toxicity of  $PM_{2.5}$  does not vary across different sources of emission. Assessing whether  $PM_{2.5}$  from wildfires is more or less harmful than  $PM_{2.5}$  from other sources is a pressing public health concern. To answer this question, we developed and compared results from a series of statistical approaches that isolate the wildfire-specific  $PM_{2.5}$  from other sources using different exposure definitions including smoke plumes and the presence of wildfire upwind. Our study covered a large population in Southern California where Santa Ana (SAW) wind-driven wildfires are most damaging. Strong SAWs in the region can increase  $PM_{2.5}$  concentrations by spreading smoke downwind. Overall, we conclude that wildfire-specific  $PM_{2.5}$  is up to 10 times more harmful than  $PM_{2.5}$  from other sources. Specifically, we found increases in respiratory hospital admissions of 9.8% (95% CI: 3.3, 16.3) and 0.90% (95% CI: 0.59, 1.2) associated with a  $10 \mu g m^{-3}$  increase in wildfire-specific  $PM_{2.5}$  and non-wildfire  $PM_{2.5}$  respectively. Our conclusions are robust across several approaches used to isolate wildfire-specific  $PM_{2.5}$ , and point to the need for air quality policies to consider the variability in  $PM_{2.5}$  impacts on human health according to the sources of emission. This is especially relevant in California and other regions where most  $PM_{2.5}$  is expected to come from wildfires.

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Theme: **Wildfire, solid fuel**

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**P-1295**

**Using longitudinal survey and sensor data to understand the social and ecological determinants of suspending clean cookstove use in rural Ghana**

**Presenter:** Daniel Carrión, Icahn School of Medicine at Mount Sinai, New York, United States

**Authors:** D. Carrión<sup>1</sup>, R. Prah<sup>2</sup>, C. F. Gould<sup>3</sup>, M. Mujtaba<sup>2</sup>, A. Pillarisetti<sup>4</sup>, O. Agyei<sup>2</sup>, S. Chillrud<sup>3</sup>, T. Tawiah<sup>2</sup>, D. W. Jack<sup>3</sup>, K. Asante<sup>2</sup>;

<sup>1</sup>Icahn School of Medicine at Mount Sinai, New York, NY, <sup>2</sup>Kintampo Health Research Centre, Kintampo, GHANA, <sup>3</sup>Columbia University, New York, NY, <sup>4</sup>Emory University, Atlanta, GA.

**Background:** Efforts to reduce the health and ecological burdens of biomass combustion are underway in Ghana, primarily by promoting clean cookstoves. While studies often examine sustained use of clean or improved cookstoves, others show that intervention stoves often go unused or abandoned. We developed and employed a novel framework, based on health behavior theory, to understand reasons for disuse: stove use suspension.

**Methods:** We leveraged data from the Ghana Randomized Air Pollution and Health Study (GRAPHS) (N=1412) where households received either improved biomass (BioLite) or liquified petroleum gas (LPG) stoves for free. LPG users were given free LPG refills during GRAPHS. Fieldworkers administered weekly questionnaires throughout GRAPHS, and digital stove use monitors tracked a subcohort (n = 220) 6 months before and after the fuel subsidy. We examined social and ecological determinants of stove disuse and suspension. **Results:** 60% of BioLite and 80% of LPG participants reported intervention stove use by GRAPHS' termination. We found that participants cooked on intervention stoves less for meals requiring vigorous stirring. We also found that burns from intervention stoves were associated with less use among BioLite (RR: 0.96, p=0.009), but not LPG users. Using open response data, we found that device breakage was an impediment to intervention stove use in 18% of LPG user responses and 1% for BioLite. Finally, we assessed stove use suspension after the LPG subsidy using stove use monitor data, and household characteristics as explanatory variables, with Cox regressions. We found that tree canopy within a spatial buffer (a proxy for biomass access) was the only significant factor in univariate and adjusted analyses (HR = -0.56, p<0.001). **Conclusion:** We recommend that future studies employ the suspension framework to identify leverage points for increasing sustained use of clean cookstoves, with the ultimate goal of decreasing household air pollution exposures.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1296**

### **Association between maternal sociodemographic characteristics and Compliance to Clean Cookstove use in Rural Ghana**

**Presenter:** Kenneth Ayuurebobi AeNgibise, Kintampo Health Research Centre, Kintampo, Ghana

**Authors:** K. A. AeNgibise<sup>1</sup>, D. W. Jack<sup>2</sup>, F. Agbokey<sup>1</sup>, F. B. Oppong<sup>1</sup>, M. Mujtaba<sup>1</sup>, E. A. Boamah<sup>1</sup>, B. J. Wylie<sup>3</sup>, K. P. Asante<sup>1</sup>, P. L. Kinney<sup>4</sup>;

<sup>1</sup>Kintampo Health Research Centre, Kintampo, GHANA, <sup>2</sup>Mailman School of Public Health, Columbia University, New York, NY, <sup>3</sup>Beth Israel Deaconess Medical Center, Boston, MA, <sup>4</sup>Boston University School of Public Health, Boston, MA.

**Background/Aim:** The use of cleaner technologies and efficient biomass energy is an appropriate strategy to mitigate global climate, health risks, and help in attaining the sustainable development goal's (SDG's) target on access to reliable, affordable, and modern energy services by 2030. We evaluated the association between maternal sociodemographic characteristics and compliance to clean cookstove use in a rural setting in Ghana. **Methods:** This was a cluster-randomised intervention trial conducted among 890 women in the Kintampo North Municipality and Kintampo South District of Ghana, West Africa. Twenty-two rural communities were randomized to one of 2 efficient biomass interventions: BioLite (527 women from 13 communities) and LPG (361 women from 9 communities). Study fieldworkers visited participant homes weekly and documented use of intervention stoves. For each participant, compliance was computed as the number of visits for which assigned clean cookstove was used divided by the total number of visits made to that individual. Fractional logit model was used to assess the association between sociodemographic characteristics of study participants and compliance with efficient biomass use. **Results:** Overall compliance to clean cookstove use ranged from 0% (no clean cookstove use) to 100% (all clean cookstove use). Compliance was significantly higher for participants who used LPG compared to those who used Biolite (0.98% vs. 0.88%, p-value <0.001). In an unadjusted analysis, participants with any form of education were less likely to comply with the use of clean cookstove compared to those with no formal education. Traders had significantly lower compliance compared to farmers (3.2% CI: 0.3% to 6.2%; p-value: 0.033). Compared to the poorest, less poor and least poor were significantly less likely to comply to clean cookstove use. **Conclusions:** Socio-demographic factors play a role in the adoption of cleaner cooking methods. Understanding these factors can help in providing targeted interventions on cleaners fuel use.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1297**

### **Efficiency of improved cookstoves and emission of Carbon Monoxide and Carbon Dioxide: An intervention study in Northern Ghana**

**Presenter:** Ali Moro, Navrongo Health Research Center, Navrongo, Ghana

**Authors:** A. Moro;  
Navrongo Health Research Center, Navrongo, GHANA.

Title: Efficiency of improved cookstoves and emission of Carbon Monoxide and Carbon Dioxide: an intervention study in Northern Ghana

Abstract: Biomass burning for home energy use is a major environmental health concern. Improved cooking technologies could generate environmental health benefits, yet prior results regarding reduced exposure to air pollution from improved cookstoves are mixed. In this study, 20 in-field uncontrolled cooking tests were conducted in domestic settings to assess the emission and efficiency of the Ace and the Jumbo stoves using the Emission Pod (EPOD) to measure emissions in real-time. Carbon Dioxide (CO<sub>2</sub>) and Carbon Monoxide (CO) emissions, Emission Factors (EF), Modified Combustion Efficiency (MCE) and Cooking time were all calculated across a variety of meal types using the two stoves. Overall average CO emission was estimated at 248.71±44.66 ppm for the Ace stove while that of the Jumbo stove was calculated to be 103.66±24.4 ppm (P=0.024). The Jumbo stove had a higher MCE of 0.93 against the Ace stove (0.84). Using the partial capture Carbon Balance Method (CBM), EF was calculated for both stoves with the Ace recording a CO EF of 1425.04 g/kg and CO<sub>2</sub> EF of 1318.35 g/kg. The Jumbo, on the other hand, had a CO EF of 151.57 g/kg and a CO<sub>2</sub> EF of 1215.82 g/kg. The study concluded that although the stoves had better performance in most of the parameters studied compared to other stove interventions in the literature, they still fell short when compared with some of the traditional cooking methods. While the Jumbo falls within the International Workshop Agreement (IWA) tier 4 category guidelines for cookstove, the Ace stove which is much fancier falls in WHO-IWA category 0.

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Theme: **Wildfire, solid fuel**

**P-1298**

**Blood pressure, spirometry, and indoor fine particulate matter in homes heated by wood stoves: pre-intervention results from the EldersAIR randomized trial**

**Presenter:** Ethan S Walker, University of Montana, Missoula, United States

**Authors:** E. S. Walker<sup>1</sup>, C. W. Noonan<sup>1</sup>, A. Belcourt<sup>1</sup>, J. Boulafentis<sup>2</sup>, C. Garcia<sup>3</sup>, N. Hoskie<sup>4</sup>, E. Quintana<sup>4</sup>, E. O. Semmens<sup>1</sup>, P. Smith<sup>1</sup>, D. Ware<sup>1</sup>, T. J. Ward<sup>1</sup>;

<sup>1</sup>University of Montana, Missoula, MT, <sup>2</sup>Nez Perce Tribe Environmental Restoration and Waste Management, Lapwai, ID, <sup>3</sup>Nimiipuu Health, Lapwai, ID, <sup>4</sup>Navajo Nation Environmental Protection Agency, Window Rock, AZ.

**Background/Aim:** Household air pollution from burning biomass fuels can lead to high concentrations of indoor fine particulate matter (PM<sub>2.5</sub>) and is associated with many adverse health outcomes. Household heating using wood stoves is common in rural American Indian (AI) communities; however, research on the associations between PM<sub>2.5</sub> and health in such communities is limited. Our aims were to assess PM<sub>2.5</sub> concentrations and indicators of cardiopulmonary health in older AI adults who use wood stoves for heating, and to evaluate the feasibility of interventions (i.e., education and air filtration) that lower household levels of PM<sub>2.5</sub>. **Methods:** EldersAIR was a three-arm pre-post randomized trial in wood stove households from a Northern Rocky Mountain Reservation (n=68) and a Southwestern United States Reservation (n=76). Here, we present pre-intervention concentrations of indoor PM<sub>2.5</sub> measured over 2-day sampling periods and measures of peripheral systolic and diastolic blood pressure (SBP; DBP), forced vital capacity (FVC), and forced expiratory volume (FEV1) in older adults. **Results:** In preliminary analyses, the mean indoor PM<sub>2.5</sub> concentration was 38 µg/m<sup>3</sup> (standard deviation [sd]=85, median=10) across all homes; 43% of homes had mean PM<sub>2.5</sub> concentrations ≥ 25 µg/m<sup>3</sup>. Participants were 69 years of age on average (sd=9) with mean body mass index of 30 kg/m<sup>2</sup> (sd=6). Participants had mean SBP of 138 mmHg (sd=20) and mean DBP of 77 mmHg (sd=13); 46% had stage-2 hypertension (SBP≥140 or DBP≥90). Mean percent-predicted FVC for participants was 79% (sd=16) and mean percent-predicted FEV1 was 85% (sd=20); 30% had FEV1/FVC ratio < 0.7 or percent-predicted FEV1 < 75%.

**Conclusions:** We observed elevated PM<sub>2.5</sub> concentrations inside rural AI homes that used wood stoves for heating. Participants had high SBP and low percent-predicted FVC and FEV1. Our findings highlight the need for interventions that reduce indoor air pollution in an effort to improve health in AI communities.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1299**

**Health and economic impacts associated with smoke from summer bushfires in Australia, 2000-2020**

**Presenter:** Fay H Johnston, Menzies Institute for Medical Research, University of Tasmania, Hobart, Australia

**Authors:** F. H. Johnston<sup>1</sup>, N. Borchers Arriagada<sup>1</sup>, G. G. Morgan<sup>2</sup>, B. Jalaludin<sup>3</sup>, A. J. Palmer<sup>1</sup>, G. J. Williamson<sup>4</sup>, D. M. Bowman<sup>4</sup>;

<sup>1</sup>Menzies Institute for Medical Research, University of Tasmania, Hobart, AUSTRALIA, <sup>2</sup>University Centre for Rural Health, School of Public Health, University of Sydney, Sydney, AUSTRALIA, <sup>3</sup>School of Public Health and Community Medicine, University of New South Wales, Sydney, AUSTRALIA, <sup>4</sup>School of Natural Sciences, University of Tasmania, Hobart, Tasmania, AUSTRALIA.

Background: Summer bushfires are an integral feature of temperate forests in Australia, which are largely dominated by eucalypts. Global warming is changing the pattern of bushfire activity by increasing the frequency of weather conditions associated with extreme fires. Objective: To quantify health impacts and associated economic costs attributable to bushfire smoke-related PM<sub>2.5</sub> produced during Australian fire seasons (1<sup>st</sup> October - 31<sup>st</sup> March) since 2000/2001. Methods: We included all regions in temperate climate zones in Australia with long term air monitoring networks, covering approximately 90% of the population. We applied standard methods for health impact assessments to estimate the number of premature deaths, cardiorespiratory hospitalizations and asthma emergency department (ED) attendances attributable to bushfire smoke-related particulate matter (PM<sub>2.5</sub>). Health costs were quantified using the value of a statistical life for mortality and average health care costs for morbidity outcomes. We did a sensitivity analysis on the PM<sub>2.5</sub> cut-off points used to identify fire smoke affected days, and applied alternative economic valuation methods to estimate health costs. Results: We found large interannual variation. The 2019/2020 fire season was the worst in recent history with estimated health costs of \$1.96 billion (AUD), more than 9 times the median estimated costs of the past 19 fire seasons (\$204 million). The two next worst seasons were 2002/2003 and 2006/2007 with estimated costs of \$552 million and \$360 million respectively. For 2019/2020 we estimated smoke-related health impacts of 431 premature deaths, 3240 cardiorespiratory hospitalizations, and 1333 asthma ED attendances. Our sensitivity analysis shows slight differences in magnitude of impacts for each fire season, but the relative importance of these remains unaltered. Conclusions: Bushfire smoke is associated with substantial health economic costs. Our analysis illustrates the potential for major increases in the health burden from air pollution due to increased bushfire risk associated with the changing climate.

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Theme: **Wildfire, solid fuel**

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**P-1300**

**Cleaner cooking with liquefied petroleum gas (LPG) in Northern Ghana: Interdisciplinary experiment measuring willingness to pay, behavior change, and impacts on personal exposure**

**Presenter:** Maxwell Dalaba, Institute of Health Research, University of Health and Allied Sciences, Ho, Ghana

**Authors:** M. Dalaba<sup>1</sup>, E. Coffey<sup>2</sup>, Z. Brown<sup>3</sup>, R. Alirigia<sup>2</sup>, J. Awaregya<sup>4</sup>, J. Aburiya<sup>4</sup>, M. Ali<sup>5</sup>, D. Agao<sup>5</sup>, N. Banacos<sup>6</sup>, M. Jones<sup>3</sup>, M. Hannigan<sup>2</sup>, A. Oduro<sup>5</sup>, K. L. Dickinson<sup>6</sup>;

<sup>1</sup>Institute of Health Research, University of Health and Allied Sciences, Ho, GHANA, <sup>2</sup>University of Colorado Boulder, Boulder, CO, <sup>3</sup>North Carolina State University, Raleigh, NC, <sup>4</sup>Organization for Indigenous Initiatives Ghana, Navrongo, GHANA, <sup>5</sup>Navrongo Health Research Centre, Navrongo, GHANA, <sup>6</sup>Colorado School of Public Health, Aurora, CO.

**Introduction:** Liquefied petroleum gas (LPG) is promoted as a clean cooking fuel to replace biomass in many low- and middle-income countries, but LPG use is low in many regions. An experimental study was conducted (Jan 2017-Dec 2018) in the Kassena-Nankana Districts of northern Ghana to examine demand for LPG, stove use patterns, and impacts on personal exposure to air pollution. **Methods:** To measure willingness to pay (WTP) for LPG stoves and fuel, we conducted a Becker-DeGroot-Marshack auction with 262 randomly selected urban participants. Participants bid on 6 stove-fuel packages that included a 1-burner stove, a 2-burner stove, or no stove; all packages included an LPG cylinder and fuel refill vouchers, and some included home delivery of fuel refills. To investigate effects of LPG package purchases on cooking behaviour, stove use monitoring with temperature loggers and surveys was conducted in 56 study households. Forty of these were also enrolled in personal exposure sampling, capturing time-resolved carbon monoxide and fine particulate matter exposure over multiple 48-hour periods for primary cooks. **Results:** Of 262 participants, 182 (69%) won an LPG package. The highest-valued package included a 2-burner stove with home delivery of fuel refills. WTP for 1- and 2-burner LPG stoves was close to their market value, while average WTP for the fuel package (an LPG cylinder plus 4 fuel refills) was about \$29 compared to its market value of \$110. LPG stove purchases resulted in decreased use of charcoal stoves and increased use of LPG; further analysis of adoption and disadoption trends using stove use monitoring and assessment of impacts on exposure are underway. **Conclusion:** Affordability of LPG fuel may need to be addressed to increase sustained use of LPG in the study area. In addition, cylinder recirculation and LPG home delivery strategies should be explored to increase LPG access.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1301**

**Monitoring of traditional stove use in the context of a clean fuel (liquefied petroleum gas, LPG) intervention trial in Guatemala, India, Peru, and Rwanda**

**Presenter:** Ashlinn K Quinn, National Institutes of Health, Bethesda, United States

**Authors:** A. K. Quinn<sup>1</sup>, L. M. Thompson<sup>2</sup>, A. Pillarisetti<sup>2</sup>, D. L. Wilson<sup>3</sup>, M. Howard<sup>2</sup>, Y. Chen<sup>2</sup>, L. Elon<sup>2</sup>, A. Díaz Artiga<sup>4</sup>, T. Gurusamy<sup>5</sup>, G. Rosa<sup>6</sup>, K. Balakrishnan<sup>5</sup>, J. P. McCracken<sup>4</sup>, J. L. Peel<sup>7</sup>, W. Checkley<sup>8</sup>, J. P. Rosenthal<sup>1</sup>, T. F. Clasen<sup>2</sup>, S. A. Harvey<sup>8</sup>, K. N. Williams<sup>8</sup>, - on behalf of HAPIN investigators<sup>2</sup>;

<sup>1</sup>National Institutes of Health, Bethesda, MD, <sup>2</sup>Emory University, Atlanta, GA, <sup>3</sup>Geocene, Inc., Vallejo, CA, <sup>4</sup>Universidad del Valle de Guatemala, Guatemala City, GUATEMALA, <sup>5</sup>Sri Ramachandra Institute of Higher Education and Research, Chennai, INDIA, <sup>6</sup>London School of Hygiene & Tropical Medicine, London, UNITED KINGDOM, <sup>7</sup>Colorado State University, Fort Collins, CO, <sup>8</sup>Johns Hopkins University, Baltimore, MD.

**Background:** The Household Air Pollution Intervention Network (HAPIN) trial enrolled 3200 pregnant women who cooked with biomass fuel in Guatemala, India, Peru, and Rwanda; half were randomized to receive a liquefied petroleum gas (LPG) stove, approximately 18 months of free LPG, and behavioral messaging to promote LPG use. Although the intervention was designed to enable exclusive LPG use, investigators expected that some traditional stove use (TSU) would persist among intervention households. **Methods:** Thermocouple stove use monitors (SUMs, Geocene, Inc, Vallejo, USA) were installed on traditional stoves in intervention households. Data from SUMs were downloaded approximately every two weeks and TSU identified using a sensitive, deterministic algorithm. HAPIN fieldworkers visited households with detectable TSU events to administer a questionnaire on the reasons for TSU and reinforce exclusive LPG use. **Results:** Over 454,281 post-intervention household-days of monitoring among 1548 households (400 in Guatemala, 398 in India, 357 in Peru, and 393 in Rwanda), the rate of days with TSU per 100 household-days of observation was 0.83 (1.2 in Guatemala, 0.06 in India, 1.3 in Peru, and 0.8 in Rwanda). 95.1% of all households recorded one or no days with TSU on average per month (96.2% in Guatemala, 99.7% in India, 87.9% in Peru, and 95.9% in Rwanda). Primary reasons reported for TSU included: challenges with timely requests or receipt of LPG refills; resistance of other household members to LPG; uncertainty about how to clean, maintain, or check the LPG stove; and inability to cook large quantities of food with LPG. **Conclusions:** In the context of a free stove-and-fuel intervention combined with behavioral strategies to encourage exclusive LPG use, TSU events, measured by SUMs and direct observation, were infrequent at trial midpoint. The combination of SUMs data with household questionnaires provides a rich understanding of TSU persistence in the context of free LPG.

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## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1303**

### **Solid fuel-related indoor air pollution and poor sleep quality in the elderly: a national longitudinal study in China**

**Presenter:** Haiqing Yu, Yale University, New Haven, United States

**Authors:** H. Yu, J. Luo, K. J. Pollitt, Z. Liew;  
Yale University, New Haven, CT.

Background: Sleep disorders are a public health issue in an aging society. Outdoor air pollution has been linked to poor sleep quality, but few studies have investigated the relationship between indoor air pollution from solid fuel combustion and sleep quality in elderly. Objective: To evaluate the association between indoor air pollution due to cooking solid fuels and sleep quality among elderly in China. Methods: We analyzed data from CHARLS, a national survey of ~17,000 residents aged over 45 from 150 counties in China. Participants were restricted to those who completed waves of CHARLS in 2011, 2013, and 2015 (n=8,668). Sleep quality was indicated by self-reported average sleep duration (hours/night) and the numbers of restless days per week in the 2015 survey. Participants also reported household cooking fuel type in all three surveys. We compared the “solid fuels”, primarily coal and wood burning, with the “clean fuels” including electric, natural gas, and liquefied petroleum gas as the reference. Years of solid fuel use (0, 1-4 or ≥5 years) were evaluated. We used multinomial logistic regression to estimate the odd ratios (OR) and 95% confidence interval (CI) for sleep duration (7-9 hours/night as the reference) and restless sleep (0 day as the reference) according to fuel types adjusting for potential confounding factors. Results: Solid fuels use for 5 or more years was associated with a shorter duration of sleep (OR=1.17 95%CI 1.02, 1.35 for ≤6 hours/day) and higher frequencies of restless days of sleep (OR=1.30 95%CI 1.11, 1.52 for ≥5 days/week) compared with clean fuels users. The associations were smaller in magnitude for solid fuels use in 1-4 years. Conclusions: Primary cooking fuel was associated with poor sleep quality in an elderly Chinese population. Further research of the specific type of fuels and indoor air pollutants to inform intervention strategies.

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Theme: **Wildfire, solid fuel**

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**P-1304**

**GOES16-Based Estimation of Hourly PM<sub>2.5</sub> Levels during the Camp Fire Wildfire Episode in California**

**Presenter:** Bryan N. Vu, Emory University, Atlanta, United States

**Authors:** B. N. Vu, J. Bi, Y. Liu;  
Emory University, Atlanta, GA.

**Background/Aim:** Wildfire events release vast amounts of PM<sub>2.5</sub> into the atmosphere, which may be transported via smoke plumes and traverse tens to thousands of kilometers in distance, resulting in excess mortality and morbidity. Although many studies have shown positive associations between chronic and daily exposure to ambient PM<sub>2.5</sub> and adverse health outcomes, few studies investigate the effects of acute and intense exposures during wildfire events due to lack of hourly exposure measurements. We investigate the feasibility of using aerosol optical depth (AOD), smoke mask, and fire detection parameters retrieved by GOES16, a geostationary satellite, to estimate hourly PM<sub>2.5</sub> levels in California between October 1 and November 30 2018 at 3-km<sup>2</sup> spatial resolution to capture the Camp Fire wildfire event. **Methods:** We used an advanced machine learning Random Forest Model approach to fit GOES16 AOD, smoke mask, and fire detection parameters, meteorological variables from High-Resolution Rapid Refresh (HRRR) atmospheric model, and land use data including percent vegetation, road distance and elevation to existing ground measurements from low-cost (Purple Air) sensors and EPA Air Quality System (AQS) monitors. **Results:** There were 252,541 hourly measurements from a total of 887 combined Purple Air sensors and AQS monitors during the study period. The out of bag R<sup>2</sup> (RMSE) was 0.89 (8.05 µg/m<sup>3</sup>). Importance ranking indicated that land use variables including road distance and percent herbaceous land and satellite-measured AOD were the top three predictors. **Conclusions:** Our model allows for construction of historical hourly PM<sub>2.5</sub> levels at good spatial resolution during significant wildfire events to support fundamental epidemiological studies that investigate the effects of short-lived but acute and intense exposure to smoke PM<sub>2.5</sub>.

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# 32<sup>nd</sup> Annual Conference of the International Society for Environmental Epidemiology



Advancing Environmental Health in a Changing World



**ISEE  
2020**  
August 24-27, 2020

## ABSTRACT E-BOOK

Theme: **Wildfire, solid fuel**

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**P-1306**

### **Vulnerability to Respiratory Symptoms Associated with Smoke Exposure from the 2017 Northern California Wildfires**

**Presenter:** Francesca Rubino, UC Davis, Davis, United States

**Authors:** F. Rubino, I. Hertz-Picciotto;  
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The increasing severity and frequency of wildfires poses a significant threat to human health. On October 8th, 2017 multiple fires erupted across Northern California. In response, the UC Davis EHS Center launched "WHAT-Now-CA?". A survey was conducted on a convenience sample publicized through social and traditional media. Data were collected from one respondent per household. Preliminary results for this study represent 680 households and 1,477 individuals. Prevalence of six respiratory symptoms reported as occurring between Oct 9th and Oct 31st were documented: asthma, bronchitis, wheezing, cough, itchy or irritated eyes, and sneezing. Exposure to wildfire smoke was quantified by the level of PM<sub>2.5</sub> at the household level calculated using the Community Multiscale Air Quality Modeling System. Robust Poisson models were fit to analyze whether participants reported any of the three major symptoms (asthma, wheezing, bronchitis). Due to clustering of individuals within households, hierarchical models were fit. The number of days people experienced PM<sub>2.5</sub> levels above 30 ug/m<sup>3</sup> (the maximum daily average concentration in the region during the days preceding the fires) was significantly associated with greater prevalence for respiratory symptoms ( $p=0.03$ ). Every day individuals experienced PM<sub>2.5</sub> levels above 30 ug/m<sup>3</sup> was associated with an increased prevalence of 4%. Prior asthma (PR= 3.54,  $p$  under 0.001) and older age (PR= 1.68,  $p$  under 0.001) were significantly associated with increased prevalence of major respiratory conditions. Males had a significantly lower prevalence. As neighborhood socioeconomic status increased, respiratory symptoms decreased. These preliminary analyses suggest that increasing PM<sub>2.5</sub> levels from wildfires predict increased odds of negative respiratory outcomes. Additionally, they suggest individual demographics (such as race, sex, age) and neighborhood socioeconomic level as well as prior asthma predict who has greater odds of developing respiratory symptoms during wildfire events.

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