ABSTRACTS
TUESDAY AUGUST 27

KEYNOTES, SYMPOSIA, ORAL PRESENTATION SESSIONS,
POSTER DISCUSSION SESSIONS, THEMATIC POSTER SESSIONS

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History and future of environmental epidemiology
# Table of contents

**Tuesday August 27 9:00 AM – 10:00 AM**  
Keynote Lectures  
Protecting and promoting health in the Anthropocene ........................................ 20  
Low-tech mining of materials critically needed for high-tech applications: impacts on air, water, places and ... people .............................................. 20  
**Tuesday August 27, 10:30 AM – 12:00 PM**  
**S02:** Harmonizing insights from intervention studies, contextual information and resource availability to develop policy advocacy for clean cooking and domestic fuel adoption in Africa  
Adoption of Clean Cook stoves in Rural Ghana .................................................. 22  
Can transition to a cleaner fuel from Kerosene or firewood be beneficial in pregnant Nigerian women? .23  
Evaluating sustainable cooking fuels for refugee populations in Ethiopia .................... 24  
Prioritizing population health and cultural sensitivities in energy development programs in Nigeria ...... 26  
**S06:** Lead’s long-term legacy: what past exposures can tell us about future disease ............ 27  
Present, Past and Future of Lead Pollution Through the World’s Highest-Resolution Atmospheric Record from the European Alps and Historical Testimonies ........................................................... 27  
The long-term implications of childhood lead exposure: Evidence from midlife follow-ups in the New Zealand Dunedin Cohort .............................................................................. 28  
Toxic Chemicals and the Mysterious Decline in Coronary Heart Disease ......................... 29  
Exposure to lead causes dementia – or does it? ......................................................... 30  
**S07:** Of moderators and mediators: Complex relationships between greenness, air pollution, noise, and health behaviors in driving health outcomes ..................................................... 31  
Evidence from the Canadian Census Health and Environment Cohort. On greenness moderating the association between exposure to air pollution and risk of mortality ........................................ 31  
Physical Activity, Air Pollution, and Social Integration as mediators of Exposure to Greenness and Cognitive Decline .................................................................................. 32  
Greenness, Obesity and Incident Breast Cancer: Evidence from the Canadian National Breast Screening Study ...................................................................................... 33  
Green space exposure and childhood health – a question of moderation or mediation? .......... 34  
On traffic-related air pollution and noise, mediating associations between urban design (including greenness) and mental health. Evidence from the Barcelona Health Survey ................................................................. 35  
**GREEN, AIR, LMIC: PECHAKUCHA COMES TO ISEE!** .................................. 36  
Green spaces, land cover, street trees and cardiovascular health in a megacity .................. 36  
Woman at work and other untold stories from 35,000 wearable camera images taken on an informal electronic-waste recovery site ........................................................................ 37
Resilient public health in the context of large-scale, drought-related migration in East Africa: Knowledge status and knowledge needs

Acute respiratory effects of livestock related air pollution on a panel of COPD patients

Development of compensation strategies for control participants in an environmental trial with an intervention of significant value: experience from the Household Air Pollution Intervention Network (HAPIN) multi-country trial

Health impact of Asian dust and protective effect of masks

Residential proximity to major roads and neighbourhood green space in relation to biological stress in the second trimester of pregnancy in the IPANEMA cohort

Residential green space and mental health in a prospective cohort of tree pollen allergy patients

Effects of a cleaner-burning biomass cookstove intervention on augmentation index and central pulse pressure during a randomized controlled trial in rural Honduras

A nationwide study of particulate matter and daily hospitalizations for respiratory diseases in Italy

Lung function up to adolescence and residential greenspace

Long-term effects of air pollution on metabolic control in children and adolescents with type 1 diabetes – a repeated measurements analysis

**OPS 06: Health effects of source-specific outdoor air pollution**

Source-apportionment of fine-particulate matter (PM < 2.5 µg/m3) and associations with local and regional cardio-pulmonary health risk

The effect of river dust and chemical constituents of air pollution on respiratory function among schoolchildren in Mailiao, Taiwan

Long-term exposure to air pollution components (total and source-specific) and incidence of stroke and cardiac events in the Heinz Nixdorf Recall study

Ambient Ultra Fine Particulate Sources Associated Changes in Blood Pressure in Healthy Adults

Association between sources of ultrafine particles and mortality in four European Cities

Outdoor PM2.5 Associations with Cardiovascular Disease Incidence in Dhaka, Bangladesh, and the Respective Roles of Fossil Fuels and Biomass Combustion

**OPS 07: Farm animals, antibiotics, infections and the microbiome**

Early-life antibiotic exposure, the gut microbiome, and the risk of childhood asthma

Health Risk of Bacteriological Contamination of Food Utensils in Mass Catering Establishments

Zoonotic diseases, livestock densities, social and environmental factors in New Zealand

Prevalence of non-specific symptoms in livestock dense areas: Looking beyond respiratory conditions

Occurrence and Spatial diversity of airborne resistomes in the poultry and household environment in Bangladesh

Estimating time-varying exposures to air emissions from animal feeding operations to assess short-term exposure effects in children with asthma

**OPS 11: Health effects of climate change in low- and middle-income countries**

Impact of Meteorological Factors on Rotavirus Infection among Children below 5 Years of Age in Kathmandu, Nepal
The Impact of 2016 Severe Flood on Infectious Diarrhea in Anhui Province, China: An Interrupted Time-Series Study ................................................................. 61
Maternal Health in the Aftermath of Hurricanes Irma and Maria in Puerto Rico ................................................. 62
The causal effects of flooding on infectious diarrheal diseases during and after flood and the related social modifiers in Anhui province, China ......................................................... 63
Temporal Analysis of Short and Long-Term Impact of Drought on Child Health; A Case Study of North Kordofan, Sudan ................................................................. 64
Monsoon flooding and early childhood health in India ...................................................................................... 65

**OPS 24: Drinking water contamination and children’s health** ................................................................. 66
Public Drinking Water Contamination and Birth Outcomes: New Estimates from Community Water System Sampling Data ........................................................................ 66
Exposure to manganese in drinking water during childhood and association with attention-deficit/hyperactivity disorder: A nationwide cohort study ......................................................... 67
Associations between exposure to drinking water chlorination by-products and being born small or preterm - a nation-wide register-based prospective study including 500,000 singleton births ......................................................... 68
Impact of rotavirus vaccination and piped water access on childhood diarrhea rates in Peru, 2005-2015 69
PFOA exposure assessment in North Rhine-Westphalia, Germany, linking birth registry data with tap water concentrations ................................................................. 70
Early life and adolescent arsenic exposure from drinking water and blood pressure in adolescence: evidence from rural Bangladesh ........................................................................... 71

**OPS 27: Radiation, EMF and morbidity** .................................................................................................. 72
Maternal Exposure to High Magnetic Field Non-Ionizing Radiation During Pregnancy and the Risk of Headaches and Migraines in Offspring: ............................................. 72
A prospective cohort study with up to 21 years of follow-up ....................................................................... 72
Radiofrequency electromagnetic fields exposure, screen time and cognitive function in children and adolescents at 9-18 years old ...................................................................... 73
Residential radon – next generation exposure models for Switzerland ......................................................... 74
Light exposure patterns and sleep in children ................................................................................................. 75
Is uranium exposure associated with an increase in thyroid-related antibodies? ........................................ 76
Ambient particle radioactivity and risk for gestational diabetes among pregnant women in Massachusetts, USA ................................................................................................................................ 77

**OPS 49: Air pollution exposure methods** .......................................................................................... 78
A New Method of Estimating Global PM2.5 Concentrations using Satellite Images ........................................ 78
Short-term PM$_{2.5}$ and cardiovascular admissions in NY State: assessing sensitivity of exposure model choice .................................................................................................................. 79
Assessing spatial variation of PM2.5 and NO2 across Europe using Geographically Weighted Regression 80
Bayesian Nonparametric Ensemble for PM2.5 Prediction and Uncertainty Characterization .................. 81
Potential underestimation of ultrafine particle exposure when using proxy pollutants: Lessons from long-term measurements at fixed sites and mobile monitoring .......................................................... 82
Spatiotemporal Land-Use Regression Modeling of Fine Particulate Matter in the Middle Eastern Megacity of Tehran Using Distributed Space-Time Expectation-Maximization ............................................. 83

**OPS 53: Air pollution and neurological outcomes** .................................................................................................................. 84

A population-based study on the association of air pollution with risk of dementia ........................................... 84

Association between Prenatal and Early Childhood Exposure to Ambient Particulate Matters and Risks of Autism Spectrum Disorder: An Exposure-Response Meta-analysis ............................................................... 85

Longitudinal Analyses of Fine Particulate Air Pollutants and Volumetric Changes in the Medial Temporal Lobe ........................................................................................................... 86

Identification of windows of neurodevelopmental vulnerability to air pollution using white matter microstructure data .................................................................................................................. 87

Ambient Air Pollution and Cognition in India ....................................................................................................................... 88

Associations between exposure to ambient air pollutants and Parkinson’s disease: a cross-sectional study ................................................................................................................................................ 89

**PDS 63: Chemicals and metals: health effects** ..................................................................................................................... 90

Cadmium exposure and risk of adverse pregnancy outcomes: A systematic review and dose-response meta-analysis of cohort studies .................................................................................................. 90

Exposure to Particulate Matter and Respiratory Health among Electronic Waste Workers at Agbogbloshie, Accra, Ghana .............................................................................................................. 91

Risk Factors for Head and Neck Cancer among World Trade Center Health Program General Responders: Results from a Nested Case-Control Study ........................................................................... 92

Blood Lead Concentrations and Mortality in Korean Adults: Results from the Korea National Health and Nutritional Examination Survey 2008-2013 .................................................................................... 93

Prenatal exposure to nitrates in drinking water and low birthweight: A population-based cohort study from Denmark, 1991-2011 ............................................................................................................. 94

Combined phthalates exposure in pregnancy and increased children’s blood pressure at age 4 to 6 years ................................................................................................................................................... 95

Arsenic Exposure, DNA methylation and Cancer Mortality in the Strong Heart Study ........................................................................................................ 96

Cardiovascular and cancer mortality in relation to dietary polychlorinated biphenyls and marine polyunsaturated fatty acids: nutritional-toxicological aspects of fish consumption .................................................................. 97

Cadmium exposure and breast cancer risk: a systematic review and dose-response meta-analysis of cohort studies ..................................................................................................................................... 98

Serum Organochlorine pesticides residues and the risk of breast cancer: a case-control study .................................................................................................................................................. 99

Blood lead levels and risk of atherosclerosis in the carotid artery: Results from a Swedish cohort ................................................................................................................................. 100

Prenatal Phthalate Exposure and Child Cognitive Performance in a Large, Well-Characterized Pregnancy Cohort Study ............................................................................................................................................ 101

Life-shortening as an alternative measure of effect of an environmental hazard: the case study of a coal-fired thermal power plant in Italy .................................................................................................. 102

The association between perfluoroalkyl substances and lipids in cord blood ............................................................................................................................................................................................... 103

Association of blood mercury levels with non-melanoma skin cancer in the United States using NHANES data from 2003-2016 ............................................................................................................. 104

Fluoride Exposure and Kidney and Liver Function among Adolescents in the United States .................................... 105
Systematic review and meta-analyses of putative human health effects of exposure to per- and polyfluoroalkyl substances in children and adults

Chlorinated persistent organic pollutants and type 2 diabetes - a population-based study with pre- and post-diagnostic plasma samples

Amyotrophic lateral sclerosis incidence following exposure to inorganic selenium in drinking water

Use of Blood Metals to Improve the Prediction of Death from Cardiovascular Causes: An Environmental Risk Score Approach

Blood lead levels and prevalent breast cancer among US women

**Tuesday August 27 1:30 PM – 3:00 PM**

**S10: Quasi-Experimental Designs in Environmental Epidemiology: Applications to the Health Impacts of Energy Policy Changes**

A multi-level analysis of the impact of changes in coal-fired power plant emissions on asthma-related healthcare utilization and symptoms in Louisville, Kentucky

The Causal Impact of Fracking on Indoor Radon Levels: A Difference-in-Difference Approach

Impact of Oil and Gas Drilling Activities on Small-for-Gestational-Age Infants in Texas: A Difference-in-Differences Analysis

Impact of Shale Gas Development on Drinking Water Quality and Infant Health: A Difference-in-Differences Design

**S14: Use of Exposomic Methods Incorporating Sensors in Environmental Epidemiology**

Use of Exposomic Methods Incorporating Sensors in Environmental Epidemiology

The Fresh Air Wristband: A wearable air pollutant monitor

Environmental Pollutants and Plasma Metabolomics in a Pregnancy Cohort

Environmental sensing: sense and sensibility

**S18: Landmarks of Air Pollution Epidemiology: Legacy of Douglas Dockery**

Steubenville, Steel and Standards: ambient PM episodes and respiratory health of children

When Air Pollution Strikes Out of the Blue

A Tale of Six Cities: The Landmark Harvard Six Cities Study

Achilles’ Heel: Exposure Assessment Advances in Environmental Epidemiology

Lines that Connect: Informing and Evaluating Public Policy

**OPS 04: Environmental justice**

Socioeconomic Disparities in Incidents at Toxic Sites during Hurricane Harvey

Air pollution spatial variability in relation to socioeconomic indicators in nine European metropolitan areas

Environmental justice implications of flaring from unconventional oil wells in Texas: racial/ethnic inequalities in exposure

Birth cohort environmental context: Socio-economic and ethnic inequalities in greenspace accessibility

Global Patterns of Environmental Inequities within the Prospective Urban and Rural Epidemiology Study
Community-level Crime and Deprivation Role in Pollution Susceptibility in Pediatric Asthma .................. 129

**OPS 05: Statistical methods to analyze mixtures** ................................................................. 130

- What is the influence of exposure measurement error in the context of multi-pollutant models? A simulation study ................................................................. 130
- Using DNA methylation to characterize more efficiently associations between the exposome and child lung function ................................................................. 131
- A Three-Phase Approach to Examining Multiple Environmental Exposures and Age at Menarche ........ 132
- A quantile-based g-computation approach to addressing the effects of exposure mixtures .................. 133
- Causal inference and ensemble learning as new important tools for investigations of health effects of chemical mixtures ................................................................. 134
- Performance of variable selection methods for estimating the non-linear health effects of correlated chemical mixtures: a simulation study ................................................................. 135

**OPS 30: Green space and morbidity** .................................................................................. 136

- Greenspace and cardiovascular morbidity: a comparative study in two European cities ...................... 136
- Residential Surrounding Greenspace and Arterial Stiffening: A Whitehall II Longitudinal Study .................. 137
- Estimating increasing greenness on all-cause mortality across the 34 largest metropolitan areas in the United States .................................................................................. 138
- Impacts of Forest Change on Mortality for Chinese Older Adults ...................................................... 139
- Residential greenness and lung function in a prospective cohort of European adults: The ECRHS study . 140
- Socioeconomic inequalities in the associations between green spaces and self-perceived health in the Brussels Capital Region: An intersectional approach .................................................. 141

**OPS 31: Health effects of multiple environmental stressors** .............................................. 142

- Multiple Urban Environmental Exposures and Antihypertensive Use in the Helsinki Capital Region .... 142
- The Association of PM2.5 and Greenness with Term Low Birth Weight ............................................. 143
- The combined impact of environmental and built environment exposures on birthweight in an urban population in Massachusetts .................................................. 144
- Air pollution, noise, green spaces and built environment and the risk of overweight and obesity during childhood .................................................................................. 145
- Ocean health in Belgium: Living near the coast is associated with better health .................................. 146
- The association of perceived neighborhood walkability and environmental pollution with frailty among community-dwelling older adults in rural areas: a cross-sectional study .................................. 147

**OPS 32: Health impact of interventions 1** ....................................................................... 148

- Reducing PM2.5 levels is associated with lower cancer incidence ................................................. 148
- Potential benefits of cool roofs in reducing heat-related mortality during heatwaves in a European city 149
- The use of portable HEPA air cleaners to improve residential indoor air quality during biomass burning events .................................................................................. 151
- Towards a comprehensive heat-health warning system of Hong Kong: an evidence-based multi-stage approach .............................................................................. 152
Effects of a large-scale distribution of water filters and natural draft cookstoves on diarrhea, acute respiratory infection, water quality, and personal PM2.5: a cluster randomized trial in Western Province, Rwanda. ................................. 153

**OPS 35: Health effects of indoor air pollution in LMIC countries** ................................................................. 154

Methylated PAHs from household coal use and risk of lung cancer among never-smoking women in Xuanwei and Fuyuan, China ........................................................................................................... 154

Variability of exposure to PM2.5 related to indoor pollution sources in low socio-economic urban households, Durban, South Africa .................................................................................................... 155

Prenatal Risk factors and environmental exposure associated with early childhood wheezing in the Mother and Child in the Environment (MACE) Birth Cohort ................................................................. 156

The association of household particulate-bound metal concentrations and tuberculosis in women and children in Pune, India ........................................................................................................... 157

Associations of household solid fuel suspension with blood pressure and markers of arterial stiffness and atherosclerosis in a multi-provincial cohort of Chinese adults ...................................................................... 158

Indoor Gaseous Pollution as Determinants of Overweight/Obesity ................................................................. 159

**OPS 60: Social factors and environmental health across the world** ............................................................. 160

Outdoor NO2 Exposure Disparities at Public Schools in the Contiguous United States .................... 160

Trends in heat-attributable vulnerability and mortality in Europe: role of macroeconomic growth during the Great Recession ........................................................................................................ 161

Role of socio-economic status in the relationship between air pollution and health: an analysis on mortality in a large cohort in Italy ....................................................................................................... 162

Prenatal exposure to DDT and pyrethroids and humoral response to vaccines among South African children from an area sprayed for malaria control: The VHEMBE study ........................................ 163

Effect of improved cook stove intervention on pulmonary function tests of rural women in Andhra Pradesh ........................................................................................................................................... 164

Social inequalities in environmental resources of green and blue spaces: a review of evidence in the WHO European Region ........................................................................................................... 165

**Tuesday August 27, 3:00 PM – 4:30 PM** ........................................................................................................ 166

**TPS 631: Metals and health 1** ....................................................................................................................... 166

Chronic long-term exposure to cadmium air pollution and breast cancer risk in the French E3N cohort. 166

Low concentration of cadmium, nickel, and lead in human body and cardio-metabolic diseases in the industrial area of Civitavecchia ....................................................................................................... 167

Variability of Seminal Plasma Cadmium Concentrations and Its Associations with Semen Quality among Healthy Chinese Men Screened as Potential Sperm Donors ........................................................................ 168

Metals mixture exposure in pregnancy is associated with increased fetal growth .................................. 169

Early-life Dentine Manganese Concentrations and Intrinsic Functional Brain Connectivity in Adolescents and Young Adults ................................................................................................................ 170

Associations between prenatal and concurrent lead concentrations and IQ in preschool children in Korea ........................................................................................................................................... 171

Sex-specific associations of blood mercury and iodine with thyroid hormones: results from the NHANES 2009-2012 ......................................................................................................................... 172
Assessment of Mercury Exposure with Decrease of Liver Function in Adults .......................................................... 176
Maternal copper status and neuropsychological development in infants and preschool children ........ 177
Factors affecting arsenic methylation capacity: the Italian case ................................................................. 178
Exposure to cadmium is associated with impaired fasting glucose ......................................................... 179
Cadmium and mammographic volumetric density – preliminary results .............................................. 180
Elemental Analysis of Nasal Epithelial Lining Fluid in COPD Patients: A Pilot Study ................................... 181
The association between in utero and early life metals and early life gut microbiota ................................. 182
Prenatal manganese exposure and neurodevelopmental effects at 1 year of age in the INMA cohort (Spain) .......................................................................................................................... 188
Maternal Exposure to Metals Associated with Increased Cord Blood Immunoglobulin E .......................... 184
Dietary Counseling on Risks and Benefits of Fish Consumption and Mercury Testing in Reproductive Age Women in a Health Clinic Setting ...................................................................................... 185
Estimating effects of soil remediation on children’s blood lead near a former lead smelter in Omaha NE, U.S ........................................................................................................................................ 186
The association of selenium and other metal/metalloids with incident cardiovascular disease in the Strong Heart Study ................................................................................................................. 187

TPS 632: Health effects of flame retardants and plasticizers ........................................................................ 188

Health risk assessment of human exposure to phthalates-contaminated indoor dust in the environment of homes ........................................................................................................................................ 188
Maternal Urinary Concentrations of Organophosphate Flame Retardant Metabolites: Effects on Maternal Gestational Weight Gain, Early Life Anthropometry, and Infant Eating Behaviors ......................................................... 189
Urinary biomarkers of phthalates exposure in relation to thyroid hormone levels among thyroid disorder patients .................................................................................................................................................. 190
Phthalate exposure and stressful life events in pregnancy have a joint effect on preterm birth .......... 191
Perfluoroalkyl substances (PFAS) exposure associated with immune markers: T & B lymphocytes and natural killer (NK) cells ........................................................................................................ 192
Phthalate exposure in pregnant women with systemic lupus erythematosus (SLE) ................................. 193
Exposure to Phthalates and Association with Circulating Microparticles in A Young Population .......... 194
The association of brominated flame retardant exposure and semen parameters among men at a fertility clinic .................................................................................................................................................. 198
The associations with thyroid hormone levels according to the urinary concentrations of bisphenol A, F, and S in children ................................................................................................................ 196
Prenatal Phthalates Exposure and Childhood Adiposity, Adipokines, and Lipid Profiles at 48 and 72 months ........................................................................................................................................ 197
Exposure to di-(2-ethylhexyl) phthalate and skeletal muscle mass in 6-year-old children .......... 198
Sex-specific effects of bisphenol A exposure on adiposity in early childhood: a prospective cohort study .........................................................................................................................199
Prenatal exposure to PFOS and anti-mullerian hormone concentrations in female adolescents .......... 200
Prenatal exposure to mixture of bisphenol A and mono(2-ethyl-5-hydroxyhexyl) phthalate increases body mass index of 6 month-infants ........................................................................................................201
Prospective evidence for the association between urinary bisphenol A and incidence of metabolic syndrome in Chinese males ........................................................................................................202
Plasma concentrations of brominated flame retardants and risk of uterine leiomyomata .................. 203

TPS 633: Health effects of pesticides ........................................................................................................204
Parental occupational exposure to pesticides and risk of childhood cancer in Switzerland: A census-based cohort study ........................................................................................................204
Domestic pesticide use during the perinatal period and risk of testicular germ cell tumor in adulthood: a French case-control study ...................................................................................................205
The association between estimated dietary pesticide residue risk index and mortality in a population-based cohort ................................................................................................................................206
Pesticide use and breast cancer risk among farmers’ wives in the Agricultural Health Study .......... 207
Prenatal organophosphorus pesticide exposure and childhood adiposity in the Mount Sinai Children’s Environmental Health Study .............................................................................................. 208
Association between urinary triclosan concentration with bone mass density and osteoporosis in the US adult women, 2005-2010 ........................................................................................................ 209
Association of Pesticides with Measures of Sex Steroid Hormones in Adult Males: Findings from the 1999-2004 National Health and Nutrition Examination Survey (NHANES) ................................................................... 210
The Effects of Glyphosate Based Herbicides on Rat Sperm Mitochondria ........................................ 211
Pesticides in Sao Paulo, Brazil and impacts on human health. Exploratory analysis of mortality in population in the period 2013-2018 ........................................................................................................... 212
Epidemiologic Evidence of Glyphosate’s Carcinogenic Potential ......................................................... 213
Residential proximity to specific crops and cause-specific mortality in The Netherlands .................. 214
Agricultural Pesticide Exposure and Congenital Abnormalities (CA) in Mexico: A Systematic Review .... 215
Impact of Organophosphate Pesticide Exposures on Zika Infection Health Outcomes ....................... 216

TPS 634: Health effects of pops, voc and other chemicals ........................................................................217
Gene-Dioxin Interactions and Time to Pregnancy in the Seveso Women’s Health Study ................. 217
Environmental toxicants in breast milk of Norwegian mothers and gut bacteria composition and metabolites in their infants at one month ........................................................................ 218
Low-dose persistent organic pollutants and mitochondrial dysfunction in humans ......................... 219
Exposure to chemical and toxic elements following Hurricane Harvey ........................................... 220
Associations between endocrine disrupting chemicals (EDCs) and thyroid hormones: a community-based survey in rural Newfoundland (Canada) ................................................................. 221
Associations of PCB and PBDE congeners with thyroid hormones in Great Lakes sport fish consumers .222
Persistent organic pollutants and the association with maternal and child thyroid hormone levels ....... 223
Spatiotemporal distributions of benzene exposure in the inner city, urban fringe and suburban areas over the whole of Bangkok by using Space-time Bayesian maximum entropy method .................................................. 224
A prospective study of urinary melamine levels and renal function deterioration in early stages of chronic kidney disease .................................................................................................................. 225

**TPS 651: Air pollution exposure modeling 1** ................................................................................. 226
Visualizing and quantifying human internal black carbon load ..................................................... 226
Development of Smartphone Application for Modeling Personal Exposures to Ambient PM2.5 and Ozone ......................................................................................................................................... 227
Extracellular Vesicles in Saliva as Biomarkers of Exposure and Effect: A feasibility pilot in the context of the New York City Biking and Breathing Study ............................................................................. 228
Opportunities for mobile-phone based air pollution exposure assessment ........................................ 229
West Africa-Michigan CHARTER II in GEOHealth: Climate variables, ambient air quality and human exposure to environmental pollutants ..................................................................................... 230
Generating Spatiotemporal Records of Exposure for Utilization in Environment Epidemiology ........ 231
Outdoor and indoor levels of black carbon in central Stockholm, Sweden – implications for epidemiological studies .......................................................................................................................... 232
Ambient and Personal PM2.5 Measurements: What’s the Difference When Determining Associations with Individual Health Effects? .......................................................................................... 233
A Nationwide Land Use Regression Model for Ultrafine Particles .................................................. 234
Changes in the air pollution levels during heating seasons in Krakow based on individual measurements of pollutants over the last 15 years .................................................................................... 235
A Low-Cost Passive Monitor for Black Carbon Air Pollution: Initial Testing .................................... 236
Personal exposure to black carbon in Stockholm, using different intra-urban transport modes ........ 237
NO2 Air Pollution Exposure Assessment in Urban Mysore, India ...................................................... 238
Assessment of automatic geocoding tools in Temuco, Chile: a study using addresses from hand-written hospital record ........................................................................................................... 239
The effect of route selection on PM2.5, particle number count and lung deposited surface area concentrations during bicycle commuting .......................................................................................... 240
Novel exposure estimation for assessing the effects of long-term exposure to pollutants in cohort studies. .................................................................................................................................................. 241
Land Use Regression models for Ultrafine Particles: development and transferability within a mega-city .............................................................................................................................................. 242

**TPS 664: Climate change: temperature effects 2** ........................................................................... 243
Impact of the mitochondrial genome on the relationship between short-term changes outdoor temperature and cognitive function ......................................................................................................... 243
Impact of meteorological variables on physical activity in a sub-tropical city: evidence from mobile app data ................................................................................................................................. 244
Towards the development of a heat-health early warning system for South Africa ......................... 245
The Health Impact of Air Conditioning Use During the 2018 Heatwave in South Korea ................ 246
Health effects of ambient black carbon and ultrafine particles: review and integration of the epidemiological evidence..............................................................................................................275
Trends in Annual Associations between Ozone and Circulatory Mortality by Age and Sex in Canada for 1984-2012 ........................................................................................................................................276
Air pollution and cause-specific mortality in Switzerland: results from a large administrative cohort in the ELAPSE project..........................................................................................................................277
Cross-sectional Study of Children’s Respiratory Health and Ambient Air Exposure in two communities in Lanzhou ..................................................................................................................................................278

TPS 701: Spatial determinants of population health.................................................................................................................................279

Physical function as a moderator of associations between neighbourhood environments and neighbourhood (dis)satisfaction in older adults: Hong Kong & Ghent .................................................................................................................................279
Association between residential stressors and mental health outcomes in Belgium ........................................................................................................280
Natural environments and perceived health in Metro Vancouver, Canada ....................................................................................................281
Do area-level factors reduce individual-level socioeconomic mortality disparities associated with particulate matter? ..................................................................................................................................................282
Cumulative Environmental Quality Associations with Limb Reduction Birth Defects ..........................................................................................283
Built environment survey in a small community: determinants of noise annoyance and sleep disturbance .................................................................................................................................284
Impact of commuting distance on travel mode choice: active and passive transport ........................................................................................285
The perceived contribution of a biosphere reserve to physical and mental health .....................................................................................286
Place and air connect through early life stress to affect inflammation ...........................................................................................................287
Impact of a riverside accessibility intervention on use, physical activity, and wellbeing: A mixed methods pre-post evaluation ..................................................................................................................288
Spatio-Temporal Analysis of Ovarian Cancer Mortality in California ........................................................................................................289
Urban design and suicide in a megacity: a study on the long-term association ............................................................................................290
Neighborhood Socioeconomic Status and Mortality Among Heart Failure Patients ...................................................................................291

TPS 721: Low and middle income countries: e-waste, occupational health .................................................................292

Non-Cancer risk among electronic waste workers due to inhalation of particulate matter emitted from informal electronic waste recycling activities in Ghana .................................................................................................................292
Health Status and Occupational Risks in Nepali Informal Waste Workers .........................................................................................................................293
Disruption of thyroid hormone regulated proteins and gene expression by polychlorinated biphenyls, polybrominated diphenyl ethers, and new flame retardants in residents of an e-waste region ..........................................................................................................................294
Occupational dust exposure and lung functions of steel industry workers in Tamilnadu – a cross sectional study ..................................................................................................................................................295
Occupational exposure to pesticides and mental health among smallholder family farmers in Brazil ........................................................................................................296
Risk factors associated with self-reported health among waste pickers in landfill sites in Johannesburg Municipality, South Africa ..................................................................................................................297
PM4 exposures and respiratory symptoms in waste reclaimers at a landfill site, Pretoria, South Africa .................................................................................................................................298
A National Analysis of Potential Chronic Kidney Disease of Undetermined Causes in Ecuador .................................................................................................................................299
Recycling of scrap metal into artisanal cookware: a public health threat? .................................................................................................................300
TPS 732: Neurological effects in adults ........................................................................................................301
Study of mixtures of organic solvent exposures and amyotrophic lateral sclerosis in Denmark ..........301
Plasma Extracellular Vesicle microRNA Expression in Amyotrophic Lateral Sclerosis Patients ........302
Predictors and long-term neurological effects of pesticide poisonings in smallholder farmers in Costa Rica ........................................................................................................................................303
Air pollution and plasma amyloid beta levels in an older cohort: evidence from the Ginkgo Evaluation of Memory Study ................................................................................................................304
Air pollution and Parkinson’s disease: A systematic review and meta-analysis up to 2018 ........305
The association between PM10 and Quality of Life (QoL) in South Korea: A Cross-sectional study ........306
Long-term Exposure to Ambient Air Pollution, APOE-ε4 status, and Trajectories of Cognitive Decline in an Urban Cohort of Older Adults ...........................................................................307
Prenatal exposure to chemical mixtures and inhibition among adolescents in the New Bedford Cohort.308
Exposure to fine particulate matter and the temporal dynamics of episodic memory and depressive symptoms in older women ........................................................................................................309
Long term fine particulate matter exposure and cerebrospinal fluid markers of vascular injury, oxidative stress, and neurodegeneration ................................................................................................310
Social Networking Site use in young adolescents: association with health-related quality of life and behavioural difficulties ..................................................................................................................311
The association of short-term effects of air pollution and sleep disorders among elderly residents in China ........................................................................................................................................312
Ambient Air Pollution and Daily Hospital Admission Risk of Depression in 75 Cities in China ..........313
Association of Ambient Air Quality with Hand Grip Strength of Korean Elderly ................................314

TPS 742: Adverse birth outcomes 1 ........................................................................................................315
Adverse birth outcomes in Suriname related to maternal iron intake through consumption of leafy vegetables .................................................................................................................................315
Prenatal Exposure to organophosphate and pyrethroid pesticides and birth outcomes in two Urban cohorts of Pregnant Women ................................................................................................................................316
Associations between ambient air pollutant concentrations and birth weight: a quantile regression analysis .............................................................................................................................................317
Prenatal exposure to BPA and birth outcomes- The TMICS Group ................................................................318
Higher Neonatal Blood Pressure in Association with Air Pollution Exposure During the Last Weeks of Pregnancy: an ENVIRONAGE birth cohort study .....................................................................319
Associations between psychosocial stress and oxidative stress during pregnancy in Puerto Rico ..........320
Ambient Air Pollution and Risk of Pregnancy Loss among Women Undergoing Assisted Reproduction ........................................................................................................................................321
Oil and gas development activity and spontaneous preterm birth risk in California ................................322
Ambient air pollution and fetal mortality in Sao Paulo, Brazil ........................................................................323
Effects of maternal exposure to neonicotinoid pesticide and oxidative stress on birth outcomes ..........324
Maternal factors and risk of spontaneous preterm birth due to high ambient temperatures in New South Wales, Australia ...........................................................................................................325
Organophosphate pesticide exposure during pregnancy associated with total gestational weight gain: preliminary results from the New York University Children’s Health and Environment Study ...............326
Association of exposure to particulate matter with adverse birth outcomes in the Panel Study on Korean Children ........................................................................................................327
Modeling of Nitrogen Oxide Exposure during Pregnancy on Birthweight using Generalized Additive Model: A Case of MACE Birth Cohort Study in Durban, South Africa ..........................................................328
Nitrogen Dioxide pollutant exposure and Birthweight among HIV exposed Newborns within the MACE Birth Cohort ......................................................................................................................................329
Prenatal Exposure to Organophosphate Pesticide Metabolites Associated with Reductions in Gestational Age and Birth Weight: Results from a population-based cohort study in New York City .................................................................................................330
Prenatal exposure to ambient PM2.5, roadway proximity, pre-term birth, and effect modification by socioeconomic indicators and infant sex ........................................................................................................331
Maternal gestational exposure to di-butyl phthalate (DBP) from medications and birthweight of progeny ......................................................................................................................................................332
Ambient Air Pollution Exposure During Pregnancy and Neurobehavioral Status at Birth ..........................................................................................................................................................333
El Niño Southern Oscillation (ENSO) and Birthweight in Tuvalu ..............................................................................................................................................................................................334
A National Study of Maternal and Paternal Occupational Exposure to Endocrine Disrupting Chemicals and Pregnancy Outcomes ..................................................................................................................335

TPS 752: Respiratory effects and allergies ........................................................................................336
Prenatal exposure to phenols and lung function, wheeze, and asthma in school-age children from 8 European birth cohorts ........................................................................................................................................336
Short-term exposure to air pollution and pollen and associations with lung function in French children from the PARIS birth cohort ..................................................................................................................................337
Interaction between air pollution and pollen seasons on allergic rhinitis control ........................................................................................................338
Sensitization profiles at age 8-9 years in the PARIS birth cohort and related environmental risk factors. 339
Use of cleaning agents at home and respiratory and allergic symptoms in adolescents: the PIAMA birth cohort study ........................................................................................................................................340
Determinants of airborne rodent allergens in Dutch households: a pilot study ..................................341
Is childhood asthma associated with biological aging markers? .............................................................342
The body of evidence on pollen-related asthma exacerbations in children in the climate change era ......343
Assessment of Airborne Fungal Spores in a tertiary care hospital in South Western Nigeria ..................344
Role of timing of exposure to pets and dampness or molds on asthma and sensitization in adolescence ...........................................................................................................................................345
Cross-sectional associations between per- and polyfluoroalkyl substances and asthma in children .......346
Breathe Easy Dallas: Measuring the Impact of School-Based Interventions on Air Quality and Daily Asthma Exacerbations at High Risk Schools ..................................................................................................347
Prenatal exposure to perfluoroalkyl substances and children’s allergic diseases ........................................348
Prenatal exposure to phthalate esters and its associations with childhood allergies (TMICS Study) ........349
Improving Indoor Microbiological Measurements for Health Protection .............................................350
Infections, Respiratory Symptoms, and Allergy in Relation to Rice Cereal Consumption in a United States Cohort...........................................................................................................................................351
Air microflora study of selected offices In Elizade University, Ilara-Mokin ..............................................352
Childhood Atopy and Airway Inflammation among communities with high ambient pollution ..............353
Investigation of the Association between Adult Wheeze and Household Beta(1→3)-glucan Exposures in First Nations Communities in Canada...........................................................................................................................................354
Exposures and respiratory health among children in an ongoing birth cohort in Puerto Rico..............355
Respiratory health outcomes associated with different grass taxa in the UK ........................................356
Relative influence on childhood allergic diseases of meteorological factors and air pollutants in Shanghai, China.......................................................................................................................................................................357
The association between pediatric asthma and body composition in Lima, Peru........................................358
Pollen Flowing over the Great Dividing Range, Australia...........................................................................359
Association between Chemical Components of PM2.5 and Children’s Primary Care Night-time Visits due to Asthma Attacks: a Case-crossover Study...........................................................................................................................................360
Association of airborne endotoxin concentrations with pulmonary function and airway inflammation among students..........................................................................................................................................................361
Association between early life indoor environment factors and prevalence and onset of asthma/allergic disease among preschool children in Taiyuan .........................................................................................................................362

TPS 781: Health effects of noise .....................................................................................................................363

Sex/gender differences in the association of environmental noise exposure and cardiovascular health - systematic review and meta-analysis ...........................................................................................................................................363
Long-term exposure to road traffic noise, air pollution and adiposity markers: a joint analysis of HUNT3, Lifelines and UK Biobank...................................................................................................................................................................364
Health effects of exposure to aircraft noise: a cross-sectional study on adult residents near the Orio al Serio International Airport, Italy ...........................................................................................................................................365
Associations between exposure to road traffic noise and particles and the prevalence of renal dysfunction in Taichung, Taiwan.................................................................................................................................................366
Road traffic noise and markers of adiposity in the Danish Nurse Cohort: a cross-sectional study ..........367
High spatial resolution health risk assessment of road traffic noise on ischemic heart disease deaths for Melbourne, Australia in 2011.................................................................................................................................................................368
Depression as an effect modifier of an association between outdoor and indoor traffic noise and cognitive function - Results from the Heinz Nixdorf Recall study ......................................................................................................................................369
Can vegetation cover and traffic noise exposure be differentiated at residential address-level in UK Biobank? ...........................................................................................................................................................................370
Aircraft noise exposure assessment for a case-crossover study in Switzerland........................................371
Sociodemographic and Segregation Patterns of Civil Aviation Noise Exposures........................................372
Long-term Exposure to Road Traffic Noise, Air Pollution and Incidence of Atrial Fibrillation: A Danish Nurse Cohort Study.........................................................................................................................................................373
Leisure noise exposure and its association with tinnitus among adolescents............................................374

TPS 792: Occupational health 2 ......................................................................................................................375
Genotoxic damage in a Bolivian agricultural population exposed to a mixture of pesticides..........375
Oxidative Stress Profile of workers exposed to formaldehyde in the hospital.................................376
Oxidative stress induction in woodworkers exposed to wood dust and formaldehyde .........................377
Longitudinal study of effects of welding fumes on the cardiovascular system ................................378
Occupational Risk Factors for Health Disparities among Latina Farm Workers in Southern Idaho........379
Differences in physical activity between employed and unemployed individuals: a cross-sectional study ..........................................................380
Validity of Retrospective Occupational Exposure Estimates of Lead and Manganese in a Case-Control Study ........................................................................381
Early Life Respiratory Status And Adult Occupational Exposures: Prospective Evidence For Healthy Worker Bias ........................................................................382
Self-reported health status of tour managers leading tours to different geographic areas .....................383
The Association of Sleep Disorder and PTSD Symptoms by Work Tasks in Firefighters ................384
The association between salivary cortisone level and structural change of Limbic system based on differences in blood heavy metal concentration among Korean firefighters: a cross-sectional study .....385
Exposure to styrene and styrene-7,8-oxide among workers in the glass fibre-reinforced plastics industry ..........................................................................................................................386
Professional Drivers Exposure to Black Carbon in London; the Diesel Exposure Mitigation Study ..........387
Evaluation of the reliability and convergent validity of a monitoring battery including three Screening Test (CDT, FAB and TMT) of neuropsychological outcomes on agricultural and non-agricultural workers from Chile.................................................................................................................................388
Environmental risk factors for acute kidney injury in agricultural workers in Spain ............................389
Measurement of urinary 1-hydroxy pyrene in a pilot study of airport workers exposed to jet fuel........390
Occupational exposure to n-hexane is associated with reduced gonadotropins and with prolonged menstrual cycles in Mexican workers of reproductive age..........................................................391

Tuesday August 27, 4:30 PM – 5:30 PM ..........................................................................................392

OPS 20: Chemicals, biomarkers, omics .........................................................................................392
Associations between PM2.5 and mid-pregnancy inflammation measured using a novel proteomics chip ..........................................................................................................................392
Per- and polyfluoroalkyl substance concentrations during pregnancy and post-pregnancy biomarkers of cardiometabolic health in Project Viva ........................................................................393
Distribution of polybrominated diphenyl ethers (PBDEs) in Newfoundland seafood and associations with human serum thyroid hormone concentrations ........................................................................394
Prenatal phthalate exposure and cord blood methylation: an epigenome-wide association study in the Mexico City PROGRESS cohort ........................................................................395

OPS 22: Behavioral effects of chemical exposures .........................................................................396
Prenatal phthalate exposure and behavior in the CHAMACOS cohort............................................396
Exposure to per- and polyfluoroalkyl substances in association with autism spectrum disorder: a case-control study ...........................................................................................................397
Role of genetic predisposition to neurobehavioural deficits from prenatal exposure to methylmercury.398
Prenatal and postnatal polycyclic aromatic hydrocarbons (PAH) exposure and behavioral development in early adolescence. ..............................................................................................................................................................................399

**OPS 28: Green space and biomarkers** .................................................................................................................................400

Neighbourhood green space and allostatic load in school-aged children. Findings from the Generation XXI birth cohort. ..................................................................................................................................................................................................................400

Exposure to Greenspace and Telomere Length in Preschool Children..........................................................................................400

Greater residential tree-cover and time spent outdoors are associated with reduced allostatic load in residents of central North Carolina........................................................................................................................................................................402

Neighborhood characteristics may impact inflammation-related epigenetic loci in a concerted manner 403

**OPS 36: Health effects of dietary exposures** ............................................................................................................................404

Fluoride Exposure from Infant Formula and Child IQ in a Canadian Birth Cohort........................................................................404

Maternal lean fish intake during pregnancy is associated with child growth in the Norwegian Mother and Child Cohort Study (MoBa) .................................................................................................................................................................................................................................405

Fish consumption during pregnancy, exposure to mercury, and child metabolic syndrome..................................................406

Ingested nitrate and nitrite and bladder cancer in Northern New England .................................................................................................407

**OPS 38: Effects of metals on child health** .................................................................................................................................408

Prenatal Metal Mixture Concentrations and Reward Motivation in Children.................................................................................408

Blood Lead Level in Infants and Subsequent Risk of Malaria: A Prospective Cohort Study in Benin, Sub-Saharan Africa .............................................409

Exposure to metal mixtures and growth-related traits in Bangladeshi children aged 5-7 years.........................................................410

A Prospective Study of Methylmercury Exposure and Prepulse Inhibition Deficits in Children and Adolescents: The Early Life Exposures in Mexico to Environmental Toxicants Birth Cohort .........................................................................................................411

**OPS 43: Noise, stress and mental health** .................................................................................................................................412

Association of exposure to road traffic noise with cognitive function in elderly women ............................................................412

Traffic noise and mental illness – a systematic review .................................................................................................................................413

Green space, air pollution, traffic noise and saliva cortisol in children aged 12 years: the PIAMA birth cohort ........................................................................................................................................................................................................414

Environmental factors affecting stress in children: interrelationships between traffic-related noise, air pollution, and the built environment ........................................................................................................................................................................415

**OPS 44: Occupational health studies with environmental implications** ........................................................................................416

Occupational Heat Stress and DNA damage among steelworkers in Southern India........................................................................416

Is CKDu an occupational or an environmental disease? .................................................................................................................................417

Factors associated with reduced eGFR in fishing and farming communities in Sri Lanka ..................................................................................418

Genomic instability reflected by elevated Alu retroelement copy-number among workers exposed to diesel engine exhaust ........................................................................................................................................................................419

**OPS 46: Exposure assessment to air pollution in Asia and Africa** .................................................................................................420


Exposure assessment of PM2.5 on elders in a cohort study .................................................................................................................................421
Land use Regression Model for Exposure Assessment in the Mace Birth Cohort Study in Ethekwini ..................................................422
Mobile-monitoring of Black Carbon and PM2.5 Air Pollution - Data only approach from Bangalore, India .................................................................................................................................423

OPS 47: Increasing spatiotemporal resolution in assessment of exposure to outdoor air pollutants ..................................................424
Daily NO2 modelling using OMI satellite data over Switzerland for 2005 – 2016 ......................................................................................424
Estimating daily PM2.5 and PM10 over Italy using an ensemble modeling approach .................................................................................425
High resolution spatiotemporal assessment of ambient air pollution using ensemble modeling and links with hypertension in a Delhi based cohort ...........................................................................426
Source-specific Fine Particulate Using Spatiotemporal Concentration Fields Developed using Chemical Transport Modelling and Data Assimilation: Application to North Carolina for Health Associations with Coronary Heart Disease ..................................................................................................................427

PDS 67: Outdoor air pollution cardiometabolic effects ..........................................................................................................................428
Associations between short-term exposure to fine particles and systemic inflammation, coagulation, vasoconstriction and metabolism cytokines: A nested case-control panel study .......................................428
Exposure to Particulate Matter of Different Fraction Sizes and Blood Glucose in Children and Adolescents ..................................................................................................................................................429
Long-term exposure to NO2 and PM2.5 on renal function in type 2 diabetes ............................................................................................430
Urban environment and body mass index trajectories during first 5 years of life ..................................................................................431
Ambient air pollution association with anaemia prevalence and hemoglobin levels in Chinese older adult; cross-sectional study from who wave 1 study on global aging and adult health (sage) ..............................................................................432
How Protective is China’s National Ambient Air Quality Standard on Short-term PM2.5? Findings from Blood Pressure Measurements of 1 Million Adults ....................................................................................................433
Dynamic changes in long-term exposure to ambient PM2.5 and incidence of diabetes in adults: A natural experiment .........................................................................................................................................................434
The relationship between air pollution exposure and the risk of diabetic retinopathy ........................................................................435
Association between air pollution and venous thromboembolism: a 16 years time-series study in Rome ..............................................................................................................................................................436
Effects of different size fractions of ultrafine particles from short-term exposure to indoor sources on arterial stiffness using single and multipollutant modeling .............................................................................437
Long term exposure to air pollution and coronary artery calcification in the SCAPIS cohort .......................................................................438
Long-term ambient air pollution exposure and measures of brachial arterial stiffness: results from COMPASS study ..................................................................................................................................................439
Long-term Exposure to Air Pollution and Incidence of Stroke: A Danish Nurse Cohort Study ........................................................................440

PDS 71: Exposome ..................................................................................................................................................................................441
Prenatal Household Air Pollution Exposure and Cord Blood Mononuclear Cell Telomere Length: Sex-specific Associations ......................................................................................................................................................441
Placental methylation signatures from maternal smoking during pregnancy and potential impacts on fetal growth: meta-analyses from 7 cohorts ..................................................................................442
Latent classes for meaningful chemical mixtures analyses in epidemiology: An example using phthalate and phenol exposure biomarkers in pregnant women ........................................................................443
The domains, methods, and tools used in human exposome studies: a systematic review ..........................444
Recent and chronic residential air pollution exposure and buccal telomere length in children ..............445
The association of urinary phosphorous-containing flame retardant metabolites and oxidative stress among pregnant women in Puerto Rico ..................................................................................................................446
Linking mitochondrial and telomere damage in foetal tissue: TP53 and PPARGC1α as a central hub? .....447
The urban exposome framework and a proof-of-concept study ..................................................................448
Identifying novel metal biomarkers and biochemical networks in the Strong Heart Family Study: An integrative metallome-metabolomic analysis ...........................................................................................................449
Childhood Type 1 Diabetes: an Environment Wide Association Study across England .......................450
Prenatal exposures to mixtures of endocrine disrupting chemicals and children’s growth up to six years of age in the SELMA study ........................................................................................................................451
Maternal Serum Metabolome and Ambient Air Pollution Exposure in Pregnancy ...............................452
Tuesday August 27 9:00 AM – 10:00 AM

Keynote Lectures
Protecting and promoting health in the Anthropocene

Ebi K
1University Of Washington

Keynote Lectures Tuesday, Beatrix theater, August 27, 2019, 9:00 AM - 10:00 AM

Climate change is altering our future, affecting the magnitude and distribution of a wide-range of climate-sensitive health outcomes, and affecting the functioning of healthcare facilities worldwide. Preparing for and managing these risks will affect environmental health as a field and practice. A systems-based, all hazards approach is needed that considers what sets of interventions and recovery resources will be needed at the scale of individuals, communities, and nations, over short and longer temporal scales. Environmental health policies and programs will need to evolve as exposures continue to change, incorporating plans for managing hazards that could overwhelm functional capacities.
Low-tech mining of materials critically needed for high-tech applications: impacts on air, water, places and ... people

Nemery B

1 KU Leuven

Keynote Lectures Tuesday, Beatrix theater, August 27, 2019, 9:00 AM - 10:00 AM

Modern technology requires various critical commodities, such as cobalt or tantalum, which are abundant in the subsoil of various areas in the Democratic Republic of Congo. Their extraction (often by artisanal mining) and further processing are associated, in many places, with considerable air, water and soil contamination. This lecture will summarize collaborative epidemiological studies conducted in DR Congo, first, to assess the degree and main routes of metal exposure among the general population and mineworkers and, then, to evaluate possible adverse health effects of this pollution, especially among children.
Tuesday August 27, 10:30 AM – 12:00 PM

S02: Harmonizing insights from intervention studies, contextual information and resource availability to develop policy advocacy for clean cooking and domestic fuel adoption in Africa

Adoption of Clean Cook stoves in Rural Ghana

Prah R¹, Carrion D², Tawiah T¹, Agbokey F¹, Oppong F¹, Gyaase S¹, Agyei O¹, Twumasi M¹, Asante K¹, Jack D², Ae- Ngibise K³

¹Kintampo Health Research Centre, ²Mailman School of Public Health, Columbia University, ³University of Newcastle

Background/Aim: Clean cook-stoves reduce exposure to household air pollution and associated health problems, conserve firewood, and save time from firewood gathering and cooking. Despite these benefits, adoption of these stoves is low in many countries. The aim of the study is to help determine the best way to promote the adoption and sustained use of clean cook-stoves in rural Ghana.

Methods: Participants for this study were sampled from the Ghana Randomized Air Pollution and Health Study (GRAPHS), which provided participants with BioLite (an improved biomass cook stove) and Liquefied Petroleum Gas (LPG) cook-stoves. Qualitative interviews were conducted to identify the motivators and barriers to the adoption of clean cook-stoves. Quantitatively, stove use and time use surveys were conducted. Behavioral change and LPG delivery models were also implemented to improve adoption of clean cook-stoves in the study area.

Results: Participants in the qualitative survey reported that the clean cook-stoves cook faster, emit no or very little smoke, improve their health and promote harmony in the home. Cost was the main barrier to the adoption of clean cook-stove especially the LPG stoves. LPG participants spent about 19 minutes less time gathering firewood compared to users of the traditional three-stone cook-stoves and about 15 minutes less time compared to users of the Biolite cook-stove. This was significant at a p-value of 0.002. Cooking time per cooking episode was lesser for LPG users compared to the other stove users.

Conclusion: Understanding the motivators and barriers to clean cook-stove usage could help promote usage of these stoves. LPG were well liked, and save household time for gathering firewood and also time per cooking episode. Cost remains a critical barrier.
Can transition to a cleaner fuel from Kerosene or firewood be beneficial in pregnant Nigerian women?

Olopade C1, Karrison T1, Alexander D3, Ibigbami T4, Olamijulo J4, Ojengbede O5

1University of Chicago, 2University of Chicago, 3Global Alliance for Clean Cookstoves, 4Healthy Life for All Foundation, 5Healthy Life for All Foundation, 6University of Ibadan

.S02: Harmonizing insights from intervention studies, contextual information and resource availability to develop policy advocacy for clean cooking and domestic fuel adoption in Africa, Room 417, Floor 4, August 27, 2019, 10:30 - 12:00

Background/Aim: Exposure to household air pollution from cooking with solid fuel accounts for 3 million premature deaths yearly and has been linked to adverse pregnancy outcomes. In Nigeria, 70% of households cook with kerosene or firewood. A randomized controlled trial was undertaken in Ibadan, Nigeria to determine the impact of cooking with kerosene or firewood on personal exposures, the health of pregnant women and pregnancy outcomes.

Methods: Three hundred twenty four pregnant women were randomized to either control (C-continued cooking using own kerosene/firewood stove; or intervention groups (E-received CleanCook stove). Ultrasonography and blood pressure measurements were performed at six visits during pregnancy. 72-hour personal exposure monitoring of particulate matter with diameter less than 2.5 micrometers (PM2.5) was performed in the second and third trimester. Birth outcomes (miscarriages, pre-term deliveries and birth weights) were recorded. Placenta was collected at birth and analyzed for chronic hypoxia and biomarker levels of hypoxia inducing factor.

Results: Of the enrolled participants, 18 dropped out of the study (8 E, 10 C). Mean birthweight for the ethanol and control groups was 3076.2 and 2988.0g, respectively; the difference, 88.2g (95% confidence interval: -18.0g to 194.5g), was not statistically significant (p=0.103). However, after adjusting for marital status and BMI, the difference reached statistical significance (p=0.020). Average gestational age at delivery was significantly (p=0.015) higher in ethanol group (39.2 weeks) compared to controls (38.2 weeks). There were fewer preterm infants (<37 weeks), stillbirths, miscarriages, and neonatal deaths in the ethanol group compared to controls. The percentage of miscarriages, stillbirths, or neonatal deaths was twice as high in controls compared to the ethanol group (9.9% vs. 4.6%; p=0.037). The likelihood of developing hypertension at term and diastolic BP was significantly lower in the ethanol group.

Conclusions: Replacing kerosene and firewood with ethanol in pregnant Nigerian women improved pregnancy outcomes.
Evaluating sustainable cooking fuels for refugee populations in Ethiopia

Benka-Coker M¹, Tadele W², Getaneh D³, Munangagwa C², Stokes H²
¹Gettysburg College, ²Project Gaia, Inc., ³Gaia Association

.S02: Harmonizing insights from intervention studies, contextual information and resource availability to develop policy advocacy for clean cooking and domestic fuel adoption in Africa, Room 417, Floor 4, August 27, 2019, 10:30 - 12:00

Energy is an essential component of humanitarian action for refugee and internally displaced populations. Many refugee populations are located in remote, resource-stressed areas, and humanitarian agencies may often find themselves providing energy solutions which are both costly and unsustainable—or not providing any intervention at all. The adoption of energy strategies for displaced populations that are clean, affordable and sustainable is of critical importance now more than ever. Project Gaia, Inc., with its Ethiopian collaborator, Gaia Association, have a goal of enabling local commercial and humanitarian actors to establish sustainable cooking solutions for displaced populations that are rooted in the local context. In 2018, Project Gaia was awarded a Humanitarian Clean Cooking Fund (HCCF) grant by the Clean Cooking Alliance to implement a commercialization program in the Assosa refugee camps of Ethiopia in conjunction with a UN High Commissioner for Refugees-driven cash voucher system that enables refugees to purchase stoves and fuels from locally operated refugee business associations. Gaia Association has helped set up these associations and has provided ethanol and briquette stoves and fuel, reaching more than 4,000 households. In this skills-based model, refugees are incorporated into the value chain and work on assembling stoves, procuring and managing fuel, selling stoves and fuel, tracking carbon, conducting financial accounting, and providing aftermarket support. In this talk we will highlight the importance of considering energy as a priority in humanitarian settings and provide updates on the implementation of the commercialization and cash voucher programs in the Assosa camps. We will discuss how our work, and that of our colleagues in the session, can inform energy policy and choices that promote clean fuels and the goal of sustainability. We will emphasize the need for additional research on energy-related issues in humanitarian contexts, especially as refugee populations continue to grow, as seems likely.
Clean Energy Access for the Prevention of Non-Communicable Disease in Africa: the NIHR CLEAN-Air (Africa) Global Health Research Group

Puzzolo E1,2, Menya D3, Asante K4, MBatchou B5, Quansah R6, Anderson de Cuevas R1, Stanistreet D7, Ronzi S1, Pope D1

1University of Liverpool, 2Global LPG Partnership, 3Moi University, 4Kintampo Health Research Centre, 5Douala General Hospital, 6University of Ghana, 7Royal College of Surgeons in Ireland

S02: Harmonizing insights from intervention studies, contextual information and resource availability to develop policy advocacy for clean cooking and domestic fuel adoption in Africa, Room 417, Floor 4, August 27, 2019, 10:30 - 12:00

Background: In Sub-Saharan Africa, most cooking is undertaken using biomass fuels, posing significant health and environmental risks and inhibiting economic development, especially for biomass collectors unable to participate in the cash economy. In 2016, exposure to household air pollution (HAP) associated with solid fuel use resulted in an estimated 520,000 premature deaths (7% of total) in the region. Biomass burning also contributes to climate change, deforestation and perpetuating the poverty cycle particularly for women and children who share the majority of domestic responsibilities. Switching to clean burning fuels is recommended by the World Health Organization to reduce exposure to HAP and tackle climate change.

Aims: Identify policy and intervention strategies to support more equitable and large-scale uptake of clean fuels across the population to inform national policy; estimate the health and climate impacts of scaled clean fuel adoption in line with government targets; develop capacity through health systems strengthening; facilitate public-policy exchange as research is undertaken alongside national policy implementation.

Methods: The CLEAN-AIR(Africa) Global Health Research Group funded by the UK National Institute for Health Research is working directly with Cameroon, Ghana and Kenya government ministries who have made ambitious commitments to scale-up population access to Liquefied Petroleum gas (LPG) for the majority. Survey, quasi-experimental, ethnographic and qualitative methodologies will evaluate the anticipated reduction in personal exposures to HAP, explore factors influencing fuel stacking and clean fuel uptake and evaluate interventions that could facilitate more equitable adoption and sustained use of clean fuel (e.g. microfinance, pay-as-you cook).

Anticipated outcomes: Through a multi-disciplinary program of research, capacity building and public, policy and stakeholder engagement, CLEAN-AIR(Africa) will work across health, energy and education sectors to deliver (i) impactful policy-relevant research, and (ii) develop bespoke training modules for health practitioners on the health impacts of HAP and prevention strategies to protect vulnerable groups.
Prioritizing population health and cultural sensitivities in energy development programs in Nigeria

Mustapha A¹

¹Nigerian Institute For Medical Research/Imperial College London

.S02: Harmonizing insights from intervention studies, contextual information and resource availability to develop policy advocacy for clean cooking and domestic fuel adoption in Africa, Room 417, Floor 4, August 27, 2019, 10:30 - 12:00

Nigeria is the most populated country in Africa, with over 180 million people. Energy poverty in Nigeria is widespread. The installed capacity of grid electricity is about 6000MW, of which about 67% is thermal (fossil -gas) and the balance is from hydropower. Only about 40% of the country has access to the national grid and those connected to the grid have electricity less than 60% of the time. Energy production in rural areas is mainly from the burning of fuelwoods. More than 74% of households rely on fuelwood or charcoal for cooking, about 25% rely on kerosene; clean fuel penetration is less than 1%. Kerosene stoves and lamps are often poorly maintained and release toxic fumes. Air pollution is especially bad, both in ambient and indoor environments. Indoor air pollution is estimated to cause about 90,000 deaths annually representing about 4% of national disease burden. There are several efficient cookstove programs in the country but none have achieved adequate adoption or coverage of the entire country.

Nigeria is the seventh largest producer of natural gas in the world. The country produces 22 million tonnes per annum of Liquified Natural Gas (LNG) that are shipped to Europe, USA, Far East, Middle East and South America. Nigerian LNG company commitment since 2007 to deliver up to 250,000 tonnes of LPG for domestic use has led to about 50% reduction in the end-user price of LPG. The country is said to emit approximately one-third of the global amount of greenhouse gases from deliberate gas flaring during oil production. This talk will discuss energy access and adoption of clean domestic fuel in Nigeria. It will highlight the imperatives to scale up clean fuel adoption in a culturally acceptable manner and the government drive to harness renewable energy potentials to increase energy security.
S06: Lead’s long-term legacy: what past exposures can tell us about future disease
Present, Past and Future of Lead Pollution Through the World’s Highest-Resolution Atmospheric Record from the European Alps and Historical Testimonies
More A1,2, Spaulding N2, Clifford H2, Handley M2, Kurbatov A2, Korotkikh E2, Loveluck C3, Sneed S2, McCormick M1, Mayewski P2
1Harvard University, Initiative for the Science of the Human Past, Department of History, 2Climate Change Institute, University of Maine, 3Department of Classics and Archaeology, University of Nottingham

Recent literature in public health and toxicology has shown that even extremely low-level exposure to pollutants such as lead (Pb) significantly increases mortality. Current government standards are often based on the assumption that pre-industrial levels of pollution are safe, merely because they occurred before the onset of widespread industrialization. As multiple studies have now shown conclusively, this line of argument is flawed.

Our ultra-high-resolution glaciochemical records from the heart of western Europe in combination with tens of thousands of historical records have allowed us to address the question of what constitutes true natural levels of pollution, and how they compare to post-industrial and current levels which are at least 3 orders of magnitude higher.

We have focused in particular on lead (Pb), presenting the most highly resolved record for the past 2000 years, in combination with highly detailed historical records, indicating that lead pollution plummeted to natural levels only once in the last millennium due to a collapse (ca. 50%) of the European population, as a result of greatest pandemic ever to ravage Eurasia.

Our ultra-high-resolution glaciochemical records obtained through Laser Ablation ICP-MS—applied for the first time to an ice core—have shown that economic, political and epidemiological events have a much deeper impact on anthropogenic pollution than previously hypothesized. In turn, this new data adds further urgency to the need to reduce ongoing lead emissions.

Carefully matching historical data with scientific records has provided a new perspective of what constitute true, natural levels of pollution, how they compare with current standards, and how long we have lived in a “leaded society.”
The long-term implications of childhood lead exposure: Evidence from midlife follow-ups in the New Zealand Dunedin Cohort.

Reuben A\textsuperscript{1}, Schaefer J\textsuperscript{1}, Broadbent J\textsuperscript{3}, Poulton R\textsuperscript{3}, Caspi A\textsuperscript{1,2}, Moffitt T\textsuperscript{1,2}, \textbf{Lanphear B}\textsuperscript{4}

\textsuperscript{1}Duke University, \textsuperscript{2}King’s College London, \textsuperscript{3}University of Otago, \textsuperscript{4}Simon Fraser University

S06: Lead’s long-term legacy: what past exposures can tell us about future disease, Room 315, Floor 3, August 27, 2019, 10:30 - 12:00

Millions of adults now entering midlife and old age were exposed to high levels of lead, a developmental neurotoxin, as children. While childhood lead exposure has been linked to disrupted cognitive and behavioral development, the long-term consequences remain poorly characterized. This talk presents recent findings from a series of follow-up studies conducted within a group of lead-tested children from the population-representative 1972-73 New Zealand birth cohort, the Dunedin Study – a cohort where the extent of lead exposure was unrelated to family socioeconomic status. These follow-up studies, which have examined cognitive, socioeconomic, and psychiatric outcomes, collectively represent the longest, largest, and most comprehensive attempts yet to identify the long-term consequences of childhood lead exposures from the era of peak lead-in-gasoline use (the mid-1970s). Study members exposed to modest levels of lead as children were found to suffer from a number of deficits relative to their less-exposed peers, including dismissed cognitive ability, disadvantageous personalities, greater rates of mental illness, and lowered socioeconomic outcomes. Implications for social equity, public policy, clinical practice, future research, and looming public health concerns will be discussed.
Toxic Chemicals and the Mysterious Decline in Coronary Heart Disease

Lanphear B1
2Simon Fraser University

.S06: Lead’s long-term legacy: what past exposures can tell us about future disease, Room 315, Floor 3, August 27, 2019, 10:30 - 12:00

In the fall of 1978, physicians and scientists from across the world gathered in Bethesda, Maryland to solve a mystery: why had the death rate for coronary heart disease (CHD) suddenly plummeted? The attendees of the Decline Conference conveniently concluded that individual preventive measures and specialized medical care contributed equally to the decline. Clearly, however, nobody really knew why coronary deaths had plummeted. This presentation will focus on three distinct periods to explore the role of lead and other toxic chemicals in the decline: the initial decline in deaths from the peak of the epidemic in 1968 to 1978; the precipitous decline in hypertension during the 1980s; and the ongoing decline in hypertension and coronary heart disease from the 1990s onward. Building on data from the United States, Britain and the Netherlands, we will investigate the mysterious decline in CHD deaths, the relative contribution of medical care and population strategies to the decline, and the rise of CHD deaths in industrializing countries. This investigation, which weaves a narrative based on historical and epidemiologic studies, will help to solve two other scientific puzzles about CHD, elevate the role of toxic chemicals as risk factors in the CHD epidemic and accelerate the elimination of this preventable disease.
Exposure to lead causes dementia – or does it?

Weuve J

1Boston University School Of Public Health

.S06: Lead’s long-term legacy: what past exposures can tell us about future disease, Room 315, Floor 3, August 27, 2019, 10:30 - 12:00

With the assistance of humans, lead has insinuated itself into human bodies for centuries, wreaking havoc on humans’ vascular systems, blood, kidneys, moods, and developing brains. As human lifespans have stretched into seven and eight decades, the question has arisen as to whether lead might affect the risk of conditions of older age, particularly dementia. Dementia is extraordinarily common with advancing age, affecting 1 in 10 adults ages 65 years and older and nearly a third of adults 85 and older. More than other conditions of older age, dementia is condition that many people would like to avoid developing. Lead is a suspect in the etiology of dementia owing to its potent neurotoxicity and cardiovascular toxicity, as well as its capacity to linger in the body for decades. Over the past few decades, lead exposures have plummeted to historically low levels, due largely to a near complete ban of leaded fuel and paint. Even so, historic exposures may yet reverberate into the future of the dementia epidemic: nearly 90% of U.S. children in 1976 had blood lead levels exceeding 10 microg/dL, and many people who were born as late as the 1990s may have incurred childhood exposures that could influence their dementia risks later in life.

High-quality studies that directly address this important public health question about lead’s effect on dementia risk are essentially absent. Studies with high-quality assessments of cumulative lead exposure rarely also entail high-quality assessments of dementia, and vice versa. Yet abundant indirect mechanistic and epidemiologic evidence supports a role of lead in dementia etiology. I will trace that line of evidence, which includes studies of well-characterized lead exposure and preclinical outcomes. I will also characterize the key challenges in conducting this research, including differential misclassification and selection bias, and how future research might overcome them.
S07: Of moderators and mediators: Complex relationships between greenness, air pollution, noise, and health behaviors in driving health outcomes

Evidence from the Canadian Census Health and Environment Cohort. On greenness moderating the association between exposure to air pollution and risk of mortality

Crouse D¹, Pinault L², Balram A³, Brauer M³, Burnett R⁴, Martin R⁵, van Donkelaar A⁵, Villeneuve P⁶, Weichenthal S⁷

¹University of New Brunswick, ²Statistics Canada, ³University of British Columbia, ⁴Health Canada, ⁵Dalhousie University, ⁶Carleton University, ⁷McGill University

Background: Studies have consistently demonstrated that exposure to fine particulate matter (PM2.5) is associated with increased risks of mortality. To a lesser extent, a series of studies suggest that living in greener areas is associated with reduced risks of mortality. Few studies have examined the interplay between PM2.5, greenness, and mortality.

Methods: We investigated the role of residential greenness in modifying associations between PM2.5 and non-accidental and cardiovascular mortality in a national cohort of Canadian adults (i.e., the 2001 Canadian Census Health and Environment Cohort). Specifically, we examined associations between satellite-derived estimates of PM2.5 exposure and mortality across quintiles of greenness measured within 500 m of individuals' place of residence during 11 years of follow-up. We adjusted our survival models for many personal and contextual measures of socioeconomic position; residential mobility data allowed us to characterize annual changes in exposures.

Results: Our cohort included approximately 2.4 million individuals at baseline, 194,270 of whom died during follow-up. Adjustment for greenness attenuated the association between PM2.5 and mortality (e.g., HRs and 95% CIs per interquartile range increase in PM2.5 in models for non-accidental mortality decreased from 1.065 (95% CI: 1.056-1.075) to 1.041 (95% CI: 1.031-1.050)). The strength of associations between PM2.5 and mortality decreased as greenness increased. This pattern persisted in models restricted to urban residents, in models that considered the combined oxidant capacity of ozone and nitrogen dioxide, and within neighbourhoods characterised by high or low deprivation. We found no increased risk of mortality associated with PM2.5 among those living in the greenest areas.

Conclusions: Our findings suggest that residential greenness modifies the association between exposure to PM2.5 and mortality. The magnitude of association between PM2.5 and mortality was attenuated in greener areas, and studies that do not account for greenness may overstate the air pollution impacts on mortality.
Physical Activity, Air Pollution, and Social Integration as mediators of Exposure to Greenness and Cognitive Decline

Pescador Jimenez M\textsuperscript{1}, James P\textsuperscript{2}
\textsuperscript{1}Department of Epidemiology, Harvard T.H. Chan School Of Public Health, \textsuperscript{2}Department of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute

\textsuperscript{S07}: Of moderators and mediators: Complex relationships between greenness, air pollution, noise, and health behaviors in driving health outcomes, Beatrix theater, August 27, 2019, 10:30 - 12:00

Background—Recent evidence suggests that higher levels of residential greenness may contribute to better overall health. Despite this, few studies have considered the relationship between greenness exposure and cognitive decline, and the mediating role that physical activity, air pollution, and social integration might play in this relationship.

Aim—We aimed to quantify the extent to which physical activity, air pollution, and social integration contribute to the explanation of the association between residential greenness and cognitive decline.

Methods—Using data from the US based Nurses’ Health Study, we used linear regression and a mediation approach to estimate the association between residential greenness and cognitive decline. We defined greenness surrounding each participant’s address using satellite imagery [Normalized Difference Vegetation Index (NDVI)]. We followed 16,144 women with repeated measures of cognitive decline from 1995-2001.

Results—Results will demonstrate relationships between residential greenness and cognitive decline. We will also examine whether physical activity, social integration, or air pollution mediate this relationship. This study will provide information on whether greenness plays a role in slowing cognitive decline, and whether this relationship is mediated by physical activity and social integration.

Conclusions—Higher exposure to natural environments may be related to lower rates of cognitive decline, which may be driven primarily through increased physical activity and social integration among those in greener areas.
Greenness, Obesity and Incident Breast Cancer: Evidence from the Canadian National Breast Screening Study

Villeneuve P1, Mansouri R1, Crouse D2, To T3,4, Wall C4, Miller A4
1Department of Health Sciences, Carleton University, 2University of New Brunswick, 3Hospital for Sick Children, 4Dalla Lana School of Public Health, University of Toronto

S07: Of moderators and mediators: Complex relationships between greenness, air pollution, noise, and health behaviors in driving health outcomes, Beatrix theater, August 27, 2019, 10:30 - 12:00

Background: Breast cancer is the most commonly diagnosed cancer among Canadian women. Environmental exposures, including air pollution, have been associated with an increased risk of breast cancer. More recently, findings from a multi-centre case-control study in Spain, and the US Nurses Health Study suggest that proximity to greenness may reduce the risk of breast cancer. Both publications highlight the need to better understand the pathways involved.

Methods: To address this gap, we investigated associations between residential greenness, obesity and the incidence of breast cancer among 89,247 participants of the Canadian National Breast Screening Study. The original aim of this randomized controlled trial was to investigate whether mammography screening reduced the mortality of breast cancer. Enrollments occurred between 1980 and 1985, and record linkage to national cancer incidence identified approximately 6500 cases of breast cancer through 2005. Estimates of the Normalized Difference Vegetation Index (NDVI) within a 500 m buffer and ambient PM2.5 were linked to the participants' place at residence at enrollment. Baseline surveys were used to collect information on risk factors for breast cancer, and measured height and weight were obtained used to derive body mass index (BMI). Cox proportional hazards models using attained age as the time scale were fit to provide estimates of the hazard ratios associated with the NDVI and BMI.

Findings: Ambient PM2.5 and the NDVI were inversely associated with each other (r= - 0.14). An interquartile range increase in the NDVI was associated with a 4% reduction in the risk of breast cancer (hazard ratio(HR)=0.96, 95% CI=0.92 – 0.99). Analyses of variance indicated that those who were obese (BMI>30) lived in areas with a lower mean NDVI (p<0.05).

Conclusions: Our findings provide further support for the hypothesis that proximity to greenness may reduce the risk of breast cancer independently of air pollution, or obesity.
Green space exposure and childhood health – a question of moderation or mediation?
Sbihi H[String_1], Jarvis I[String_1], van den Bosch M[String_1]

1The University of British Columbia

Background. An increasing number of studies indicate that exposure to urban greenspace has various positive health effects, including improved birth outcomes and childhood development. Different pathways are suggested for the positive health effects, including regulating ecosystem services, such as reduction of air pollution and noise.

Methods. Using a small sub-set of our study population in the metropolitan area of Vancouver, Canada, we assessed multiple spatially co-varying environmental exposures during pregnancy up to birth. To analyse whether any positive effect of greenspace exposure on birthweight could be mediated by various pathways of influence, we used structural equation modelling where air pollution, noise, and blue spaces were entered as a latent variable. Two different metrics for assessing greenspace exposure were examined – the Normalised Difference Vegetation Index (NDVI), based on remote sensing images of 250m resolution (MODIS), and a segmented index developed from Google Street View (GSV), indicating different types of vegetation, such as trees, grass, and flowers. Air pollution was derived from land use regression models of NO2 and noise was assessed from existing predictive models. Blue space was derived from GSV as the sum of the proportion of images reflecting lakes, rivers, waterfalls, and sea. Premature births were excluded and all models were adjusted for gestational age.

Results. We found no direct effect of green space when using the average value of the GSV-index, but in the models using NDVI we found a small direct effect (total effect estimate=0.061, SE=0.033) and a non-significant indirect effect (p=0.070).

Conclusions. Our results suggest that any positive effect on birth weight of green space exposure may be due to a moderation of harmful exposures, rather than a mediation effect. Future studies should include larger sample sizes as well as area-level social indicators. Further analysis of different effects depending on greenspace metric is also warranted.
On traffic-related air pollution and noise, mediating associations between urban design (including greenness) and mental health. Evidence from the Barcelona Health Survey

Zijlema W1, Dadvand P1, Bartoll X2, Cirach M1, Borrell C2, Nieuwenhuijsen M1

1Barcelona Institute for Global Health (ISGlobal), 2Agència de Salut Pública de Barcelona

S07: Of moderators and mediators: Complex relationships between greenness, air pollution, noise, and health behaviors in driving health outcomes, Beatrix theater, August 27, 2019, 10:30 - 12:00

Background/Aim
The urban built environment and environmental exposures such as road traffic noise and ambient air pollution could affect mental health, but it’s unclear how these factors interact. We aim to study these factors simultaneously to holistically evaluate the impact on mental health.

Methods
This cross-sectional study is based on a population-based sample of 3362 individuals aged 15-97 years residing in Barcelona, Spain that participated in the Barcelona Health Survey 2016. A face-to-face interview was carried out by trained interviewers at the respondent’s residence. We characterized the built environment (e.g. population density, facility richness, greenness), road traffic noise, and ambient air pollution at the residential level using a geographical information system (GIS). Mental health was assessed with the 12-item General Health Questionnaire.

Results
Characteristics of the built environment, road traffic noise and air pollution were low-to-moderately correlated with each other. Adjusted mixed effects regression showed that higher facility richness was associated with a higher likelihood of poor mental health (odds ratio 1.01; 95%CI 1.00, 1.03), while residing in areas with higher slopes was associated with lower a likelihood of poor mental health (per interquartile range, OR 0.88; 0.81, 0.95). Odds ratios for greenness and poor mental health were <1 but were not statistically significant. Noise and air pollution indicators appeared to be associated with poor mental health, but this was only statistically significant for coarse particulate matter (per iqr, OR 1.27; 1.07, 1.51).

Conclusion
Characteristics of the built environment and air pollution were associated with poor mental health. Further factor and mediation analysis will be carried out to shed light on interrelations between these factors and pathways to poor mental health.
Background: Proximity to green spaces has been shown to be beneficial to several cardiovascular outcomes in urban spaces. Few studies have analyzed the relation of green spaces and land cover uses in the megacities of the developing world, where disordered urbanization and air pollution impose several health hazards. This study used a subgroup of the dataset of The Brazilian Longitudinal Study of Adult Health ELSA-BRASIL (n= 3418) to correlate the medical diagnosis of hypertension to green spaces in the megacity of Sao Paulo.

Methods: For each participant, we assessed demographic data and cardiovascular risk factors (smoking habits, body mass index, diabetes, dyslipidemia, excessive drinking, salt consumption and level of physical activity). In the ELSA-BRASIL, hypertension was defined as a systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg or reported use of medication to treat high blood pressure. Land cover classification was performed using the Random Forest Algorithm (program QGIS2.18.11; Plugin Dtezaka) using an orthophoto with a spatial resolution of 2 m on the pixel side. Using the program QGIS2.18.11, three different indicators of exposure to green spaces were used: land cover, street tree numbers and number of parks within 1 km. Results: The number of street trees in the regional governments (OR = 0.937; p = 0.038; CI (95%): 0.881 to 0.996) and number of parks within 1 km (OR = 0.876; p = 0.047; CI (95%): 0.769 to 0.998) were inversely associated with the diagnosis of hypertension. Sixty-three percent of the population had no parks within 1 km of their residence. Street trees are able to decrease the hypertension diagnosis while others land covers such as grass, green spaces, treetops and roofs are not.

Conclusions: Street trees improve cardiovascular health. Our data encourage large-scale tree planting in megacities to mitigate the effects of disordered urbanization.
As part of my doctoral research, I have viewed 35,588 time-lapse images taken by a wearable camera worn by electronic-waste (e-waste) recovery workers at an informal worksite in Ghana. Each consecutive image captures an instant of life on the job. The images were collected as an alternative to standard pen and paper time-activity diaries. Despite the effort to process the images, they proved to be a highly precise and transparent source of time-activity data. When combined with contemporaneous and continuous measures of personal exposure to size-specific particulate matter (PM), they allowed us to describe associations between specific job tasks and personal PM exposure. We observed several predicted associations, but it is the unpredicted patterns captured by images that I want to share in this presentation.

For example, our study is comprised of 100 male e-waste workers, however, it was the colorfully dressed women on the worksite that kept catching my eye. Not only were they on-site selling food and water, but they were most commonly standing near the male workers while they burned e-waste in open, surface fires. Among all the jobs captured in our data, burning e-waste is associated with the highest overall levels of PM2.5 exposure (Geometric Mean: 90 µg/m3). Why was this vulnerable population lingering near the men putting e-waste in and out of the fire and why were they not included in our study? One image captured a woman pouring water on copper wires that had recently been pulled from the fire. In low-and-middle-income countries, there are more women in informal employment than men. This presentation is, most importantly, to honor these female workers who are not invisible.

Note: The images to be used in this Pechakucha presentation were collected with the permission of all study participants. No images with identifiable visual information will be used.
Resilient public health in the context of large-scale, drought-related migration in East Africa: Knowledge status and knowledge needs

Schumann B\textsuperscript{1}, Lindvall K\textsuperscript{1}, Kinsman J\textsuperscript{1}

\textsuperscript{1}Umeå University

GREEN, AIR, LMIC: PECHAKUCHA COMES TO ISEE!, Johan Friso Foyer, Floor 1, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim
Millions of people are at risk of famine in East Africa, due to droughts and environmental degradation. Driven by climate change and political instability, people are forced to migrate in order to survive. This places a severe burden on public health systems. Our project aimed at identifying knowledge status and needs regarding climatic and environmental changes, their impacts on migration and, subsequently, public health in Ethiopia, Somalia and Kenya.

Methods
In 2018, we synthesised documentary evidence from international and national sources, and conducted interviews with 39 stakeholders from the three countries, recruited by eight in-country colleagues, and representing different organisations and academic fields. Preliminary findings were discussed and validated at a stakeholder workshop in Nairobi. The three final country reports included recommendations for building climate-resilient health services in East Africa.

Results
In East Africa, droughts and floods are becoming more prolonged and widespread. Climate change, overpopulation and land degradation threaten the livelihoods of farmers and pastoralists, and lead to large-scale displacement. Refugee camps in Kenya and Ethiopia accommodate up to several hundred thousand cross-border migrants, while several million internally displaced people (IDPs) settle informally in urban areas, particularly in Somalia.

Knowledge gaps exist in particular regarding the health status and needs of IDPs, while there is better coverage for cross-border migrants. Migrants’ mental health needs are reportedly enormous, but these are poorly understood and scarcely addressed. There is also an ongoing urgency to engage affected communities in needs assessments, and to conduct high quality evaluations of health interventions targeting IDPs and cross-border migrants who have been displaced long-term by droughts.

Conclusions
IDPs, pastoralists and ethnic minorities appear to be the most vulnerable groups. Cross-border and cross-sectoral collaboration is necessary to build resilient public health systems to serve migrants displaced by droughts and floods in East Africa.
Living close to livestock farms has been associated with increased symptoms in patients with chronic obstructive pulmonary disease (COPD). The causes of these effects are still poorly understood. This panel study attempts to assess the acute effects of livestock related air pollution in patients with COPD living in an area with intensive livestock farming in the Netherlands.

Between February 2015 and July 2016, 82 patients took spirometry measurements twice daily during a 3-month period, resulting in 12,672 FEV1 and PEF records. Patients also kept a diary on respiratory symptoms as well as livestock related odor annoyance. Daily average ammonia (NH3) (a proxy for livestock-related air pollution) and fine particulate matter (PM10) levels were collected from monitoring stations in the area. Lung function was analyzed as decrements of >10% and >20% from their median as well as absolute values. Self-reported odor annoyance was analyzed as a dichotomous variable. All analyses were done using generalized estimated equations. We adjusted for age, gender, height, humidity, temperature, linear trend, and took multiple testing into account.

We found an odds ratio of 1.14 95%CI [1.05;1.25] for decrements >20% in morning FEV1 per interquartile range (12µg/m3) increase in NH3 concentration (lag 2). Odor annoyance was negatively associated with evening PEF (-4.46 l/min 95%CI [-7.59; -1.33]). Sensitivity analyses comparing these associations between participants with different COPD definitions yielded no significant differences. No associations with symptoms were found.

Our results show acute effects of livestock related air pollution on lung function in COPD patients living in close proximity to farms.
Development of compensation strategies for control participants in an environmental trial with an intervention of significant value: experience from the Household Air Pollution Intervention Network (HAPIN) multi-country trial

Quinn A1, Williams K2, Thompson L3, Rosa G4, Díaz Artiga A5, Thangavel G6, Balakrishnan K6, Miranda J7, Rosenthal J1, Clasen T8, Harvey S9

1Fogarty International Center, National Institutes of Health, USA, 2Johns Hopkins University School of Medicine, Division of Pulmonary and Critical Care Medicine, 3Nell Hodgson Woodruff School of Nursing, Emory University, 4Department of Disease Control, Faculty of Infectious and Tropical Diseases, London School of Hygiene & Tropical Medicine, 5Centro de Estudios en Salud, Universidad del Valle de Guatemala, 6Department of Environmental Health Engineering, Sri Ramachandra Institute of Higher Education and Research, 7Centonias Center of Excellence in Chronic Diseases, and School of Medicine, Universidad Peruana Cayetano Heredia, 8Rollins School of Public Health, Emory University, 9Johns Hopkins Bloomberg School of Public Health, Department of International Health, Social and Behavioral Interventions Program

Background: The Household Air Pollution Intervention Network (HAPIN) trial is a randomized controlled trial to assess the health impact of providing a clean cooking intervention to households using solid cooking fuel in Guatemala, India, Peru, and Rwanda. The intervention — a liquefied petroleum gas (LPG) stove and 18 months of free LPG — has significant value in these communities, where it is seen as aspirational, yet unaffordable. Although control households in randomized trials often receive the intervention at the trial conclusion, in HAPIN this was logistically unfeasible. It was therefore necessary to develop a tailored compensation strategy for control households that would be comparable across four distinct settings.

Methods: Investigators generated a set of underlying ethical principles to guide development of compensation packages. Field staff conducted interviews, surveys, and focus groups to obtain input on appropriate compensation for control participants in each setting. This feedback was compared across the four sites and evaluated against initial underlying principles.

Results: In Guatemala, control compensation consists of coupons equivalent to the LPG stove value that can be redeemed for the participant’s choice of household items, which could include an LPG stove. In Peru, control households receive several small items during the trial plus the intervention stove and one month of fuel at the conclusion. Rwandan participants are given small items during the trial and a choice of a solar kit, LPG stove, or cash equivalent at the end. India is the only setting in which control participants receive the intervention (stove and 18 months of fuel) at the trial’s end, in accordance with local ethics committee requirements.

Conclusions: Applying common principles that are adaptable to different settings can generate ethical and contextually appropriate compensation packages in trials with highly valued interventions. The approach presented here could inform future randomized trials in multi-country settings.
Health impact of Asian dust and protective effect of masks

Onishi K1, Nojima M2, Umemura T3, Maki T4, Kurozawa Y5

1Graduate School Of Public Health, St. Luke’s International University, 2Center for Translational Research, The Institute of Medical Science Hospital, The University of Tokyo, 3Department of Health and Psychosocial Medicine, Aichi Medical University School of Medicine, 4College of Science and Engineering, Kanazawa University, 5Division of Health Administration and Promotion, Department of Social Medicine, Faculty of Medicine, Tottori University

Background/Aim: The health effects of Asian dust (AD) originating from drylands, such as the Gobi Desert and Taklamakan Desert, have been a concern in Asia. To overcome the mineral dust phenomenon and global issue of air pollution, wearing masks is recommended. However, the protective effect of wearing masks are unclear. We assessed the health impact of AD and protective effect of masks.

Methods: We administered diary-style web-based questionnaires to 104 volunteers who lived in Yonago City in Japan between 2013 and 2015. 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 AD were assessed using a linear mixed model. We used light detection and ranging observations as AD indicators. Data regarding climate (temperature, humidity, and atmospheric pressure) and environmental factors (e.g., NO2, SO2, Ox) were used as covariates. Regarding symptom prevention measures, we measured particle leakage rates of participants’ masks.

Results: The differences in scores of nasal symptoms (sneezing and blockage) on the AD and non-AD days were 0.054 (95% confidence interval (CI): 0.03–0.08, p < 0.001) and 0.053 (95% CI: 0.02–0.08, p < 0.001), respectively. A strong association was also observed for cough and throat-related symptoms. The relationship between symptoms and AD 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 AD 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.
Residential proximity to major roads and neighbourhood green space in relation to biological stress in the second trimester of pregnancy in the IPANEMA cohort

Verheyen V1,2, Van den Eeden L3,4, Lambrechts N1, Remy S1,6, Govarts E1,2, Nielsen F7, Verachtert E1, Colles A1, Jacquemyn Y3,5, Schoeters G1,2,7

1Flemish Institute For Technological Research, 2Department of Biomedical Sciences, University of Antwerp, 3Faculty of Medicine, University of Antwerp, 4People and Health, Thomas More University College, 5Department of Obstetrics and Gynaecology, Antwerp University Hospital, 6Department of Epidemiology and Social Medicine, University of Antwerp, 7Institute of Public Health, Department of Environmental Medicine, University of Southern Denmark

GREEN, AIR, LMIC: PECHAKUCHA COMES TO ISEE!, Johan Friso Foyer, Floor 1, August 27, 2019, 10:30 AM - 12:00 PM

Background/aim: Living near a major road during pregnancy has been associated with adverse birth outcomes. The underlying biological mechanisms however, are poorly understood. Major roads may act as an environmental stressor while natural environments may reduce biological stress. Cortisol is the body’s main stress hormone. The cortisol concentration in scalp hair (HCC) is a retrospective measure of long-term cortisol secretion. This study aimed to investigate second trimester HCC in 129 mothers of the IPANEMA pregnancy cohort (Impact of Particulate Matter on mother and babies in Antwerp) in relation to residential proximity to major roads and access to neighbourhood green space (NGS).

Method: Residential proximity to major roads and access to NGS were calculated using ArcGIS. NGS was defined as 10 hectares of green space within a 800 buffer from the participant’s residence. Hair samples were analysed using High-Performance Liquid Chromatography in combination with triple quadropole mass spectrometry. Limit of quantification was 1.0 pg/mg hair. A stepwise multiple regression model was built, HCC and distance to roads were logarithmically transformed.

Results: The geometric mean HCC was 3.99 (95% CI: 3.54-4.5) pg/mg hair. In a model, corrected for season of sampling, access to NGS (p=0.019), distance to major roads (p=0.004), as well as the interaction between both (p=0.035) were significantly associated with HCC (R²=12.9%). The model predicted 15% higher HCC when living at an average distance (308 meters) from a major road in the absence of NGS compared to living at the same distance with access to NGS (4.15 (3.19-5.4) versus 3.61 (3.14-4.17) pg/mg hair).

Conclusion: Results suggest that proximity to a major road may activate cortisol secretion and biological stress whereas access to neighbourhood green space may have a moderating effect. Our findings, if confirmed, may contribute to evidence-based urban planning towards greener environments.
Residential green space and mental health in a prospective cohort of tree pollen allergy patients

Aerts R¹², Stas M², Hendrickx M¹, Bruffaerts N¹, Hoebeke L¹, Saenen N¹ ³, Aerts J², Van Orshoven J², Nawrot T² ³, Somers B²

¹Sciensano (Belgian Research Institute of Health), ²University of Leuven, ³University of Hasselt

BACKGROUND: Green space may improve human health, for example by promoting physical activity and by reducing stress. Conversely, green space may exacerbate the burden of allergic disease by emitting aeroallergens.

OBJECTIVES: We examined whether residential exposure to green space had impacts on mental health in adults sensitized to tree pollen allergens during two airborne tree pollen seasons (2017, 2018).

METHODS: In this cross-sectional study, data from a prospective Belgian cohort of tree pollen allergy patients (N = 88) were analyzed using Poisson regression. The primary outcome was self-reported mental health, assessed with the standardized 12-item General Health Questionnaire (GHQ-12). Predictors of distress included perceived presence of allergenic trees near the residence (hazel, alder, birch) and cumulative green space area within 1 km distance. Results were compared to distress in a representative sample of the general population (N = 2,467).

RESULTS: Short-term distress [mean GHQ-12 score 2.1 (95% confidence interval 1.5–2.7)] was higher in the study population than in the general population [1.5 (1.4–1.7)]. Distress increased with BMI [adjusted odds ratio [95% confidence interval] 1.06 (1.02–1.10)], smoking [2.10 (1.02–4.38)] and perceived presence of allergenic trees [2.04 (1.36–3.07)]. Physical activity [≥1×/week 20 minutes of activity vs. less: 0.59 (0.42–0.85)], age [0.97 (0.96–0.99)] and green space [≥ 3m tall, per combined surface area of 10 ha: 0.94 (0.90–0.99); < 3m tall, per 10 ha: 0.85 (0.78–0.93)] had protective effects against short-term distress.

CONCLUSIONS: The perceived proximity to allergenic tree species modulates the protective effect of residential green space against short-term emotional distress during the airborne pollen season. Negative expectations of adults sensitized to tree pollen allergens regarding exposure to allergenic tree species may affect short-term mental health outcomes during the pollen season.
Effects of a cleaner-burning biomass cookstove intervention on augmentation index and central pulse pressure during a randomized controlled trial in rural Honduras

Young B1, Walker E1, Peel J1, Benka-Coker M1, Rajkumar S2, Brook R2, Keller J1, Volckens J1, Wilson A1, Clark M1

1Colorado State University, 2University of Michigan Medical School

GREEN, AIR, LMIC: PECHAKUCHA COMES TO ISEE!, Johan Friso Foyer, Floor 1, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim. Household air pollution from combustion of solid fuels for cooking and heating is an important risk factor for global morbidity and mortality. Cleaner-burning biomass cookstoves have been developed to reduce exposure to air pollution, but the health impacts of these cookstoves are unclear. We assessed a cleaner-burning biomass cookstove intervention on measures of central hemodynamics (augmentation index [AIx], central pulse pressure [CPP]) in a randomized controlled trial among women in rural Honduras.

Methods. Participants (n=230 women) used only traditional biomass cookstoves at baseline. Data collection occurred during six household visits approximately every six months over three years. Women were randomly assigned to one of two study arms (n=115 per arm) to receive a cleaner-burning biomass Justa cookstove (with chimney and improved combustion chamber) after the second visit or after the fourth visit. AIx and CPP were measured during each visit using the SphygmoCor XCEL. Linear mixed models were used in an intent-to-treat analysis to assess the intervention. Separate models evaluated age and body mass index (BMI) as potential effect modifiers.

Results. Participants had the following characteristics at baseline (mean, standard deviation): age (38 years, 9); BMI (26 kg/m², 4); AIx (22%, 15); CPP (34 mmHg, 8). Results (n = 1162 observations) suggest the intervention had little impact on AIx and CPP: AIx was 0.3 percentage points higher for Justa vs traditional cookstove users (95% confidence interval: -0.8, 1.5); CPP was 0.3 mmHg higher for Justa vs traditional cookstove users (95% confidence interval: -0.3, 0.9). We did not observe evidence that age or BMI modified the relationships. During the final visit, 53% of participants self-reported using a traditional biomass cookstove in addition to the intervention cookstove.

Conclusion. We did not observe meaningful changes in AIx or CPP following a cleaner-burning biomass cookstove intervention in rural Honduras using an intent-to-treat analysis.
A nationwide study of particulate matter and daily hospitalizations for respiratory diseases in Italy.

**Renzi M**1, Michelozzi P1, Gariazzo C2, Maio S3, Davoli M1, Forastiere P4, Viegi G4, Stafoggia M1,5, BEEP Collaborative Group

1Department of Epidemiology, Lazio Regional Health Service / ASL Roma 1, 2INAIL, Department of Occupational & Environmental Medicine, 3Pulmonary Environmental Epidemiology Unit, CNR Institute of Clinical Physiology, 4Institute of Biomedicine and Molecular Immunology “Alberto Monroy”, National Research Council, 5Karolinska Institutet, Institute of Environmental Medicine

GREEN, AIR, LMIC: PECHAKUCHA COMES TO ISEE!, Johan Friso Foyer, Floor 1, August 27, 2019, 10:30 AM - 12:00 PM

**Background/Aim:**

The relationship between air pollution and respiratory morbidity has been widely addressed in urban and metropolitan areas but little is known about the effects in non-urban settings. Our aim is to assess the short-term effects of PM10 and PM2.5 on respiratory admissions in the whole country of Italy during 2006-2015 in the BEEP project.

**Methods:**

We estimated daily PM concentrations at the municipality level using satellite data and spatiotemporal predictors. We collected daily counts of respiratory hospital admissions for each Italian municipality. We considered five different outcomes: all respiratory, asthma, chronic obstructive pulmonary disease (COPD), lower and upper respiratory tract infections (LRTI and URTI). We ran municipality-specific time-series models and we meta-analyzed individual effects to obtain national estimates for each of the five outcomes considered. Finally, we tested for effect modification by sex, age classes and degree of urbanization of the municipality. Analyses for PM10 were conducted in the entire study period, while for PM2.5 we restricted them to 2013-2015 cause the goodness of fit of our exposure estimation.

**Results:**

A total of 4,154,887 non-scheduled acute respiratory admission were registered during 2006-2015, of which 29%, 12%, 6%, and 3% were for LRTI, COPD, URTI and asthma, respectively. Daily mean PM10 and PM2.5 concentrations over the study period were 23.3 and 17 μg/m3. For each 10 μg/m3 increases in PM10 and PM2.5 at lag 0-5 days, we found excess risks of total respiratory diseases equal to 1.10% (95% confidence intervals: 0.82, 1.39) and 0.82 (0.35, 1.30), respectively. The effects for the specific diseases were similar, with the strongest effects for asthma. Higher effects were found in the elderly and in areas less urbanized.

**Conclusions:**

Short-term exposure to PM is harmful for the respiratory system, especially in elderly patients. Strong effects were found also in rural areas.
Background/Aim:
Residing in greener areas has been linked to several health outcomes (e.g. mental health, cardiovascular), but limited work has been done on respiratory health. We examined associations between residential greenness levels and nearby green spaces with lung function up to 15 years in the Avon Longitudinal Study of Parents and Children: a birth cohort of children born 1991-92 in/around Bristol, United Kingdom.

Methods:
Forced expiratory volume in one second (FEV1), forced vital capacity (FVC) and forced expiratory flow between 25% and 75% of FVC (FEF25-75) were measured using spirometry before bronchodilation at 8 and 15 years. Greenness levels in circular 300m buffers around the birth, 8- and 15-year home addresses were calculated using the satellite-derived Normalized Difference Vegetation Index (NDVI; ranges -1 to 1; time-varying greenness) and subsequently averaged (lifetime greenness). The presence of urban green spaces, forests and agricultural land in the 300m buffers was also determined. Mixed effects linear regression models, adjusted for individual (e.g. socioeconomic status) and environmental factors assessed associations between lifetime and time-varying greenness levels and nearby green spaces with lung function.

Results:
Averaged lifetime greenness (N=1862, 46.6% male) was positively associated with FEV1, FVC and FEF25-75 (mean difference [95% confidence intervals]: 47.5 ml [7.5, 87.6], 47.4 ml [4.3, 90.6] and 67.0 ml/s [-13.7, 147.6] per 0.2 increase in NDVI, respectively). Effect estimates were positive but attenuated when greenness levels at 8 and 15 years were instead entered as time-varying (18.1 ml [-9.5, 45.6], 25.4 ml [-4.4, 55.2] and 10.1 ml/s [-40.0, 60.2] for FEV1, FVC and FEF25-75, respectively) or after adjustment for asthma. No associations were found for nearby urban green spaces, forests or agricultural land.

Conclusions:
Higher lung function by 15 years was associated with residing in greener areas throughout life, but not with nearby structured green spaces.

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Long-term effects of air pollution on metabolic control in children and adolescents with type 1 diabetes – a repeated measurements analysis

Lanzinger S1,2, Rosenbauer J3,3, Schikowski T4, Altug H4, Rathmann W2,3, Holl R1,2
1Institute of Epidemiology and Medical Biometry, ZIBMT, Ulm University, 2German Centre for Diabetes Research (DZD), 3Institute for Biometrics and Epidemiology, German Diabetes Centre, Leibniz Centre for Diabetes Research at Heinrich Heine University Düsseldorf, 4Leibniz Research Institute for Environmental Medicine (IUF), Düsseldorf

GREEN, AIR, LMIC: PECHAKUCHA COMES TO ISEE!, Johan Friso Foyer, Floor 1, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim: Cross-sectional studies on the association between air pollution and metabolic control in children and adolescents with type 1 diabetes reported inconsistent results. We aimed at investigating the long-term effects of particulate matter <10 µm (PM10), nitrogen dioxide (NO2) and accumulated ozone exposure (O3-AOT) on HbA1c in type 1 diabetes patients considering repeated measurements per patient.

Methods: 31,131 type 1 diabetes patients <21 years of age from the multicentre diabetes patient follow-up registry (DPV) with repeated HbA1c measurements from 2009 to 2014 were studied. Demographic and clinical data were aggregated by year and by patient. PM10-, NO2-yearly means and O3-AOT quinquennial means (2009-2014) were linked via the five-digit postcode areas of residency. Mixed-effects models (random participant intercept) were used to study the association between air pollution quartiles (Q1 lowest, Q4 highest concentration) and HbA1c.

Results: Type 1 diabetes patients had a median age of 13.0 years (Q1: 9.7 - Q3: 15.9; HbA1c 7.67% (6.96-8.58)). HbA1c was higher in association with a PM10-concentration ≥19.9 µg/m³ (Q4: 8.00% [95% confidence interval: 7.98-8.03]) compared to lower PM10-concentration <16.1 µg/m³ (Q1: 7.94% [7.92-7.96], p<0.001).

Similar results were observed with NO2 (Q4 ≥19.4 µg/m³: HbA1c 7.99% [7.97-8.02], Q1 <11.9 µg/m³: 7.94% [7.92-7.97], p=0.008). High O3-AOT exposure ≥15,661 µg/m³*h was associated with a lower HbA1c (Q4: 7.92% [7.89-7.94]) compared to lower O3-AOT exposure <10,858 µg/m³*h (Q1: 8.00 [7.98-8.02], p<0.001).

Conclusions: Considering repeated measurements we observed higher HbA1c levels with higher PM10 and NO2 concentration. We found an inverse association between O3-AOT and HbA1c. Differences in HbA1c between air pollution quartiles were small, but statistically significant and due to the consistent exposure relevant.
OPS 06: Health effects of source-specific outdoor air pollution

Source-apportionment of fine-particulate matter (PM < 2.5 ug/m3) and associations with local and regional cardio-pulmonary health risk.

Malecki K1, Schultz A1, Bea M1,2, Spicer A1, Gangnon R1, Schauer J2

1University Of Wisconsin Madison, School of Medicine and Public Health, Department of Population Health Sciences,
2University Of Wisconsin Madison, School of Medicine and Public Health, Department of Civil and Environmental Engineering, 3Mokpo National University, Department of Environmental Engineering

Background – Fine particulate matter (PM<2.5 ug/m3), is a complex mixture and varies by location. Few studies examine the individual contribution of PM 2.5 sources and cardio-pulmonary health in the context of regional and local air pollution. Source apportionment supports the identification of unique regional and local sources of PM 2.5.

Methods – Ambient air samples were collected from United States air monitoring stations in two northern counties; Milwaukee (largely industrial) and Waukesha (largely suburban and residential) with unique regional and localized sources. Twenty-four-hour air monitoring data were collected every three to six days between January 1, 2004, through December 31, 2013. Positive factorization matrix analyses were used to identify key elements and sources contributing to overall PM 2.5 mass including soil, road salt, gas or diesel car emissions, industry, biomass, secondary sulfate and nitrate, and bromine. Daily cardiovascular disease (ICD codes 410-414, 427, 428, 433-437, 440, 443, 444, 451-453), respiratory disease (codes 460-466, 477, 480-488, 491-493, 496, 786.09) and injury (800-999) emergency department admissions (ER) from 2004-2013 were obtained from the Wisconsin Department of Health Services. Time-series analyses using negative binomial generalized additive models (GAM) were performed in R to examine associations between daily emergency department visits and unique sources. Natural cubic splines were used to capture non-linear relationships with time, day, humidity, and temperature.

Results –In Milwaukee, interquartile range (IQR) increases in car gasoline (p=0.04), secondary nitrates (p=0.02) and secondary sulfates (p=0.05) were predictors of ER visits for respiratory outcomes, while, in Waukesha, car emissions (p=0.06) were. No associations between air pollution sources and ER visits for cardiovascular disease or injury were identified.

Conclusion – Localized variability in air pollution sources contribute to differential cardiopulmonary risk in local populations. Source apportionment analyses are important for effective regulating air pollution sources, yet are currently overlooked in most global standards.
The effect of river dust and chemical constituents of air pollution on respiratory function among schoolchildren in Mailiao, Taiwan.

Chen C1,2, Wu C3, Huang C4, Guo Y2,3
1Department of Environmental and Occupational Medicine, National Taiwan University Hospital Hsin-Chu Branch, 2Department of Environmental and Occupational Medicine, National Taiwan University (NTU) College of medicine and NTU Hospital, 3Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University, 4Research Center for Environmental Changes, Academia Sinica

OPS 06: Health effects of source-specific outdoor air pollution, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Background/Aim: River dust and emission from petrochemical industry has been a health concern around the estuary of the Zhuo-Shui River during winter season. The study aims to evaluate the effect of air pollution and its chemical constituents on airway function among allergic children living in the Mailiao Township, Taiwan.

Methods: Forty-seven schoolchildren aged 9~11, 23 of asthma, and 24 of allergic rhinitis, were trained to record their peak expiratory flow rate (PEFR) twice a day, at 7:00~8:00 and 17:00~18:00, from Feb 24 to March 20, 2016. Daily levels of air pollutants and meteorological conditions were retrieved from an EPA monitoring station in the Mailia Elementary school. Elemental constituents of PM10 was measured by real-time X-ray fluorescence. Positive matrix factorization was adopted to explore the source apportionment of PM10 from river dust. Linear mixed effect model was used to examine the short-term (0~7 days) lag effect of exposure on PEFR by adjusting for age, gender, asthma, height, weight, airway symptoms, temperature, and humidity. Daily variation of PEFR was calculated by dividing daily difference of PEFRs with daily mean.

Results: During the study period, the mean levels of PM10 and PM2.5 were 76.8 and 33.6 μg/m3, respectively, and up to 191.4 and 70.8 μg/m3 during river dust episode. There were significant reductions in morning PEFR associated with NO2, and evening PEFR with PM10, SO2, and PM10 constituents (barium, arsenic, nickel, vanadium), and river dust. PM10 constituents (barium, nickel and vanadium) and river dust were significantly associated with the increase in daily variation of PEFR. Nickel and vanadium, but not barium and river dust, induced more daily variation in asthmatic children than non-asthmatics.

Conclusions: Our findings provided evidence for the respiratory effects of river dust and specific chemical constituents of air pollution among children with allergic airway diseases.
Long-term exposure to air pollution components (total and source-specific) and incidence of stroke and cardiac events in the Heinz Nixdorf Recall study

Rodins V1, Lucht S1,2, Hennig F1, Moebus S3, Jöckel K3, Schramm S3, Erbel R3, Hoffmann B1

1Environmental Epidemiology Group, Institute of Occupational, Social and Environmental Medicine, Medical Faculty, Heinrich-Heine University Düsseldorf; 2Institute for Medical Statistics, Medical Faculty, Heinrich-Heine University Düsseldorf; 3Institute of Medical Informatics, Biometry and Epidemiology (IMIBE), University Hospital Essen, University of Duisburg-Essen

OPS 06: Health effects of source-specific outdoor air pollution, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Background/Aim: Epidemiological studies have established that air pollution (AP) exposure adversely affects cardiovascular health. However, there has been little research on the effects of source-specific (industry and traffic) AP and individual components of particulate pollution. We therefore investigated the association between long-term exposure to components of total and source-specific AP and incidence of stroke and cardiac events (CE).

Methods: We used data from the Heinz Nixdorf Recall cohort study (N = 4,814, aged 45–75). We estimated long-term residential AP exposures over the baseline period (2001-2003) using the European Air Pollution Dispersion chemical transport model (EURAD). Exposure was modelled for total NO2, total and source-specific particulate matter (PM) PM10, PM2.5, accumulation mode particle number concentration (PNAM), and PM components (anthropogenic organic compounds, black carbon, elemental carbon, NH4, NO3, SO4). Outcomes were defined as time to first stroke or CE during follow-up (until 2017). We applied Cox proportional hazards model to estimate hazard ratios (HR) per interquartile range increase in exposure to each pollutant/component, controlling for baseline sex, age, socio-economic status, body mass index, smoking, alcohol consumption, physical activity, nutrition, and traffic noise. In the analyzed population without stroke or CE prior to baseline (N = 4,224), a total of 120 strokes and 200 CE were observed during the study period (mean follow-up 12 years).

Results: We observed positive associations between AP exposure and incidence of stroke, e.g. for industry-specific PM10 (HR: 1.34, 95% CI: 1.01, 1.78 per 2.22 µg/m3), industry-specific PNAM (HR: 1.28 [1.00, 1.64] per 208 particles/mL), and traffic-specific PNAM (HR: 1.30 [1.01, 1.68] per 138 particles/mL). Point estimates for CE were less consistently elevated. Adjustment for traffic noise did not change the results substantially.

Conclusions: Our results support a positive association of long-term residential exposure to source-specific AP and PM components with incidence of stroke.
Ambient Ultra Fine Particulate Sources Associated Changes in Blood Pressure in Healthy Adults

Zhang Q¹, Xu H¹, Chen J¹, Zhang Y¹, Zhao Q¹, Feng B¹, Song X¹, Huang W¹
¹Department of Occupational and Environmental Health, Peking University School of Public Health, Peking University Institute of Environmental Medicine

OPS 06: Health effects of source-specific outdoor air pollution, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Background: Alterations of blood pressure (BP) have been proposed to be responsible for particulate air pollution-associated cardiovascular events; however, the effects of particulate pollutants exposures on BP attributable to specific sources of particulates remain poorly understood.

Methods: Seventy-three healthy adults (66% female, mean age of 23.3 years) were followed-up with four repeated visits in 2014–2016 in Beijing, China. Resting BP and concentrations of homocysteine were measured at each clinical visit. Sources of ambient particulates were identified based on the number concentrations of particulates (PNC) in sizes of 5-560 nm including a total of 32 size distribution segments, using the positive matrix factorization. Linear mixed-effects models were applied to estimate associations between individual sources of particulates and BP.

Results: Of 73 participants, 33% were overweight (body mass index ≥ 25 kg/m²). Average daily concentration of PNC in sizes of 5-560 nm was 23,262 particles/cm³. Four sources were identified including gasoline vehicle emissions, aged vehicle emissions, nucleation and secondary aerosols. No effects on systolic BP were observed for exposures to any sources of particulates, whereas significant increases in diastolic BP of 2.1 mm Hg (95% CI: 0.4, 3.7) to 2.9 mm Hg (95% CI: 1.3, 4.4) and 1.7 mm Hg (95% CI: 0.1, 3.4) to 2.9 mm Hg (95% CI: 0.6, 5.1) were observed in associations with interquartile range increases in moving average concentrations of aged vehicle emissions and secondary aerosols at prior 1 to 7 days before each visit, respectively. Further, the associations of aged vehicle emissions and secondary aerosols with systolic and diastolic BP were greater in participants with overweight and those with higher homocysteine levels (above 12 μmol/L).

Conclusions: Our findings suggest that specific sources of particulates could be responsible for particulate pollutants-associated BP changes, and potential metabolic conditions may confer susceptibility of air pollution exposure.
Association between sources of ultrafine particles and mortality in four European Cities

Rivas I1, Vicens L2, Basagaña X3, Querol X3, Hüglin C4, Katsouyanni K1, Harrison R5, Pekkanen J6, Kulmala M7, Kelly F1

1King’s College London, 2Barcelona Institute for Global Health (ISGlobal), 3Institute of Environmental Assessment and Water Research (IDAEA-CSIC), 4Laboratory for Air Pollution and Environmental Technology, Swiss Federal Laboratories for Materials Science and Technology (EMPA), 5School of Geography, Earth & Environmental Sciences, University of Birmingham, 6Dpt. of Public Health, University of Helsinki, Helsinki, 7Institute of Atmospheric and Earth System Sciences / Physics, University of Helsinki

OPS 06: Health effects of source-specific outdoor air pollution, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Background: Evidence on the association between ultrafine particles (UPF, diameter <100nm) and mortality is still inconsistent. In addition, health effects of specific UFP sources have not been explored. We evaluated the impact of UFP sources on daily mortality in four European cities: Barcelona, Helsinki, London, and Zurich.

Methods: Using the Positive Matrix Factorisation (PMF) on size-resolved UFP number concentrations we identified and quantified the sources in each of the cities. Common sources were photonucleation, two traffic sources (size mode around 30 nm and 70 nm), and secondary aerosols. Different periods were investigated in each city: Barcelona 2013-2016, Helsinki 2009-2016, London 2010-2016, and Zurich 2011-2014. The associations between total particle number concentrations and UFP sources and daily (natural, cardiovascular, and respiratory) mortality was investigated applying city-specific Distributed Linear Models (DLM), adjusting for long-term trends, temperature, day of the week, bank holidays, and influenza.

Results: For most sources and outcomes, we found no associations. Preliminary results indicate that from all the sources, the traffic source of particles around 30 nm was the one showing most of the associations: an IQR of source (3402 pt/cm³ for Zurich, 3582 pt/cm³ for Barcelona) was associated with a 3.00 (95% CI 0.2 – 5.9%) of cardiovascular mortality at Lag 1 (previous day) in Barcelona and a 7.3 (95% CI 0.9 – 14%) of respiratory mortality at Lag 2 among men in Zurich. The analyses for Helsinki and London (with longer timeseries) are in process.

Conclusions: We found no consistent associations between different sources of UFP and mortality in Barcelona and Zurich, although the traffic source of particles around 30 nm was associated with increased cardiovascular mortality in Barcelona and respiratory mortality in Zurich.

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Outdoor PM2.5 Associations with Cardiovascular Disease Incidence in Dhaka, Bangladesh, and the Respective Roles of Fossil Fuels and Biomass Combustion

Rahman M1, Begum B2, Hopke P3, Thurston G1
1Department of Environmental Medicine, NYU School of Medicine, 2Atomic Energy Centre, 3Department of Public Health Sciences, University of Rochester School of Medicine and Dentistry

OPS 06: Health effects of source-specific outdoor air pollution, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Rationale: Dhaka City, Bangladesh is among the cities with the highest fine particulate matter (PM2.5) air pollution levels (mean= 82 μg/m³). The assumption has been that the health effects of PM2.5 per mass is similar in the developing world as in the developed world, despite the fact that the PM2.5 pollution sources (and their particle characteristics) are different. We seek to evaluate the appropriateness of this assumption in Dhaka, Bangladesh.

Methods: The analysis applied time-series generalized quasi-Poisson regression, adjusting for temporal trend, day of week, holidays, relative humidity, and temperature. Daily weather data were obtained from Bangladesh Department of Environment and Bangladesh Meteorological Department. Daily counts of cardiac emergency department visits (EDV, n= 340,758), hospitalizations (n= 253,407), and mortality (n= 16,858) were obtained from National Institute of Cardiovascular Diseases (NICVD) for September 2013 through December 2017.

Results: PM2.5 yielded significant associations with increased CVD EDV [ER= 0.33%, 95% CI: 0.07 ,0.59], hospitalizations [ER= 0.44%, 95%CI: 0.11 ,0.78], and deaths [ER= 0.86%, 95% CI: 0.26, 1.46] per 10 μg/m³ increase, but with effect estimates per mass below those found in developed-world studies. Examining the relationship as a function of PM2.5 concentration reveals that the effect estimates are larger at lower PM2.5 concentrations, but smaller, and non-significant, at higher concentrations, when biomass (e.g., crop) burning dominates exposures. The health effects relationships followed that of sulfur, indicating that, when sulfur containing combustion (e.g., coal burning) PM2.5 does not increase, the overall PM2.5 CVD effect also is not increased, despite rising mass concentrations.

Conclusion: This study provided a confirmatory evidence of the effect of air pollution on CVD morbidity and mortality in Dhaka. However, the CVD effect size varied depending on mix of air pollution sources, with biomass burning PM2.5 suggested as having a lower CVD effect per μg/m³ than fossil fuel combustion-related PM2.5.
BACKGROUND
Many early-life features of Westernized lifestyle are risk factors for asthma. Several of these factors, in particular antibiotics, are modifiable, yet have not been addressed despite: (1) high asthma prevalence, (2) mounting evidence in support of exposure to beneficial microbes in infancy, and (3) documented decreased antibiotic prescriptions in British Columbia (BC), Canada, that parallels a decrease in pediatric asthma. Here, we harness the power of a three-tier study to explore causation and biological plausibility by defining the associations between early-life antibiotic use, the structure of the gut microbiome, and the risk of asthma.

METHODS
We used administrative linked health data to examine the association between antibiotic prescribing (age<1yr) and asthma incidence (ages 1-4yr) at the ecological level and examined 2,644 children from the Canadian Healthy Infant Longitudinal Development (CHILD) Study, who were clinically assessed for asthma (5yr). In an asthma-enriched subset (n=1,000), gut microbiota was defined by 16SrRNA sequencing of stool samples collected at 3 and 12 months of age.

RESULTS
We report a 76% decrease in antibiotic use among children in BC and a decline in asthma incidence. Antibiotic prescribing predicted asthma incidence (IRR=1.2 for 10% increase; p<0.001). In the CHILD study, we also demonstrate a near doubling of asthma risk among participants who received systemic antibiotic use in the first year of life (aOR: 1.8, p=0.006), while this risk was reduced with increased gut microbiota α-diversity (aOR=0.68 for one IQR increase; p=0.046). The gut microbiota, represented by diversity and differentially expressed taxa, was a significant mediator between antibiotics and asthma (p=0.041).

CONCLUSION
Antibiotic exposure in the first year of life increases the risk of being diagnosed with asthma in childhood. Our findings are consistent with a mechanism by which antibiotics disturb the balance of the microflora skewing the developing immune system toward hypersensitivity.
Health Risk of Bacteriological Contamination of Food Utensils in Mass Catering Establishments

Birke Eshete W¹, Teshome T¹, Zawide F¹
¹Jimma University

OPS 07: Farm animals, antibiotics, infections and the microbiome, Room 110, Floor 1, August 27, 2019, 10:30 - 12:00

Background
Despite a few studies on the sanitary condition of food establishments in urban centers of Ethiopia, there is no scientific evidence based on laboratory examination to confirm the health risk of food contamination by pathogenic organisms due to unclean utensils used in mass catering. This study is aimed at investigating the bacteriological quality of food utensils used in mass catering establishments as evidence of food safety risk factor in Jimma town.

Methods
A cross-sectional survey of 72 (20%) randomly selected mass catering establishments out of a total 360 was carried out from February 8 to March 8, 2017. Standardized and structured questionnaires were used to gather information. Standard swab samples were collected from food utensils in the 72 establishments and analyzed for bacteriological quality using standard methods.

Results
Of all the utensils tested 33.3% were found to be contaminated by Coliform bacilli with above the acceptable level (>100 colonies/100ml) and 53.3% were grossly contaminated by fecal coliform (>39.5 fecal coliform/100 ml). The presence of fecal coliform is an indicator of possible contamination of utensils by unclean water during washing. Observational studies also indicated that other causes of contamination could be inefficient washing, sanitizing and drying, cross contamination of contact surfaces during storage and, unhygienic kitchen practices of food handlers. The study showed that 86.1% of the establishments had licenses, 59.7% were operating in their own private building and 30.5% of the owners had educational grade level of 11-12.

Conclusions
The study confirms that eating meals outside the home is a risk factor for obtaining food-borne diseases. There is a need to create public awareness in order to improve the sanitary standard of mass catering establishments through efficient inspection, regulatory compliance, education and motivation of food handlers and owners in coordination with the relevant stakeholders.
Background/Aims
Infectious enteric diseases pose a substantial economic and public health problem in New Zealand (NZ). Recently, the country has seen rapid intensification of the dairy industry. Higher dairy stocking rates have resulted in increased pressure on natural resources with the potential to impact public health.

Aims are to (i) identify spatio-temporal clusters of zoonotic disease; and (ii) analyze the relationship between disease clusters, livestock densities, social, and environmental factors.

Methods
Notified cases of campylobacteriosis and cryptosporidiosis from 1997-2015 were obtained from a national surveillance system. A retrospective space-time permutation was used to identify statistical clusters of these zoonoses. Cluster data were spatially linked to census and environmental variables from livestock, hydrological, and water supply databases. Classification and Regression Tree (CRT) analysis was used to assess potential associations between disease clusters and the covariates.

Results
SaTScan analysis detected nine significant (p<0.05) campylobacteriosis clusters and 38 significant cryptosporidiosis clusters. The location and timing of disease clusters suggested an influence of livestock production and environmental factors in rural areas. CRT analyses indicated that population density, age profile, an index of socioeconomic deprivation, dairy cattle density, and low elevation river source of flow were significant predictors for both campylobacteriosis and cryptosporidiosis clusters. Climatic conditions in river catchments were also associated with cryptosporidiosis clusters, while drinking water supply characteristics were associated with campylobacteriosis clusters.

Conclusions
Overall, the results suggest that social and environmental factors play an important role in the occurrence of enteric disease events. Dairy farming in NZ may influence zoonotic disease patterns. However, further research is required to clarify the complex interactions between potential explanatory variables in order to forecast zoonotic disease under scenarios of agricultural intensification and climate change.
Prevalence of non-specific symptoms in livestock dense areas: `Looking beyond respiratory conditions

Gerbecks J\textsuperscript{1}, Bialiatsas C\textsuperscript{2}, Yzermans J\textsuperscript{3}, Dückers M\textsuperscript{4}

\textsuperscript{1}Nivel, \textsuperscript{2}Nivel, \textsuperscript{3}Nivel, \textsuperscript{4}Nivel

OPS 07: Farm animals, antibiotics, infections and the microbiome, Room 110, Floor 1, August 27, 2019, 10:30 - 12:00

Background
A large body of studies showed that prevalence of respiratory health problems is higher when people live closer to livestock farms, compared to people who live further away. Acute somatic and mental health symptoms such as headache, sleep problems and anxiety can also be directly or indirectly associated with environmental exposures, especially in the light of recent zoonoses with a severe impact on human health. The present study aims to gain more insight in possible differences between residents of livestock dense and non-dense regions, in the prevalence of diverse acute non-specific symptoms (NSS), taking into account socio-demographic factors and psychiatric morbidity.

Methods
Prevalence of diverse acute health symptoms as well as anxiety and depression was assessed for the year 2017, based on electronic health records registered in 39 general practices in the Netherlands. Data were obtained from the Primary Care Database (PCD) of Nivel. The “study group” included people who lived in rural areas with high livestock density (n=74093) and was compared to a “control group” (people in other rural areas with low livestock density) (n=50139). Multiple logistic multilevel regression analyses were performed.

Results
Prevalence of anxiety was significantly higher among people living in livestock dense regions, while there was no significant difference in depression. There was a significantly higher chance that people in the study group had acute health symptoms such as abdominal complaints, diarrhea, headache, dizziness, sleep disturbance, coughing, and skin symptoms, compared to the control group.

Conclusions
The study suggests that the previously identified higher risk of respiratory health problems in livestock dense areas also applies to the prevalence of various NSS. The results need to be verified while considering individual livestock exposure estimates and other relevant individual and environmental factors over a broader time period.
Occurrence and Spatial diversity of airborne resistomes in the poultry and household environment in Bangladesh

Zaman F, Asaduzzaman M

1Directorate General of Health Services (DGHS), Bangladesh, 2International Centre For Diarrhoeal Disease Research, Bangladesh (icddr, b)

OPS 07: Farm animals, antibiotics, infections and the microbiome, Room 110, Floor 1, August 27, 2019, 10:30 - 12:00

Background

Antimicrobial resistance (AMR) is an alarming issue with environmental evolution and transmission to a larger extent. We studied whether the outdoor environment (air) in Bangladesh acts as a reservoir for bacteria that can confer resistance to antibiotics with spatial diversity.

Methods

We collected air samples during January to July 2018 from both urban and rural settings in four distinct outdoor environments - i) Urban live bird markets (LBM) ii) Urban residential area (URA) iii) Commercial poultry farms (CPF) and iv) Rural households (RHH). We used standard plates and media supplemented with 3rd generation cephalosporin (3GC), carbapenem, oxacillin and vancomycin to obtain the gram negative resistant organisms, both 3GC resistant (3GCr) and carbapenem resistant Enterobacteriaceae (CRE) as well as gram positive resistant organisms like Methicillin (Oxacillin) resistant Staphylococci (MRS) and Vancomycin resistant Enterococci (VRE) respectively.

Results

All types of resistant organisms were present in each of the study sites. We found the presence of 3GCr, CRE, MRS and VRE in 85%, 60%, 100% and 80% air samples respectively. Considering sampling sites, 3GCr, CRE and MRS were found highest in the air samples obtained from the environment of commercial poultry farms and VRE was present higher in the live bird markets. The alarming finding is the presence of resistant organisms like MRS, VRE and 3GCr in urban residential area with high frequency (>90%) whereas the rural household were heavily burdened with 3GCr and MRS (60-100%).

Conclusion

So far our knowledge, this is the first study in SouthEast Asia to quantify the resistant organisms in air. The presence of airborne resistomes highlights the importance of intervention in outdoor environments. Our study findings emphasize on the inclusion of air in the system approach to tackle AMR. In addition, the burden of resistant infections with air resistomes and their clonal relationship with clinical cases need to be further evaluated.
Estimating time-varying exposures to air emissions from animal feeding operations to assess short-term exposure effects in children with asthma

Loftus C1, Afsharinejad Z1, Sampson P1, Torres E2, Arias G3, Tchong-French M1, Vedal S1, Karr C1

1University Of Washington, 2Northwest Communities’ Education Center, 3Sea Mar Community Health Center

OPS 07: Farm animals, antibiotics, infections and the microbiome, Room 110, Floor 1, August 27, 2019, 10:30 - 12:00

Background/Aim: Industrial-scale animal feeding operations (AFOs) have adverse impacts on regional air quality. Air emissions include endotoxins and other pro-inflammatory components, and exposure may cause airway inflammation and respiratory effects in susceptible individuals residing nearby. We aimed to develop and validate metrics for estimating time-varying exposure to AFO air pollution in surrounding communities and, secondly, to determine whether exposure is associated with health effects in children with asthma.

Methods: We conducted a longitudinal cohort study of N=58 children with asthma in an agricultural region of Washington State with a high density of dairy AFOs. Children were followed for up to 26 months with repeated measures of respiratory health, and urine was collected in a subcohort (N=16) at biweekly intervals over three months and analyzed for leukotriene E4 (LTE4), a biomarker of systemic inflammation. We developed an approach to estimate daily exposure to AFO airborne emissions based on distance to AFOs, AFO size, and daily wind speed and direction and validated the measure against direct measurements of ammonia, a chemical marker of AFO emissions, measured biweekly at 18 sites across the region for 14 months. Short-term relationships between AFO pollutant exposure and outcomes were assessed using regression models accounting for within-subject correlation and several potential confounders.

Results: Estimates of daily AFO air pollution correlated moderately well with outdoor ammonia measurements (N=842; r=0.62). Forced expiratory volume in one second (FEV1) as percent of predicted was 2.0% (95% CI: 0.5, 3.5) lower with each interquartile increase in previous day exposure, but no associations with asthma symptoms were observed. There was suggestive evidence that LTE4 concentrations were higher following days of elevated exposure to AFO emissions (p=0.07).

Conclusions: A simple metric of time-varying exposure to AFO emissions predicted daily outdoor ammonia levels. Children with asthma may be adversely affected by exposure to AFO contaminants.
OPS 11: Health effects of climate change in low- and middle-income countries

Impact of Meteorological Factors on Rotavirus Infection among Children below 5 Years of Age in Kathmandu, Nepal.

Bhandari D, Bi P, Dhimal M, Shergand J, Easay S

1The University Of Adelaide, 2Nepal Health Research Council, 3Public Health Research Laboratory

OPS 11: Health effects of climate change in low- and middle-income countries, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Introduction: Rotavirus infection shows a variable degree of seasonality across different climatic belts of the world, highlighting the role of local climatic factors on disease epidemiology. This study investigated the effects of meteorological factors on rotavirus infection among children below 5 years of age in Kathmandu, Nepal.

Methods: We fitted generalized linear Poisson regression equations with distributed lag non-linear model to estimate the effect of meteorological factors on weekly count of rotavirus infection, among the children younger than 5 years living in Kathmandu, Nepal. Seasonality and long term effects were adjusted in the model using Fourier terms and a linear function of time, respectively. Risk ratios of rotavirus infection in response to exposure variables were estimated with reference to their median value.

Results: A total of 733 cases of rotavirus infection were recorded during the study period. An inverse non-linear association between rotavirus infection and average weekly mean temperature was detected, with increased risk (RR: 1.52; 95% CI: 1.08-2.15) at 10th percentile and decreased risk (RR: 0.64; 95% CI: 0.43-0.95) at the 75th percentile. Likewise, an increased risk [(RR: 1.93; 95% CI: 1.40-2.65) and (RR: 1.42; 95% CI: 1.04-1.95)] of rotavirus infection was detected, for both maximum and minimum temperature at their lower quantile. The overall effect of temperature on rotavirus infection was acute and immediate in all the cases. We did not observe significant association between rotavirus infection and relative humidity or total rainfall.

Conclusion: We observed an inverse association between rotavirus incidence and all three indices of temperature and no significant association between rotavirus infection and total weekly rainfall or weekly mean relative humidity.
The Impact of 2016 Severe Flood on Infectious Diarrhea in Anhui Province, China: An Interrupted Time-Series Study

Zhang N1, Huang C1
1School of Public Health, Sun Yat-sen University

OPS 11: Health effects of climate change in low- and middle-income countries, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Background: Climate change may bring more frequent and severe floods that threaten public health, especially for infectious diarrhea in susceptible populations. Affected by heavy rainfall and El Niño, a destructive flood attacked Anhui province in China on 18th June, 2016. This study aims to investigate the impact of this severe flood on infectious diarrhea, and further to identify factor lead to the different risk estimates across cities. Methods: We obtained individual infectious diarrhea data during 2013-2017 from the National Disease Surveillance System. An interrupted time-series design was used to estimate the city-level effects of the flood on diarrhea among 16 cities. Then we applied a meta-analysis to estimate the area-level pooled effects of the flood in flooded area and non-flooded area, respectively. Finally, a meta-regression was applied to explore factor accounting for different risk estimates across cities. Stratified analyses by gender and age were also conducted for flooded area. Results: A significant increase in infectious diarrhea (RR=1.11, 95%CI: 1.01, 1.21) after flood was found in flooded area although the impacts varied across cities, while there was no change in non-flooded area. We found that diarrheal risk post-flood is increased across cities as the distance to Yangtze river decreased, and children aged 5-14 were identified at highest risk of infectious diarrhea post-flood in flooded area. Conclusion: Our study provided strong evidence that severe flood significantly increases infectious diarrheal risk. Local public health agencies are recommended to take developed intervention programs to prevent and control infectious diarrhea when a flood attack, especially in areas close to waterbody, and among children aged 5-14 years old.
Maternal Health in the Aftermath of Hurricanes Irma and Maria in Puerto Rico
Torres Zayas H1, Rosario Z1, Welton M2, Agosto L1, Cardona N1, Vélez C1, Alshawabkeh A3, Cordero J2, Meeker J4, Watkins D4, Díaz Z1

1University of Puerto Rico, Medical Sciences Campus, School of Public Health, 2University of Georgia, College of Public Health, Department of Epidemiology and Biostatistic, 3Northeastern University, Department of Civil and Environmental Engineering, 4University of Michigan, Department of Environmental Engineering

OPS 11: Health effects of climate change in low- and middle-income countries, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Background: Prior to Hurricane Maria, Puerto Rico had 200+ hazardous waste sites, significant contamination of water resources, and marked disparities in reproductive health, including higher rates of preterm birth, low birthweight, and infant mortality compared to the mainland US. Since 2010, the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) Center has been investigating prenatal environmental exposures and preterm birth on the island. When Maria struck Puerto Rico in September 2017, there were 102 pregnant PROTECT participants. Previous research suggests that pregnant women who experience a natural disaster are at higher risk of adverse birth outcomes.

Methods: In Fall 2018, we administered a questionnaire to identify hurricane-related sources of stress and environmental exposures to women who were pregnant during Maria or who became pregnant in the aftermath (n=176). Demographic and health data were obtained from the PROTECT database.

Results: Women who continued participation or enrolled in PROTECT after Maria had slightly higher income and education compared to previous participants. Currently, 122 women have completed the questionnaire, 7 declined, 2 are pending, and 45 were unreachable. On average, respondents were without electricity for 108 days, and 88% reported use of a power generator during the emergency. In the aftermath of the hurricane, 10% of women reported having asthma during pregnancy and 16% indicated having problems completing their prenatal visits. 24% indicated living in a place other than their pre-hurricane residence, 65% indicated damages to their property, and 31% reported living with stagnant water near or inside their homes.

Conclusions: Analysis of questionnaire data in relation to hurricane-related exposures and stress, as well as birth outcomes, is in progress. This work, along with ongoing community engagement efforts, will identify ways to minimize the impact of future natural disasters on maternal and child health in Puerto Rico.
The causal effects of flooding on infectious diarrheal diseases during and after flood and the related social modifiers in Anhui province, China

Liao W1, Yang L1, Huang C1
1School of Public Health, Sun Yat-sen University

OPS 11: Health effects of climate change in low- and middle-income countries, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Background

The frequency and intensity of flooding are projected to increase in a changing climate, which may have great implications for diarrhea. Yet the causal relationship between flood and diarrhea remains uncertainties and very limited study had detected its modifiers.

Methods

Daily number of diarrheal cases and meteorological data from June 18th 2013 to August 31th 2017 and background data of flood in Anhui province were obtained. The differences-in-differences (DID) approach with propensity score matching were applied to examined the causal effects of the 2016 flood in Anhui during flooding and in post-flood period. The difference-in-difference-in-difference (DDD) analysis was deployed to detect the modifiers of flood’s impacts, including gender, age, occupation and community health resource.

Results

During the study period, 359,580 cases of diarrhea occurred in Anhui province, with an average of 258.6 cases per day. The adjusted DID model estimated that the flood had immediately increased the risk of dysentery (RR: 1.29, 95% CI: 1.14 – 1.46) and have caused 21% increase of all-cause diarrhea in post-flood period, with 49%, 36%, 9% of risk increasing for Typhoid and Paratyphoid, Dysentery, Other Infectious Diarrhea. The DDD model showed that the flood had posed a higher risk to males, under 5 and 5-14-years old children, and non-farmers. People belonged to county with high density of health professionals had a significantly lower risk of diarrhea during flooding (RR: 0.81, 95% CI: 0.67 – 0.99) and in post-flood period (RR: 0.83, 95% CI: 0.74 - 0.92).

Conclusions

Flooding has increased the risk of diarrhea and the effects were modified by age, gender, occupation and density of health professionals. Our findings recommended using DID design to detect causal effect of floods and other climate extremes and highlighted the protective effects of community health workforce on the health impacts posed by flooding.
Temporal Analysis of Short and Long-Term Impact of Drought on Child Health; A Case Study of North Kordofan, Sudan.

Fadulelsied A, Pal I, Awadalla H, Mohyeldeen N, Morshed M

1 Master student at Asian Institute Of Technology, Asian Institute of Technology, Public Health Institute, Public Health Institute, Asian Institute of Technology

OPS 11: Health effects of climate change in low- and middle-income countries, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Drought is recognized as being one of the major hazards that threaten public health in Sudan. Since El Niño Southern Oscillation affecting the weather and rainfall patterns in Sudan, the next decades are likely to see a considerable rise in drought's severity and frequency. The present study aims to assess the impact of drought on child health in rural and semi-urban communities in North Kordofan state, Sudan, to identify the critical determinants for child health risk associated with drought, and the social vulnerability in the study area. A critical review of national policies was also done to identify its implication on health risk reduction and governance of health risk impact of drought. Health facility base survey has also been conducted to assess the effect of drought on the quality, availability, and utilization of the health services in the rural and semi-urban communities in North Kordofan state. Health Statistics and metrological data used to check the correlation between the annual precipitation and child health in the study area. The study found that children aged less than five years are more likely to get moderate or severe wasting (underweight for age) in the second and third year of drought where annual rainfall decreased by 8–15% compared to long-term average rainfall. The study recommends few concerns on proactive health risk management associated with drought, the establishment of drought monitoring and early warning system to support developing risk-based drought reduction policy for reduction drought-induced short-medium-long term health risks in Sudan.
Monsoon flooding and early childhood health in India

Dimitrova A\textsuperscript{1,2}, Kumar Bora J\textsuperscript{1,3}

\textsuperscript{1}Wittgenstein Centre for Demography and Global Human Capital, \textsuperscript{2}International Institute for Applied Systems Analysis, \textsuperscript{3}Indian Institute of Dalit Studies

OPS 11: Health effects of climate change in low- and middle-income countries, Room 117, Floor 1, August 27, 2019, 10:30 - 12:00

Background: India is expected to experience an increase in the frequency and intensity of floods in the coming decades, which poses serious risks to human health and wellbeing in the country. Objective: This paper aims to shed light on the possible detrimental effects of flood exposure on childhood undernutrition in India using the Demographic and Health Survey 2015-16, in combination with fine resolution climate data. Methods: Undernutrition is captured through measures of stunting, wasting and being underweight among children age 0-59 months. The standardised precipitation and evapotranspiration index (SPEI) is used to identify wetter than normal conditions during the monsoon season, which is a strong predictor of flood build-ups. We focus on children’s early years of life, starting from in-utero up until age 5. Results: The results of a multivariate logistic regression show that wetter than normal conditions during the monsoon season exacerbate undernutrition among rural children, while the effects on urban children is limited. Continuous exposure to wetter than normal conditions increases the odds of stunting by 23% for rural children (99% confidence) and has no effect on urban children. Further, climatic conditions in utero and during infancy can have long-lasting implications on the child’s later development; rural children exposed to positive SPEI shocks during these early years continue to be at higher risk of stunting up to age 5. Short-term effects are also found; rural children exposed to positive SPEI shocks during the latest monsoon months are at higher risk of being underweight (10% at 99% confidence). These effects are different across regions in India, with children in rural central and eastern India consistently at a higher risk of undernutrition due to positive SPEI shocks. Conclusions: The findings of the present analysis warn of the urgent need to provide long-term nutritional programs to assist children in flood-prone areas.
Background: Recent public drinking water contamination crises, such as in Flint, Michigan, have brought more attention to the state of public drinking water in the US. However, these crises are at levels that the EPA deems unsafe for consumption. We aim to quantify the health effects of contamination below the regulatory threshold.

Methods: We build a data set that links infant health outcomes from the universe of birth records in Pennsylvania from 2003–2014 and Community Water System (CWS) drinking water contaminant measurements using the geocoded coordinates of a mother’s residence and public drinking service area boundaries. We restrict our sample to births that are singleton and not exposed to regulatory violations. Using longitudinal linear regression models with CWS fixed effects, we estimate birth outcomes (e.g., low birth weight (LBW); preterm birth (PTB)) associated with standardized measures of overall contamination and separately for bacterial and chemical contamination. We adjust for maternal socio-economic status, pregnancy risk factors, birth month-year, and weather (e.g., temperature, precipitation).

Results: Our results suggest that moving from the 10th to the 90th percentile of chemical contamination among births not exposed to regulatory violations increases the chance of low birth weight by about 1.3pp and the chance of pre-term birth by 1.9pp. We find consistent adverse effects when using small for gestational age or term birth weight as outcomes. Estimates are slightly attenuated when we compare contamination between siblings. We find small effects on fertility, no effect on maternal mobility between pregnancies, and consistent results when we include births that are exposed to regulatory violations.

Conclusion: This work demonstrates that greater overall public drinking water contamination during gestation negatively affects birth outcomes, even when regulatory violations are not triggered. The health effects of pollution at levels below regulatory limits are critical considerations for revising environmental health policy.
Exposure to manganese in drinking water during childhood and association with attention-deficit/hyperactivity disorder: A nationwide cohort study.

Schullehner J1,2,3, Thygesen M1,2, Kristiansen S4, Hansen B3, Pedersen C1,2, Dalsgaard S1,5
1National Centre for Register-based Research, Aarhus University, 2Centre for Register-based Research at Aarhus University CIRRAU, 3Geological Survey of Denmark and Greenland, 4Department of Geoscience, Aarhus University, 5iPSYCH - The Lundbeck Foundation Initiative for Integrative Psychiatric Research

OPS 24: Drinking water contamination and children’s health, Room 411, Floor 4, August 27, 2019, 10:30 - 12:00

Background/aim: Exposure to manganese (Mn) in drinking water is suspected to be associated with adverse neurodevelopmental outcomes, amongst others Attention-Deficit/Hyperactivity Disorder (ADHD). Young children are susceptible to accumulate Mn, which can act as dopamine-related toxin. Previous epidemiological studies are few, of small size and did not address the characteristic longitudinal exposure pattern of drinking water Mn.

Methods: A nationwide population-based cohort study of all singletons born to Danish parents between 1992 and 2007 (N=643,401). Mn in drinking water was measured in 82,574 samples and linked spatially to the residential history of each child. Exposure was modelled both as highest exposure during the first five years of life and duration exposed to different Mn levels. The former model fitted the data best. Cox proportional hazards models were used to assess the association between Mn in drinking water and risk of ADHD and its subtypes ADHD-Inattentive subtype and ADHD-Combined subtype. Analyses were adjusted for age, sex, calendar year, socio-economic status (SES), parental psychiatric diagnoses and urbanicity.

Results: For ADHD overall, only females in the highest exposure quartile (>100 µg/l) had a small statistically significant increased hazard ratio (HR) of 1.09 (95% CI: 1.00-1.18) after adjusting for SES. No association was found in males. However, for ADHD-Inattentive subtype, both females and males showed an exposure-response association. In the highest quartiles, females had an HR of 1.51 (95% CI: 1.18-1.93) and males 1.20 (95% CI: 1.01-1.42).

Conclusions: Exposure to elevated levels of Mn in drinking water is associated with increased risk of ADHD, mainly driven by the association in females and the ADHD-Inattentive subtype. This is the largest epidemiological study on this topic and the only one to model exposure longitudinally. Further studies are needed to support these findings, disentangle potential confounding with other elements in drinking water and assess possible gene-environment interactions.
Associations between exposure to drinking water chlorination by-products and being born small or preterm - a nation-wide register-based prospective study including 500,000 singleton births

Säve-söderbergh M$^{1,2}$, Berglund M$^2$, Toljander J$^1$, Åkesson A$^2$

$^1$Science Division, National Food Agency, $^2$Institute of Environmental Medicine, Karolinska Institutet

Background
Chlorination is used globally for the production of clean drinking water, but by-products such as trihalomethanes (THM) are easily formed. There are indications that chlorination by-products may increase the risk of some adverse reproductive outcomes, but results are inconsistent. We conducted a nation-wide register-based prospective study to assess whether gestational exposure to THM via drinking water was associated with risk of small-for-gestational-age (SGA), preterm birth (PTB) and very preterm birth (VPTB).

Methods
We included all singleton births 2005-2015 of mothers residing in Swedish localities having >10,000 inhabitants, ≤ two operating water treatment plants, adequate information on chlorination procedures and sufficient number of routine THM measurements in tap water. Individual maternal exposure was obtained by linking THM measurements to residential history, categorized into no chlorination, <5, 5-15 and >15 µg THM/L. We also stratified by chlorination procedure. Outcomes and covariates were obtained via the linkage to Swedish health and administrative registers. Odds ratios (OR) and 95% confidence intervals (CI) were estimated by logistic regression using inverse probability weighting.

Results
Based on ~500,000 births and after full multivariable adjustment, we observed no clear association between THM exposure and risk of SGA based on all assessments. Stratifying by chlorination procedure revealed dose-dependent increased risk of SGA for hypochlorite (OR, 1.20; 95% CI, 1.08-1.33), comparing highest THM exposure with no chlorination, but not for monochloramine. For PTD and VPTD, we observed ORs 0.94 (95% CI, 0.88-1.00) and 0.83 (95% CI, 0.70-0.98), respectively comparing highest THM exposure with no chlorination.

Conclusions
This is one of the largest studies assessing drinking water THM-associated adverse reproductive outcomes and we were able to consider time-specific windows of exposure and all relevant individual confounders. After considering the chlorination procedure we observed indications of increased risk of SGA which occurred at a lower exposure than previously observed.
Impact of rotavirus vaccination and piped water access on childhood diarrhea rates in Peru, 2005-2015

Delahoy M¹, Carcamo C², Ordoñez L³, Vasquez V², Lopman B¹, Clasen T¹, Gonzales G², Steenland K¹, Levy K¹
¹Rollins School Of Public Health, Emory University, ²Universidad Peruana Cayetano Heredia, ³Ministerio de Salud del Perú (Ministry of Health, Peru)

OPS 24: Drinking water contamination and children’s health, Room 411, Floor 4, August 27, 2019, 10:30 - 12:00

Background: Peru has undergone several health and infrastructure developments since 2005, including increased access to piped drinking water and national introduction of oral rotavirus vaccination. We examined whether these factors were associated with lower diarrhea rates in children under five.

Methods: We fit a negative binomial model investigating the impact of rotavirus vaccination and piped water access on diarrhea rates in the 195 Peruvian provinces from 2005-2015, considering the interaction between these factors, and controlling for long-term and seasonal (El Niño) trends. We compared the “pre-(rotavirus) vaccine” (2005-2009) and “post-vaccine” (2010-2015) eras. Annual percentages of households in each province with access to piped water were analyzed in quartiles.

Results: The 2005 childhood diarrhea rate was ~27 annual clinic visits per 100 children and decreased ~3% per year. Higher access to piped water was associated with significantly lower childhood diarrhea rates in the post-vaccine era only. We found no effect of the rotavirus vaccine in the lowest quartile of piped water access. Controlling for long-term trend, compared to the pre-vaccine era, the diarrhea rate was lower in the post-vaccine era by 7% (95% confidence interval (CI): 2-12%), 13% (95% CI: 7-19%), and 15% (95% CI: 10-20%) in the 2nd, 3rd, and 4th quartiles of piped water access, respectively. Diarrhea rates were significantly higher (6%, 95% CI: 4-8%) during moderate or strong El Niño events.

Conclusions: Explanations for higher reductions in diarrhea rates from the pre- to post-vaccine era in provinces with better piped water access include: children without piped water may be predisposed to environmental enteric dysfunction, diminishing oral vaccine impact, and/or the etiologic patterns of diarrhea (and effectiveness of a vaccine targeting a viral pathogen) may differ by water source. Improved access to piped water and rotavirus vaccination may operate synergistically to reduce childhood clinic visits for diarrhea in Peru.
PFOA exposure assessment in North Rhine-Westphalia, Germany, linking birth registry data with tap water concentrations

Kolbe A, Rathjens J, Becker E, Bucker-Nott H, Ickstadt K, Holzer J
1 Ruhr University Bochum, Department of Hygiene, Social and Environmental Medicine, 2 TU Dortmund University, Chair of Mathematical Statistics with Applications in Biometrics, 3 Medical Association Westphalia-Lippe

OPS 24: Drinking water contamination and children’s health, Room 411, Floor 4, August 27, 2019, 10:30 - 12:00

Background:
In 2006, Perfluorooctanoic Acid (PFOA) had been detected in drinking water of several waterworks supplying more than 4 million residents in North Rhine-Westphalia, Germany. Tap water consumption is regarded a major route of exposure to PFOA in these areas. We here report on an exposure assessment model and its validation by comparing the predicted PFOA-concentrations with observed data from biomonitoring studies of the Arnsberg cohort.

Methods:
Data from more than 1.7 million women between 2003 and 2014 was derived from the birth registry. Human biomonitoring data was available from a cohort of highly-exposed women (Arnsberg; n = 161) and from background-exposed women (n = 150).
A single-compartment pharmacokinetic model based on age, body weight and PFOA concentrations in tap water was developed to calculate PFOA serum concentrations for 2002 to 2014. Model parameters such as age-dependent water consumption, volume of distribution and PFOA-background exposure were derived from literature. Linkage of predicted PFOA-concentrations to mothers from the birth registry was based on PFOA concentrations in drinking water, body-weight, age and date of conception.

Results:
Predicted PFOA values are successfully linked to 321,282 mothers from the birth registry.
For highly-exposed mothers from the Arnsberg cohort predicted mean serum PFOA-concentration is 29.3 ng/ml, while the observed mean serum level is 26.8 ng PFOA/ml. For background-exposed mothers predicted and observed mean serum PFOA concentrations are 2.3 and 3.2 ng/ml, respectively. For all participants of the biomonitoring studies (n = 311), Spearman rank correlation coefficient of predicted and observed PFOA serum concentrations is 0.77 (p-value < 0.0001).

Conclusions:
The exposure estimation allows to differentiate satisfactorily between exposed and non-exposed residents and reflects temporal trends of PFOA concentrations in drinking water. The data will be used to investigate associations between PFOA-exposure and possible health outcomes, e.g. birth weight.
Early life and adolescent arsenic exposure from drinking water and blood pressure in adolescence: evidence from rural Bangladesh

Chen Y, Wu F, Ahsan H, Graziano J

1 New York University, 2 The University of Chicago, 3 Columbia University

OPS 24: Drinking water contamination and children’s health, Room 411, Floor 4, August 27, 2019, 10:30 - 12:00

Background: Inorganic arsenic (As) exposure from drinking water has been related to cardiovascular disease and increased blood pressure (BP) in adults. However, evidence of the association between inorganic As exposure, especially early-life exposure, and BP in adolescence is limited.

Methods: We conducted a cross-sectional study of 726 adolescents aged 14–17 (mean 14.75) years whose mothers were participants in the Bangladesh Health Effects of Arsenic Longitudinal Study (HEALS). Adolescents’ BP was measured at the time of their recruitment between December 2012 and December 2016. We considered maternal urinary As (UAs) which was repeatedly measured during childhood as proxy measures of early childhood (< 5 years old, T1) and childhood (5-12 years old, T2) exposure and current UAs from the adolescents at the time of the recruitment (14-17 years of age, T3).

Results: Every doubling of UAs at T3 and maternal UAs at T1 was positively associated with a difference of 0.7-mmHg (95% confidence interval [CI]: 0.1, 1.3) and a 0.7-mmHg (95% CI: 0.05, 1.4) in SBP, respectively. These associations were stronger in adolescents with a BMI above the median (17.7 kg/m2) than those with a BMI below the median (P for interaction = 0.03 and 0.03, respectively). There was no significant association between any of the exposure measures and DBP. Mixture analyses using Bayesian Kernel Machine Regression identified UAs at T3 as a significant contributor to SBP and DBP independent of other concurrent blood levels of cadmium, lead, manganese, and selenium.

Conclusions: Our findings suggest an association of current exposure and early childhood exposure to As with higher BP in adolescents, which may be exacerbated by higher BMI at adolescence.
OPS 27: Radiation, EMF and morbidity
Maternal Exposure to High Magnetic Field Non-Ionizing Radiation During Pregnancy and the Risk of Headaches and Migraines in Offspring: A prospective cohort study with up to 21 years of follow-up

Li D1, Chen H1, Hirst A1, Ferber J1, Odouli R1
1Division Of Research, Kaiser Permanente

Background/Aim: Both human and animal studies have shown that in-utero exposure to magnetic field non-ionizing radiation (MF) could impact neurodevelopment in offspring. Taking advantage of a large prospective cohort study with objective measurements of maternal MF exposure during pregnancy, we examined the relationship between maternal MF exposure level in pregnancy and the risk of headaches and migraines in offspring.

Methods: Consented pregnant members of Kaiser Permanente Northern California were asked to wear an EMDEX meter for 24 hours to measure MF exposure levels from all sources during pregnancy. We used the 95th percentile of the 24-hour MF measurements to categorize MF level, focusing on high MF level. Offspring were followed throughout their childhood to identify clinical diagnoses of recurrent headaches (two or more) and migraines from our medical records. A total of 734 mother-child pairs were included in the analysis. The Cox Proportional Hazards regression was used for analysis, accounting for varying follow-up times.

Results: After controlling for multiple confounders, the children whose mothers were exposed to higher MF levels [95th percentile ≥ 5 milligauss (mG)] had a 73% higher risk of recurrent headache with or without migraine [hazard ratio (HR) (OR)=1.73, 95% confidence interval (CI): 1.11-2.69] compared to children of mothers whose MF level was lower than 5 mG. The association was stronger for offspring with both headache and migraine diagnoses (HR=2.43, 95% CI: 1.28-4.61) with a dose-response relationship. The association appears to be stronger among Whites and male offspring.

Conclusions: Maternal high MF exposure during pregnancy is associated with an increased risk of recurrent headaches and migraines in offspring. Some maternal and children’s characteristics such as race/ethnicity and sex may contribute to the susceptibility to the exposure. This is the first human study with MF exposure objectively measured during pregnancy to show such a long-lasting MF impact.
Radiofrequency electromagnetic fields exposure, screen time and cognitive function in children and adolescents at 9-18 years old

Cabré-Riera A1, van Wel L2, Liorni I3, Capstick M3, Vermeulen R2,4,5, Gonzalez-Safont L8, Ibarluzea J7,9,10, Torrent M11, Vrijheid M1,6,7, Guxens M1,6,7,12

1Isglobal, 2Institute for Risk Assessment Sciences (IRAS), 3IT’IS Foundation, 4Julius Center for Health Sciences and Primary Care, University Medical Center, 5School of Public Health, Imperial College London, 6Pompeu Fabra University, 7Spanish Consortium for Research and Public Health (CIBERESP), Instituto de Salud Carlos III, 8Epidemiology and Environmental Health Joint Research Unit, FISABIO-Universitat Jaume I, Universitat de València, 9BODONOSTIA Health Research Institute, 10Departamento de Salud del Gobierno Vasco, Subdirección de Salud Pública de Guipúzcoa, 11Ib-salut, Area de Salut de Menorca, 12Department of Child and Adolescent Psychiatry/Psychology, Erasmus University Medical Centre–Sophia Children’s Hospital

OPS 27: Radiation, EMF and morbidity, Room 210, Floor 2, August 27, 2019, 10:30 - 12:00

Purpose: To evaluate the association between radiofrequency electromagnetic fields (RF-EMF), screen time, and cognitive functions in children and adolescents aged 9-18 years.

Methods: Cross-sectional study in children of 9-11 years old (n=2,952) and adolescents of 17-18 years old (n=261), from the Dutch ABCD Study and the Spanish INMA Project. Information on children’s use of telecommunication and other screen devices (i.e.: mobile phones, tablets, and laptops) was collected and whole-brain and lobe specific brain radiofrequency electromagnetic fields (RF-EMF) doses (joules/kg/day) were estimated using an integrated exposure algorithm. Validated cognitive tests were performed to assess non-verbal IQ, verbal IQ, attentional function, working memory, task shifting, cold executive function, visuomotor coordination, fine psychomotor speed and coordination, and processing speed. Multiple imputation and inverse probability weighting were applied to correct for potential attrition bias.

Results: In children, the increase of 0.1 joule/kg/day of whole brain or lobe specific RF-EMF doses, depending on the outcome, was associated with lower non-verbal IQ [e.g. β -0.01 points (95%CI -0.02; -0.01)], and poorer visuomotor coordination [e.g. β 970.07 milliseconds (95%CI 60.28; 1879.85)]. In adolescents, the increase of 0.1 joule/kg/day to the whole brain was associated with lower three-back detectability, a proxy of superior working memory [β -0.07 (95%CI -0.15; -0.01)]. Higher screen times were associated with better or poorer performance of the different cognitive tests, depending on the type of device.

Conclusion: RF-EMF dose to the brain was associated with poorer cognitive function including non-verbal IQ, visuomotor coordination, and working memory. However, screen time has different pattern of association depending on the cognitive function assessed.
Background: Based on the known association between inhaled radon and lung cancer, residential radon is recognised as a major public health issue in Switzerland. Using a previous Swiss-wide residential radon model an association with skin cancer mortality in adults was also found. To support ongoing epidemiological research, an updated national radon model is needed.

Methods: Models were developed using the Swiss Radon Database (ca. 200,000 measurements; 1994-2017) including information on dosimeter type, start and end dates, room type, geographic coordinates, and floor number. After data cleaning ca. 73,000 measurements were retained, and randomly stratified into 80% for model development and 20% for external validation. A range of geographic predictors (i.e. geology, soil texture, terrestrial radiation, urbanisation) and building specific predictors (i.e. dwelling type, construction period, and floor of the dwelling) were included in the 3-D models (x,y, floor). Three modelling algorithms were tested: linear regression, spatial error model, and Random forest. Spatial clustering of measurements was accounted for in the latter two. Predictions were made for all residential dwellings in the country.

Results: Important predictors in all models were geology, soil texture, dwelling type, construction period and floor on which the measurement was taken. The Random forest performed best on validation, with preliminary results indicating 30% of the variation in radon concentration explained. This was followed by the spatial error model with 22% explained, and linear regression with 17% explained. The estimated mean (standard deviation) long-term radon exposure for adults in Switzerland, for example, was estimated as 70.2 (31.3) Bq/m³ using the linear regression.

Conclusion: Random forest and the spatial error model offered gains in performance compared to the linear regression and the previous Swiss model. All three models will be applied to the population and further compared prior to final selection and use epidemiological research.
Light exposure patterns and sleep in children

Huss A, van Wel L, Bogaards L, Vrijkotte T, Vermeulen R

1Utrecht University, 2Department of Public Health, UMC, University of Amsterdam, Amsterdam Public Health Research Institute

OPS 27: Radiation, EMF and morbidity, Room 210, Floor 2, August 27, 2019, 10:30 - 12:00

Background: Experimental studies have reported effects of evening or light at night (LAN) exposure on melatonin and sleep. Few studies have been performed in children that objectively assessed light exposure and sleep under normal living conditions. We aimed at exploring effects of timing of first instance of, and duration (in minutes) of bright daylight exposure (>1000lux), light in the hour before children went to bed, and bedroom LAN exposure on sleep onset delay, sleep efficiency and sleep duration in 244 children aged 11-13 years.

Methods: Children were instructed to wear a light meter (logging average illuminance per 10 seconds) as a pendant during the day, to place it on their nightstand during the night, and to wear an accelerometer on their non-dominant wrist during 8 days (logging interval 100Hz). We evaluated the effect of light metrics on sleep efficiency and sleep onset delay (both dichotomized at the 80th percentile) using mixed effects logistic regression, and on sleep duration using linear mixed models, nested in participants and adjusted for age, sex and weekday.

Results: We observed reduced sleep efficiency and longer sleep onset delay in children with higher light levels in the hour before they went to bed, but not with LAN levels or with the duration of bright light children had received during the day. In contrast, LAN levels and duration of bright light during the day, but not light in the hour before children went to bed, were associated with shorter sleep duration. Timing of bright light did not affect assessed sleep outcomes.

Interpretation: Exposure to light received at different time points during the day, evening or night has effects on different aspects of sleep.
Is uranium exposure associated with an increase in thyroid-related antibodies?

Van Gerwen M1, Alpert N1, Taioli E1

1Icahn School Of Medicine At Mount Sinai

OPS 27: Radiation, EMF and morbidity, Room 210, Floor 2, August 27, 2019, 10:30 - 12:00

Background/ Aim:
Ionizing radiation is a known risk factor for thyroid cancer. However, the effect of uranium, a radioactive element naturally present in the environment, on thyroid function is not fully understood. Some studies suggested an association between increasing levels of urinary uranium and decreased total and free thyroxine levels, however the effect of uranium exposure on thyroid-related antibodies is unknown. Thyroglobulin antibodies (TgAb's) are thought to distinguish between who are euthyroid or who have clinical disease.

Methods:
We used the National Health and Nutrition Examination Survey (NHANES) from 2007-2010 to analyze the relationship between urinary uranium levels and two thyroid related antibodies; thyroid peroxidase antibodies (TPOAb) and thyroglobulin antibodies (TgAb) in adults > 20 year old without thyroid disease (n=3125). TPOAb and TgAb (IU/mL) were creatinine- and log-adjusted. Models with uranium as a log-adjusted/ creatinine-adjusted continuous variable, and divided into quartiles of exposure, adjusting for age, sex, race, and BMI were assessed, using complex survey design.

Results:
The median (IQR) creatinine-adjusted urinary uranium level was 0.006 (0.003, 0.011) μg/g creatinine. After adjustment, there was a significant positive association between higher uranium exposure and TgAb (β=0.11, 95% CI: 0.02-0.20 for quartile 2; β=0.11, 95% CI: 0.01-0.22 for quartile 3; β=0.08, 95% CI: -0.02-0.22 for quartile 4, compared to quartile 1). There was a marginally positive association between urinary uranium levels and TgAb (p=0.0947) in the continuous model. There was no significant association of TPOAb with urinary uranium in either model.

Conclusions:
Exposure to uranium is significantly associated with increasing TgAb levels; this association was not found for TPOAb. Since TgAb provides a surrogate for thyroglobulin, a precursor for thyroid hormones, our results possibly suggest that long-term exposure to uranium may lead to thyroid dysfunction.
Ambient particle radioactivity and risk for gestational diabetes among pregnant women in Massachusetts, USA

Papatheodorou S1
1Harvard TH Chan School Of Public Health

OPS 27: Radiation, EMF and morbidity, Room 210, Floor 2, August 27, 2019, 10:30 - 12:00

Background/aim: Radiation exposure has been associated with development of type 2 diabetes mellitus (T2DM), and air pollution, which may contain radioactive particles, has been associated with greater risk of gestational diabetes (GDM). However, the effect of ambient PM radioactivity on GDM risk has not been evaluated.

Methods: We obtained data on GDM incidence and delivery date from the Massachusetts Registry of Vital Records from 2001-2016 including primiparous women without pre-existing diabetes. We estimated regional mean particulate matter (PM) gross beta activity from five monitors in the greater Boston area as a surrogate for ambient PM radioactivity, and we calculated exposures for each participant in three different time windows: first trimester, second trimester and average exposure during first and second trimester for each woman. We used logistic regression to examine the association between gross beta activity exposure and GDM, adjusted for sociodemographics, year of delivery, other prenatal comorbidities, and trimester specific PM2.5 exposure.

Results: Of 428,016 women, 16,223 (3.8%) developed GDM. First trimester and cumulative first and second trimester exposures were associated with greater risk of GDM. Each interquartile range (IQR) increment in PM gross beta activity (6.7×10⁻⁵ Bq/m³) during the first trimester was associated with 5% greater odds of developing GDM (95% CI: 1-9%). The association was stronger for first and second trimester average exposure, where each IQR (5.6 1.0×10⁻⁵ Bq/m³) increment in PM gross beta activity was associated with 7% greater odds of developing GDM (95% CI: 2-8%).

Conclusion: In Massachusetts, early pregnancy exposure to low-level environmental radiation was associated with an increased risk of GDM. Particle radioactivity is an overlooked characteristic of air pollution and may provide additional insight into mechanisms through which air pollution manifests its toxicity. Since the incidence of GDM and subsequent T2DM are rising, identification of potentially modifiable risk factors is of great importance.
OPS 49: Air pollution exposure methods

A New Method of Estimating Global PM2.5 Concentrations using Satellite Images

Hong K1, Weichenthal S1

1McGill University

Background: Few studies have examined deep learning image analysis for use in evaluating environmental exposures

Methods: Here we present a new method of predicting spatial variations in outdoor fine particulate air pollution (PM2.5) concentrations using deep convolutional neural networks. Specifically, we trained new deep learning models over the global exposure range (<1-436 ug/m3) using a large database of satellite images paired with ground level PM2.5 measurements available from the World Health Organization. In addition, we trained models over the more limited exposure range of North America (<1-16 ug/m3) using a large database of satellite images linked to ground-level PM2.5 estimates obtained through remote sensing. Final model selection was based on a systematic evaluation of well-known architectures for the convolutional base including InceptionV3, Xception, and VGG16. Models were developed to predict continuous exposures as well as categorial estimates across ten ordinal categories of exposure split by deciles.

Results: The Xception architecture performed best in both models. For the global model, a root mean square error (RMSE) value of 13.01 ug/m3 was observed with a strong correlation between measured and predicted values in the disjoint test set (R2=0.75). For North America, the RMSE value was 0.74 ug/m3 with an R2 value of 0.89.

Conclusions: Our findings suggest that deep convolutional neural networks may offer an alternative, cost-effective means of predicting spatial variations in long-term average PM2.5 concentrations.
Short-term PM$_{2.5}$ and cardiovascular admissions in NY State: assessing sensitivity of exposure model choice

He M$^1$, Do V$^1$, Liu S$^1$, Kinney P$^2$, Fiore A$^1$, Jin X$^1$, DeFelice N$^3$, Kioumourtzoglou M$^1$

$^1$Columbia University, $^2$Boston University, $^3$Icahn School of Medicine at Mount Sinai

OPS 49: Air pollution exposure methods, Room 412, Floor 4, August 27, 2019, 10:30 - 12:00

Background: In recent years, there has been an increasing use of air pollution prediction models in health studies for exposure assessment even in areas without monitoring stations. To date, these studies have assumed that a single prediction model is correct. However, a systematic evaluation of the sensitivity of the estimated effects to exposure model choice is lacking.

Methods: We obtained county-level daily cardiovascular (CVD) admission counts and four sets of fine particulate matter (PM$_{2.5}$) predictions for New York State (2002-2012), including the Community Multi-scale Air Quality Model (CMAQ), the Centers for Disease Control and Prevention’s Wide-ranging Online Data for Epidemiologic Research (CDC), among others. We employed overdispersed Poisson models to investigate the relationship between daily PM$_{2.5}$ exposure and CVD admissions, adjusting for potential confounders, separately for each set of PM$_{2.5}$ predictions. We also used PM$_{2.5}$ measured at monitoring stations available in 18 of 62 counties and repeated analyses.

Results: Across different exposure datasets, we observed positive, significant associations between PM$_{2.5}$ and CVD for three out of the four PM$_{2.5}$ datasets. Per 10 µg/m$^3$ increase in daily PM$_{2.5}$, effect estimates ranged from 0.23% (95%CI: -0.06, 0.53%) to 0.88% (95%CI: 0.68, 1.08%). In general, results from CMAQ yielded the highest effect estimates, while results from CDC yielded the lowest effect estimates. For the counties with monitoring data, the effect estimate was 0.96% (95%CI: 0.62, 1.30%).

Conclusions: While effect estimates varied by a factor of almost four across methods, likely due to exposure measurement error, the association between PM$_{2.5}$ and CVD admissions was robust, regardless of the exposure metric. Uncertainty related with the exposure model selection is not captured in the individual estimated effects. Methods are needed for improved exposure assessment that minimizes error and includes uncertainty characterization and propagation into the health models.
Assessing spatial variation of PM2.5 and NO2 across Europe using Geographically Weighted Regression

Chen J1, de Hoogh K2,3, van Donkelaar A4, Ketzel M5,6, Hertel O5, Gulliver J7, Martin R4,8, Brunekreef B1,9, Hoek G1

1Utrecht University, 2Swiss Tropical and Public Health Institute, 3University of Basel, 4Dalhousie University, 5Aarhus University, 6University of Surrey, 7University of Leicester, 8Harvard-Smithsonian Center for Astrophysics, 9University Medical Center Utrecht

OPS 49: Air pollution exposure methods, Room 412, Floor 4, August 27, 2019, 10:30 - 12:00

Background/ Aim
Standard Land Use Regression (LUR) models assume the relationships between air pollution and predictors are constant across spaces, which may not be true. Geographically Weighted Regression (GWR) can deal with spatially varying relationships. We aimed to develop Europe-wide GWR models, and to check whether they model spatial variability of air pollution better than the standard models.

Methods
Air pollution models were developed based on 2010 routine monitoring data from the AIRBASE (543 sites for PM2.5 and 2399 sites for NO2), using satellite observations, chemical transport model estimates and land use variables as potential predictor variables. We first built a standard LUR model across Europe using a supervised step-forward linear regression. Predictor variables selected by the standard model were included in a GWR model to allow spatially varying coefficients. Kriging was performed on the residual variation from the LUR models and added to the pollution estimates. We evaluated the models by performing five-fold cross-validation (CV) and by external validation (EV) using annual average concentrations measured at 416 (PM2.5) and 1396 sites (NO2) from the ESCAPE study.

Results
The PM2.5 GWR model performed well across Europe (CV-R2 0.68; EV-R2 0.70). Kriging only slightly improved the model performance (CV-R2 0.69; EV-R2 0.73). The GWR model outperformed the standard model (CV-R2 0.60; EV-R2 0.53) and the standard model plus kriging (CV-R2 0.64; EV-R2 0.67). Chemical transport model estimates and satellite observations were two of the most important predictors for the GWR model. The regression coefficient of road density was higher in western Europe and lower in northern and southern Europe. The NO2 GWR model had similar performance as the standard model. No reliable kriging could be fit through residuals of the NO2 estimates.

Conclusions
Geographically weighted regression modestly improved modeling of spatial variation of PM2.5 across Europe compared to a standard model.
Bayesian Nonparametric Ensemble for PM2.5 Prediction and Uncertainty Characterization

Liu J\textsuperscript{2}, Paisley J\textsuperscript{1}, Schwartz J\textsuperscript{2}, Martin R\textsuperscript{3}, Coull B\textsuperscript{2}, Kioumourtzoglou M\textsuperscript{1}

\textsuperscript{1}Columbia University, \textsuperscript{2}Harvard University, \textsuperscript{3}Washington University

OPS 49: Air pollution exposure methods, Room 412, Floor 4, August 27, 2019, 10:30 - 12:00

Background. Air pollution health studies rely on model predictions for exposure assessment. A significant limitation is that health effect estimates from these studies and their statistical uncertainty assume that a single exposure model is correct. Furthermore, none of these models provide spatio-temporal uncertainty estimates of these predictions.

Methods. We developed a Bayesian Nonparametric Ensemble (BNE) prediction model that uses existing prediction models as inputs, and adaptive and calibrated ensemble learning to weigh each candidate model by its prediction accuracy in space. BNE provides interpretable uncertainty estimates that reflect both inter- and intra-model uncertainty, as well as the uncertainty in ensemble prediction. To ensure proper uncertainty quantification, we non-parametrically model the ensemble’s predictive cumulative density function to be consistent with the empirical data distribution. We applied BNE to model PM2.5 concentrations in the Boston, MA, area in 2011, using inputs from three candidate models.

Results. In simulations, BNE greatly outperformed existing ensemble approaches for prediction and adequately quantified uncertainty. In the Boston, MA, application, BNE outperformed existing ensemble approaches by 30%-60% when comparing the cross-validation root mean square errors. The average BNE-predicted PM2.5 concentration in 2011 around Boston was 7.8 $\mu$g/m\textsuperscript{3} (interquartile range, IQR: 7.3–8.4), and the average standard deviation for these predictions was 0.32 $\mu$g/m\textsuperscript{3} (IQR: 0.17–0.43). As expected, uncertainty was highest at locations that the three candidate models provided discordant predictions, and were farthest from monitoring stations.

Conclusions. We developed a flexible ensemble model that weighs each candidate model by its spatial predictive accuracy, and—for the first time—provides spatially resolved uncertainty estimates. BNE can be extended to spatio-temporal applications. Our method transitions from single exposure model assumed to be correct to information integration from multiple exposure models, while fully characterizing exposure uncertainty, which can subsequently be propagated into health effects estimation for valid inferences.
The health risks of ultrafine particle (UFP, Dp<100 nm) exposure are an important subject of current investigation in air pollution epidemiology. With routine monitoring of UFP still uncommon, studies often use other co-emitted pollutants as proxy for UFP, with NOx considered a good choice. We use long term fixed site measurements along with extensive mobile monitoring data to evaluate the spatiotemporal correlation of UFP and NOx. We incorporate 3–6 years of hourly particle number (PN) concentration data from multiple fixed sites across the San Francisco Bay Area that include near freeway, urban, suburban and rural sites. In addition, we incorporate observations from a 32-month mobile monitoring campaign comprising >3,000 h of coverage of a range of road types and land uses.

Overall annual-average PN at the fixed sites span a range of $3 \times 10^3$ #/cm³ at rural site to $30 \times 10^3$ #/cm³ at near-freeway site. Across all sites, PN measurements on nearly all summer days show consistent, prominent mid-day peaks, lasting 5–7 h. This diurnal concentration pattern—characteristic of new particle formation (NPF)—is not observed for other co-emitted pollutants (NOx, BC, CO). While we found moderate correlation in diurnal patterns of NOx and UFP at sites with high traffic, the correlation dropped significantly for low traffic areas—especially during high insolation periods (e.g., summer daytime). Mobile monitoring data yielded similar results: NOx was observed to be a weaker proxy of UFP for non-freeway roads during high insolation periods. UFP in urban atmosphere is known to result primarily from vehicular traffic and photonucleation events, however, UFP exposure may be underestimated—especially in high insolation areas—if we use proxies for UFP that represent only emissions and not NPF. Our findings are especially important for ongoing and upcoming epidemiology studies that use other co-emitted pollutants as proxy of UFP.
Spatiotemporal Land-Use Regression Modeling of Fine Particulate Matter in the Middle Eastern Megacity of Tehran Using Distributed Space-Time Expectation-Maximization

Taghavi-shahri S\textsuperscript{1}, Fassò A\textsuperscript{2}, Mahaki B\textsuperscript{3}, Amini H\textsuperscript{4,5,6}

\textsuperscript{1}Department of Epidemiology and Biostatistics, School of Health, Isfahan University of Medical Sciences, \textsuperscript{2}Department of Management Information and Production Engineering, University of Bergamo, \textsuperscript{3}Department of Biostatistics, School of Health, Kermanshah University of Medical Sciences, \textsuperscript{4}Department of Environmental Health, Harvard T.H. Chan School of Public Health, \textsuperscript{5}Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, \textsuperscript{6}University of Basel

OPS 49: Air pollution exposure methods, Room 412, Floor 4, August 27, 2019, 10:30 - 12:00

Background: Land use regression (LUR) has been widely applied for exposure assessment in epidemiological research. In this study, for the first time, we developed a spatiotemporal LUR model using the recently introduced Distributed Space-Time Expectation-Maximization (D-STEM) software. The D-STEM accounts for spatial and temporal auto-correlations and the inclusion of spatial, temporal, and spatiotemporal predictors. Moreover, D-STEM concurrently imputes missing data and estimates the model parameters using the Expectation-Maximization algorithm.

Methods: The study area was the Middle Eastern megacity of Tehran, which has about 9 million urban residents, and its populated area covers approximately 613 km\textsuperscript{2}. Daily data of fine particulate matter (PM2.5) were obtained from a set of 30 fixed monitoring stations for the year 2015. A pool of 210 potentially predictive variables in six classes and 73 sub-classes was used for the model building process. The h-block cross-validation (h-block CV), a cross-validation method that accounts for spatial dependency, with two different block sizes were used for model selection and validation.

Results: The annual mean of the observed PM2.5 concentrations was 33 µg/m\textsuperscript{3}. The daily mean PM2.5 concentrations were higher than the 25 µg/m\textsuperscript{3} (WHO 24-hour guideline) in 254 days, higher than 35 µg/m\textsuperscript{3} (unhealthy for at least sensitive groups) in 124 days, and higher than 55 µg/m\textsuperscript{3} (unhealthy for at least sensitive groups) in 33 days. The R-squared and the average R-squared of 2-block and 5-block h-block CVs were 0.73 and 0.60 when the spatiotemporal aspect of the LUR model was assessed. These values were 0.68 and 0.47 when the spatial aspect of the LUR model was assessed, and 0.995 and 0.992 when the temporal aspect of the LUR model was assessed.

Conclusions: This study showed the competence of the D-STEM in LUR modeling. Moreover, it provides both short-term and long-term exposure assessment for future epidemiological studies.
Background/Aim: The association of air pollution with dementia has been recently reported. However, both specific air pollutant(s) and exposure time windows prior to dementia diagnosis, mostly relevant to the risk of dementia have not been investigated. This claim data-based study aimed to investigate the risk of diagnosed dementia in relation to PM10, SO2, O3, NO2, CO, respectively.

Methods: We used a population-based case-control design nested within one-million people with Taiwan’s National Health Insurance program in 2005, who were then followed to the end of 2013. Cases were newly diagnosed dementia patients aged 65 years and older in 2005-2013. Four controls were randomly selected, using density sampling method, for each case by matching date of dementia diagnosis, age, and sex. Air pollution data were retrieved from 76 nationwide air quality monitoring stations, and exposure was estimated, using spatial analyst method, for the 3, 5, and 7-year period, respectively prior to dementia diagnosis.

Results: Totally 7,053 cases of all-cause dementia and 28,212 controls were identified. After controlling for potential confounders, the multi-pollutants model showed no significant associations of all-cause dementia with any specific air pollutant regardless of exposure time-window. Disease-specific analysis showed an increased adjusted odds ratio (aOR) of Alzheimer's disease in relation to the highest quartile exposure of PM10 and O3 during 5- and 7-year period before diagnosis, with an aOR of 1.66 and 1.59, respectively for PM10, as well as 1.44 and 1.58, respectively for O3. Additionally, the highest quartile exposure to NO2 in the 5- and 7-year period before diagnosis was significantly associated with increased risk of vascular dementia, with an aOR of 2.06 and 1.94, respectively.

Conclusions: While PM10 and O3 were found to be significantly associated with increased risk of Alzheimer’s disease, NO2 was associated with significantly elevated risk of vascular dementia.
Association between Prenatal and Early Childhood Exposure to Ambient Particulate Matters and Risks of Autism Spectrum Disorder: An Exposure-Response Meta-analysis

Chang Y, Lin C, Lee F, Chen S
1Department of Environmental Health, Harvard T.H. Chan School of Public Health, 2Department of Health Policy and Management, Harvard T.H. Chan School of Public Health, 3Department of Epidemiology, Harvard T.H. Chan School of Public Health

OPS 53: Air pollution and neurological outcomes, Room 217, Floor 2, August 27, 2019, 10:30 - 12:00

Background
Complex genetic and environmental interactions could contribute to the development of autism spectrum disorder (ASD). The association between particulate matter (PM) exposure and risks of ASD in children remained controversial. The National Ambient Air Quality Standards (NAAQS) for PM$_{2.5}$ are intended to protect health of sensitive populations.

Methods
We searched PubMed, Embase, Cochrane, Web of Science, Compendex, Biosis Previews, and Agricultural & Environmental Science Databases for studies published before February 2019, investigating the association between prenatal and postnatal PM$_{2.5}$ exposure and risks of ASD in children. Primary analysis focused on risks of ASD during different exposure windows (1st, 2nd, 3rd trimesters, and early childhood period). Exposure-response meta-regression was performed to summarize pooled risks of ASD across various background PM$_{2.5}$ levels.

Results
We identified 11 studies (2 cohort and 9 case-control studies), including 311,789 children, eligible for this meta-analysis. Exposure to PM$_{2.5}$ with per 10 $\mu$g/m$^3$ increment at the 3rd trimester and early childhood period was associated with increased risks of ASD by 35% (relative risk, RR = 1.35, 95% C.I. = 1.18 – 1.55) and 64% (RR = 1.64, 95% C.I. = 1.16 – 2.34), respectively, but not significant at the 1st and 2nd trimesters. The effects of PM$_{2.5}$ exposure with per 10 $\mu$g/m$^3$ increment increased in an exposure-response manner, from 30% (RR = 1.30, 95% C.I. = 1.02 – 1.66) to 77% (RR = 1.77, 95% C.I. = 1.21 – 2.61) at background PM$_{2.5}$ levels from 8 $\mu$g/m$^3$ to 42 $\mu$g/m$^3$, respectively.

Conclusions
Our findings suggested the association between PM$_{2.5}$ exposure and risks of ASD, particularly within specific exposure windows. The risks of ASD could occur at broad PM$_{2.5}$ levels, even lower than current NAAQS for PM$_{2.5}$. 
Longitudinal Analyses of Fine Particulate Air Pollutants and Volumetric Changes in the Medial Temporal Lobe

Younan D1, Wang X1, Petkus A2, Serre M2, Vizuete W2, Espeland M3, Gatz M1, Resnick S4, Shumaker S3, Chen J1
1University Of Southern California, 2University of North Carolina, 3Wake Forest School of Medicine, 4National Institute on Aging

OPS 53: Air pollution and neurological outcomes, Room 217, Floor 2, August 27, 2019, 10:30 - 12:00

Background/Aim
Ambient fine particulate matter (PM₂.₅) is a novel environmental risk factor for brain aging. The medial temporal lobe (MTL) is vulnerable to the neuropathological changes in aging and Alzheimer’s disease (AD), but no studies have explored the putative neurotoxic effects of PM₂.₅ on the MTL.

Methods
Cognitively-intact community-dwelling older women (n=665; aged 71-89) from the Women’s Health Initiative Memory Study completed two structural brain MRI scans (MRI-1: 2005-6; MRI-2: 2010-11). A Bayesian Maximum Entropy spatiotemporal model was used to estimate 3-year average PM₂.₅ residential exposure preceding MRI-1. Generalized linear models were used to assess the PM₂.₅-effects on volumetric measures (5-year standardized difference) of the MTL and its components (hippocampus; parahippocampus; entorhinal cortex; perirhinal cortex; uncus).

Results
Women with greater PM₂.₅ exposures had progressive losses in MTL volumes, and this neurotoxic effect primarily affected the entorhinal cortex, parahippocampus, and uncus, but not the hippocampus or perirhinal cortex, independent of intracranial volume, geographic region, socio-demographics, lifestyle factors, and clinical characteristics. For each interquartile (2.81 µg/m³) increment of 3-year average PM₂.₅ exposure, the adjusted average volume significantly (p<0.05) decreased by 0.15 cm³ in the MTL, 0.04 cm³ in the entorhinal cortex, 0.06 cm³ in the parahippocampus, and 0.02 cm³ in the uncus. These associations were equivalent to more than 5-years of accelerated brain aging and remained statistically significant after adjusting for MRI measures of cerebrovascular damage. Further adjustment for neuroanatomic changes using the AD pattern similarity score greatly weakened the observed association with the MTL, while the adverse effects on the entorhinal cortex, parahippocampus, and uncus remained significant.

Conclusions
The overall neurotoxic effects of PM₂.₅ on MTL atrophy may be independent of cerebrovascular damage but largely contributed by preclinical AD neuropathologies. These assumed neuropathological processes could not fully explain the differential vulnerability to PM₂.₅ neurotoxicity on the entorhinal cortex, parahippocampus, and uncus.
Background. Air pollution has been related to brain structural alterations, but it is yet unclear during which developmental time-windows the brain is most vulnerable to exposure to air pollution. Here, we aimed to determine these windows of vulnerability.

Methods. We used data from 2,954 children from the Generation R Study, a birth cohort from Rotterdam, The Netherlands (enrollment: 2002-2006). Concentrations of nitrogen oxides, particulate matter of various sizes, and a proxy for black carbon were estimated at each home address that the participants have resided in during fetal life and childhood. These concentrations were then back- and forward extrapolated to cover the periods of interest on daily time scale. Diffusion tensor images were obtained when the children were 9-12 years old. Next, we used penalized distributed lag non-linear models to explore critical windows of susceptibility, defining the lag response relationship by cubic b-spline functions and adjusting for child and parental socioeconomic, and life-style characteristics. To minimize the potential attrition bias, we used inverse probability weighting.

Results. We found associations between fetal life exposures to all the analyzed pollutants with alterations in fractional anisotropy and mean diffusivity between weeks 24 and 30 of pregnancy (e.g. an increase in fractional anisotropy of 0.02 [95% CI 0.01 to 0.03] for each 20 µg/m3 increase in nitrogen oxides). In childhood analysis, we found associations between exposure to nitrogen oxides and black carbon at 3 to 4 years of age and alterations in mean diffusivity.

Conclusion. We identified critical windows of susceptibility to air pollutants highly ubiquitous in an urban setting in relation with alterations in the white matter microstructure of school-age children in weeks 24 to 30 for fetal exposures and years 3 to 4 for childhood exposures.
Ambient Air Pollution and Cognition in India

Adar S1, D’Souza J1, Shaddick G2, Langa K3, Bloom D4, Arokiasamy P5, Khobragade P6, Banerjee J7, Dey A7, Lee J6

1University of Michigan School of Public Health, 2University of Exeter, 3Michigan Medicine and Veterans Affairs Center for Clinical Management Research, 4Harvard TH Chan School of Public Health, 5International Institute of Population Sciences, 6University of Southern California, 7All India Institute of Medical Sciences

OPS 53: Air pollution and neurological outcomes, Room 217, Floor 2, August 27, 2019, 10:30 - 12:00

Background/Aim: Indians experience some of the highest air pollution levels in the world. We aimed to study if ambient PM2.5 levels are associated with poorer cognition in older Indians.

Methods: We used data from the Longitudinal Aging Study in India - Diagnostic Assessment of Dementia (LASI-DAD). LASI-DAD is a study nested within a nationally representative sample of older (>45 years) Indians. During the first phase of LASI-DAD, a subsample of participants (>60 years) underwent a battery of cognitive tests, including verbal fluency, word recall, and the Hindi Mental State Examination (HMSE). Participants also self-reported sociodemographic data. We estimated ambient PM2.5 for each participant’s residence using the Data Integration Model for Air Quality, which fuses satellite information on aerosol optical depth with ground level monitoring data and local geographic information. We then used linear regression models to estimate associations between ambient PM2.5 and cognitive scores, adjusting for age, gender, socioeconomic status, and region (North, Delhi, South).

Results: Among 1,480 participants, the average age was 69±7 years and 55% were female. Greater PM2.5 concentrations (117±24 µg/m3) and lower cognitive scores (HMSE: 16±11) were found in northern India (excluding Delhi) as compared to southern India (45±13 µg/m3 and 22±8, respectively). Ambient PM2.5 was suggestively associated with worse cognition after adjustment for region and other sociodemographic confounders. For example, we observed associations of -0.07 (95%CI: -0.2, 0.03) lower HMSE scores per 10 µg/m3 of PM2.5.

Conclusions: Among older adults living throughout India, we observed associations between higher ambient PM2.5 and poorer cognition even after adjustment for individual sociodemographic characteristics and regional trends.
Associations between exposure to ambient air pollutants and Parkinson's disease: a cross-sectional study

Morgan G\textsuperscript{1}, Salimi F\textsuperscript{1}, Hanigan I\textsuperscript{1}, Heyworth J\textsuperscript{2}, Knibbs L\textsuperscript{4}, Guo Y\textsuperscript{5}, Jalaludin B\textsuperscript{3}

\textsuperscript{1}University Of Sydney, \textsuperscript{2}University of Western Australia, \textsuperscript{3}University of New South Wales, \textsuperscript{4}University of Queensland, \textsuperscript{5}Monash University

OPS 53: Air pollution and neurological outcomes, Room 217, Floor 2, August 27, 2019, 10:30 - 12:00

Background: Epidemiological studies have reported contradictory results on the effects of ambient air pollution on Parkinson’s disease (PD). This study investigated the associations between long-term exposure to particles < 2.5 um in diameter (PM2.5) and nitrogen dioxide (NO2) and PD among participants in the 45 and Up Study who were adults older than 45 years living in New South Wales, Australia.

Methods: Annual NO2 and PM2.5 concentrations were estimated at the participants’ residential address using satellite-based land use regression and chemical transport model, respectively. Logistic regression was used to quantify the associations of these pollutants with self-reported doctor-diagnosed PD while adjusting for a range of individual- and area-level covariates. Stratified analyses were undertaken for sex and smoking status.

Results: Out of around 148,816 participants, 918 (0.6%) reported physician-diagnosed PD. Mean PM2.5 and NO2 concentrations assigned to study participants were 3.96 and 14.80 μg.m\(^{-3}\), respectively. We observed not statistically significant positive associations of PD with PM2.5. The adjusted odds ratio for a 1 μg.m\(^{-3}\) increase in PM2.5 was 1.06 (95% confidence interval (CI): 0.96 – 1.16). The adjusted odds ratio for a 5 μg.m\(^{-3}\) increase in NO2 was 1.04 (95% CI: 0.92 – 1.17). In subgroup analyses, larger the associations for men were, per 1 μg.m\(^{-3}\) increase in PM2.5, (OR: 1.10 (95% CI: 0.99 – 1.22) and past smokers (OR 1.16 (95% CI: 1.05 – 1.27).

Conclusions: Overall, limited evidence for associations between exposures to NO2 or PM2.5 and PD were found. The associations found among men and past smokers should be further investigated.
PDS 63: Chemicals and metals: health effects
Cadmium exposure and risk of adverse pregnancy outcomes: A systematic review and dose-response meta-analysis of cohort studies

Amegah A1, Sewor C1
1Public Health Research Group, Department of Biomedical Sciences, University Of Cape Coast

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim: Maternal cadmium exposure has been associated with adverse reproductive outcomes. A systematic review of the available evidence on cadmium exposure and reproductive health outcomes found insufficient evidence for most outcomes to draw meaningful conclusions, and as a result suggested the conduct of prospective studies to better evaluate the relationship. A significant number of prospective studies have since been published and calls for an evaluation of the available evidence. We therefore conducted a systematic review and dose-response meta-analysis to evaluate the quality and strength of the available evidence and to establish evidence of causality.

Methods: PubMed and Scopus databases were searched from their inception to January, 2019 with no language restrictions imposed. Eighteen prospective studies satisfied the inclusion criteria. Random effects model was used in computing the summary effect estimates and their corresponding 95% confidence intervals.

Results: Cadmium exposure resulted in 11.61g (95% CI: -20.87, -2.36) reduction in birth weight, and 0.145cm (95% CI: -0.247, -0.043) reduction in head circumference. Cadmium exposure also resulted in 21% (95% CI: 1.02, 1.43), 32% (95% CI: 1.05, 1.67) and 10% (95% CI: 0.96, 1.27) increased risk of low birth weight (LBW), preterm birth (PTB) and small for gestational age (SGA), respectively, with the risk for all outcomes decreasing with decreasing exposure. In fixed effects dose-response meta-regression analyses, we found no evidence of an association between cadmium exposure, and LBW and SGA. However, for PTB, a 1 µg/l increment in cadmium exposure corresponded to a 0.5% (OR = 1.005, 95% CI: 1.003, 1.007) increase in the risk of PTB.

Conclusions: We found cadmium exposure to be associated with risk of adverse birth outcomes. With regards to PTB, the formal dose-response meta-analyses suggests the association found may be causal.
Exposure to Particulate Matter and Respiratory Health among Electronic Waste Workers at Agbogbloshie, Accra, Ghana

Amoabeng Nti A1, Arko-Mensah J1, Basu N2, Batterman S3, Fobil J1, Robins T3

1University Of Ghana, 2Mcgill University, 3University of Michigan

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim: Particulate matter (PM) exposure has been linked to informal electronic waste (e-waste) recycling activities, and PM inhalation has been associated with several respiratory health problems, including increased prevalence of respiratory symptoms and lung function changes. This study investigated the association between measured personal exposure levels of PM (1 and 2.5 µm) and the respiratory health of e-waste workers at the large Agbogbloshie, Ghana, site.

Methods: 100 e-waste workers engaged in informal e-waste recycling at Agbogbloshie and 51 control subjects from Madina–Zongo were recruited and studies from March to April 2017. Each participant provided self-reported respiratory symptoms, diseases and work and home respiratory exposures. Lung function, including forced vital volume in one second (FEV1), forced vital capacity (FVC) and ratio (FEV1/FVC), was measured using a portable spirometer (Easy One) and personal breathing zone PM exposures (1 and 2.5µm) were measured using an optical instrument (MetOne Aerocet 831). Multiple regression analysis was performed to test the association between the PM and lung function measures.

Results: Higher mean concentrations of PM1, PM2.5 and PM10 were recorded among the e-waste recyclers (41± 2 and 84 ±7) compared to the control group (14 ± 1 and 33 ± 2). Overall, burners recorded the highest mean concentrations of PM1, PM2.5 and PM10, (49 ± 6 and 112 ±18) compared to dismantlers (34 ±3 and 54 ±7). No significant association was found between the PM (1, and 2.5µm) concentrations and lung function (FEV1) measures (-0.25, P=0.806; 0.41, P=0.685).

Conclusion: While e-waste workers had significantly higher exposure to PM in the breathing zone, associations with lung function measurements were not significant. This may be due to the short term (4-hours) measurements of PM among the workers. PM exposure patterns and e-waste tasks are being studied over time, to better understand the associated respiratory health effects.
Risk Factors for Head and Neck Cancer among World Trade Center Health Program General Responders: Results from a Nested Case-Control Study

Bover Manderski M1, Udasin I2, Giuliano A3, Black T3, Dasaro C4, Crane M5, Harrison D5, Luft B6, Moline J7, Graber J1,2

1Department of Biostatistics and Epidemiology, Rutgers School Of Public Health, 2Environmental and Occupational Health Sciences Institute, Rutgers, The State University of New Jersey, 3Department of Cancer Epidemiology, H. Lee Moffitt Cancer Research Center, 4WTC Health Program General Responder Data Center, Icahn School of Medicine at Mount Sinai, 5Department of Environmental Medicine, Bellevue Hospital Center/New York University School of Medicine, 6Department of Medicine, Stony Brook University Medical Center, 7Department of Occupational Medicine, Epidemiology and Prevention, Hofstra Northwell School of Medicine at Hofstra University

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background/AIM: Head and neck cancers (HNCs) may be among the health consequences of the World Trade Center (WTC) response efforts that followed September 11, 2001. We conducted a nested case-control study within the WTC Health Program (WTCHP) General Responder Cohort (GRC) to examine the effects of WTC exposures and behavioral risk factors on HNC.

Methods: We enrolled 64 cases and 136 controls without cancer, matched on age, sex, and race/ethnicity within risk sets. We assessed behavioral risk factors (tobacco, alcohol, sexual activity) during three time periods (before, during, and after WTC exposure until case diagnosis) via questionnaire. We obtained WTC exposure information (duration [first to last day], total days, and location of work) from the WTCHP General Responder Data Center. We estimated odds ratios and 95% confidence intervals (CI) using conditional logistic regression and assessed interaction among exposures and risk factors.

Results: Responders in protective services occupations had 2.51 times (95% CI: 1.09, 5.82) the odds of HNC than those in other occupations. Among those in non-protective services occupations, arriving to the WTC effort on 9/11/01 as opposed to later was associated with 3.77-fold increased odds of HNC (95% CI: 1.00, 14.11). Duration of work was not significantly associated with HNC. Lifetime and post-WTC years of cigarette smoking and post-WTC number of sex partners were positively and significantly associated with HNC, while alcohol consumption was not.

Conclusions: In this cohort of WTC general responders, we saw evidence that WTC exposures, occupation, and behavioral risk factors may be associated with risk for HNCs. These findings suggest opportunities for risk mitigation (e.g., smoking cessation, human papillomavirus vaccination) and contribute to a risk factor profile which may assist WTCHP clinicians with identifying high-risk responders and improve detection and treatment outcomes in this population.
Blood Lead Concentrations and Mortality in Korean Adults: Results from the Korea National Health and Nutritional Examination Survey 2008-2013

Byun G¹, Kim S¹, Kim S¹, Park D¹, Lee J¹,²

¹BK21PLUS Program in ‘Embodiment: Health-Society Interaction’, Department of Public Health Sciences, Graduate School, Korea University, ²School of Health Policy and Management, College of Health Science, Korea University

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim: Previous studies have reported an increased risk of mortality at high blood lead level. In Korea, the association between blood lead and mortality has not been investigated. While food is the major source of human exposure to lead and dietary pattern can be related to health, to best our knowledge, none of the previous studies have considered food intake as a potential confounder. Thus, we aimed to examine the association of mortality with blood lead for Korean adults considering lead-contaminated food intake.

Methods: From 2008-2013 KNHANES-linked mortality data which are followed through December 2016, we used 7,939 participants (46,990 person-years) who aged over 30 at the time of examination. We estimated the relative hazard of mortality from all-cause, circulatory diseases, and cancer through Cox-proportional hazard regression adjusted for potential confounders. Intake of grains, vegetables, and seafood calculated from dietary 24hr-recall data was additionally adjusted.

Results: Blood lead levels tended to increase as intake of grains, vegetables, and seafood increased. The natural log unit increase of blood lead levels was associated with an increase of all-cause (HR: 1.67, 95% CI: 1.11-2.53), circulatory diseases (HR: 2.84, 95% CI: 1.13-7.13), and cancer (HR: 1.77, 95% CI: 1.02, 3.08) mortality. Further adjustment of lead-contaminated food intake slightly increased the magnitude of the associations: all-cause (HR: 1.72, 95% CI: 1.14-2.60); circulatory diseases (HR: 3.02, 95% CI: 1.25-7.29); cancer (HR: 1.74, 95% CI: 0.98, 3.10).

Conclusions: We found that blood lead concentration was significantly associated with mortality in a representative sample of Korean adults, which is consistent results with previous studies. Lead-contaminated food intake is suspected to be a negative confounder as high consumption of grains, vegetables, and seafood is likely to be associated with a reduction in mortality.
Prenatal exposure to nitrates in drinking water and low birthweight: A population-based cohort study from Denmark, 1991-2011

Coffman V1, Søndergaard Jensen A2, Plana-Ripoll O2, Pedersen C2, Sigsgaard T2, Olsen J3, Guldberg Hansen B4, Schullehner J2,4, Pedersen M5, Stayner L1

1University Of Illinois at Chicago, 2Aarhus University, 3Aarhus University Hospital, 4Geological Survey of Denmark and Greenland, 5University of Copenhagen

Background/Aim: Findings from studies examining the effects of prenatal exposure to nitrate on fetal growth restriction have been inconsistent, small, and mostly ecologic in nature. The aim of this study was to assess maternal exposure to nitrates in drinking water and fetal growth restriction in a large population-based cohort study.

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 960,158 full-term singleton live births in Denmark during 1991-2011. The primary outcomes of interest were low birthweight (LBW) (<2500 grams) and birth weight (BW) at term (≥37 weeks of gestation). Logistic and linear regression models were used for LBW and BW respectively.

Preliminary Results: In the cohort, the median nitrate exposure, averaged over the entire pregnancy, was 2.23 mg/L NO3-. The highest decile of exposure (≥10.5 mg/L NO3-) compared to the lowest (<0.53 mg/L NO3-) was associated with an increased odds of LBW (odds ratio (OR): 1.11; 95% confidence interval (CI): 1.01, 1.21) and a reduction of -9.32 grams BW (95% CI: -13.90, -4.74) in fully-adjusted models. This exposure-response was also observed for log-transformed continuous nitrate exposure in fully-adjusted models for both LBW and BW and when the analyses were restricted to those births with home nitrate levels below the current European Union regulatory standard (50 mg/L NO3-).

Conclusions: In these preliminary findings, nitrate exposure was seen to be associated with an increased risk of LBW and reduced BW in full-term Danish-born children during 1991-2011. These findings suggest that current allowable level of nitrates in drinking water may not be sufficient to protect children from fetal growth restriction.
Combined phthalates exposure in pregnancy and increased children’s blood pressure at age 4 to 6 years

Collicino E1, Deierlein A2, Just A1, Hair G1, Svensson K3, McRae N1, Pizano-Zarate M4, Pantic I4, Schnaas L4, Tamayo-Ortiz M5, Calafat A6, Baccarelli A7, Tellez-Rojo M8, Wright R1,9, Sanders A1,9

1Department of Environmental Medicine and Public Health, Icahn School Of Medicine At Mount Sinai, 2College of Global Public Health, New York University, 3Department of Health Sciences, Karlstad University, 4Division of Community Interventions Research, National Institute of Perinatology, 5National Council of Science and Technology, National Institute of Public Health, 6National Center for Environmental Health, Centers for Disease Control and Prevention, 7Department of Environmental Health Sciences, Mailman School of Public Health, Columbia University, 8Center for Nutrition and Health Research, National Institute of Public Health, 9Department of Pediatrics

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background
Developmental exposure to endocrine disrupting chemicals, such as phthalates, may contribute to poorer metabolic health in childhood; however, there is limited previous research with inconsistent findings. We developed a Bayesian mixture approach to examine the association of combinations of urinary phthalate metabolites as a complex mixture with children’s blood pressure (BP) using a large prospective cohort of Mexican mother-child pairs.

Methods
We analyzed data from 529 mother-child dyads participating in the Programming Research in Obesity, Growth, Environment, and Social Stressors (PROGRESS) study for which prenatal urinary phthalate metabolites and children’s BP at age 4-6 years were available. We quantified urinary concentrations of 15 phthalate metabolites in spot samples collected from the 2nd and 3rd trimesters, and corrected concentrations for specific gravity. Our Bayesian mixture approach identifies both the linear association of each trimester mixture exposure with childhood BP and the contribution of each mixture component to the overall association. Covariates included maternal education and body mass index at 2nd trimester. Children’s BP percentiles were calculated based on age, sex, and height. Additional models were stratified by sex.

Results
We identified no association between phthalate metabolites and child BP overall. However, when stratified by sex, a complex mixture predominantly composed of eight phthalate metabolites [mono-2-ethyl-5-carboxypentyl (mECPP), mono-carboxyisonoxy (MCNP), mono-2-ethyl-5-hydroxyhexyl (MEHHP), mono-2-ethylhexyl (MEHP), mono-isobutyl (MiBP), mono-hydroxybutyl (MHBP), mono-hydroxyisobutyl (MHIIBP)] assessed in the 3rd trimester was associated with increased systolic BP among girls 4-6 years old (β=0.08; 95%CrI: 0.00; 0.16). No association was identified between SBP and the same mixture during 2nd trimester (β=0.01; 95%CrI: -0.07; 0.10).

Conclusion
Our findings suggest that early life exposure to select phthalates may increase BP in girls as early as 4-6 years of life. Long-term follow-up will increase our understanding of whether these subtle early life changes may influence later life cardiometabolic trajectories.
Arsenic Exposure, DNA methylation and Cancer Mortality in the Strong Heart Study

Domingo A1, Haack K2, Fallin D3, Tang W3, Herreros M4, Garcia E5, Bozack A1, Cole S2, Tellez M6, Navas A1
1Columbia University Mailman School of Public Health, 2Texas Biomedical Research Institute, 3Johns Hopkins Bloomberg School of Public Health, 4INCLIVA Biomedical Research Institute, 5Preventive Medicine and Public Health Department, Autonomous University of Madrid, 6National Center for Epidemiology

Background: Inorganic arsenic is an established human carcinogen. Epigenetic dysregulations, in particular DNA methylation (DNAm), are known to be major drivers of tumorigenesis. The objectives of this study were to evaluate the association of DNAm with overall and specific cancer mortality, as well as to assess the potential mediating role of DNAm in the relationship between inorganic arsenic and cancer.

Methods: DNAm was measured in blood samples taken at baseline (1989-1991) using the EPIC 850K platform in 2351 individuals of the Strong Heart Study. Data preprocessing included correction for batch effects and cell heterogeneity. Cancer mortality was available through 2008 (244 deaths). Differentially Methylated Positions (DMPs) between cases and non-cases were identified using linear regression in the R package limma as well as Cox regression (hazard ratio of the p90 vs p10 of DNAm). Differential variability was evaluated using the iEVORA algorithm. The potential mediating role of DNAm on the association between inorganic arsenic and cancer was evaluated using the Causal Inference Test (CIT) approach.

Results: Several DMPs were found for overall (6509), lung (144), and lymphatic and hematopoietic (29368) cancers. DMPs from linear regression versus survival analysis were not identical, but showed overlap for overall and lymphatic and hematopoietic cancers. They did not overlap for lung cancer. Differentially Variable Positions were found for the three types of cancer. Several CpG sites annotated to the gene NFYA, which has been previously related to leukemia, showed differential variability with lymphatic and hematopoietic cancers. We found no evidence supporting a mediating role of DNAm on the association between inorganic arsenic and cancer.

Conclusions: Our results show differentially methylated and differentially variable blood CpGs prospectively associated with later cancers. Further epigenetic studies should examine variability as well as differential means. These results need to be replicated in an external population.
Cardiovascular and cancer mortality in relation to dietary polychlorinated biphenyls and marine polyunsaturated fatty acids: nutritional-toxicological aspects of fish consumption

Donat Vargas C, Bellavia A, Berglund M, Glynn A, Wolk A, Åkesson A

1Cardiovascular and Nutritional Epidemiology, Institute of Environmental Medicine, Karolinska Institutet, Box 210, SE-171 77, 2Department of Environmental Health, Harvard T.H. Chan School of Public Health, 3Department of Biomedical Sciences and Veterinary Public Health, Swedish University of Agricultural Sciences (SLU), Box 7028, SE-750 07

Background: Co-exposure to environmental contaminants present in fish could counterbalance the beneficial effects of fish consumption and possibly explain the lack of association observed for mortality in certain regions.

Objective: To assess the independent associations between dietary polychlorinated biphenyl (PCB) exposure and long-chain omega-3 fish fatty acids intake, and all-cause, cardiovascular and cancer mortality.

Methods: We used the prospective population-based Swedish Mammography Cohort and the Cohort of Swedish Men comprising 32,952 women and 36,546 men, free from cancer, cardiovascular disease and diabetes at baseline in 1997. Validated estimates of dietary PCBs and long-chain omega-3 fish fatty acids [eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA)] were obtained via a food frequency questionnaire at baseline. Information on death was ascertained through register linkage.

Results: During a mean follow-up of 15.5 years, we ascertained 16,776 deaths. In women, comparing extreme quintiles for all-cause mortality in models mutually adjusted for PCBs and EPA-DHA, dietary PCB was associated with hazard ratio, HR 1.30; (CI 95%:1.10 to 1.55) [corresponding to one year and three months lower median age at death], and EPA-DHA with HR, 0.79; (CI 95%: 0.67 to 0.93) [corresponding to one year and two months higher median death age]. For cardiovascular mortality, the corresponding results were HRs 1.30 (95% CI 0.98-1.71) and 0.82 (95% CI, 0.63 to 1.17), respectively, and in men HRs 1.32 (CI 95%:1.02 to 1.70) and 0.76 (CI 95%: 0.59 to 0.98), respectively. Neither PCB nor EPA-DHA intakes were associated with cancer mortality in women or men.

Conclusion: The beneficial effect of fish consumption on the cardiovascular system seems compromised by co-exposure to PCBs – a likely explanation for the unclear associations observed between fish consumption and mortality.
Cadmium exposure and breast cancer risk: a systematic review and dose-response meta-analysis of cohort studies

Filippini T1, Kasdagli M2, Naska A2, Torres D3,4, Lopes C3,5, Carvalho C3,4, Moreira P3,4, Malavolti M1, Orsini N6, Vinceti M1,7

1Environmental, Genetic and Nutritional Epidemiology Research Center (CREAGEN), Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, 2Department of Hygiene, Epidemiology and Medical Statistics, School of Medicine, National and Kapodistrian University of Athens, 3EPIUnit - Institute of Public Health, University of Porto, 4Faculty of Food and Nutrition Sciences, University of Porto, 5Department of Public Health and Forensic Sciences, and Medical Education, Unit of Epidemiology, Faculty of Medicine, University of Porto, 6Department of Public Health Sciences, Karolinska Institute, 7Department of Epidemiology, Boston University School of Public Health

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background and aim: Cadmium is a heavy metal which has been implicated in breast cancer etiology because of its toxic properties such as endocrine disruption. The general population is exposed to cadmium through dietary intake, cigarette smoking, emissions of motorized traffic and industrial facilities. We carried out a systematic review and dose-response meta-analysis of the cohort studies investigating the association between cadmium exposure and breast cancer risk, for which inconsistent results have been reported in the literature.

Methods: Following online database search up to January 2019, we carried out a dose-response meta-analysis to identify the relation between cadmium exposure and disease risk. We used a restricted cubic spline model and the ‘one-stage’ approach, stratifying for exposure assessment method and menopausal status.

Results: We identified 12 studies, 9 using breast cancer incidence and 3 mortality as an outcome. In six studies cadmium exposure was assessed through dietary questionnaires, in five through urinary excretion levels, and in one based on environmental air levels. Seven studies included post-menopausal women only. Overall, we observed a positive linear relation between breast cancer risk and dietary cadmium intake (relative risk (RR) 1.04, 95% confidence interval (CI) 0.81-1.33 at 10 µg/day, and RR 1.12, 95% CI 0.80-1.56 at 20 µg/day). On the converse, risk was not associated with urinary excretion. Analysis restricted to post-menopausal women showed a positive association between cadmium exposure assessed through either dietary intake and urinary excretion, for levels higher than 20 µg/day and 1.65 µg/g creatinine, respectively.

Conclusions: Our dose-response meta-analysis suggests that cadmium exposure may be positively and linearly associated with breast cancer risk. Results were, however, dependent on the method used to assess exposure. For post-menopausal women, the shape of the association suggests that a threshold of exposure may be needed to raise cancer risk.
Serum Organochlorine pesticides residues and the risk of breast cancer: a case-control study

Hamad F

Gezira University

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background: breast cancer is the most common malignancy in women around the world and the leading cause of cancer mortality in developing countries. Organochlorine pesticides (OC) are positively related to increased breast cancer risk.

Aim: the aim of this study was to find the relationship between the Organochlorine pesticides residues and the females’ breast cancer risk in Sudanese female breast cancer patients attending the Wad- Madani Teaching Hospital, Gezira State, Sudan.

Method: the study was a case-control study performed on 67 females’ breast cancer patients. Fifty two healthy person’s cancers free were chosen as control group. The Organochlorine pesticides residues in serum were measured through using a modified QuEChERS method by Gas Chromatography/Mass-Spectrometer.

Results: most of the Organochlorine pesticides means were higher in the patients than in the control group. A significant relationship was appeared between some Organochlorine pesticides and the breast cancer risk special in rural areas.

Conclusion: further study is needed to confirm these results. This study suggested that Organochlorine pesticides exposures may increase breast cancer risk among Sudanese women. Regulation and controlling the wild used of pesticides must be active special in rural community.
Blood lead levels and risk of atherosclerosis in the carotid artery: Results from a Swedish cohort


1Department of Occupational and Environmental Medicine, Sahlgrenska University Hospital and University of Gothenburg, 2Department of Clinical Sciences, CRC, Lund University and Skåne University Hospital, 3Department of Molecular and Clinical Medicine, Wallenberg Laboratory for Cardiovascular and Metabolic Research, Sahlgrenska University Hospital and University of Gothenburg, 4Department of Clinical Chemistry, Sahlgrenska University Hospital

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim: Lead exposure has been associated with increased incidence of adverse clinical cardiovascular outcomes. Atherosclerosis has been suggested as one of the underlying mechanisms, and findings from experimental studies support this, but human data are scarce. Our objective was to determine the association between environmental lead exposure based on blood lead concentrations and the prevalence of atherosclerotic plaque in the carotid artery.

Methods: We used cross-sectional data from the Malmö Diet and Cancer Study cardiovascular cohort (MDCS-CC; recruitment in 1991-1994) covering 4172 middle-aged men and women. Blood lead (B-Pb) at baseline, measured by inductively coupled plasma mass spectrometry, was used as exposure biomarker. Presence of atherosclerotic plaque in the carotid artery was determined by B-mode ultrasonography. We used logistic regression to estimate odds ratios (OR) for prevalence of plaque in the carotid artery according to blood lead quartiles.

Results: The median B-Pb was 25 µg/L (range 1.5-258) and 36% of the cohort had any atherosclerotic plaque. After controlling for confounders and known cardiovascular risk factors, the OR for prevalence of plaque in the highest quartile of blood lead compared to the lowest quartile was 1.31 (95% CI 1.06, 1.62) in the total group, 1.53 (95% CI 1.16, 2.02) among women, and 1.16 (95% CI 0.81, 1.66) among men. ORs were even higher in postmenopausal women (OR 1.68; 95% CI 1.23, 2.28) and in individuals with decreased kidney function (OR 2.13, 95% CI 1.08, 4.18), but much weaker and non-significant in never-smokers.

Conclusions: Our study shows an association between blood lead concentrations and occurrence of atherosclerotic plaque in the carotid artery, adding evidence for an underlying pro-atherogenic role of lead in cardiovascular disease. Menopause and decreased kidney function seem to increase the susceptibility.
Prenatal Phthalate Exposure and Child Cognitive Performance in a Large, Well-Characterized Pregnancy Cohort Study

LeWinn K1, Bush N1, Szpiro A2, Barrett E3, Loftus C2, Ni Y4, Davis R4, Karr C2, Tylavsky F4, Sathyanarayana S2,5

1University Of California, San Francisco, 2University of Washington, 3Rutgers University, 4University of Tennessee Health Science Center, 5Seattle Children's Research Institute

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background:
Studies examining associations between prenatal phthalate exposure and neurodevelopment, and whether associations are sex-specific have yielded inconsistent findings. We investigated associations between prenatal phthalate exposure and child Full Scale IQ (FSIQ) in the Conditions Affecting Neurocognitive Development and Learning in Early childhood (CANDLE) study of the ECHO PATHWAYS Consortium.

Methods:
We measured 13 phthalate metabolites in third trimester urine in mother-child dyads who completed a preschool visit. Child FSIQ (ages 4-6) was assessed using the Stanford Binet-5. We used multivariable linear regression to estimate associations with individual phthalates, and Weighted Quantile Sum (WQS) regression to identify independent phthalate mixtures that were negatively and positively associated with FSIQ. Final models were adjusted for: maternal IQ, race, marital status, smoking, BMI, socioeconomic status; child age, sex, and breastfeeding. We assessed effect modification by sex in multivariable and WQS regressions, and estimated WQS results in sex-stratified samples.

Results:
Our sample (N=1022) was predominantly African American (62%) with a high school education or less (57%). No significant associations were observed in individual phthalate or full-sample WQS regressions. In girls, sex-stratified WQS analyses identified a phthalate mixture dominated by mono-carboxy-isononyl phthalate (mCINP; weight=73%) that was positively associated with IQ [B=0.99; 95%CI: 0.02, 1.96], as well as a mixture of mono-benzyl phthalate (mBzBP; weight=34%), mono-2-isobutyl phthalate (mIBP; weight=16%), and mono-[(2-carboxymethyl)hexyl] phthalate (mCMHP; weight=14%) that was negatively associated with IQ [B=-1.61;95%CI: -2.93, -0.28]. In boys, a phthalate mixture weighted on mono-methyl phthalate (mMP; weight=35%) and mono-carboxy-isoctyl phthalate (mCIOP; weight=19%) was positively associated with IQ (B=1.96;95%CI: 0.38, 3.54).

Conclusions:
In one of the largest studies to date, we observed no association between individual phthalate metabolites and child FSIQ, which may be explained by rigorous adjustment for potential confounders. Our WQS analyses suggest that there may be small, sex-specific associations between prenatal phthalate exposure and child cognitive performance.
Life-shortening as an alternative measure of effect of an environmental hazard: the case study of a coal-fired thermal power plant in Italy

Minichilli F¹, Crosignani P², Bianchi F¹
¹Environmental Epidemiology Unit, Institute Of Clinical Physiology, National Research Council, ²University of Pavia, Occupational Medicine Institute

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim.
In North-western Italy, a Coal-fired thermal power plant (CPP) was active from 1970 to 2014, when was seized by the Prosecutor’s Office. Risk association measures are commonly used to estimate the health consequences of environmental exposures; however, individual impacts are not always studied. Our aim is to estimate the life-shortening as measure of effect of an environmental hazard.

Methods.
The survival of two residential cohorts with dichotomous exposure to SO2 emitted by the chimneys of the CPP was evaluated. Exposure was determined using an atmospheric diffusion model and a 10-years follow-up of all residents was carried out (1,418,274 person-years). The life-shortening period was calculated by Kaplan-Meier survival method.

Results.
The overall (all-ages) Hazard Ratio (HR) was 1.49 for cardiovascular causes and 1.76 for respiratory causes for those heavily exposed. However, age-specific survival analyses, for cardiovascular and respiratory causes combined, showed no effect of exposure before age 65, whereas the HR was 1.72 (95% CI 1.48-2.01) for those aged 65-74 and 1.65 (95% CI 1.47-1.86) for those aged 75-84.
The 10-years cumulative survival for those less exposed aged 65-74 was 0.96 and for those heavily exposed 0.93. The survival of 0.96 was reached after 6.58 by the heavily exposed years of observation, i.e. 3.42 years before. For those aged 75-84 and less exposed, the 10-years overall survival was 0.84 and for those heavily exposed 0.76. The survival of those less exposed was reached after 7.21 years, 2.79 years before by those heavily exposed.

Conclusion.
The life-shortening was significantly reduced in the highly exposed elderly subjects compared to those less exposed. This indicator appears useful to describe the effect of environmental exposures on human lives. The results enhance the usefulness of developing specific statistical tools to evaluate exposure and survival time in order to properly estimate the shortening of individual life.
The association between perfluoroalkyl substances and lipids in cord blood
Spatlen M¹, Perera F², Lederman S³, Robinson M³, Kannan K³,⁴, Herbstman J¹, Trasande L⁵,⁶,⁷
¹Columbia Center for Children’s Environmental Health, Department of Environmental Health Sciences, Columbia University Mailman School of Public Health, ²Department of Population and Family Health, Columbia University Mailman School of Public Health, ³Wadsworth Center, New York State Department of Health, ⁴Department of Environmental Health Sciences, School of Public Health, State University of New York at Albany, ⁵Department of Environmental Medicine, New York University School of Medicine, ⁶Department of Pediatrics, New York University School of Medicine, ⁷Department of Population Health, New York University School of Medicine

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Introduction: Perfluoroalkyl substances (PFAS) were among various persistent organic pollutants suspected to have been released during the collapse of the World Trade Center (WTC) on 9/11. Evidence suggests PFAS may have cardiometabolic effects, including alterations in lipid profiles. This study evaluated the association between cord PFAS and lipids in a population prenatally exposed to the WTC disaster.

Methods: 222 pregnant women in the Columbia University WTC birth cohort enrolled between December 13, 2001 and June 26, 2002 at hospitals located near the WTC site: Beth Israel, St. Vincent’s, and New York University Downtown were included in the study. We evaluated the association between five cord blood PFAS (perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorohexanesulfonic acid (PFHxS), perfluorononanoic acid (PFNA), perfluorodecane sulfonate (PFDS)) and cord blood lipids (total lipids, total cholesterol, triglycerides).

Results: Median (interquartile range (IQR)) concentrations of PFAS were 6.32 (4.58-8.57), 2.46 (1.77, 3.24), 0.38 (0.25, 0.74), 0.66 (0.48, 0.95) and 0.11 (0.09, 0.16) ng/mL for PFOS, PFOA, PFNA, PFHxS and PFDS, respectively. Median (IQR) for lipids were 59.0 (51.5, 68.5) mg/dL for total cholesterol, 196.5 (170.5, 221.2) mg/dL for total lipids and 33.1 (24.2, 43.9) mg/dL for triglycerides. In fully adjusted models, several PFAS were associated with significant increases in lipid levels, including evidence of a linear trend between triglycerides and both PFOA and PFHxS. Principal component analyses supported these findings: the first principal component, reflecting generally high loadings across all PFAS, was associated with higher total lipids; and the second principal component, displaying high loadings for PFOA and PFHxS, was associated with higher triglycerides.

Conclusions: Findings support previous evidence of an association between PFAS exposure and altered lipid profiles and add novel information on this relationship in cord blood, as well as for an understudied PFAS, PFDS.
Association of blood mercury levels with non-melanoma skin cancer in the United States using NHANES data from 2003-2016
Rhee J1, Vance T2, Qureshi A1, Cho E1,3, Rotem R4

1Department of Dermatology, The Warren Alpert Medical School of Brown University, 2Department of Nutrition and Dietetics, State University of New York at Plattsburgh, 3Channing Division of Network Medicine, Department of Medicine, Brigham and Women’s Hospital and Harvard Medical School, 4Harvard T.H. Chan School Of Public Health / Maccabi Institute for Research and Innovation

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim: Some studies have reported that mercury is associated with an increased risk of lung and esophageal cancers. However, few epidemiological studies investigated mercury exposure in relation to skin cancer risk. Mercury inactivates glutathione peroxidase (GPX) and lower GPX activity is associated with increased risk of skin cancer. Therefore, we investigated the association between blood mercury levels and skin cancer.

Methods: We used National Health and Nutrition Examination Survey (NHANES) data from 2003 through 2016. Our exposures of interest were blood total (tHg), inorganic (iHg), and methyl mercury (MeHg). The main outcome was a reported diagnosis of non-melanoma skin cancer. We included participants aged ≥18 having information on exposures, outcome, and covariates (age, sex, race, BMI, smoking history, and income). We conducted logistic regression analysis adjusting for above covariates and survey year.

Results: Among 30,103 participants, the median age was 48, 52% were female, 46% Non-Hispanic White, and 21% Non-Hispanic Black. A total of 477 subjects reported diagnosis of non-melanoma skin cancer; 95% of whom were Non-Hispanic White. Median levels of tHg and MeHg were 0.9 µg/L and 0.6 µg/L, respectively. A 1 µg/L increase in blood tHg was associated with 6% increased odds of non-melanoma skin cancer (OR: 1.06; 95% CI: 1.02, 1.09). Compared to subjects with tHg ≤ 0.46 µg/L, subjects with tHg >1.72 µg/L had approximately double the odds of non-melanoma skin cancer (OR:1.93, 95% CI: 1.31, 2.84). Similarly, subjects with MeHg > 1.43 µg/L had 1.8 times greater odds of non-melanoma skin cancer (OR: 1.82, 95% CI: 1.18, 2.79) compared to subjects with MeHg ≤ 0.21 µg/L.

Conclusions: We found that higher blood tHg and MeHg levels were associated with higher prevalence of non-melanoma skin cancer. Our findings add to the limited evidence from epidemiologic studies supporting the role of mercury exposures in skin cancer.
Fluoride Exposure and Kidney and Liver Function among Adolescents in the United States

Sanders A², Malin A¹, Lesseur C¹, Busgang S¹, Curtin P¹, Wright R¹

¹Icahn School of Medicine at Mount Sinai

Background/Aim: Hepato- and nephrotoxicity of fluoride have been demonstrated in animals, but few studies have examined potential effects in humans. We hypothesized that adolescents with greater fluoride exposure would have poorer kidney and liver function.

Methods: We conducted a population-based cross-sectional study to examine the relationship between fluoride exposure and kidney and liver function among adolescents in the United States (U.S.), utilizing data from the National Health and Nutrition Examination Survey (2013-2016). Fluoride was measured in plasma and household tap water; kidney and liver parameters were measured in serum samples. We analyzed data from 1,983 and 1,742 healthy adolescents who had plasma and water fluoride measures respectively, as well as kidney and liver measures. These population-based samples represent 25,930,302 and 23,287,332 adolescents respectively. We employed survey-weighted linear regression to examine relationships between fluoride exposure and kidney and liver parameters after adjusting for covariates. Covariates included age, sex, race, socioeconomic status, body mass index and daily protein intake. A Holm-Bonferroni correction accounted for multiple comparisons.

Results: A 1 µmol/L increase in plasma fluoride was associated with a 10.36 mL/min/1.73 m² lower estimated glomerular filtration rate [95% CI: -15.93, -4.79; p =0.002], a 0.29 mg/dL higher serum uric acid level [95% CI: 0.08, 0.50; p =0.04], and a 1.29 mg/dL lower blood urea nitrogen level [95% CI: -1.87, -0.70; p < 0.001]. A 1 mg/L increase in water fluoride was associated with a 0.93 mg/dL lower blood urea nitrogen level [95% CI: -1.39, -0.47; p =0.001] and a 0.06 g/dL lower serum albumin level [95% CI: -0.10, -0.02; p =0.05].

Conclusions: Fluoride exposure may contribute to complex changes in kidney and liver related parameters among U.S. adolescents. As the study is cross-sectional, reverse causality cannot be ruled out; therefore, altered kidney and/or liver function may impact bodily fluoride absorption and metabolic processes.
Systematic review and meta-analyses of putative human health effects of exposure to per- and polyfluoroalkyl substances in children and adults

Smurthwaite K1, Armstrong B2, Bräunig J4, Trevenar S1, D'Este C1, Lucas R1, Korda R1, Mueller J4, Kirk M1

1Australian National University, 2University of Sydney, 3University of Western Australia, 4University of Queensland

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aims
Contamination of the environment with per- and polyfluoroalkyl substances (PFAS) has led to substantial community concern and media interest around potential human health effects. Despite many studies, the public health significance of exposure to these chemicals is unclear.

Methods
We used the PRISMA checklist to systematically review the literature for human health effects of PFAS exposure until 7 February 2017. Two independent reviewers searched scientific and grey literature using standardised keywords on health effects and PFAS. We adapted the International Agency for Research on Cancer’s criteria for evaluating the strength of evidence for carcinogenicity to assess risk of bias. Where feasible, we conducted meta-analyses using fixed effect analyses.

Results
Our search identified 6,692 titles, of which we included 221 in our final review of 19 different PFAS exposures and 148 health outcomes. We found sufficient evidence of a positive association between increased risk of hypercholesterolemia and human serum concentrations of perfluorooctanoic acid (PFOA) (12 out of 22 studies) and perfluorooctane sulfonate (PFOS) (8 out of 16 studies). We further identified limited evidence of a positive association between serum PFOA and PFOS concentrations and increased risk of hyperuricaemia, chronic kidney disease, kidney and testicular cancer, and an inverse association between serum concentrations of various PFAS and vaccine-derived immunity for diphtheria and rubella.

Conclusions
In this comprehensive systematic review, we identified that current peer-reviewed literature does not provide strong evidence that exposure to PFAS has marked effects on human health. The strongest evidence is for hypercholesterolemia, with weaker evidence for adverse effects on renal function, genitourinary cancers and vaccine-derived immunity. Many studies had a high risk of bias or were conducted in populations with background levels of exposure. There is a need to conduct high-quality epidemiological studies in exposed populations to improve the evidence base for adverse health effects.
Chlorinated persistent organic pollutants and type 2 diabetes - a population-based study with pre- and post-diagnostic plasma samples

Tornevi A¹, Bergdahl I¹
¹Umeå University

Background: Persistent organic pollutants (POPs) have been associated with type 2 diabetes (T2D), but causality is uncertain.

Objective: Within longitudinal population-based data from northern Sweden, we assessed how POPs associated with T2D prospectively and cross-sectionally, and further investigated factors related to individual changes in POP concentrations.

Methods: For 129 case-controls pairs matched by age, sex and date of sampling, plasma concentrations of HCB, p,p´-DDE, dioxin-like PCBs (PCB-118, -156), and non-dioxin like PCBs (PCB-74, -99, -138 -153, -170, -180, -183 -187) were analyzed twice (baseline and follow-up, 9-20 years apart). The cases received their T2D diagnose between baseline and follow-up. Prospective (using baseline data) and cross-sectional (using follow-up data) odds ratios (ORs) for T2D on lipid standardized POPs (HCB, p,p´-DDE, ∑DL-PCBs, ∑NDL-PCBs) were estimated using conditional logistic regression, adjusting for body mass index (BMI) and plasma lipids. The influence of BMI, weight-change, and plasma lipids on longitudinal changes in POP concentrations were evaluated among non-diabetic individuals (n=306).

Results: POPs were associated with T2D in both the prospective and cross-sectional assessments. Of a standard deviation increase in POPs, prospective ORs ranged 1.42 (95% CI: 0.99, 2.06) for ∑NDL-PCBs to 1.55 (95% CI: 1.01, 2.38) for HCB (p<0.05 only for HCB), and cross-sectional ORs ranged 1.62 (95% CI: 1.13; 2.32) for p,p´-DDE to 2.06 (95% CI: 1.29, 3.28) for ∑DL-PCBs (p<0.05 for all POPs).

In analyses of non-diabetic individuals, higher baseline BMI, decreased weight and decreased plasma lipid concentrations were associated with a slower decrease of POPs. Cases had, besides a higher BMI, reduced cholesterol and weight gain at follow-up compared to controls, which can explain the higher ORs in the cross-sectional assessments.

Discussion: The indication that individuals body fat history might influence POP-T2D associations through decreased elimination rate, weakens the epidemiological support for a causal association.
Amyotrophic lateral sclerosis incidence following exposure to inorganic selenium in drinking water

Vinceti M¹, Filippini T¹, Malagoli C¹, Violi F¹, Mandrioli J², Consonni D³, Rothman K⁴, Wise L⁴
¹University of Modena and Reggio Emilia Medical School, ²Modena University Hospital Policlinico, ³Fondazione IRCCS Ca’ Granda Ospedale Maggiore Policlinico, ⁴Boston University School of Public Health

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background and aim. Some laboratory and epidemiologic studies have documented an association between high intake of the trace element selenium and risk of amyotrophic lateral sclerosis (ALS), a degenerative disease of the motor neurons. We aimed to further investigate this possible association.

Methods. From 1986 through 2015, we followed a community cohort in northern Italy that had been inadvertently exposed in the 1974-86 period to drinking water with unusually high levels of selenium, around 8 µg/l, in its inorganic hexavalent form (selenate). In this cohort, we previously identified a high incidence of ALS during 1986-94. Here we report extended follow-up of this exposed cohort, as well as of an unexposed cohort including over 95,000 municipal residents, for an additional 21 years. We identified incident cases through administrative sources and a specialized registry.

Results. During follow-up, 7 and 112 ALS cases were newly diagnosed in the exposed and unexposed cohorts, respectively, yielding incidence rates of 14 and 5 per 100,000 person-years. A Poisson regression analysis adjusting for age, sex, and calendar year produced an overall rate ratio for ALS of 2.8 (95% confidence interval 1.3 - 6) in the entire period of follow-up. The association was stronger earlier than later in follow-up (1986-1994 vs. 1994-2015), and among women than men. All exposed cases were of the sporadic, non-familial form for the disease.

Conclusions. Overall, results from this ‘natural experiment’ indicate a positive association between chronic exposure to inorganic hexavalent selenium and ALS incidence, with rates in the exposed cohort declining over time after cessation of exposure. Also taking into account the recognized neurotoxicity of this metalloid, particularly its selective toxicity on motor neurons observed in animal studies, the present study provides additional support for the hypothesis that selenium exposure increases ALS risk.
Use of Blood Metals to Improve the Prediction of Death from Cardiovascular Causes: An Environmental Risk Score Approach

Wang X1, Mukherjee B2, Park S1,3

1Department of Epidemiology, University of Michigan, 2Department of Biostatistics, University of Michigan, 3Department of Environmental Health Sciences, University of Michigan

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background/Aim: We evaluated whether blood markers of toxic metals (lead, cadmium, and mercury) can improve risk prediction for cardiovascular disease (CVD) mortality when added individually, jointly, or as an integrative index— the Environmental Risk Score (ERS), in a model with established risk factors.

Methods: Our study sample comprised 16,030 adults aged 40 years or older who were enrolled in the NHANES 1999-2012 and followed up through December 31, 2015. Individuals were linked with the National Death Index. The study sample was randomly split into a training set for the ERS construction (n=8,044), and a testing set for evaluation of the prediction performance (n=7,986). ERS was an integrative index of health risk of exposure to multiple toxicants, which was computed for CVD mortality using elastic-net (ENET) penalized Cox’s model with 9 candidate predictors including 3 linear terms, 3 squared terms, and 3 pairwise interactions of blood lead, cadmium, and mercury concentrations.

Results: During median follow-up of 7.2 years, 517 died from CVD. In training set, linear terms of cadmium and mercury, squared terms of lead and mercury, and all 3 pairwise interactions were selected by ENET for ERS construction. In testing set, addition of all 3 linear term, 3 squared term, and 3 pairwise interactions of blood metals simultaneously to established risk factors in the Cox’s models improved C-statistic from 0.843 to 0.856. The C statistic also increased to 0.853 when the ERS was added to established risk factors. The improvement in risk assessment remained significant and strong when it was estimated by other metrics including net reclassification improvement and integrated discrimination improvement.

Conclusions: The use of multiple predictors of exposure to blood lead, cadmium, and mercury improves risk prediction performance over established risk factors. Our findings highlight the importance of incorporation of environmental toxicants for CVD risk assessment and prevention.
Blood lead levels and prevalent breast cancer among US women

Wei Y\textsuperscript{1}, Zhu J\textsuperscript{2}

\textsuperscript{1}Mercer University School of Medicine, \textsuperscript{2}Fort Valley State University

PDS 63: Chemicals and metals: health effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 10:30 AM - 12:00 PM

Background: Lead is a toxic nonessential heavy metal that is ubiquitously present in the environment, leading to widespread exposure in the general population. Little is known about the effect of lead on endocrine function and hormone-related cancers. This study was to examine the association between exposure to the heavy metal lead, measured as blood lead levels (BLLs), and breast cancer in US women.

Methods: A nationally representative subsample of 9791 women aged $\geq$20 years in the 2003-2012 National Health and Nutrition Examination Survey was analyzed for the association of BLLs with prevalent breast cancer using multivariate logistic regression models, adjusting for potential confounders. To analyze specificity of association, we also examined associations of blood levels of the other two toxic heavy metals, cadmium and mercury, with prevalent breast cancer using the same analytical models.

Results: Of the study participants, 284 women (weighted prevalence, 2.8%) were self-reported being diagnosed with breast cancer during 2003-2012. Breast cancer women showed elevated BLLs. A significant and dose-dependent increase in the prevalence of breast cancer was seen among the participants cross increasing quartiles of BLLs ($p$-trend <0.0001). After adjusting for potential confounders, we found that women in all of the higher quartiles of BLLs had significantly increased odds of prevalent breast cancer compared with those in the lowest quartile. This association was not seen with the other toxic heavy metals, cadmium and mercury.

Conclusion: Our study demonstrates a potential relationship between lead exposure, measured as BLLs, and female breast cancer. Additional epidemiologic and mechanistic studies would further explore these interactions and elucidate the potential role of lead exposure in breast cancer etiology.
Tuesday August 27 1:30 PM – 3:00 PM

S10: Quasi-Experimental Designs in Environmental Epidemiology: Applications to the Health Impacts of Energy Policy Changes

A multi-level analysis of the impact of changes in coal-fired power plant emissions on asthma-related healthcare utilization and symptoms in Louisville, Kentucky

Casey J1,2, Su J1, Henneman L3, Zigler C4, Neophytou A1,5, Chen Y6, Moyer S6, Barrett M7
1University of California, Berkeley School of Public Health, 2Columbia University Mailman School of Public Health, 3Department of Biostatistics, Harvard TH Chan School of Public Health, 4Department of Statistics and Data Sciences and Department of Women's Health, University of Texas, Austin, 5Department of Environmental Health and Radiological Sciences, Colorado State University, 6Louisville Metro Department of Public Health and Wellness, 7Propeller Health

Background/aim: Recently, U.S. electricity generation has both implemented air emissions controls and begun to shift away from coal as a fuel source. Such energy transitions at individual power plants serve as natural experiments for assessing health benefits of resulting changes in air quality. We aimed to evaluate the impact of a coal-fired power plant retirement and 3 SO2 emission control installations on asthma outcomes in Louisville, Kentucky.

Methods: We characterized exposure via a land use regression model for SO2 concentrations and a power plant emission exposure model (HyADS), which quantified the extent to which any power plant influences air quality in each U.S. ZIP code. At the ZIP code-level from 2012–2016, we evaluated associations between these two air quality measures and counts of quarterly asthma hospitalizations/emergency department (ED) visits. In a second analysis spanning 2012–2017, we evaluated associations between air quality and daily rescue inhaler use (measured spatiotemporally by digital medication sensors) among 207 AIR Louisville participants before and after an emission control installation.

Results: During the study period, the median SO2 concentration was 1.62 ppb (IQR: 0.94, 2.21) and the median (unitless) HyADS exposure was 6553 (IQR: 2283, 9702). In models adjusted for indicators of socioeconomic status and meteorological conditions, we observed 0.67 (95% CI: -0.10, 1.53) additional ZIP code-level quarterly asthma hospitalizations/ED visits per 1 ppb increase in SO2 concentrations and 1.22 (95% CI: 0.52, 1.92) additional per IQR increase in HyADS exposure. A 1-IQR reduction in HyADS exposure translated into about 171 fewer annual visits county-wide. At the individual-level, the scrubber installation was associated with an immediate reduction in rescue medication use (-0.15 uses per day, 95% CI: -0.24, -0.06) and a 30% reduction over time.

Conclusion: Air quality improvements due to coal-fired power plant retirements and scrubber installations may improve asthma outcomes.
The Causal Impact of Fracking on Indoor Radon Levels: A Difference-in-Difference Approach

Black K1, McCoy S2, Weber J1
1Kenyon College, 2University of Nevada - Las Vegas, 3University of Pittsburgh

Background: Unconventional gas development (fracking) is controversial principally because of environmental and health concerns. Pennsylvania has vaulted into the second largest energy producer in the United States, mainly attributed to fracking. This abundance of spatial and temporal activity makes Pennsylvania an ideal research setting.

Aims: The goal of this project is to inform policy makers regarding the causal impact of fracking on indoor radon levels. We study documented radon levels across Pennsylvania before and after the arrival of hydraulic fracturing.

Methods: Well location and spud date are linked spatially to nearby indoor radon readings. Using the universe of radon readings (1987 – 2016), we allow for treatment (i.e. within 2 km of a well) to vary spatially and temporally, but we extend a traditional difference-in-differences analysis by allowing treatment to vary non-linearly. We compare radon levels taken from homes before a nearby well arrives to those readings after. Our most flexible model illustrates an estimation of treatment effects where treatment is continuous (number of wells), varies in intensity (distance to the wells), and in duration of exposure (the time since wells were drilled). This approach can reveal how a potential effect of fracking varies non-linearly with distance and, holding distance constant, the time between drilling and testing.

Results: Using 23,626 observations, we find that there is a precisely estimated zero effect of wells on radon concentrations in nearby buildings. Drilling occurred in areas with higher pre-existing radon levels, supporting a correlated relationship, not a causal one. In our robustness analysis, we show that prior estimates are sensitive to changes in sample and specification.

Conclusion: Exposure to fracking wells does not appear to have a causal impact on indoor radon levels. Our study thoroughly explores causality and finds a precisely estimated zero effect of fracking on radon levels.
Impact of Oil and Gas Drilling Activities on Small-for-Gestational-Age Infants in Texas: A Difference-in-Differences Analysis

Willis M1, Hill E2, Kile M2, Carozza S1, Hystad P1
1Oregon State University, 2University of Rochester

Background: Although 15% of Texas residents live within 1.6km of an oil or gas drilling site, health outcomes associated with air pollution from this industry remain largely understudied. A key challenge with oil and gas drilling is that large economic changes occur simultaneously with potential environmental exposures. This study quantifies associations among in utero drilling pollution exposures and incidence of small-for-gestational-age (SGA) infants in a difference-in-differences analysis.

Methods: We leverage a geocoded population-based retrospective birth cohort in Texas between 1996 and 2009 (n=2.8 million), which corresponds to the rapid increase in drilling activities across the state. Using a difference-in-differences design, we compare SGA among pregnant women who reside within 2,000m of an active drilling site to SGA among pregnant women who reside within the same buffer of a drilling site before it becomes active, and then compare these women to a contemporaneous population of pregnant women that reside 3,000-10,000m away. Within this framework, we use multilevel logistic regression with adjustments for infant demographics, maternal socioeconomic status, and neighborhood contextual characteristics. We present results from a traditional epidemiological regression and the difference-in-differences framework to demonstrate variations in results by approach.

Results: We show that the socioeconomic impact of drilling substantially changes regional population characteristics but not local population characteristics, thus the difference-in-difference method is justified. Our results demonstrate increased risk of SGA (OR: 1.06; 95% CI: 1.04, 1.08) among pregnant women who resided within 2,000m of at least one drilling site during pregnancy. These results were attenuated (OR: 1.02; 95% CI: 1.00, 1.05) by the inclusion of county fixed effects to account for potential residual spatial variations.

Conclusions: Increased risks of SGA are associated with drilling exposures in Texas. Furthermore, we demonstrated that difference-in-differences designs are needed to isolate effects from the substantial socioeconomic contextual changes associated with drilling activities.
Impact of Shale Gas Development on Drinking Water Quality and Infant Health: A Difference-in-Differences Design

Hill E¹, Ma L²
¹University Of Rochester, ²University of Kentucky

Background: Widespread hydraulic fracturing of shale formations has yielded a range of economic and environmental benefits. However, adverse health outcomes associated with shale gas development (SGD) remain uncertain. This study aims to quantify reproductive health risks associated with SGD via drinking water contamination.

Methods: We build a novel data set that links gas well activity to both infant health outcomes from the universe of birth records in Pennsylvania from 2003 – 2015 and Community Water System (CWS) drinking water contaminant measurements using the geographical coordinates of a mother’s residence, gas wells, and public drinking water source locations. We compare water quality and birth outcomes (e.g. low birth weight (LBW); preterm birth (PTB)) for water systems with well bores close (e.g. 1 km) to their source to water systems with well bores further away (e.g. 10 km) using a difference-in-differences design. We use linear regression with fixed effects for CWS adjusting for maternal socio-economic status, pregnancy risk factors, drinking water quality, air quality, birth month-year and residential proximity to major roads, coal mining and gas wells.

Results: We find that drilling an additional well within 1km of CWS source locations increases shale gas-related contaminants by 1 to 3 percent. We find that an additional well within 1km of CWS source locations increases PTB by 1pp and LBW by 0.7pp. We find similar magnitudes when we use continuous measures (e.g., birth weight), only estimate models for siblings, and a dose response until 1.5km of CWS source locations.

Conclusion: Our paper contributes to an increasing body of research that estimates the causal impacts of SGD on the environment and health in order to weigh the extent of these potential costs against its economic and environmental benefits. In addition, this work demonstrates a unique application of economic methods in a public health setting.
Use of Exposomic Methods Incorporating Sensors in Environmental Epidemiology

Mark Nieuwenhuijse, The Barcelona Institute for Global Health, Barcelona

The exposome is the totality of environmental exposure during a lifetime. A number of studies are implementing the concept and, as part of the work, include sensors. This presentation will introduce the field of exposomics and the role of technological developments in characterizing the exposome. The presentation will focus on a number of recent European projects (HELIX, EXPOsOMICS, PASTA, PHENOTYPE) that used sensors to measure the exposome and share some of the experiences and lessons learned. Furthermore, it will look forward to the future to see what will become available in the near future.

The presentation will focus to a large extent on exposure measurement of air pollution, noise, green space, temperature and physical activity, but will also address some work around health outcome measures (e.g. symptoms, blood pressure, lung function).

Some of the main limitations and strengths will be discussed and recommendations made for future projects.
Background: Evaluation of cumulative exposure to air pollutant mixtures has been challenged by traditional measurement techniques. Wearable passive air pollutant monitors have emerged as a tool for assessing personal exposure to environmental chemicals. These monitors concentrate airborne pollutants onto a substrate which can subsequently be analysed off-line for a broad range of compounds using mass spectrometry (MS). Longitudinal exposure assessment in vulnerable populations is facilitated by the lightweight, wearable form factor of these monitors. The low cost of this sampling technique further enables deployment across large populations, increasing the quantity of environmental data available for evaluating environmental risk factors for disease.

Methods: We have applied a polydimethylsiloxane (PDMS) sorptive extraction technique to passively concentrate non-polar compounds from the air. Gas rods are coated with a thin PDMS film and then mounted into a silicone band (the Fresh Air Wristband). The wristband is worn by an individual for period of several hours to days depending on ambient levels. Sample analysis is performed using a gas chromatograph Orbitrap MS equipped with the thermal desorption unit. Using this technique, we can quantify time-integrated exposure to a range of semi-volatile organic compounds. We deployed the Fresh Air wristband in several large epidemiologic studies based in the U.S., Canada, South Africa and China.

Results: The PDMS sorbent in the Fresh Air wristband exhibited linear uptake of chemicals across a range of exposure concentrations that are representative of ambient air levels ($R^2>0.99$). Low variation was observed across replicate samples exposure to airborne pollutants in field tests ($CV<10$). Deployment of the wristband with children, pregnant women the elderly has enabled characterisation of unique exposure profiles.

Conclusions: Capturing the cumulative exposure of an individual to mixtures of air pollutants using wearable passive samplers is a novel advancement towards identifying disease risk factors.
Environmental Pollutants and Plasma Metabolomics in a Pregnancy Cohort
Doherty B\textsuperscript{1}, Gui J\textsuperscript{1}, Stewart D\textsuperscript{2}, Madan J\textsuperscript{1}, Hoen A\textsuperscript{1}, Sumner S\textsuperscript{2}, Karagas M\textsuperscript{1}, Romano M\textsuperscript{1}
\textsuperscript{1}Dartmouth College, \textsuperscript{2}University of North Carolina at Chapel Hill

This presentation will describe preliminary results of an investigation of exposures to environmental pollutants during pregnancy in relation to plasma metabolomics and include a discussion of challenges and opportunities of linking high-dimensional exposomic data to high-dimensional outcome data. The New Hampshire Birth Cohort Study used silicone wristbands to passively measure exposures to a suite of environmental pollutants in a cohort of women during pregnancy. Women wore the silicone wristbands for 1 week during gestation (~14 gestational weeks), which were analyzed for concentrations of over 1500 environmental pollutants, including personal care products, pesticides, flame retardants, polycyclic aromatic hydrocarbons, and others. For this pilot study, we used data from 111 wristbands; from these wristbands, 140 unique pollutants were quantified and 21 pollutants were detected in >50% of samples. At approximately 24 to 28 gestational weeks, women provided blood samples that were analyzed for 188 endogenous metabolites in plasma using UPLC-MS and the AbsoluteIDQ™ p180 kit from Biocrates Life Sciences. This method provides quantitation or semi-quantitation of amino acids and biogenic amines, acylcarnitines, sphingolipids, and glycerophospholipids. Using these data, as well as rich supporting covariate data, we investigated the relationships between the exposures to environmental pollutants measured using the silicone wristbands and the concentrations of plasma metabolites. We will present our preliminary findings of an exposome-metabolome wide association study and results from networks-based methods. Emerging tools and sensors provide new opportunities for linking high-dimensional exposomic data with metabolomics data for the study of health outcomes.
Environmental monitoring of our surroundings can provide information about spatial and temporal variability of exposure and the sources and routes of these exposure. Over the past decades we have employed a multitude of methods to quantify exogenous exposures, ranging from the population (measurements, modeling, geographic information systems, remote sensing) to the individual (questionnaires, measurements) level. Recent technological developments have enabled more comprehensive measurements of environmental factors for population level (e.g., moving from large-spatial scale assessments to hyperlocal maps using mobile and distributed sensors) and individual-level [e.g., ecological momentary assessments, sensors, accelerometry, and global positioning system (GPS) tracking] assessments. But how far are we with the implementation of these new technologies? And have they lead to new insights?
Around 1980, many of us were led to believe by a major AJE review that air pollution levels were no longer harmful to health in the US and Europe. Then Doug published the Steubenville Alert study (JAPCA 1982;32:937-42), showing transient changes in lung function in kids exposed to time-varying TSP levels which were supposedly safe. Steubenville air pollution was dominated by steel mill emissions at the time. In 1985 we, by coincidence, found transient changes in lung function in kids related to particle mass near a steel mill in the Netherlands. That same year I at a WHO workshop met Les Grant and Judy Graham from EPA who were preparing the first ever mass and physiology based standard for PM – PM10 being the mass fraction that can actually be inhaled. Coffee break chats made Les and Judy aware of our still unpublished data – and both jumped on me to get this out in the public domain a.s.a.p. The Dassen paper was published (JAPCA 1986;36:1223-7), and then I spent my sabbatical in 1986/1987 at Harvard, working closely with Doug. In the fall of 1986, Doug dragged me to a public CASAC hearing in DC to present our studies to a critical audience. Most critical of all was dr. Manning Feinleib from the Iron and Steel Institute, who presented a systematic review of our studies, using 14 different criteria. Doug’s study did not meet 12/14; ours 13/14.....Regardless, EPA pressed ahead in promulgating the PM10 NAAQS in 1987, explicitly quoting the two studies. The rest is history. The PM10 standard led to massive expansion of PM10 measurements, first in the US, later in Europe and elsewhere. With these new PM mass data becoming available, hundreds of new epidemiology studies changed our field forever to support air pollution control measures everywhere.
When Air Pollution Strikes Out of the Blue

Peters A

1Helmholtz Zentrum München

.S18: Landmarks of Air Pollution Epidemiology: Legacy of Douglas Dockery, Beatrix theater, August 27, 2019,
13:30 - 15:00

Studies assessing the triggering of cardiac events have shown that the impact of ambient air pollution can
be life threatening in vulnerable populations. These studies indicated novel pathophysiological responses to
ambient air pollution at the time. The presentation will review the evidence collected as part of studies
focusing on vulnerable patient groups. First, it will focus on the role of air pollution to elicit arrhythmia in
patients with implanted cardioverter defibrillators. Second, it will review the evidence for ambient air
pollution as a trigger of acute myocardial infarctions. Thirdly, it will highlight the interplay between panel
studies, controlled human exposure studies and studies employing patient records in understanding the
underlying mechanisms. This research exemplifies the relevance of considering the timing of exposure
response relationships. The examples demonstrate the need to employ different designs and approaches
for assessing the acute and severe impact of ambient air pollution and in particular of fine particulate
matter. Last but not least, the paper will highlight the role of Douglas Dockery in assembling consistent and
coherent evidence for the impact of fine particulate matter on the heart.
Twenty-six years ago, Doug Dockery and colleagues introduced the world to the Harvard Six Cities Study. Their landmark publication showed strong evidence that people in dirtier cities were dying faster than people in clean cities and the mortality risk was strongly associated with fine particle (PM2.5) emissions. In 2006, continued follow-up showed that the associations persisted, and that life expectancy increased in cities that had cleaned up over time. The Six Cities Study motivated the intensive study of the long-term effects of air pollution in numerous populations all over the world, and the overwhelming weight of the evidence supported the findings of the original study. The original findings in the Six Cities was used by the US Environmental Protection Agency as the foundation for the first Clean Air Act regulations on PM2.5 in 1997. The continued follow-up was one of many studies motivating the lowering of the standards in 2012. The 1997 regulations set off protests from industries affected by the standards, leading to extensive efforts trying to disprove the science and discredit the EPA. Doug was forced to hand over all of the Six Cities data to a third party for reanalysis. The reanalysis unequivocally confirmed the original findings; however, to this day efforts trying to discredit the findings persist. Regardless, there is concrete evidence that the benefits of air pollution regulation far outweigh the costs. In 2009, Doug and colleagues examined changes in life expectancy and changes in PM2.5 in 211 counties in the US 1980-2000. They found that average life expectancy had increased by ~2.7 years and that declining PM2.5 was likely responsible for ~0.8 years of that increase. Doug’s work has led to a new agenda for air pollution research, new air quality standards, improved air quality, and evidence of the benefits of cleaner air.
In the early 1970’s, criticisms were raised regarding the limited exposure assessment in U.S. Environmental Protection Agency’s (EPA’s) Community Health and Environmental Surveillance System study in Chattanooga, TN. Subsequently, after the 1974 oil embargo, the Harvard Six Cities Study was proposed by Drs. Ferris and Speizer as an intervention study to assess the health impact of an anticipated increase in coal-related air pollution. As implemented by Drs. Dockery and Spengler, this was the first multi-city study with 1-in-2-day, central site measurements of ambient fine particulate matter (PM2.5) using the Harvard Impactor along with indoor measurements of PM2.5 and nitrogen dioxide in children’s homes. Although the anticipated increases in air pollution did not occur, time-series analysis of the impact of PM2.5 on daily mortality in these six cities made a major contribution to setting EPA’s 1997 daily National Ambient Air Quality Standard (NAAQS) for PM2.5 and a subsequent survival analysis was supportive of the annual PM2.5 NAAQS. In a joint Harvard-EPA component, the ambient PM2.5 filters were assessed with X-ray fluorescence to measure the elemental composition of particles and thereby assess the health impact of specific sources of fine particles. The subsequent Harvard-Health Canada 24-Cities Study was the first multi-city study with daily measurements of PM2.5 particle acidity using an annular denuder and, in State College, PA, daily counts of speciated fungal spores. Subsequently, in a series of intervention studies in multiple countries, Dr. Dockery has assessed the health benefits of specific control measures for particulate pollution. These studies were groundbreaking at the time and have informed design of future epidemiologic research with an emphasis on high quality exposure assessment.

The views expressed in this presentation are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.
Lines that Connect: Informing and Evaluating Public Policy

Pope C

Brigham Young University

.S18: Landmarks of Air Pollution Epidemiology: Legacy of Douglas Dockery, Beatrix theater, August 27, 2019, 13:30 - 15:00

Over the last several decades, it has been challenging to keep up with and assimilate the dramatic growth and complexity of the scientific literature regarding health effects of fine particulate matter (PM) air pollution. Douglas Dockery, a consummate scholar collaborator and primary leader and major contributor to many pioneering studies, has also been a prominent reviewer and interpreter of the broader literature. He has authored or coauthored many important and impactful reviews of the human health effects of PM—with an early focus on acute respiratory effects but a growing recognition of coherent links between fine PM exposures and more general cardiopulmonary disease morbidity and mortality. He had an early understanding of the importance of evaluating public policy designed to reduce PM air pollution exposures and helped conduct and motivate studies that evaluated health benefits of air-pollution control. This talk will highlight efforts by Douglas Dockery to review, evaluate, interpret, and connect the rapidly expanding lines of evidence that link PM air pollution to adverse health outcomes and related efforts to appraise benefits of public policy designed to control air pollution.
OPS 04: Environmental justice

Socioeconomic Disparities in Incidents at Toxic Sites during Hurricane Harvey

Lieberman-cribbin W1,3, Schwartz R1,2,3, Taioli E1,3
1Icahn School of Medicine at Mount Sinai, 2Department of Occupational Medicine, Epidemiology and Prevention, Hofstra Northwell Health School of Medicine, 3Center for Disaster Health, Trauma and Resilience

OPS 04: Environmental justice, Room 117, Floor 1, August 27, 2019, 13:30 - 15:00

Background/Aim: Hurricane Harvey made landfall in Texas on August 25 2017, resulting in extensive flooding, high-winds, power outages, and chemical exposures. The environmental justice implications of the storm are still being investigated. Here, we highlight the socioeconomic disparities present in reported incidents at toxic sites from Hurricane Harvey exposure.

Methods: The location of toxic sites and those with reported incidents due to Hurricane Harvey was retrieved from the Sierra Club environmental organization and overlaid on the FEMA Harvey Flood Depths Grid product. An index of socioeconomic disparities (ISD) was created from Zip Code Tabulation Area (ZCTA) data downloaded from the 2017 American Community Survey 5-year estimates; it included the proportion of ZCTA residents: (1) aged > 25 years with less than a high school education, (2) aged > 5 years with limited English language proficiency, (3) below the poverty level, (4) of Hispanic ethnicity, and (5) aged > 16 years and unemployed.

Results: Seventy-five of the 1431 toxic sites (5.2%) had reported incidents during Harvey, mainly at Chemical Facilities (34.7%), Hazardous Waste/Superfund Sites (17.3%), and Petroleum Bulk Terminals/Petroleum and Natural Gas Facilities (41.3%). Each component of the ISD was associated with increased likelihood of an incident at a toxic site at univariate analysis. At multivariate analyses, ZCTAs with a higher socioeconomic disparity score were associated with increased odds of an incident (adjusted odds ratio (ORadj): 1.17; 95% confidence interval (CI): 1.02 - 1.34), while flooding at the facility location was not (ORadj: 1.41; 95% CI: 0.88 – 2.25).

Conclusions: Reported incidents at toxic sites during Hurricane Harvey cannot be explained by flooding alone; areas with higher socioeconomic disparities were disproportionately exposed to incidents at toxic sites. Future disaster preparedness and response efforts must recognize these disparities and include careful maintenance and assessment of chemical and toxic waste facilities.
Air pollution spatial variability in relation to socioeconomic indicators in nine European metropolitan areas.

Samoli E1, Stergiopoulou A1, Santana P2, Dimitroulopoulou S3, Bauwelink M4, de Hoogh K5,6, Costa C2, Marí-Dell’Olmo M7,8,9, Vardoulakis S1,10, Katsouyanni K1,11

1National And Kapodistrian University of Athens, 2Centre of Studies in Geography and Spatial Planning University of Coimbra, 3Public Health England, 4Vrije Universiteit Brussel, 5Swiss Tropical and Public Health Institute, 6University of Basel, 7Agència de Salut Pública de Barcelona, 8CIBER Epidemiología y Salud Pública, 9Institut d’Investigació Biomèdica (IIB Sant Pau), 10Institute of Occupational Medicine, 11King’s College

OPS 04: Environmental justice, Room 117, Floor 1, August 27, 2019, 13:30 - 15:00

Aim: A limited number of studies have addressed environmental inequality in relation to air pollution, using various study designs and methodologies and often reaching contradictory results. We conducted an ecological study to investigate the spatial association between nitrogen dioxide (NO2), as a surrogate for traffic related air pollution, and ten socioeconomic status indicators (SES).

Methods: Following a standardized multi-city process within the European project EURO-HEALTHY we collected SES data at local administrative unit level in nine European Metropolitan Areas for the period 2001-14: Athens, Greece; Barcelona, Spain; Berlin-Brandenburg, Germany; Brussels, Belgium; Lisbon, Portugal; London, UK; Paris, France; Stockholm, Sweden and Turin, Italy. We applied mixed models for the associations under investigation with random intercepts per MA, also accounting for the spatial correlation. Results: The stronger associations were observed between NO2 levels and population density, population born outside the European Union (EU28), total crimes per 100,000 inhabitants and unemployment rate that displayed a highly statistically significant trend of rising concentrations with increasing levels of these indicators. Specifically, the highest vs the lowest quartile of each of the above indicators was associated with 48.7% (95% confidence interval (CI): 42.9%, 54.8%), 30.9% (95%CI: 22.1%, 40.2%), 19.8% (95%CI: 13.4%, 26.6%) and 15.8% (95%CI: 9.9%, 22.1%) increase in NO2 respectively.

Conclusions: Higher pollution levels in areas with higher percentages of people born outside EU28, crime or unemployment rates indicate that worse air quality is typically encountered in deprived European urban areas. The association with population density most probably reflects the higher volume of vehicular traffic, which is the main source of NO2 in urban areas. Policy makers should consider spatial environmental inequalities to better inform actions aiming to lower urban air pollution levels that will subsequently lead to improved quality of life, public health and health equity across the population.
Environmental justice implications of flaring from unconventional oil wells in Texas: racial/ethnic inequalities in exposure

Johnston J¹, Chau K¹, Franklin M¹, Cushing L²
¹University of Southern California, ²San Francisco State University

OPS 04: Environmental justice, Room 117, Floor 1, August 27, 2019, 13:30 - 15:00

Background/Aim: Unconventional extraction techniques including hydraulic fracturing or “fracking” has led to a boom in oil and gas production the Eagle Ford Shale, one of the most productive regions in the United States. An estimated 1 million people live within 5 km of an oil or gas well in this largely rural area. Prior research shows people of color live in closer proximity to wastewater disposal wells in the region, raising environmental justice concerns. We estimated racial/ethnic disparities in exposure to flaring, the practice of disposing of excess gas through combustion, which is ubiquitous in the Eagle Ford and associated with unconventional oil wells. Flares can operate continuously for months and release hazardous air pollutants such as particulate matter and volatile organic compounds in addition to causing light pollution and noxious odors.

Methods: We calculated the density of flares within a 3, 5 and 10 km buffer of Census block centroids using satellite observations from the Visible Infrared Imaging Spectroradiometer (VIIRS) between March 2012-December 2016 that were cleaned using hierarchical spatial clustering methods. We estimated the volume of gas combusted via flaring near each block utilizing a regression-based approach combining VIIRS information with reported estimates of vented and flared gas from the Railroad Commission of Texas.

Results: We found that although they are no more likely that non-Hispanic White residents to live near oil and gas wells, Hispanics are disproportionately exposed to flaring. Census blocks with majority Hispanic (>60%) populations are exposed to twice as many flares with 5 km compared to blocks with <20% Hispanics. Disparities between other racial/ethnic groups, including African Americans and Native Americans, depend on the buffer distance.

Conclusions: Preliminary findings suggest Hispanics are disproportionately exposed to flaring from oil wells in the Eagle Ford Shale, which could contribute to disparities in air pollution exposures.
Birth cohort environmental context: Socio-economic and ethnic inequalities in greenspace accessibility

Ferguson M¹
¹University of Exeter

OPS 04: Environmental justice, Room 117, Floor 1, August 27, 2019, 13:30 - 15:00

Background/Aim: An extensive body of literature indicates that green/blue spaces can be beneficial for promoting human health. A wide range of physical and mental health conditions appear to be mitigated by exposure to these natural environments, especially in urban areas. It is theorised that multiple physiological and psychological pathways may coalesce and promote good health outcomes. There is also evidence that health benefits of greenspace may be amplified for populations of lower socio-economic status, but these populations also often have reduced access to health promoting environments. This doctoral research project is investigating exposure to natural environments and health outcomes over the life course in childhood and adolescence, in the context of socio-demographic health inequalities.

Methods: The study uses birth cohort data from the Avon Longitudinal Study of Parents and Children (ALSPAC) and Born in Bradford (BiB). Preliminary analyses were conducted using the BiB cohort study area to investigate greenspace accessibility for a socio-economically and ethnically diverse population in Bradford, UK.

Results: A combination of statistical and spatial analyses identified contrasting distributions of urban green infrastructure in relation to population demographics. Street tree density was highest among more deprived neighbourhoods and those with larger Asian/Asian British populations. Conversely, less deprived neighbourhoods and those with larger White populations had better access to public greenspace. Greenspace quality was assessed, and while being highly spatially clustered, it was not distributed unevenly in relation to population socio-demographics.

Conclusions: The context for this birth cohort study indicates complex inequalities in greenspace accessibility. The study will build on these results to investigate life course exposures and outcomes, and consideration will be given to the complex dynamics between population demographics and urban green infrastructure that exist in urban environments, and how this could influence perceptions, behaviours and health.
Global Patterns of Environmental Inequities within the Prospective Urban and Rural Epidemiology Study

Hystad P¹, Willis M¹, Larkin A¹, Brauer M²

¹Oregon State University, ²University of British Columbia

Background: Most environmental justice research has been conducted in developed countries, but the largest environmental inequities may exist at a global level and within developing countries. Here, we quantify the associations between diverse environmental exposures and socioeconomic status (SES) within a global cohort study.

Methods: We leverage the 167,782 participants from 21 countries of the Prospective Urban and Rural Epidemiology cohort, spanning low to high socioeconomic development. We examined outdoor PM2.5 and NO2 air pollution, household air pollution (HAP), greenness, park access, household water access, perceived local traffic and local pollution, extreme heat days, and change in extreme heat days over a 15-year period. We compared these exposures with individual measures of SES, including education, occupation, a household wealth index, and percent income spent on food. We summarized exposure levels across SES strata and applied multinomial logistic regression models to determine associations between environmental exposures with SES, controlling for country income level, population density and urban/rural status. We examined global and country-specific environmental inequalities stratified by urban and rural communities.

Results: Across all communities, we observed the largest SES disparities for HAP, extreme temperature, increase in extreme temperature days, and decreased green space. For example, 41% of individuals with less than a primary school education cooked with solid fuels compared to 6% of individuals with post-secondary education. Individuals with less than primary school education experienced 27 extreme heat days at baseline year compared to 20 for individuals with post-secondary education. Several environmental exposures were also increased with higher SES, including NO2 and perceptions of local traffic and pollution. Substantial differences were observed between urban/rural communities and in country-specific analyses.

Conclusion: While environmental risks are associated with SES, the relationships are complex and vary by exposure and local context. It is essential for research and policy to recognize these multifaceted relationships.
Community-level Crime and Deprivation Role in Pollution Susceptibility in Pediatric Asthma

Sheffield P\textsuperscript{1}, Kinnee E\textsuperscript{2}, Shmool J, Clougherty J\textsuperscript{3}
\textsuperscript{1}Env Med and Pub Health, Icahn Som At Mt Sinai, \textsuperscript{2}University Center for Social and Urban Research, University of Pittsburgh, \textsuperscript{3}Dornsife School of Public Health, Drexel University

OPS 04: Environmental justice, Room 117, Floor 1, August 27, 2019, 13:30 - 15:00

Background/Aim: Our prior work and additional evidence suggests that chronic social stressors (e.g., low socioeconomic position (SEP), violence exposures) modify associations between air pollution exposures and respiratory health. Few studies have attempted to disentangle psychosocial from other aspects of deprivation in shaping susceptibility to pollution.

Methods: Using residence-specific daily ozone exposure estimates for multiple lag days, we apply conditional logistic regression (Cox Proportional Hazard) models in a case-crossover design, adjusting for temperature and co-pollutant exposures, to examine associations with asthma exacerbations. Modifiers included Z-scores of community level violent crime rates and SEP indicators examined via cross-stratification, continuous, and categorical modification. Outcomes included citywide hospital records for children aged 5 to 18 years, for May - September asthma Emergency Department (ED) visits (n = 11,719), from 2005-2011.

Results: We observed the highest ozone-attributable risks in the high crime/low deprivation quartile, on lag day 2, with an excess risk of 22.9 % (13.4 – 33.1 %) which is significantly greater than the low/low (reference) category on the same lag day. In contrast, the greatest excess risk for the low crime/high deprivation quartile was 17.9 % (8.3 – 28.5 %), also on lag day 2. Violence retained significance as a modifier though deprivation did not in other models.

Conclusions: This novel approach using cross-stratified models with both modifiers allowed comparison of the attributable modification from different social factors and results were robust to alternate effect modification models as well.
OPS 05: Statistical methods to analyze mixtures
What is the influence of exposure measurement error in the context of multi-pollutant models? A simulation study

Evangelopoulos D1, Katsouyanni K1, Walton H1

1King’s College London

OPS 05: Statistical methods to analyze mixtures, Room 114, Floor 1, August 27, 2019, 13:30 - 15:00

Background: Air pollution is a significant threat to human health. To quantify the effects on individuals, epidemiological time-series studies often fit multi-pollutant models using the ambient concentrations of pollutants as a proxy for population exposure. However, proxy estimates introduce measurement error which can cause problems in allocating health impacts correctly. We conducted a simulation study to assess and quantify the impact of PM2.5 and NO2 exposure error in multi-pollutant models.

Methods: Error-prone (incorporating a realistic mixture of Berkson and Classical error), error-free concentrations and an assumed all-cause mortality outcome were generated, and quasi-Poisson models were fitted to derive biased and corrected effect estimates. The input parameters were based on real data produced through a systematic review on the differences between personal exposures from outdoor sources and ambient concentrations. However, some parameters, e.g. correlations between the errors, were estimated analytically because no studies in the literature provided this information.

Results: Exposure error was found to be 33% more variant for NO2 compared to PM2.5. Mortality estimates without corrections for measurement error were underestimated by 20% and 7% on average for NO2 and PM2.5 respectively. Scenarios focusing on the European situation showed significant effect transfer up to 15% from the more poorly (NO2) to the better (PM2.5) measured pollutant. Interestingly, single-pollutant model estimates were sometimes found to be closer to the true health effects than multi-pollutant models due to a balancing out of confounding overestimation and measurement error underestimation.

Conclusions: Measurement error seems to cause significant underestimation in the air pollution epidemiological estimates and burden calculations. Thus, researchers should combine better exposure assessment with error correction methods. This may lead to the true independent effects of the pollutants, but also provide guidance for the use of proper concentration-response functions for health impact assessment and improved air quality reduction strategies.
Using DNA methylation to characterize more efficiently associations between the exposome and child lung function

Cadiou S, Lydiane A, Bustamante M, Maitre L, Basagana X, Vrijheid M, Siroux V, Slama R

1INSERM, 2ISGlobal

OPS 05: Statistical methods to analyze mixtures, Room 114, Floor 1, August 27, 2019, 13:30 - 15:00

Background: Early environmental exposures may influence lung function. Most pollutants have small effect sizes and some are correlated, potentially limiting the statistical power of agnostic exposome-wide association study (ExWAS). DNA methylation, which may act as a mediator for some exposures, could be used in exposome-health studies to increase power by reducing the exposome to exposures with biologically plausible mechanisms.

Aim: To test a method consisting in reducing the exposome dimension using DNA methylation in the context of an exposome-FEV1 (forced expiratory volume in one second) association study.

Methods: Among 919 mother-child pairs from Helix cohorts, exposures to 216 environmental factors were assessed during pregnancy or at age 7–9 years. Genome-wide DNA methylation levels in peripheral blood at 7–9 years were measured using HumanMethylation450 BeadChip, filtered and corrected for batch effects. A 3-step statistical approach was applied: (i) selecting a priori relevant DNA CpG sites for FEV1 according to an existing literature review; (ii) selecting exposures significantly associated with at least one of these CpGs, using an ExWAS approach adjusted for FEV1 and confounders; (iii) identifying by linear regression the exposures from this reduced set associated with FEV1.

Results: 314 CpGs enhancers from 31 candidate genes were selected at step 1. Step 2 identified a single exposure, postnatal blood copper level, which was associated with one CpG site located on gene ARMC2. In step 3, copper was found significantly associated with lower FEV1. A classical ExWAS analysis on FEV1 corrected for multiple comparisons did not identify statistically significant association, although copper was among the 6 exposures associated with FEV1 when no correction was applied.

Conclusion: Our 3-steps approach identified one exposure associated with lower FEV1, postnatal blood copper level, while an agnostic ExWAS reported no significant association. Further research is needed to quantify the efficiency of this approach.
A Three-Phase Approach to Examining Multiple Environmental Exposures and Age at Menarche

Oskar S1,2, Wolff M1, Teitelbaum S1, Stingone J2

1Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, 2Mailman School of Public Health at Columbia University

OPS 05: Statistical methods to analyze mixtures, Room 114, Floor 1, August 27, 2019, 13:30 - 15:00

There is increasing interest in moving from single-exposure models to a multiple exposure approach to capture the complex nature of environmental exposures. Using non-traditional data analytic approaches may enhance our ability to simultaneously investigate several environmental exposures. Data from 253 girls (12-16 years) from the National Health and Nutrition Examination Survey with 41 exposure biomarker measures across six classes of hormonal agents were analyzed. Menarche was dichotomized into “earlier” (≤11 years; 37% of girls) and “later” (≥12 years). We applied a three-phase data-driven modeling strategy to investigate associations between single and joint effects of environmental agents with earlier menarche.

Phase 1: We used elastic-net to perform variable selection. Elastic-net identified eleven exposures, with concentrations of blood cotinine having the largest effect estimate. Phase 2: Classification and regression tree (CaRT) and Random Forests (RF) were used to identify important single and joint predictors of menarche based on the variables selected by elastic-net. Urinary concentrations of 2,4,6-trichlorophenol (TCP) was identified as the most important predictor based on mean decrease in accuracy, followed by cotinine. Urinary concentrations of 1-hydroxypyrene (1-OHP) and 2-hydroxyfluorene (2-OHF) were the most frequent interaction pair identified by RF. Phase 3: The effect sizes of the identified predictors and most frequent interaction pair were obtained from binomial regression models. Cotinine was independently associated with earlier menarche, consistent with previous research, when using the threshold values provided in RF (PR =0.24, 95% CI: 0.05, 0.43) however, TCP was not. We did not observe an independent association between cotinine and menarche when the exposure was treated as a single linear term. We found evidence of multiplicative interaction between 1-OHP and 2-OHF (p=0.04). These results illustrate how combining multiple machine learning approaches can provide valuable insight when investigating high-dimensional exposure data and adverse health effects.
A quantile-based g-computation approach to addressing the effects of exposure mixtures

Keil A\textsuperscript{1,2}, Buckley J\textsuperscript{4}, O’Brien K\textsuperscript{2}, Ferguson K\textsuperscript{2}, Zhao S\textsuperscript{3}, White A\textsuperscript{2}

\textsuperscript{1}University Of North Carolina At Chapel Hill, \textsuperscript{2}Epidemiology Branch, National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health (NIH), Department of Health and Human Services (DHHS), \textsuperscript{3}Biostatistics Branch, National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health (NIH), Department of Health and Human Services (DHHS), \textsuperscript{4}Department of Environmental Health and Engineering, and Department of Epidemiology, The Johns Hopkins University

OPS 05: Statistical methods to analyze mixtures, Room 114, Floor 1, August 27, 2019, 13:30 - 15:00

Exposure mixtures frequently occur in epidemiologic data, particularly in the fields of environmental and nutritional epidemiology. Various strategies have arisen to answer questions about exposure mixtures, including methods such as weighted quantile sum regression that estimate a joint effect of the mixture components. Few other methods have been used to estimate such joint effects, even though they are of great interest for informing interventions that may act on multiple exposures. We demonstrate a new approach to estimating the joint effects of a mixture: quantile g-computation. This approach combines the inferential simplicity of weighted quantile sum regression and the immense flexibility of g-computation, a method of causal effect estimation. We demonstrate, using simulations and large sample formulae, that weighted quantile sum regression can be considered a special case of quantile g-computation, and that quantile g-computation often provides improved inference at sample sizes typically encountered in epidemiologic studies, and when the assumptions of weighted quantile sum regression are not met. We examine, in particular, the impacts of large numbers of non-causal exposures, exposure correlation, unmeasured confounding, and non-linearity of exposure effects. We show that, counter to intuition, quantile g-computation estimates can become more precise as exposure correlation increases. Quantile g-computation appears robust to many problems routinely encountered in analyses of exposure mixtures. Methods, such as quantile g-computation, that can yield unbiased estimates of the effect of the mixture are essential for understanding the effects of potential interventions that may act on many components of the mixture, and our approach may serve as an excellent tool for quantifying such effects as a way to bridge gaps between epidemiologic analysis and public health action.
Causal inference and ensemble learning as new important tools for investigations of health effects of chemical mixtures.

Oulhote Y

University Of Massachusetts Amherst

OPS 05: Statistical methods to analyze mixtures, Room 114, Floor 1, August 27, 2019, 13:30 - 15:00

Background: Studies in environmental epidemiology consider each chemical separately when assessing the adverse health effects of environmental exposures. This single pollutant approach suffers from several pitfalls including: 1) risk of false positives; 2) confounding from correlated exposures; and 3) lack of insights on the cumulative or synergistic effects of exposures.

Proposed method: We propose a flexible method that leverages an ensemble learning technique – SuperLearner - that offers greater flexibility in approximating the data generating mechanism, to estimate a robust model for the outcome, in combination with the G-computation - a maximum likelihood based substitution estimator – to infer valid estimates of individual and joint effects of mixtures. We extend the method to reconstruct dose-response relationships with no assumptions on the functional form, and to detect potential interactive effects. We end by proposing to augment the method to doubly robust estimation.

Simulation study and application: We ran multiple simulations based on real scenarios and compared the method with available approaches handling complex mixtures (e.g. elastic net, weighted quantile regressions, gradient boosting, random forests, and environmental wide association studies). We subsequently applied the method to investigate the potential effects of a mixture of pollutants on child cognitive outcomes in a Faroese cohort.

Main results: The proposed method had the lowest false discovery rate in terms of main effects and interactive effects and was able to adapt to the true underlying structure of the data. In the application part, the method confirmed previously reported associations between mercury and lower cognitive function. Additionally, some perfluorinated compounds showed detrimental effects on cognitive function.

Conclusions: By combining concepts from data sciences and causal inference, the proposed approach opens new perspectives for estimating causal effects of environmental chemicals in high-dimensional settings, and will allow to correctly address environmental health causal questions that have policy-relevant consequences.
Performance of variable selection methods for estimating the non-linear health effects of correlated chemical mixtures: a simulation study

Lazarevic N¹, Knibbs L¹, Sly P², Barnett A³

¹School of Public Health, The University Of Queensland, ²Child Health Research Centre, The University of Queensland, ³School of Public Health and Social Work, Queensland University of Technology

OPS 05: Statistical methods to analyze mixtures, Room 114, Floor 1, August 27, 2019, 13:30 - 15:00

Background/Aim:
Statistical methods for identifying harmful chemicals in a correlated mixture often assume linearity in exposure–response relationships. Non-monotonic relationships are biologically plausible (e.g., endocrine-disrupting chemicals); however, the impact of non-monotonicity on the performance of variable selection methods has not been evaluated. In a simulation study, we assessed the performance of three methods for the identification of important mixture components when exposure–response relationships are expected to be non-linear, including Bayesian kernel machine regression (BKMR), Bayesian additive regression trees (BART), and Bayesian structured additive regression with spike–slab priors (BSTARSS). We compared these methods to lasso penalised regression assuming linearity.

Methods:
We used data on exposure to phthalates and phenols in pregnant women from the U.S. National Health and Nutrition Examination Survey to simulate realistic exposure data using a multivariate copula, which allowed us to vary the correlation structure while preserving the observed marginal distributions. We simulated datasets of size N=250 and compared methods across 32 scenarios, vary by model size and sparsity, signal-to-noise ratio, exposure correlation structure, and shape of exposure–response relationships (including linear, S-shaped, and both symmetric and asymmetric inverse-U-shaped relationships). We compared the performance of methods in terms of their sensitivity, specificity, and estimation accuracy.

Results:
BKMR and BSTARSS achieved moderate to high specificity and sensitivity in most scenarios. BART achieved high specificity (>0.96), but low to moderate sensitivity (0.12–0.66). Lasso was highly sensitive (0.75–0.99), except when exposure–response relationships were symmetric inverse-U-shaped (<0.2). Performance was affected by changes in the signal-to-noise ratio but not substantially by the correlation structure.

Conclusions:
Penalised regression methods assuming linearity, such as lasso, may not be suitable in studies of environmental chemicals hypothesised to have non-monotonic relationships with outcomes. Instead, BKMR and BSTARSS may be used to flexibly estimate the shapes of exposure–response relationships and to select among correlated exposures in small sample size studies.
Background/Aim: Living in green areas has been associated with several health benefits; however, the available evidence on such benefits for cardiovascular morbidities is still limited. This study aims to investigate the association between exposure to greenspace and cardiovascular morbidity in Barcelona and Brussels.

Methods: This cross-sectional study is based on data from the Barcelona Health Interview Survey (2016) and the Belgian Health Interview Survey (2013). Data from these two surveys were harmonised in terms of outcomes, confounders and exposure assessment. Residential exposure to greenspace was characterised as 1) surrounding green space (surface in m² based on Urban Atlas) and 2) surrounding greenness (average of modified soil adjusted vegetation index) across 100m, 300m, and 500m buffers and 3) distance in meters to the nearest green space (Urban Atlas). Data on myocardial infarction (MI), high blood pressure (HBP) and medicine use for cardiovascular conditions was self-reported. We developed logistic mixed effect models with city as random effect as well as logistic regression models to evaluate the association between each indicator of greenspace exposure and each outcome for both cities combined and each city separately, respectively. All models were adjusted for relevant covariates including indicators of individual and neighbourhood socioeconomic status.

Results: The observed prevalence was 20.4%, 1.8% and 21.5% for HBP, MI and cardiovascular medication, respectively. In our combined analyses (n=4302), one interquartile range increase in distance to green spaces was associated with increased risk of HBP (odds ratio: 1.15; 95%CI 1.04-1.26) and for use of cardiovascular medication (odds ratio: 1.15; 95%CI 1.04-1.27). Findings for residential surrounding green space and greenness were not conclusive. There were some differences between city-specific associations; however, the general patterns were in line with those of combined analyses.

Conclusion: We found an association between the residential proximity to green spaces and reduced risk for cardiovascular morbidity.
Residential Surrounding Greenspace and Arterial Stiffening: A Whitehall II Longitudinal Study

de Keijzer C1,2,3, Foraster M1,2,3, Basagaña X1,2,3, Tonne C1,2,3, Kivimäki M4, Nieuwenhuijsen M1,2,3, Antó J1,2,3, Singh-Manoux A4,5, Sunyer J1,2,3, Dadvand P1,2,3

1ISGlobal, 2Universitat Pompeu Fabra (UPF), 3CIBER Epidemiología y Salud Pública (CIBERESP), 4Department of Epidemiology and Public Health, University College of London, 5INSERM, U1153, Epidemiology of Ageing and Neurodegenerative diseases

OPS 30: Green space and morbidity, Room 110, Floor 1, August 27, 2019, 13:30 - 15:00

Background/Aim

Arterial stiffness, and its progression with age, is an important indicator of the ageing of the cardiovascular system. Exposure to greenspace may be protective against arterial stiffness; however, the available evidence on such an effect is non-existent. We aimed to investigate the association between long-term exposure to greenspace and arterial stiffness and its progression over time.

Methods

This longitudinal study was based on 4349 participants (aged 55 to 79 at baseline) of the Whitehall II Study from the UK. Arterial stiffness was assessed in two medical examinations (2007-2009 and 2012-2013) by measuring the carotid-femoral pulse wave velocity (PWV). Residential surrounding greenspace was characterized using satellite-based indices of greenspace including Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), and Vegetation Continuous Field (VCF) across buffers of 500 and 1000 meters surrounding the participants’ address at each follow-up. The association between the greenspace indicators (one at a time) and baseline PWV and the 4-year change in PWV was assessed using linear mixed effects models with the participant as random effect, controlling for demographic factors, lifestyle factors, and indicators of individual and area socioeconomic status.

Results

Higher residential surrounding greenspace was associated with a decreased 4-year change in PWV; an interquartile range increase in NDVI, EVI, and VCF in the 500 m buffer was associated with a -0.05 m/s (95% Confidence Interval (CI): -0.07, -0.03), -0.07 m/s (95% CI: -0.10, -0.04) and -0.09 m/s (95% CI: -0.12, -0.06) 4-year change in PWV, respectively. Similar results were found using 1000 m buffers. No association was found with the baseline PWV.

Conclusions

We observed that higher residential surrounding greenspace was associated with a decelerated progression in arterial stiffness. Greenspaces could contribute to the maintenance of cardiovascular health in the older population.
Estimating increasing greenness on all-cause mortality across the 34 largest metropolitan areas in the United States

Brochu P1, James P2, Pescador Jimenez M3, Kinney P1, Lane K1
1Boston University School of Public Health, 2Harvard Medical School and Harvard Pilgrim Health Care Institute, 3Harvard University T.H. Chan School of Public Health

Background/Aim:
Studies have shown that exposure to natural vegetation, or greenness, has an inverse association with all-cause mortality. A recent meta-analysis synthesized this literature and estimated a significant decrease in all-cause mortality comparing areas of high to low greenness. Building on the coefficients from this study, we examined the health benefits of greenness in thirty-four of the largest metropolitan areas in the United States (population ≥ 500,000) by quantifying the potential reduction in all-cause mortality deaths per census tract if overall greenness increased.

Methods:
We obtained county level all-cause mortality rates from the Centers for Disease Control and Prevention for 2015 for the 34 largest metropolitan areas in the US, and downscaled to cases within Census tracts using the population distribution across tracts within counties. Normalized difference vegetation index (NDVI) from Moderate Resolution Imaging Spectroradiometer (MODIS) was used to calculate cloud-free mean greenness for each census tract during the month of July 2015. NDVI quartiles were calculated specific to each city, and census tracts within the lowest NDVI quartile of their metropolitan areas were identified. The reductions in tract-level deaths were then calculated for the low NDVI tracts using the meta-analysis odds ratio for all-cause mortality (0.69 [95% CI 0.55, 0.87]).

Results:
Downscaled mean deaths across all census tracts was 31 deaths/tract (SD: 15.1). Applying the dose-response coefficient from the meta-analysis, we estimated that increasing greenness in these tracts to the level of the top quartile of greenness would result in a decrease in all-cause mortality of 32%, by approximately 53,465 deaths (range between 22,421 and 77,610).

Conclusions:
Exposure to greenness is associated with lower rates of all-cause mortality, and interventions to increase greenness in areas with low levels of greenness could lead to substantial decreases in all-cause mortality.
Impacts of Forest Change on Mortality for Chinese Older Adults

Zhu A\textsuperscript{1}, Li B\textsuperscript{1}, Ji J\textsuperscript{1}
\textsuperscript{1}Duke Kunshan University

OPS 30: Green space and morbidity, Room 110, Floor 1, August 27, 2019, 13:30 - 15:00

Background/Aim
Forests have been shown to benefit population health through reduced air pollution, restored attention and relieved stress. Our study aimed to examine the association between changes in forest cover and mortality among Chinese elderly.

Methods
We used the 2000, 2002, 2005, 2008, and 2011 wave of China Longitudinal Healthy Longevity Survey. Our participants aged 65 and over, were recruited from 22 provinces in mainland China, and were followed up between 2000 and 2012. Based on participants’ residential addresses, we downloaded data of forest coverage in 2000, forest gain and forest lost between 2000 and 2012 at a 30m*30m resolution from Global Forest Watch. Data of four different spatial scales was obtained, including 250m, 1km, 10km, and 100km radius. Cox proportional hazards models were used to explore the effect of changes in forest cover on all-cause mortality, controlling for forest cover, age, gender, ethnicity, marital status, geographical region, residence, education, occupation, financial support, social and leisure activity, smoking status, alcohol consumption, and physical activity.

Results and Conclusions
Among 25,179 participants totaling 83,808 person-years, we observed 21,449 deaths between 2000 and 2012. The mean forest cover in 2000 increased in larger scale from 6.8% in the 250m radius to 16.7% in the 100km radius. Per 1% of forest gain in the 100 km radius had 12% (hazard ratio (HR): 0.88; 95% CI: 0.84, 0.93) lower mortality. Similar association was also found in the 250m, 1km, and 10 km radius. Additionally, per 1% of forest loss in the 100 km radius was related to 5% (HR: 1.05; 95% CI: 1.02, 1.07) higher mortality. However, similar association was not found in the 250m, 1km, or 10 km radius. Our findings demonstrated potential protective effects of forest gain on longevity in China. This reflects that more input into forest conservation may benefit population health.
Residential greenness and lung function in a prospective cohort of European adults: The ECRHS study

Markevych I1,2, Fuertes E3, Marcon A4, Dadvand P5,6,7, Nowak D1,8, Garcia Aymerich J5,6,7, Jarvis D3,9, Heinrich J1,2,10

1Institute and Clinic for Occupational, Social and Environmental Medicine, University Hospital, LMU, 2Institute of Epidemiology, Helmholtz Zentrum München - German Research Center for Environmental Health, 3National Heart and Lung Institute, Imperial College London, 4Unit of Epidemiology and Medical Statistics, Department of Diagnostics and Public Health, University of Verona, 5ISGlobal, 6Universitat Pompeu Fabra, 7CIBER Epidemioología y Salud Pública, 8Comprehensive Pneumology Centre Munich, German Centre for Lung Research (DZL), 9MRC-PHE Centre for Environment & Health, Imperial College, 10Allergy and Lung Health Unit, School of Population and Global Health, University of Melbourne

OPS 30: Green space and morbidity, Room 110, Floor 1, August 27, 2019, 13:30 - 15:00

Background/Aim:
Several epidemiological studies have reported associations of residential greenspace with decreased respiratory mortality. However, other respiratory outcomes remain under-investigated. We explored the association between residential greenness and lung function in 6209 adults from 22 centres of the population-based European Community Respiratory Health Survey.

Methods:
Forced expiratory volume in 1 s (FEV1) and forced vital capacity (FVC) were measured by spirometry pre-bronchodilatation at ages 35.2±6.0 (1990-1993), 44.1±6.0 (1998-2002) and 55.3±6.1 (2009-2013) years. Greenness was assessed by the satellite-derived Normalized Difference Vegetation Index (NDVI, ranges from -1 to 1) in 100m, 300m and 500m circular buffers around the residential addresses at the time of each lung function measurement, and then averaged to estimate cumulative exposure within each buffer. Associations of greenness with the level and rate of lung function change were assessed by adjusted linear mixed effects regression models which include random intercepts for subjects nested within centres.

Results:
Higher greenness in the 500m buffer was consistently associated with higher FEV1 levels (mean difference: 31.4mL [95% Confidence Interval: 4.7, 58.2] per 0.2 increase in NDVI) and a larger decline of FVC (annual change: -1.7 mL/year [-2.6, -0.8] per 0.2 increase in NDVI). These associations were stronger after co-adjustment for particulate matter with aerodynamic diameter of less than 2.5 μm (PM2.5). In asthmatics, the association with FEV1 levels was 4-fold higher than in the general population while no association with FVC change was present. Similar, but less consistent associations were observed for greenness in the 100m and 300m buffers.

Conclusions:
Average FEV1 levels were higher among residents of greener areas. No beneficial longitudinal associations between lung function change and greenness were detected.
Background/Aim: The evidence of a relationship between green spaces and self-perceived health is moderate and the socioeconomic inequalities underlying this relationship remain unclear. We assessed the relationship between green spaces and self-perceived health in the Brussels Capital Region (BCR) in Belgium, examining whether patterns of association differ according to the intersection between age, gender, socioeconomic status and migrant background.

Methods: Information on socioeconomic indicators, perceived green quality and self-perceived health of all registered population in Belgium is available at the individual level from the 2001 Belgian Census. We included 496,450 individuals older than 15 and living in BCR in 2001. Quantity of green (percentage of green spaces within a 600m buffer), obtained from the 2006 CORINE Landcover dataset, and 2015 mean annual concentrations of PM10 were available at the statistical ward level. Multilevel logistic regression models were conducted to obtain adjusted odds ratios (aOR) and their confidence intervals (95%CI) of the association between the quantity and quality of green spaces and poor self-perceived health. Models were adjusted by age, PM10, gender, socioeconomic status, migrant background, neighbourhood socioeconomic indicators and area of the statistical ward. Interaction and stratification analyses were then performed by age, gender, educational level and migrant background.

Results: We found an inverse association between good perceived green quality and poor self-perceived health (aOR: 0.78, 95%CI: 0.76–0.79) consistent across different population groups. Quantity of green spaces was not related to poor self-perceived health after adjusting by neighbourhood socioeconomic indicators. Greater odds of reporting poor self-perceived health when living in greener areas was found among women (aOR: 1.02, 95%CI: 1.00–1.04), the lower educated and the Turkish (aOR: 1.16, 95%CI: 1.04–1.29).

Conclusions: The unexpected results might be related to specific spatial distribution of socioeconomic inequalities within the BCR. Further analyses including other urban agglomerations in Belgium may help understand our results.
OPS 31: Health effects of multiple environmental stressors

Multiple Urban Environmental Exposures and Antihypertensive Use in the Helsinki Capital Region

Okokon E, Tiittanen P, Yli-Tuomi T, Siponen T, Lanki T


OPS 31: Health effects of multiple environmental stressors, Room 412, Floor 4, August 27, 2019, 13:30 - 15:00

Background
At any time, urban dwellers are exposed to multiple environmental factors which may impact their health. Road-traffic particulates and noise have been linked to increased risk of hypertension while the availability of green space has been suggested to improve blood pressure. Little is known of the effect of residential wood burning on blood pressure.

Aim: To estimate the risk of current use of antihypertensives relative to residential woodsmoke, road-traffic sourced particulate and noise exposures, and coverage of green space.

Methodology
In 2015 and 2016, we conducted a survey to obtain information on the environmental perception, life-style and health status of residents of the Helsinki Capital Region. Recent medication with an antihypertensive was used as a proxy for hypertension. Residential addresses were georeferenced and linked with modelled outdoor levels of woodsmoke, air pollution, traffic noise, and coverage of green areas. The noise prediction model took the direction of windows into account. Relationships between exposures and hypertension were tested in multi-and single-pollutant binary logistic regression models. These models were implemented within the framework of generalized additive models while adjusting for a range of individual and area-level covariates.

Results
We had complete data for 5441 residents, 43% of whom were males and 28% were current users of antihypertensive medication. The odds ratios (95% confidence interval) for antihypertensive use in the main model were 1.06 (0.74-1.52); 1.02 (0.79 - 1.31); 0.98 (0.92 - 1.03) and 0.99 (0.94 - 1.04) for woodsmoke PM2.5, road-traffic PM2.5, noise and coverage of green space, respectively. There was no effect modification between road-traffic particulates, noise and green spaces.

Conclusion
We could not find any relationships between antihypertensive use and select urban exposures in the Helsinki Capital Region.
The Association of PM2.5 and Greenness with Term Low Birth Weight
Lee P1, Tsai X1, Wu C2, Tsai H3, Yao T4
1National Taipei University Of Nursing And Health Sciences, 2National Cheng Kung University, 3National Health Research Institutes, 4Chang Gung Memorial Hospital

OPS 31: Health effects of multiple environmental stressors, Room 412, Floor 4, August 27, 2019, 13:30 - 15:00

Background/Aim
Pregnancy exposure to air pollution, particularly PM2.5, has been associated with increased risks of adverse pregnancy outcomes such as preterm delivery and low birth weight. Growing attention has been devoted to investigating the health benefit of exposure to natural environments, including greenness, on pregnancy outcomes. However, the roles of air pollution and greenness exposures on pregnancy outcomes are unclear. Here, we investigated whether greenness exposure modified the relationship between PM2.5 and term low birth weight (TLBW) in a large cohort in Taiwan.

Methods
This is a hospital-based cohort study. We obtained data from the Chang Gung Research Database and identified 14,543 live infants born after 37 gestational weeks at the Chang Gung Memorial Hospital between 2010 and 2012. Kriging interpolation method and land-use regression models were applied to estimate daily PM2.5 concentration and monthly PM2.5 concentration, respectively. Greenness exposure was estimated based on the global Moderate Resolution Imaging Spectroradiometer Normalized Difference Vegetation Index (NDVI) database. Logistic regressions were used to estimate marginal and joint effects of PM2.5 and greenness exposures on TLBW.

Results
The incidence of TLBW was 3.2%. We found that first trimester PM2.5 exposure was significantly associated with TLBW (the OR at the top quartile of PM2.5 compared with the lowest quartile was 1.84, 95%CI=1.17-2.90). Additionally, the top quartile of NDVI was associated with decreased risk of TLBW compared with the lowest quartile (OR=0.87, 95%CI=0.65-1.16), but not statistically significant. We did not find evidence of significant interaction on a multiplicative scale between PM2.5 and NDVI on TLBW (interaction OR=0.98, 95%CI=0.86-1.12).

Conclusions
Our study indicated that first trimester PM2.5 exposure was associated with TLBW, but did not find the join effect of PM2.5 and greenness exposures on TLBW. It will be of importance to further investigate the effect of greenness exposure on pregnancy outcomes.
The combined impact of environmental and built environment exposures on birthweight in an urban population in Massachusetts

Yitshak-Sade M1, Fabian P2, Lane K2, Hart J1,3, Schwartz J1,3, Laden F1,3, James P4, Fong K5, Kloog I6, Zanobetti A1

1Harvard School Of Public Health, 2Boston University School of Public Health, 3Brigham and Women’s Hospital and Harvard Medical School, 4Harvard Medical School and Harvard Pilgrim Health Care Institute, 5Yale School of Forestry and Environmental Studies, 6Ben-Gurion University

OPS 31: Health effects of multiple environmental stressors, Room 412, Floor 4, August 27, 2019, 13:30 - 15:00

Background: Low birthweight, a leading cause of neonatal death, is partially determined by maternal environmental exposures. These exposures are often correlated with one another; therefore, it is difficult to isolate the important environmental predictors of birthweight. Multivariate regression is the classical approach used to examine these associations. However, in cases of multicollinearity or overfitting, effect estimates obtained from a standard regression may be unreliable. Therefore, we apply data reduction methods to identify the predictors of birthweight out of a set of environmental exposures, built environment characteristics, and economic stressors during pregnancy.

Methods: We included all singleton live full-term births of mothers who delivered in Massachusetts between 2001 and 2011 and resided in urban Census block-groups (n=601,927). We examined numerous exposures as potential predictors of birthweight: (fine particulate matter (PM2.5), temperature, greenness, walkability, noise, and economic segregation and dissimilarity), all estimated at the block-group level. We used an elastic-net model to select the important predictors of birthweight and constructed a multivariate model including the selected predictors, with adjustment for individual maternal and neonatal confounders. We additionally used a weighted quantile sum regression (WQSR) to assess the relative contribution of each exposure to birthweight changes.

Results: All exposures were selected as important predictors of birthweight in the elastic-net model. We observed statistically significant lower birthweight associated with lower greenness and with higher temperature, walkability, noise, and economic residential segregation. Despite significant associations in the single pollutant models, PM2.5 and economic dissimilarity were not associated with birthweight in the multivariate model. Higher noise and temperature contributed most to birthweight reductions based on WQSR.

Conclusion: Even after accounting for individual maternal and neonatal characteristics, environmental and built environment exposures were important predictors of birthweight, emphasizing the role of environmental exposures in fetal growth and development, and providing avenues for intervention.
Air pollution, noise, green spaces and built environment and the risk of overweight and obesity during childhood

de Bont J1,2, de Castro M1, Vrijheid M1, Duarte-Salles T2
1Barcelona Institute For Global Health (isglobal), 2Fundació Institut Universitari per a la recerca a l’Atenció Primària de Salut Jordi Gol i Gurina (IDIAPJGol)

OPS 31: Health effects of multiple environmental stressors, Room 412, Floor 4, August 27, 2019, 13:30 - 15:00

Background/Aim: Recent studies have linked air pollution, noise, green spaces and built environment with childhood overweight/obesity. However, few have evaluated multiple urban exposures in one study. The aim is to evaluate whether the urban environment is associated with the risk of developing overweight and obesity during childhood (between 3 and 9 years old).

Methods: A longitudinal study included children (n=112,734) identified at 4 years (±1 year) from primary care records (SIDIAP) between 01/01/2011 and 31/12/2013. They were followed up until 31/12/2016, death or transferred-out. Height/weight were measured several times during childhood and BMI was calculated (kg/m²). Overweight/obesity was categorized following the WHO reference. The urban indicators were calculated at census tract level. The estimated urban indicators were air pollution (nitrogen dioxides (NO₂), particulate matter <10μm (PM₁₀) and < 2.5μm (PM₂.₅)), noise, green spaces (Normalized Difference Vegetation Index (NDVI) and % green space) and built environment (population density, intersection density, mixed land use and walkability index). Hazard ratios (HR) were calculated using a multivariable Cox model to explore the association between the urban environment and the risk of developing overweight/obesity.

Results: We found that an interquartile (IQR) increase of NO₂ (26.5 μg/m³), PM₁₀ (8.1 μg/m³), population density (29877 people/km²) and intersection density (194.0 intersections/km²) increased the risk of developing overweight/obesity during childhood [NO₂ HR=1.04; (95%CI, 1.02-1.06); PM₁₀ HR=1.02; (1.00-1.04); population HR=1.04; (1.03-1.05); intersection HR=1.03; (1.02-1.04)]. Further, an IQR of NDVI (0.2 units), % green spaces (41.1% units), noise (5.2 dB(A)) and mixed land use (0.4 units) decreased the risk of developing overweight/obesity [NDVI HR=0.96; (0.94-0.98); %green HR=0.97; (0.94-0.99); noise HR=0.97; (0.95-0.99); mixed land use HR=0.96; (0.95-0.98)]. We did not found significant association for PM₂.₅ and walkability score.

Conclusions: This study provides preliminary results on the influence of air pollution, noise, green spaces and built environment on the development of childhood overweight/obesity.
Ocean health in Belgium: Living near the coast is associated with better health

Hooyberg A¹, Everaert G¹, Grellier J², Elliott L², Lonneville B¹, White M², Michels N³, De Henauw S³, Roose H⁴, Vandegehuchte M¹

¹Flanders Marine Institute, ²European Centre for Environment and Human Health, ³Ghent University - Department of Public Health and Primary Care, ⁴Ghent University - Department of Sociology

OPS 31: Health effects of multiple environmental stressors, Room 412, Floor 4, August 27, 2019, 13:30 - 15:00

Natural environments have long been associated with health risks, but potential benefits for health and well-being are only recently being explored. Similar to green spaces, coastal areas provide a good environmental quality with opportunities for healthy social and physical activities (e.g. in the context of blue tourism), allowing to improve mental (e.g. less stress) and physical health. However, evidence linking residential proximity to the coast with human health and well-being is scarce. The present study investigated whether Belgian citizens living closer to the coast report better health. Therefore, linear regression models were applied on data from the Belgian Health Interview Survey (n = 60,939; 52% female, all ages). Our results were standardized for demographic (e.g. age, having a chronic disease, income, smoking status, physical activity, social interactions, etc.) and environmental parameters (urbanization level, % blue space and green space in the area and air quality as PM10 and NO2 concentrations). Citizens living close to the coast (< 5 km) reported 3.7 % better subjective health than citizens from the hinterland (> 250 km). Although people living at 20-50 km reported highest scores for vitality (SF-36 score), people living in close proximity to the sea (< 5 km) also reported 5.7 % better vitality than people from the hinterland (> 250 km). Changes in psychosocial stress (GHQ-12 score) with proximity to the coast were less strong. This is the first evidence of a positive association between proximity to the coast and the physical and mental human health and well-being in Belgium. Our results endorse similar findings from the UK.

Acknowledgments: We would like to thank the providers of the data, i.e. Scientific Institute of Public health, OD Public health and surveillance (2015). Health Interview Survey 2013 [Data file and code book]. Obtainable under condition from the WIV-ISP Web site: https://his.wiv-isp.be/SitePages/Acces_microdata.aspx
The association of perceived neighborhood walkability and environmental pollution with frailty among community-dwelling older adults in rural areas: a cross-sectional study

Kim M1, Seo S1, Choi Y1, Kim B, Seo A1, Lee K1, Kim J1, Kang Y1, Jeong B1, Park K1

1Department of Preventive Medicine and Institute of Health Science, Gyeongsang National University College of Medicine

OPS 31: Health effects of multiple environmental stressors, Room 412, Floor 4, August 27, 2019, 13:30 - 15:00

Background/Aim
Frailty is one of the most problematic expression of population ageing. Older adults are often targeted for interventions to prevent frailty, especially interventions that focus on physical activity and socialization. However, the role of neighborhood environments in influencing old people’s physical activity levels, social participation and accessibility has not been fully investigated. The aim of this study was to evaluate the association of perceived neighborhood walkability and environmental pollution with frailty among community-dwelling older adults in rural areas.

Methods
Participants were 807 community-dwelling men and women aged 65 years and older in two rural towns. Comprehensive information, including demographics, socioeconomic status, grip strength, polypharmacy, perceived neighborhood environments (walkability and environmental pollution), and frailty, was collected using face-to-face interviews in June 2018 to August 2018. Walkability was measured using 20 items selected and revised from the Neighborhood Environment Walkability Scales (NEWS), the Physical Activity Neighborhood Environment Survey (PANCES), and the Neighborhood Walkability Checklist from National Heart Foundation in Australia. The Kaigo-Yobo Checklist was used to assess participants’ frailty.

Results
The overall prevalence of frailty in this community-dwelling population was 35.6%. Compare to the non-frail participants, the frail individuals were female, older, living alone, having lower education level, unemployed, having poor grip strength, taking more than three medicines. Frailty was associated with lower perceived neighborhood walkability (odds ratio [OR] = 0.881, 95% confidence interval [CI] = 0.834-0.932, p < 0.001) and worse perceived neighborhood environmental pollution (OR = 1.051, 95% CI = 1.017-1.087, p = 0.003) after adjustment for sex, age, solitariness, education level, employment status, monthly income, grip strength, and polypharmacy.

Conclusions
It is needed to improve local environments as well as personal physical, mental, and social health to prevent or reverse frailty in rural areas where population ageing is more severe and built environment is worse than urban areas.
OPS 32: Health impact of interventions 1
Reducing PM2.5 levels is associated with lower cancer incidence
1Inserm - UMS 11, 2Department of Social and Preventive Medicine, Université de Montréal, 3Swiss Tropical and Public Health Institute, 4University of Basel, 5Santé publique France, 6Univ Rennes, Inserm, EHESP, Irset (Institut de recherche en santé, environnement et travail) – UMR_S 1085

Background/Aim: Long-term exposure to fine particulate matter (PM2.5) is associated with cancer incidence of several sites. While reduction of exposure to PM2.5 leads to reduced all-cause mortality risk, this has not yet been studied for cancer incidence. Here we investigate the relationship between changes in PM2.5 levels in France and cancer incidence at individual level in Gazel, a large population-based cohort.
Methods: Gazel included 35-50 years old participants in 1989, followed-up yearly until 2016. We estimated exposure to PM2.5 at the home address using land-use regression models developed in 2010 and applied temporal extrapolation between 1990 and 2015, for all participants. We also took into account the delay between exposure and cancer diagnosis with a 10-year lag. Annual variation of PM2.5 was calculated as the difference between two consecutive years; our main exposure metric was the cumulative difference since baseline (“delta”). We excluded participants with positive delta. Our study population included 19,216 participants, among which we identified 3,656 and 355 incident cases of all-site and lung cancer, respectively. We used extended Cox models with attained age as underlying time-scale, and PM2.5 delta as a time-dependent variable, adjusted to the baseline PM2.5 exposure. We included an interaction with baseline age for these two PM2.5 variables, and adjusted for relevant confounders (including sex, tobacco, alcohol consumption, socio-economic status, calendar time).
Results: We found a significant association between PM2.5 delta and all-site cancer incidence with a hazard ratio of 0.46 (95% confidence interval 0.28-0.75) for each decrease of 5µg/m3 PM2.5. The association for lung cancer was similar but not statistically significant [0.67 (0.14-3.15)]. Interactions with baseline age were positive, indicating the effect was smaller for older participants.
Conclusions: These findings suggest potentially large public health benefits of reducing PM2.5 levels.
Potential benefits of cool roofs in reducing heat-related mortality during heatwaves in a European city

Macintyre H\(^1\)\(^2\), Heaviside C\(^1\)\(^2\)\(^3\)

\(^1\)Public Health England, \(^2\)University of Birmingham, \(^3\)University of Oxford

OPS 32: Health impact of interventions 1, Room 315, Floor 3, August 27, 2019, 13:30 - 15:00

Background:
Heatwaves are associated with a range of adverse health effects, which can lead to emergency hospitalisations and increased mortality. In towns and cities, air temperatures are often higher than in surrounding rural areas, particularly at night. This Urban Heat Island (UHI) effect can exacerbate health impacts associated with heat exposure. The UHI is often amplified during summer heatwave periods, and heatwaves are likely to become more frequent, intense, and longer, due to climate change. Birmingham in the West Midlands is a highly urbanised area with a distinct UHI. Recent work suggests that up to half of heat-related mortality in the West Midlands during the 2003 heatwave could be attributed to the UHI. High temperatures and excess-mortality also occurred in July 2006 in this region.

Actions or interventions to reduce the intensity of the UHI could potentially reduce heat-risk. Retrofitting of buildings, for example installing cool (reflective) roofs, or interventions such as increasing urban vegetation, are possible ways to reduce the UHI, and thus reduce population exposure to heat.

Methods:
In this study we use a regional weather model with detailed representation of urban areas to study the UHI across the West Midlands. We present results of the impact of interventions such as cool roofs and greenspace on reducing exposure to high ambient temperatures for a summer season, and two heatwave periods. We also explore sensitivity to different exposure-metrics used for health impact assessments.

Results and conclusion:
Our modelling suggests that during heatwaves, cool roofs could reduce mean UHI intensity by 23%, and reduce heat-related mortality attributed to the UHI by 25%. Results show targeting the most urbanised areas could contribute more than half of this reduction during heatwaves, and modifying half of all industrial/commercial urban areas could have the same impact as modifying buildings in all high-intensity residential areas.
Heo S¹, Nori-Sarma A¹, Lee K², Benmarhnia T³, Dominici F³, Bell M¹
¹Yale University School Of Forestry & Environmental Studies, ²Harvard TH Chan School of Public Health, ³Dept of Family Medicine and Public Health, UC San Diego

OPS 32: Health impact of interventions 1, Room 315, Floor 3, August 27, 2019, 13:30 - 15:00

Background: Many cities and countries have implemented heat wave early warning systems to combat the health effects of extreme heat. Little is known about whether these systems actually reduce heat-related morbidity and mortality. We examined the efficacy of heat wave warning systems in reducing mortality risk of heat waves in South Korea, utilizing a difference-in-difference analysis combined with propensity score weighting.

Methods: Daily mortality, weather monitoring, and heat wave alert announcement data were collected for 7 major cities of S. Korea, 2008-2014. We estimated the effect of heat wave warning announcements on mortality risk by comparing the risk difference between false negative heat wave days and true heat wave days from the baseline risk difference between true non-heat wave days and false positive heat wave days, with days assigned based on the heat wave alert and temperature monitoring data.

Results: The detection rate of the system for true heat wave or non-heat wave days was 81%; false negative heat wave days were 6%, false positives 13%. Overall, there was no evidence for reduction of mortality in the population (+0.62 deaths per 1,000,000 people per day; 95% CI: -0.11, 1.34). There was some evidence of reduction among people age 65+ (-1.2 deaths / 1,000,000 people; 95% CI: -3.59, 6.01), people holding blue-collar jobs (-0.09 deaths / 1,000,000 people, 95% CI: -0.22, 0.39) and people with no education (-0.57 deaths / 1,000,000 people, 95% CI: -0.24, -0.90).

Conclusion: Previous time series studies have shown reductions in heat wave health affects attributed to early warning systems. Our study found no evidence that heat wave warning systems reduced mortality in S. Korean cities. However, heat wave warnings may reduce mortality for several subpopulations of age and socio-economic status. Future iterations of heat wave alerts may improve efficacy by focusing on these sensitive subpopulations.
The use of portable HEPA air cleaners to improve residential indoor air quality during biomass burning events.

Wheeler A1, Longley I2, Reisen F3, Kachhara A2, Borchers Arriagada N4, Olivares G2, Williamson G4, Dennekamp M5, Garvey K6, Johnston F4

1Australian Catholic University, 2NIWA, 3CSIRO, 4University of Tasmania, 5EPA Victoria, 6Department of Health Tasmania

OPS 32: Health impact of interventions 1, Room 315, Floor 3, August 27, 2019, 13:30 - 15:00

Bushfires, prescribed burns and residential wood burning are a significant source of fine particles (PM2.5) affecting the health and well-being of many communities. Studies conducted internationally have demonstrated that much of the outdoor particulate matter generated through biomass burning is able to infiltrate indoors resulting in elevated residential indoor PM2.5 concentrations. There is some international evidence of the value of using portable indoor air cleaners to reduce PM2.5 exposure. These have yet to be successfully evaluated in the Australian context where building codes and housing designs differ significantly from Europe, Canada and the US, where much of this research has been previously conducted. During 2018 and 2019 three residential indoor air quality studies were undertaken to assess the efficacy of portable HEPA air cleaners at reducing indoor PM2.5 concentrations. In total, 79 homes participated in the studies that included emissions from winter woodsmoke, planned burns and a Tasmanian bushfire emergency. Residential indoor and outdoor PM2.5 concentrations were measured continuously using Plantower 3003 sensors. Baseline and intervention periods using a portable HEPA air cleaner were conducted in all homes. Housing characteristic surveys and daily diaries of household activities were tracked to interpret the findings. A subset of homes included air exchange rate measurements using the carbon dioxide decay method.

Preliminary data from regulatory monitoring stations indicate that ambient PM2.5 concentrations reached hourly averages of approximately 1,200µg/m³ during the bushfire and approximately 80µg/m³ during winter woodsmoke events. Woodsmoke impacted homes demonstrated an average change in PM2.5 indoor to outdoor ratios from baseline to HEPA interventions between 0.89–0.76. Data from all biomass events will be presented including results from the bushfire emergency. This will provide intervention data for regulatory agencies facing extreme smoke events in populated areas where evacuations are challenging or there are populations vulnerable to health effects of smoke exposure.
Towards a comprehensive heat-health warning system of Hong Kong: an evidence-based multi-stage approach

Zhang X\textsuperscript{1}, Ren C\textsuperscript{1}, Lau K\textsuperscript{2}, Shi Y\textsuperscript{2}, Wang D\textsuperscript{2}, Ho D\textsuperscript{1}

\textsuperscript{1}The University of Hong Kong, \textsuperscript{2}The Chinese University of Hong Kong

OPS 32: Health impact of interventions 1, Room 315, Floor 3, August 27, 2019, 13:30 - 15:00

Aim: Increasing urbanization, climate change and ageing bring more heat-health risks in urban areas under heatwaves especially for high-density cities. Health services need to be improved in short-term while urban planning should take in account of heat-health from a long-term perspective. A comprehensive study is necessary to capture spatial-temporal temperature pattern and hotspot areas under heatwave, and understand different extreme hot weather events (EHWEs) and its corresponding heat-health impact for different age groups.

Methods: Hong Kong was selected for an evidence-based multi-stage case study. Local health records including total mortality data from Census Department, ambulance dispatch records from hospital authority, calling records from Senior Citizen Home Safety Association were collected for summer over 2006-2015. Corresponding temperature records from 40 weather stations were obtained from Hong Kong Observatory. Two local hot weather indicators, Very Hot Day (Tmax≥33°C) and Hot Night (Tmin≥28°C) were adopted. Land use regression was performed to estimate EHWEs spatial distribution. Heat-mortality and heat-morbidity impacts under different EHWEs types (various combinations of VHD and HN defined to extensively describe the characteristics of EHWEs in Hong Kong) were evaluated.

Results: Due to intensified urban heat island effect and global warming, hours and days of HN were increasing faster than those of VHD. Downtown areas experience constant hot nights through entire summer, which causes higher risks for sensitive population. Higher heat health risk of mortality and morbidity under nigh-time prolong heat events and consecutive hot nights were detected comparing to daytime situation. The 2VHD2HN was identified to be the extreme heat event with higher priority for early warning and mitigation.

Conclusions: Findings not only provide a useful reference to develop a heat-health action plan, but also produce spatial-temporal information for local policy and design strategies. The developed research framework can be applied and contribute to other cities with high-density urban setting.
Effects of a large-scale distribution of water filters and natural draft cookstoves on diarrhea, acute respiratory infection, water quality, and personal PM2.5: a cluster randomized trial in Western Province, Rwanda.

Kirby M1, Nagel C2, Rosa G3, Zambrano L1, Musafiri S4, Ngirabega J5, Thomas E6, Clasen T1
1Emory Rollins School Of Public Health, 2University of Arkansas for Medical Sciences, 3London School of Hygiene and Tropical Medicine, 4University of Rwanda School of Medicine and Pharmacy, 5Rwanda Biomedical Center, 6University of Colorado Boulder

Background
Unsafe drinking water and household air pollution are major causes of morbidity and mortality among children under 5. Household water filters and higher efficiency cookstoves have been widely promoted to improve water quality and reduce fuel use, but there is limited evidence of their impacts on health or exposure when delivered programmatically at scale.

Methods
In a large-scale program in Western Province, Rwanda, water filters and portable biomass-burning natural draft rocket-style cookstoves were distributed and promoted to over 101,000 households in the poorest economic quartile in 72 (of 96) randomly selected sectors. We enrolled 1582 households from 174 randomly-selected village-sized clusters, half from intervention and half from control sectors. We followed them for 12 months after intervention delivery to assess reported diarrhea and acute respiratory infections (ARI) among children <5 years, along with intervention use, water quality, expired CO, and personal exposure to PM2.5.

Results
Overall, more than 62% of households were observed to have water in their filters; 65% reported using the intervention stove every day and 55% reported using it primarily outdoors. Use of both intervention filter and stove decreased throughout follow-up, while traditional stove use increased. The intervention reduced the prevalence of households with no detectable fecal contamination in drinking water by 38% (PR 0.62, p<0.0001), but had no significant impact on eCO or 48-hour log-transformed PM2.5 concentrations among cooks (β =-0.089, p=0.486) or children (β =-0.228, p=0.127). The intervention reduced the prevalence of reported child diarrhea by 29% (PR 0.71, p=0.001) and reported child ARI by 25% (PR 0.75, p=0.009).

Conclusions
The intervention improved household drinking water quality and reduced reported diarrhea among children <5. It also reduced reported ARI despite no evidence of improved air quality. Further research is necessary to ascertain longer-term intervention use and benefits and to explore the potential synergistic effects.
Background/Aim:
Lung cancer rates for never-smoking women in rural Xuanwei and Fuyuan, China are among the highest in the world. This excess has been attributed to use of “smoky” (bituminous) coal. However, the key carcinogenic component(s) of coal that drive the lung cancer risk have not been identified.

Methods
We conducted a population-based case-control study of lung cancer among 1015 never-smoking female cases and 485 controls from throughout Xuanwei and Fuyuan. Associations between 43 household air pollution (HAP) chemicals and particulates and lung cancer risk were analyzed in a multipollutant model using penalized regression. These compounds had previously been measured and modelled in a comprehensive exposure study conducted in the same general population. This exposure assessment included multiple organic and inorganic compounds, as well as methylated polycyclic aromatic hydrocarbons (PAH), which have never been directly evaluated in an epidemiologic study of any cancer.

Results:
The strongest detected risk of lung cancer was among a cluster of 28 PAHs (OR=2.21 [95%CI 1.67, 2.87] per one standard deviation change) among which 5-methylchrysene (a carcinogenic PAH) had the highest observed risk (OR=5.42 [95% CI: 0.94, 37.5]), which became stronger when analyses were restricted to smoky coal users (OR= 28.5 [95% CI: 1.02-772]). A positive association with NO2 (OR=2.06 [1.19, 3.49]) was also observed. By contrast, neither benzo(a)pyrene nor fine particulate matter (PM2.5) were associated with lung cancer risk in multipollutant models.

Conclusions:
This study is the first to comprehensively examine lung cancer risk in relation to HAP constituents estimated over the entire lifecourse. Given the global ubiquity of coal use domestically for indoor cooking and heating and commercially for electric power generation, more extensive monitoring of coal combustion products including methylated PAHs may be warranted to better assess health risks and develop prevention strategies for this exposure.
Variability of exposure to PM2.5 related to indoor pollution sources in low socio-economic urban households, Durban, South Africa

Shezi B1,2, Jafta N1, Naidoo R1
1Discipline of Occupational and Environmental Health, School of Nursing and Public Health, University of KwaZulu-Natal, 2Environment and Health Research Unit, South African Medical Research Council

OPS 35: Health effects of indoor air pollution in LMIC countries, Room 411, Floor 4, August 27, 2019, 13:30 - 15:00

Background: The goal of PM2.5 indoor assessment for use in epidemiological studies is to estimate indoor levels over time and space. Because of logistical constraints, very few studies have been conducted to assess the reproducibility of indoor PM2.5 measurements.

Objective: To evaluate PM2.5 variability in urban households of mothers participating in the Mother and Child in the Environment birth cohort study in Durban, South Africa.

Methods: Indoor PM2.5 samples were collected in warm season and cold season from 30 homes across Durban. Four measurements of PM2.5 were undertaken in each house within a 2-week interval using Airmetrics miniVol samplers. We fitted a mixed effects model to estimate the variation of PM2.5 and to determine the determinants of this variation.

Results: PM2.5 levels ranged from 1.5 to 302 µg/m3. Levels were highest (mean (SD)=60.8 (70.8) µg/m3) during the cold season and lowest (mean (SD)=43.5 (45.8) µg/m3) during the warm season. Within-home variation dominated the total variability. The results showed that PM2.5 predictors such as active smoking, environmental tobacco smoke exposure and seasonal indicators were significant determinants of PM2.5 variation (R2=0.71), contributing to 2.5–81.4% of the variability.

Conclusions: The results suggest that within home variance in PM2.5 levels influence total variability more than factors affecting PM2.5 levels variance between homes over time.
Prenatal Risk factors and environmental exposure associated with early childhood wheezing in the Mother and Child in the Environment (MACE) Birth Cohort

Asharam K\textsuperscript{1}, Jeena P\textsuperscript{2}, Mitku A\textsuperscript{1}, Tularam H\textsuperscript{1}, Muttoo S\textsuperscript{1}, Naidoo R\textsuperscript{1}

\textsuperscript{1}Occupational and Environmental Health, University of KwaZulu-Natal, \textsuperscript{2}Paediatric Pulmonology, University of KwaZulu-Natal

OPS 35: Health effects of indoor air pollution in LMIC countries, Room 411, Floor 4, August 27, 2019, 13:30 - 15:00

Background. Prenatal and environmental exposure are contributing risk factors for development of a wheezing in early childhood.

Aim. To identify maternal and environmental risk factors associated with wheezing in children aged birth to 24 months in the MACE cohort.

Method. The Mother and Child in the Environment (MACE) cohort includes pregnant females selected from the public sector ante-natal clinics in Durban (South Africa) (n=1140), with similar socio-economic profiles. Maternal questionnaires were administered during pregnancy and with child clinical follow-up done at 6 months, 12 months and 24 months. Land use regression modelling was used to describe home address measures of antenatal exposure to nitrogen dioxide (NO\textsubscript{2}).

Results. The mean maternal age at delivery was 25.92 (SD=5.96). The sample included exposure to HIV (n=37 (35.6%)), low birth weight (n=12 (11.0%)), pre-term birth (n=8 (7.3%)), exposed to passive smoking (n=77 (70.6%)) and a family history of asthma (n=40 (36.7%)). Of the children two years and younger, 466 infants had at least one follow-up visit in the first 24 months of life. Of these, 109 (23%) caregivers reported at least one incident of childhood wheeze during this period with the most number of wheeze episodes (n=63) reported at the 12 month visit. Infants exposed to passive smoking (AOR:1.737, 95% CI: 1.073-2.811) and infants with a family history of asthma (AOR: 2.724, 95% CI: 1.650-4.496) were at an increased risk of wheezing. Ambient exposure to NO\textsubscript{2} was not associated with wheezing infants (AOR: 0.849, 95% CI: 0.053-1.360).

Conclusion. Exposure to passive smoking and a family history of asthma were risk factors associated with wheezing in children from birth to 24 months in our cohort. The absence of association with NO\textsubscript{2} exposure could be explained by the misclassification of wheeze as reported by mothers/caregivers, particularly in the presence of upper respiratory tract infection in early childhood.
The association of household particulate-bound metal concentrations and tuberculosis in women and children in Pune, India


Colorado State University, Johns Hopkins Bloomberg School of Public Health, Byramjee Jeejeebhoy government Medical college - Johns Hopkins Clinical Trials Unit, Johns Hopkins School of Medicine

OPS 35: Health effects of indoor air pollution in LMIC countries, Room 411, Floor 4, August 27, 2019, 13:30 - 15:00

Background/Aim: Particulate-based heavy metal exposure is a known risk factor for respiratory and other disease, however has yet to be associated with tuberculosis (TB). We assessed the association of metals in household particulate matter and TB in women and children in Pune, India.

Methods: A case-control study was conducted among adult women and child index TB cases and healthy controls matched on geography, age, and sex. Household concentrations of particulate matter less than 2.5 microns (PM2.5) were collected at the primary cookstove for a period of 24 hours and analyzed for chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), arsenic (As), molybdenum (Mo), cadmium (Cd), tin (Sn), antimony (Sb), and lead (Pb).

Results: A total of 134 individuals in 74 matched pairs were included in this analysis (54 children and 80 adults). The median (IQR) concentration of PM2.5 was 161 (96, 272). Median metal concentrations ranged from 0.36 – 4.65 ng/m³ for Cr, Co, Ni, As, Mo, Cd, Sn, and Sb, from 14.43 – 15.35 ng/m³ for Mn and Cu, and from 49.16 – 128.47 ng/m³ for Pb, Zn, and Fe. Median concentration values were higher among TB cases as compared to controls for Cr, Co, As, Sn, Sb, and Pb, however these differences were not statistically significant. No significant difference between metal concentration was seen for type of fuel use in the home. Mn, Fe, Ni, Cu, An, As, Cd, Sn, Sb, and Pb were all statistically significantly higher in the winter months as compared to non-winter months (p < 0.05).

Conclusions: In this small matched case-control study we did not find any significant association between PM2.5-bound metal concentrations and TB or household fuels. Metal concentrations were significantly higher in winter months, which are associated with higher TB incidence.
Background. Household air pollution from solid fuel stoves is a pervasive exposure affecting over 2 billion people. Transition to clean fuels like gas and electricity can reduce household air pollution. We evaluated the associations between current and long-term exclusive use of clean fuel stoves with blood pressure and markers of arterial stiffness and atherosclerosis in rural men and women living in Beijing, Shanxi, and Guangxi provinces.

Methods. Among 784 Chinese adults (40-79y) enrolled in the INTERMAP-China Prospective Study, we obtained detailed information on household fuel and stove use between 1996 and 2016 and measured systolic (SBP) and diastolic blood pressure (DBP), brachial-femoral pulse wave velocity (bfPWV), and potential socio-demographic, dietary, and behavioral confounders in winter and summer. Ultrasound images of participants’ carotid arteries were evaluated for plaque area and stability using grayscale analysis. Mixed-effects regression models were used to investigate associations between fuel use and cardiovascular biomarkers.

Results. All participants used solid fuel stoves in 1996; 35.3% and 12% suspended use of solid fuel for cooking and heating, respectively, by 2016. In multivariable models, exclusive use of clean cooking fuel was associated with lower SBP (Difference±StErr: -2.8±1.2 mmHg) and DBP (-1.6±0.7 mmHg) and less grayscale (-3.2±2.5). Years since suspension of solid fuel cooking were associated with lower SBP [1-5y: -2.1±1.4; 6-10y: -3.4±1.6] and DBP (1-5y: -1.3±1.0; 6-10y: -1.5±0.9) compared with adults not suspending. Years since suspension of solid fuel heating was associated with less grayscale (1-5y: -6.8±3.4). These associations were larger in men, older age, and anti-hypertensive medication users. Fuel use was not associated with bfPWV.

Conclusions. In this first study of exclusive clean fuel use and cardiovascular outcomes in men and women, exclusive use of clean fuel and years since suspension of solid fuel were associated with lower BP and less plaque vulnerability and severity.
Indoor Gaseous Pollution as Determinants of Overweight/Obesity
Chen J1, Su T2
1Institute Of Occupational Medicine And Industrial Hygiene, National Taiwan University, 2Department of Environmental and Occupational Medicine, National Taiwan University Hospital

OPS 35: Health effects of indoor air pollution in LMIC countries, Room 411, Floor 4, August 27, 2019, 13:30 - 15:00

Backgrounds
Although human spent a substantial portion of time, up to 87%, indoors, limited study has focused on the adverse effects of indoor air pollutants on overweight/obesity.

Materials and Methods:
This study is the sub-study of “Effects of living environments and dietary habits on cardio-metabolic disorders in young adults”. Those who agreed to receive indoor air quality and environmental monitoring were invited to participate this study. During 2017 through 2018, we recruited 127 participants in 60 families. Every participant received cardiovascular health examination and a series of questionnaires. This study conducted 24-hour (24-h) indoor air quality monitoring in 60 households, including particulate matter with aerodiameter < 2.5 and 10 μm (PM2.5 and PM10), total volatile organic compounds (TVOCs), formaldehyde, and carbon monoxide and dioxide (CO and CO2). In this analysis, the association between overweight/obesity indices and indoor air pollution was investigated.

Results:
Most households’ air quality are within the criteria of indoor air quality Taiwan Environmental Protection Administration. Indoor gaseous air pollution are positively and significantly associated with overweight/obesity indices, body mass index, waist circumference, and body fat percentage measured by bioelectrical impedance analysis (Tanita body composition scanner, Japan). After controlling age, male gender, smoking habit, incense burning, fasting glucose, exercise habit, and education, the indoor 24-h concentration of CO2 and TVOCs were identified as two most important indoor air pollution that positively associated with overweight/obesity. For every increase an interquartile range concentration of indoor TVOCs, the adjusted odd ratio (aOR) (95% CI) for overweight/obesity are 2.26(1.38-3.72) for 12-h (6 pm-6 am) TVOCs and 1.61(1.13-2.30) for 24-h TVOCs, respectively. And, the corresponding aOR (95% CI) for indoor CO2 exposure and overweight/obesity are 1.90(1.22-2.97) for 12-h CO2 and 2.09(1.06-4.11) for 24-h CO2 respectively.

Conclusion: Indoor 24-h gaseous air pollution, particularly TVOCs and CO2, are positively associated with participants’ overweight/obesity status.
Background/Aim: Average residential exposure to outdoor air pollution is higher for racial/ethnic minorities and low-income households than for non-Hispanic whites and high-income households. Most research on this topic uses Census data to investigate concentrations at location of residence, yet, children spend substantial time in and around schools. Here we aim to assess exposure disparities for nitrogen dioxide (NO2; a traffic-related air pollutant) at all public schools in the contiguous US.

Methods: A year-2006 satellite-based land use regression for NO2 was used to estimate outdoor concentrations at all public-school locations (89,420 schools; 48 million students) in the National Center for Education Statistics School Universe Survey (2005-2006). We compare concentrations disparities by race/ethnicity and income (student eligibility for free/reduced lunch) while controlling for level of urbanization.

Results: Minority schools (> 50% students are racial/ethnic minorities, i.e., are not “non-Hispanic white”) and low-income schools (> 50% free/reduced lunch eligible students) are more likely to be above the WHO guideline (40 µg/m³) than white-majority schools (20× for all schools; 11× for schools in urbanized areas) and high-income schools (4× for all schools and for schools in urbanized areas), respectively. For large and medium urbanized areas, minority students are exposed to higher concentrations than white students, even when controlling for income. Disparities by income diminish when controlling for race/ethnicity, except for rural locations, where free/reduced lunch eligible students are exposed to lower concentrations than ineligible students.

Conclusions: We found large disparities in outdoor NO2 exposure at school locations across the contiguous US for race/ethnicity and to a lesser extent for income. This finding – that race/ethnicity is a larger driver of disparities than income – is consistent with studies evaluating residential outdoor NO2 disparities, and suggest that school exposures could exacerbate disparities, particularly for minority students.
Trends in heat-attributable vulnerability and mortality in Europe: role of macroeconomic growth during the Great Recession

Ballester J, Achebak H, Herrmann F, Robine J, Rodó X

1Barcelona Institute for Global Health (ISGlobal), 2Center for Demographic Studies (CED), Autonomous University of Barcelona (UAB), 3Division of Geriatrics, Department of Internal Medicine, Rehabilitation and Geriatrics, 4Geneva University Hospitals and University of Geneva, 5Institut National de la Santé et de la Recherche Médicale (INSERM), 6École Pratique des Hautes Études, 7ICREA

OP5 60: Social factors and environmental health across the world, Room 210, Floor 2, August 27, 2019, 13:30 - 15:00

Adaptation strategies have been increasingly implemented in Europe in recent years, and particularly since the record-breaking heat wave of summer 2003, but a systematic comparison of recent trends in temperature, vulnerability and heat-attributable mortality among European regions and countries has not been comprehensively addressed at the continental scale.

Here we explore this triple relationship by using a daily mortality database with nearly 60 million counts of death in 147 regions from 16 European countries representing over 420 million people. Results indicate that, on average, Europe is currently reducing human vulnerability to heat at a rate that generally counterbalances the recent observed warming. Our study however emphasizes that a generalized decrease in heat-attributable mortality, rather than a negligible trend, could be eventually achieved in a scenario with slower or no warming, pointing to the important role of mitigation actions reducing human-induced climate change.

Our results also show that differences in the trends among countries are largely explained by macroeconomic growth, so that the countries with the largest (smallest) increase in real gross domestic product are those with the largest increase (decrease) in both vulnerability and heat-attributable mortality. Our study therefore mounts on previous studies showing the procyclical behavior of temperature-unrelated mortality, and provides for the first time comprehensive evidence of the role of macroeconomic growth specifically on observed trends in heat-attributable vulnerability and mortality.

Our results provide a better understanding of the real impact of societal adaptation and macroeconomic growth, which are key for decision-making and the design and implementation of strategies minimizing the negative impacts of future warmer temperatures. Nonetheless, our work represents a note of warning about the inherent limits in human adaptability and the delicate balance between rising temperatures and decreasing vulnerability, particularly in the near future with the acceleration of the warming.
Role of socio-economic status in the relationship between air pollution and health: an analysis on mortality in a large cohort in Italy

Ranzi A¹, Ottone M², Broccoli S²,³, Parmagnani F¹, Bonvicini L², Caranci N³, Giorgi Rossi P², Angelini P⁴, Colacci A¹

¹Centre for Environmental Health and Prevention, Regional Agency for Prevention, Environment and Energy of Emilia-Romagna, ²Epidemiology Unit, Local Health Authority of Reggio Emilia, IRCCS, ³Regional Health Agency, ⁴Public Health Authority, Emilia-Romagna Region

OPS 60: Social factors and environmental health across the world, Room 210, Floor 2, August 27, 2019, 13:30 - 15:00

Background/aims:
Inequalities in air pollution exposure and relative health impacts are a relevant aspect in epidemiological research and policy. Aim of the study was to investigate the role of deprivation in the association between air pollution and mortality in a large Italian cohort.

Methods:
The Supersito project analyzed the effects of aerosols on health in an Italian cohort (aged 30+) of residents in an highly polluted area of Northern Italy. Three-years daily measurements (2012-2014) of PM2.5 and its components were made in 4 sites. Monitoring and modeling approach were used to assign a spatio-temporal exposure to each subject’s home address. Natural and cause-specific mortality were analyzed in relation to PM2.5 in the period 2009-2013, using Cox regression models (age of subjects as temporal axis), adjusting for education, citizenship, sex and residence area (urban, coastal, rural), and stratifying for a Deprivation Index (DI) calculated at census-block level and categorized by quintiles of population at a regional level.

Results:
6,011,667 person-years were observed. Total mortality shows an increasing trend in the crude rate related to DI quintiles. The cohort characteristics (gender, age, level of exposure to PM2.5) are homogeneous in the 5 sub-groups, with a prevalence of residence in urban area for less deprived and coastal area for most deprived. Natural mortality reported a 7% increase in risk for increases of 10 μg/m³ of PM2.5 on the whole cohort, but the increase was much higher in most compared to the least deprived [HR=1.014 (95%CI:0.93-1.10), 1.0015 (95%CI:0.93-1.10), 1.022 (95%CI:0.93-1.11), 1.08 (95%CI:1.00-1.16), 1.18 (95%CI:1.11-1.25), respectively].

Conclusions:
Stratified analysis revealed increasing associations between PM2.5 and mortality for those living in most deprived small areas. Both PM2.5 and deprivation have been measured at residence, therefore we cannot disentangle if deprivation acts at the individual or context level in increasing the effect of air pollution on mortality.
Prenatal exposure to DDT and pyrethroids and humoral response to vaccines among South African children from an area sprayed for malaria control: The VHEMBE study
Chevrier J\(^1\), Di Lenardo T\(^1\), Pillet S\(^2\), Bornman R\(^3\), Obida M\(^3\), Ward B\(^2\)
\(^1\)McGill University, \(^2\)McGill University Health Centre, \(^3\)University of Pretoria

OPS 60: Social factors and environmental health across the world, Room 210, Floor 2, August 27, 2019, 13:30 - 15:00

Background/Aim: Animals studies strongly suggest that exposure to insecticides such as DDT and pyrethroids may inhibit immune response to vaccines. However, few human studies have investigated this question and none have done so in communities where insecticides are used to control malaria as part of Indoor Residual Spraying programs. These communities experience high exposure to insecticides and may be particularly susceptible to their toxic effects due to poverty, malnutrition and poor health. Our objective was thus to evaluate whether prenatal exposure to DDT and pyrethroids was associated with reduced immune response to vaccines at age 3.5 and 5 years among South African children participating in the Venda Health Examination of Mothers, Babies and their Environment (VHEMBE) birth cohort study.

Methods: Between August 2012 and December 2013, we enrolled 752 women when they presented for delivery at Tshilidzini hospital in the city of Thohoyandou. We collected urine and blood samples at delivery for the measurement of pyrethroid metabolites and DDT via gas chromatography-mass spectrometry, respectively. At age 3.5 and 5 years, we measured measles, tetanus and Haemophilus influenzae b (Hib)-specific antibody titers in serum via enzyme-linked immunosorbent assay (ELISA).

Results: Percentages of fully-vaccinated children with antibody titers below protective levels were 5.6% for measles, 31.1% for tetanus and 29.1% for Hib. Prenatal exposure to pyrethroids was associated with elevated risks of low measles (but not tetanus and Hib) antibody titers at 3.5 years. Each 10-fold increase in maternal urinary concentrations of 3-PBA, trans-DCCA and cis-DCCA was associated with relative risks of 1.85 (95%CI=0.98, 3.49), 1.84 (95%CI=1.09, 3.09) and 2.43 (95%CI=1.38, 4.29), respectively. No associations were found with DDT and DDE. Associations with antibody titers at age 5 will also be presented.

Conclusion: Results suggest that prenatal exposure to pyrethroids may inhibit immune response to vaccines among South African children.
Effect of improved cook stove intervention on pulmonary function tests of rural women in Andhra Pradesh

Johnson P1, Mukhopadhyay K1, Durairaj N1, Rengaraj R1, Kumar P5, Leavey A2, Sheshadri A3, Kandikuppa S4, Tarsi J2, Sandeep G6, Balakrishnan K1, Schechtman K2, Mario C2, Yadama G5

1Sri Ramachandra Institute Of Higher Education & Research, 2Washington University in St. Louis, 3The University of Texas MD Anderson Cancer Center, 4University of North Carolina, 5Boston College School of Social Work, 6Viswabharathi Medical College

OPS 60: Social factors and environmental health across the world, Room 210, Floor 2, August 27, 2019, 13:30 - 15:00

Background

Traditional biomass fuels remain the most common sources of household energy in most rural areas of the developing world. Biomass in these households is often used in inefficient and poorly vented combustion devices. High concentrations of particulate matter are emitted when the combustion of solid fuels are inadequate, as a result of which, severe respiratory impairment ensues. This study was done to compare the lung function parameters of rural women using traditional cook stoves and improved cook stoves.

Methods

In this cluster randomized study, 48 households across 12 hamlets were randomly assigned either to control group (24) or intervention group (24) and one woman in each household participated in the study. Data collection comprised of a structured questionnaire and pulmonary function testing using spirometry. Post bronchodilator spirometric values of Forced vital capacity (FVC), Forced expiratory volume in 1st second (FEV1), etc., were taken for data analysis.

Results

Both the groups were comparable. Parameters such as FVC, FEV1, FEF 25-75% and PEFR values were significantly lower (p< 0.05) during follow up when compared with the baseline measurement in the control group whereas they were increased in the intervention group. The comparison of mean differences between baseline values and follow up values between control and intervention groups showed a significant change in FEV1 (-0.13±0.27 vs 0.04±0.25 ; p value - 0.02) and FEF25-75% (-0.30±0.69 vs 0.15±0.47; p value 0.01).

Conclusion

The study highlights the improvement of the lung functions that occur following the use of ICS due to reduction in the emission of particulate matter which has a negative impact on respiratory health signifying the need for an early intervention. Dissemination of this information to health authorities and the general public will help in implementing these intervention strategies in future.

Key words

Improved cook stove, Pulmonary function tests, Respiratory health, Spirometry
Social inequalities in environmental resources of green and blue spaces: a review of evidence in the WHO European Region

Schüle S1,2, Hilz L1,2, Dreger S1,2, Bolte G1,2
1Institute of Public Health and Nursing Research, Department of Social Epidemiology, University of Bremen, 2Health Sciences Bremen, University of Bremen

OPS 60: Social factors and environmental health across the world, Room 210, Floor 2, August 27, 2019, 13:30 - 15:00

Background/Aim: Evidence suggests a health promoting role of green and blue spaces. As a result, an unequal distribution of these environmental resources across social groups would also contribute to an unequal distribution of health. Therefore, the overall aim of this review was to gain a systematic overview on social inequalities in environmental resources in the WHO European Region.

Methods: The three electronic databases Medline, Web of Science, and Scopus were searched and only peer-reviewed articles in English published between 2010 and 2017 were considered. Sociodemographic and socioeconomic terms were defined according to the PROGRESS-Plus framework. The review followed the PRISMA statement and was registered in the PROSPERO review database. Evidence obtained with this review will be part of an update of the report "Environmental Health Inequalities in Europe", which has been published by the WHO Regional Office for Europe in 2012.

Results: Fourteen studies were considered for qualitative synthesis. Twelve studies analysed environmental inequalities of green spaces and two studies focused on blue space. In ecological studies, which mainly applied deprivation indices, there was a consistent trend that areas with higher deprivation had less green or blue space available than more affluent areas. In cross-sectional studies, which predominantly analysed single social indicators, results were more mixed and dependant on the type of social indicator and environmental measure. For social measures indicating education consistent relations were found meaning that individuals with a low education had less resources available or longer distances to resources. Mixed associations were found for other SEP indicators, such as income, migration background, or foreign nationality.

Conclusion: There is a need of more comparable and also longitudinal studies within and across European countries. Comparable methods would further support the development of an integrative monitoring of environmental inequalities.
Tuesday August 27, 3:00 PM – 4:30 PM

TPS 631: Metals and health 1

Chronic long-term exposure to cadmium air pollution and breast cancer risk in the French E3N cohort

Amadou A1,7, Praud D1,2, Coudon T1,2,3, Danjou A4, Faure E1, Leffondre K5, Severi G6, Salizzoni P3, Mancini F6, Fervers B1,7

1Department of Cancer And Environment, Centre Léon Bérard, 2inserm U1052, CNRS UMR5286, Univ. Lyon 1, Cancer Research Center of Lyon, 3Ecole Centrale de Lyon, INSA Lyon, Université Claude Bernard Lyon 1, 4Section of Environment and Radiation, International Agency for Research on Cancer (IARC), 5Université de Bordeaux, ISPED, Centre Inserm U1219 Bordeaux Population Health, 6Centre de Recherche en Epidémiologie et Santé des Populations (CESP, Inserm U1018), Facultés de Médecine, Université Paris-Saclay, UPS UVSQ, Gustave Roussy, 7inserm UA 08 Radiations : Défense, Santé, Environnement

BACKGROUND/AIM: Cadmium, due to its estrogen like activity, has been suspected to increase the risk of breast cancer (BC), however overall studies have reported inconsistent findings. Experimental studies reported a role of cadmium in advanced BC risk, but epidemiological evidence is lacking. We conducted a case-control study (4,059 cases and 4,059 matched controls) nested within the E3N French cohort study to estimate the risk of BC associated with long-term exposure to airborne cadmium pollution, and its effect according to molecular subtype of BC (estrogen receptor negative/positive (ER-/ER+) and progesterone receptor negative/ positive (PR-/PR+)), and by stage of diagnosis.

METHODS: Atmospheric exposure to cadmium was assessed using a Geographic Information System (GIS) based metric. Adjusted odds ratios (OR) and 95% confidence intervals (CI) were estimated using conditional logistic regression.

RESULTS: Overall, there was no significant association between cumulative dose of airborne cadmium exposure and the risk of overall, premenopausal and postmenopausal BC. However, by ER and PR status, inverse associations were observed for ER- (ORQ5 vs Q1 = 0.63; 95% CI: 0.41-0.95, P trend = 0.043) and for ER-PR- BC (ORQ4 vs Q1 = 0.62; 95% CI: 0.40-0.95, P trend = 0.088). Further analyses by stage, showed that cadmium were associated with higher risk of stages III-IV BC, ORQ2 vs Q1 = 1.77; 95% CI: 1.05-2.98 and ORQ3 vs Q1 = 1.89; 95% CI: 1.08-3.33, P trend = 0.451, but no significant associations were found for stage I and II BC.

CONCLUSIONS: Our study provides no evidence of an association between exposure to cadmium and risk of BC overall, but suggests that cadmium might be related to a decreased risk of ER- and ER-PR- BC. Cadmium may also have a role in advanced BC risk. These observations and other possible effects linked to hormone receptor status and stage warrant further investigations.
Low concentration of cadmium, nickel, and lead in human body and cardio-metabolic diseases in the industrial area of Civitavecchia

Bauleo L1, Forastiere F1, Ruggieri F2, Bocca B2, Alimonti A2, Davoli M1, Michelozzi P1, Ancona C1

1Department of Epidemiology, Lazio Regional Health Service, Italy, 2National Health Institute, Rome, Italy

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: The measurement of the metal concentrations in human body allows to assess the exposure to environmental pollutants through all routes of exposure. This study aimed at evaluating the association between low-urinary (or blood) concentrations of cadmium, nickel, and lead and cardio-metabolic disorders among residents in an Italian industrial area.

Methods: A sample of 1141 residents were selected from the Municipal Register's. Three outcomes were considered: hypertension, diabetes mellitus, and metabolic syndrome (MS). Multinomial regression models were used to assess the association among metals and pre-diabetes/diabetes (Prevalence Odds Ratios (POR) and corresponding 95% confidence intervals (95%CIs)) while modified Poisson regression models were used for hypertension and MS (Prevalence Ratios (PR) and corresponding 95%CIs). All models were adjusted for gender, age, educational level, body mass index, smoking habits, alcohol and salt consumption, physical activity, occupational level, and occupation in at-risk sectors.

Results: In the sample (58% females), the prevalence of hypertension, diabetes and metabolic syndrome was 43%, 5.4% and 29.5% respectively. After multivariable adjustment, the PR of hypertension (comparing the highest to the lowest quartiles of cadmium) was 1.17 (95% CI 0.98-1.41). When we considered the metals exposure as continuous (evaluating the variation of pollutant for difference between 95th-5th percentiles) we found an association between cadmium and hypertension (PR=1.03; 95%CI 1.00-1.07), lead and hypertension (PR=1.16; 95%CI 1.04-1.31), nickel and diabetes (POR=1.57; 95%CI 1.03-2.16), lead and MS (PR=1.09; 95%CI 0.98-1.32) and nickel and MS (PR=1.17; 95%CI 0.98-1.40).

Conclusions: This study highlight an effect of cadmium and lead on hypertension and an association between nickel exposure and prevalence of diabetes. The effects for lead and nickel on MS are probably due to the effects on hypertension and diabetes, respectively. This is one of the few available studies that analyzed and drew attention to the effect on health of low-dose exposures to cadmium, lead and nickel.
Variability of Seminal Plasma Cadmium Concentrations and Its Associations with Semen Quality among Healthy Chinese Men Screened as Potential Sperm Donors

Chen H¹
¹Department of Epidemiology and Biostatistics, and Ministry of Education Key Laboratory of Environment and Health, and State Key Laboratory of Environmental Health (Incubating), School of Public Health, Tongji Medical College, Huazhong University of Science and Technology

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: Cadmium (Cd) is a well-documented toxic metal, which has demonstrated adverse effects on male semen quality in animal studies. However, the results from human studies are inconsistent, probably due to the high within-subject variability in measurements of Cd in biological specimens and semen quality parameters.

Objectives: To characterize the variability of Cd concentrations in seminal plasma and assessed its associations with repeated measurements of semen quality among healthy men who came to the Hubei Province Human Sperm Bank for donations screening.

Methods: The reproducibility of Cd concentrations in 232 seminal plasma samples collected from 93 men was assessed using the intraclass correlation coefficient (ICC). The associations of Cd in within-subject pooled seminal plasma (n=1156) with repeated measurements of semen quality parameters (n = 5619) were assessed using linear mixed models with an individual-specific random intercept. Semen analyses were conducted by qualified laboratory technologists following the guidelines of the World Health Organization, and Cd concentration was determined by inductively coupled plasma-mass spectrometry.

Results: Cd was detected in > 85% of the seminal plasma specimens. Fair to good reproducibility (ICC = 0.71) was achieved for serial measurements of Cd. Compared with men in the lowest Cd quartile, men in the highest quartile of Cd had a reduced semen volume and total motility of 3.25% (95% CI: -6.29%, -0.20%; p for trend = 0.027) and -1.88% (95% CI: -3.82%, 0.10%; p for trend = 0.083), respectively. Similar results were achieved when modeling Cd concentration (log-transformed) as a continuous variable in cubic spline models.

Conclusion: Cd in seminal plasma were relatively stable. Exposure to high Cd may adversely affect semen volume and motility. Future studies in a larger and general population are needed to verify our findings.
Background: The prenatal environment plays a crucial role in fetal growth and subsequent childhood morbidity. Individual metal concentrations have been associated with fetal growth, defined as birthweight-for-gestational-age. However, results are heterogeneous across studies and none of those focused on the mixture effect of all metals, both toxic and nutritional, on fetal growth.

Aim: To assess the relationship between fetal growth and exposure to metals mixture; and the relationship between maternal and childhood metals concentrations.

Methods: We analyzed data from 94 mother-child dyads participating in the Inova Childhood Longitudinal Study, for which urinary metals measures and fetal growth were available. Urinary concentrations of 19 metals were measured at 2nd trimester in mothers and delivery in both mothers and newborns; all metals concentrations were log2-transformed. We correlated maternal and children individual metals levels using Pearson coefficients. We leveraged on an unsupervised Self-Organizing-Map approach to cluster individuals into three categories, based on their metals levels (highly, moderately and low exposed). We then included those clusters into mixed effect models, adjusting for maternal age, education and pre-pregnancy body mass index.

Results: Metals levels were positively correlated within the same time-period (p>0.5), and individuals (p~0.2). Newborns metals levels were not correlated with maternal metals concentrations, and fetal growth was normally distributed around the 0.5 z-score unit (Standard Deviation: 0.9). We identified some evidence for a positive association between metals mixture exposure and fetal growth (β: 0.16, Standard Error (SE): 0.1; p-value-for-trend=0.1). Moderate and high metals levels exposure associated with an increase of 0.13 (SE: 0.17; p-value: 0.46) and 0.31 (SE: 0.19; p-value: 0.11) fetal growth z-score, respectively.

Conclusions: Our findings suggested prenatal metals mixture exposures may increase fetal growth, and the benefit of nutritional metals may overcome the toxic effects of the other chemicals.
Early-life Dentine Manganese Concentrations and Intrinsic Functional Brain Connectivity in Adolescents and Young Adults

de Water E1, Papazaharias D1, Ambrosi C2, Mascaro L2, Levin-Schwartz Y1, Rechtman E1, Cagna G3, Corbo D3, Gasparotti R3, Lucchini R1,2, Oppini M3, Placidi D3, Austin C1, Arora M1, Tang C1, Smith D4, Wright R1, Horton M1
1Icahn School Of Medicine At Mount Sinai, 2ASST Spedali Civili Hospital, 3University of Brescia, 4UC Santa Cruz

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: Early-life manganese (Mn), an essential nutrient and neurotoxicant, is associated with impaired cognitive and motor control and changes in the prefrontal cortex (PFC) and basal ganglia. We examined associations between early-life Mn concentrations and intrinsic functional connectivity (iFC) of the brain in adolescents and young adults, focusing on the PFC and basal ganglia. Measuring Mn in deciduous teeth allows a direct measure of fetal exposure and insight into early-life windows of vulnerability.

Methods: 60 participants (33 girls; 15-23 years) from the PHIME study (Public Health Impact of Manganese Exposure) in Italy completed a resting state functional Magnetic Resonance Imaging (fMRI) scan and provided deciduous teeth. We used laser ablation inductively coupled plasma mass spectroscopy (LA-ICP-MS) to determine prenatal (2nd trimester - birth), early postnatal (0-1 years) and childhood (1-6 years) dentine Mn concentrations. We performed seed-based correlation analyses (FDR-corrected p<0.05) of associations between natural log-transformed Mn concentrations and iFC of 6 basal ganglia seed regions (left and right putamen, caudate, pallidum) and 1 PFC seed region (bilateral middle frontal gyrus) from Harvard-Oxford Structural Atlases, adjusting for socioeconomic status, age and IQ.

Results: Higher prenatal Mn was associated with: 1) reduced connectivity between the middle frontal gyrus and superior parietal lobule (β = -0.21, FDR-corrected p = 0.001); 2) Increased connectivity between the right putamen and cerebellum (β = 0.18, FDR-corrected p = 0.013). Higher early postnatal Mn was associated with: 1) reduced connectivity between the middle frontal gyrus and medial prefrontal cortex (β = -0.24, FDR-corrected p = 0.009); 2) increased connectivity between the left pallidum and precuneus (β = 0.13, FDR-corrected p< 0.001).

Conclusions: Higher prenatal and early postnatal Mn concentrations are associated with altered iFC of brain areas involved in cognitive (i.e., PFC, parietal cortex) and motor control (i.e., putamen, pallidum, cerebellum) in adolescents and young adults.
Associations between prenatal and concurrent lead concentrations and IQ in preschool children in Korea

Kim W1, Lim Y2, Kim B3, Shin C4, Lee Y4, Kim J3, Hong Y1,2,5

1Department Of Preventive Medicine, Seoul National University College Of Medicine, 2Institute of Environmental Medicine, Seoul National University Medical Research Center, 3Division of Children and Adolescent Psychiatry, Department of Psychiatry, Seoul National University Hospital, 4Department of Pediatrics, Seoul National University Children’s Hospital, 5Environmental Health Center, Seoul National University College of Medicine

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: The toxicity of blood lead concentrations during childhood is documented, however the effects of relatively low concentration of lead on child neurocognitive function lacks conclusive evidence. Therefore, we conducted a study based on an urban population with relatively low levels of lead exposure to explore the association of blood lead and intellectual function of children.

Aim: The aim of this paper was therefore to test the associations between gestational and early childhood blood lead concentrations with intellectual function in preschool Korean children. We also tested for the moderation of these associations by sex of the child.

Methods: As part of an on-going cohort named “The Environment and Development of Children”, 574 mother-child pairs from Seoul, Korea were enrolled between 2008 and 2011. Whole blood concentration of prenatal maternal and child lead was analyzed. The Korean Educational Development Institute-Wechsler Intelligence Scales for Children (KEDI-WISC) were administered to each child at 6 years of age. Multivariable linear regression models were used to investigate the relationship between maternal and concurrent blood lead concentrations and child neurocognitive function at age 6.

Results: A 2-fold increase in prenatal lead level was significantly associated with a 3.09% [95% confidence interval (CI): -0.087%, -0.004%] decrease in FSIQ scores in children 6 years of age, and a 2-fold increase in concurrent child lead levels at 6 years was significantly associated with a 4.57% [95% confidence interval (CI): -0.119%, -0.016%] decrease in FSIQ scores and 9.01% [95% confidence interval (CI): -0.246%, -0.026%] decrease in PSIQ scores in boys but not girls, as indicated by the linear regression model.

Conclusions: Our study highlights that Korean preschoolers are exposed to relatively low levels of lead, and that their IQ was negatively associated with concurrent blood lead as well as prenatal maternal blood lead concentrations.
Sex-specific associations of blood mercury and iodine with thyroid hormones: results from the NHANES 2009-2012

Kim K², Turyk M¹
¹Division of Epidemiology and Biostatistics, School of Public Health, University Of Illinois At Chicago

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Thyroid hormones play an essential role in regulating many functions, including metabolism and cardiac function. Disruption of thyroid homeostasis may result in clinical or subclinical disease. The impact of low and moderate levels of mercury exposure on thyroid homeostasis in adults is controversial, and most prior investigations have not examined sex differences. A sufficient supply of iodide is required for thyroid hormone synthesis, but mercury can accumulate in the thyroid and reduce iodide uptake by binding to iodide. Thus, iodide levels may modify associations of mercury with thyroid hormones. A cross-sectional study with 3,369 participants, excluding those taking thyroid medications, in the National Health and Nutrition Examination Study 2009-2012 was conducted to investigate associations of total blood mercury with thyroid hormones - triiodothyronine (T3), total thyroxine (T4), free forms of T3 and T4 (FT3 and FT4), and thyroid-stimulating hormone (TSH). Blood mercury and urinary iodide were examined simultaneously using multivariable linear regression models stratified by sex, and interaction effects between mercury and iodine deficiency (<150 µg/L urine, the WHO recommendation) were investigated. The geometric means of blood mercury and creatinine-adjusted urinary iodine were 0.96 µg/L and 144.40 µg/L, respectively, and 59% of males and 50% of females had urinary iodide <150 µg/L. Associations between mercury and thyroid hormones varied by sex; significant inverse associations of mercury with and T3 and T4 were observed in females, but thyroid parameters were not associated with mercury in males. Negative associations between iodine and T3 and FT3 were detected in males and females. Interactions between mercury and iodide deficiency on thyroid hormones were not significant (P>0.05) in either sex. In conclusion the impacts of mercury and iodine on thyroid hormones were independent in this study. These findings illustrate the importance of conducting sex-stratified analyses in investigations of environmental exposures on thyroid hormone disruption.
Association between blood mercury and selenium levels with infant birth weight in the Japan Environment and Children’s Study

Kobayashi S1, Saijo Y2, Ito Y3, Araki A1, Miyashita C1, Itoh S1, Minatoya M1, Yamazaki K1, Ait Bamai Y1, Kishi R1

1Hokkaido University, 2Asahikawa Medical University, 3Japanese Red Cross Hokkaido College of Nursing

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Articles on the association between prenatal mercury and selenium levels with infant birth weight are limited. Therefore, we examined the association between prenatal mercury and selenium levels with birth weight.

Methods: A prospective birth cohort study was conducted among 100,000 pregnant women who delivered live singletons in 15 regions, Japan, from 2011 to 2014. Total 15,444 pregnant women were included in the analysis with both exposure and birth outcome data. Total mercury and selenium levels in maternal blood between the 2nd and 3rd trimesters of pregnancy were measured using inductively coupled plasma - mass spectrometry (ICP-MS). Birth weight, infant sex, and gestational age were confirmed by medical records. Maternal characteristics were obtained from the questionnaire administered during pregnancy. Multiple linear regression models were used to examine the association between blood total mercury and selenium levels with birth weight adjusted for the confounding factors.

Results: Median (inter-quartile range [IQR]) of blood mercury and selenium levels were 3.66 (2.59-5.18) ng/g and 170.0 (158.0-183.0) ng/g, respectively. Blood mercury and selenium levels were not associated with infant birth weight. In subgroup analysis, among the group of mothers with the lowest quartile of blood selenium levels, those of mothers with the highest quartile of blood mercury levels had a birth weight decrease (-41 g, 95% confidence interval [CI]: -75, -5) compared to infants of mothers with the lowest quartile of blood mercury levels.

Conclusions: Although the association between blood mercury level and infant birth weight among the group of mothers with the lowest quartile of blood selenium levels was found, birth weight decrease was about 1% of mean birth weight.
Social impairment in 6-year-old children exposed to manganese during prenatal and postnatal periods

Lee W¹, Lim Y², Kim B³, Shin Y⁴, Kim J³, Hong Y¹,⁵

¹Department of Preventive Medicine, Seoul National University College of Medicine, ²Institute of Environmental Medicine, Seoul National University Medical Research Center, ³Division of Child and Adolescent Psychiatry, Department of Psychiatry, Seoul National University College of Medicine, ⁴Department of Pediatrics, Seoul National University College of Medicine, ⁵Environmental Health Center, Seoul National University College of Medicine

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: Manganese (Mn) is an essential nutrient for humans and animals, but excess intake of Mn can lead to adverse developmental outcome. Several studies have suggested associations between manganese exposure and neurodevelopment in children, but studies on IQ scores have been focused, and research on social impairment is still limited. In this study, we assessed the relationship between manganese exposure and social impairment in 6-year-old children.

Methods: We conducted an analysis of 512 participants in the Environment and Development of Children (EDC) Study who were 6 years old from 2015 to 2016. Manganese concentration was measured in children’s blood at 6 years of age. We evaluated the association between blood Mn concentration and social impairment using Korean version of the Social Communication Questionnaire (K-SCQ). We also assessed the association between prenatal manganese exposure and social impairment in children.

Results: The mean Mn concentration in children’s blood at 6 years of age was 12.749 μg/L. Blood Mn concentration was significantly associated with a decrease in the social impairment in children (β = -0.253, P = 0.011). When stratified by gender, boys showed meaningful decrease in social impairment (β = -0.417, P = 0.002), and girls were not related (β = -0.062, P = 0.679). In addition, maternal serum manganese concentrations showed a U-shaped relationship with the social impairment of 6-year-old children, and this tendency was remarkable in boys.

Conclusion: Our study results suggest that exposure to Mn in 6-year old children decreases children’s social impairment, particularly in boys. On the other hand, there was a U-shaped relationship in prenatal exposure to manganese.
Lead's seasonality: it's all One Health

Levin R1, Vieira C1
1Harvard School of Public Health

Background/aims: The seasonality of human lead exposures, with blood lead levels increasing in warmer weather has driven the search for a ‘silver bullet’ for decades. Evidence from domesticated and wild animals and plants show that the phenomenon crosses species lines.

We used an integrated One Health/Total Environment approach to investigate lead’s seasonality.

Methods: EPA’s Integrated Science Assessments of Lead served as our basis, and with subsequent and related publications, we used a One Health/Total Environment lens to integrate data on lead contamination and movement through all of the earth’s systems.

Results: 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, with 3 principal drivers: higher growth rates, slightly increased exposures, and more Vitamin D exposure/production. An independent terrestrial seasonality involves higher temperatures, solar radiation, humidity and pollution from human activities; these factors lower pH in air, water and soil, increasing lead’s bioavailability and mobility and intensifying human, animal and plant exposures seasonally.

Discussion and conclusions: An integrated One Health/Total Environment lens yields several insights. First, ‘seasonality’ is multifactorial and a terrestrial phenomenon affecting animals, plants and humans, as well as the natural world; human activities have exacerbated natural cyclicities. Second, long-term human lead remediation strategies must consider the total environment, especially in urban areas. Finally, global warming may increase lead exposures and toxicity to all species throughout the total environment.
Association of Mercury Exposure with Decrease of Liver Function in Adults
Lim H¹, Hong Y¹,², Yook J¹, Park C¹
¹Department of Preventive Medicine, College of Medicine, Seoul National University, ²Institute of Environmental Medicine, Seoul National University Medical Research Center

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim

The effects of mercury(Hg) exposure on liver function have been rarely reported. This study was set to investigate whether Hg exposure in adults was associated with elevated serum levels of the liver enzymes.

Methods

From the National Health and Nutrition Examination Survey (NHANES, 2015–2016), five thousand seven hundred nineteen adults aged twenty years and above were selected for analysis. Hg exposure was indirectly reflected by Hg sampled in blood and urine; total Hg, methyl Hg, and urine Hg. Hepatic function was inferred from the five serum liver-related enzyme activities; aspartate aminotransferase(AST), alanine transaminase(ALT), alkaline phosphatase(ALP), gamma-glutamyltransferase(GGT), and total bilirubin. Generalized linear models were used to examine the associations of interest.

Results

AST, ALT, GGT, ALP levels were significantly associated with total Hg(AST;β= 0.015, ALT;β= 0.015, GGT;β= 0.042, ALP;β= 0.029, p<0.001) and methyl Hg(AST;β= 0.013, ALT;β= 0.013, GGT;β= 0.034, ALP;β= 0.023, p<0.001). There was a statistically significant association between liver function test and total Hg(AST;β= 0.018, ALT;β= 0.045, GGT;β= 0.033, p<0.001) and methyl Hg(AST;β= 0.015, ALT;β= 0.037, GGT;β= 0.027, p<0.001) in participants without history of liver disease, but we found no significant association in participants with history of liver disease.

Conclusions

This study showed a significant association between liver function(AST,ALT,GGT,ALP) and serum Hg(total and methyl Hg). Future prospective studies are needed to expand these findings.
Maternal copper status and neuropsychological development in infants and preschool children
Amorós R\textsuperscript{1}, Murcia M\textsuperscript{2,3}, González L\textsuperscript{2}, Soler-Blasco R\textsuperscript{2}, Rebagliato M\textsuperscript{2,3}, Lozano M\textsuperscript{4}, Lopez-Espinosa M\textsuperscript{2,3}, Broberg K\textsuperscript{5}, Ballester F\textsuperscript{2,3}, Llop S\textsuperscript{1,2}
\textsuperscript{1}University of Edinburgh, \textsuperscript{2}Epidemiology and Environmental Health Joint Research Unit, FISABIO–Universitat Jaume I–Universitat de València, \textsuperscript{3}CIBERESP, \textsuperscript{4}FISABIO, \textsuperscript{5}Karolinska Institutet

Background:
Copper (Cu) is an essential element involved in biological processes; however, excessive Cu could be harmful because of its reactive nature. Very few studies have evaluated its potential neurotoxic effects. The objective of this study is to evaluate the association between maternal Cu levels and children's neuropsychological development.

Methods:
Study subjects were mother-child pairs from the Spanish INMA (i.e. Childhood and Environment) Project. Cu was measured in serum samples taken at the first trimester of pregnancy (2003–2005). Neuropsychological development was assessed using the Bayley Scales of Infant Development (BSID) at 12 months (n=651) and the McCarthy Scales of Children’s Abilities (MSCA) at 5 years of age (n=490). Covariates were obtained by questionnaires during pregnancy and childhood. Multivariate linear and non-linear models were built in order to study the association between maternal Cu and child neuropsychological development. Effect modification by sex was assessed.

Results:
The mean ± standard deviation of maternal Cu concentrations was 1606 ± 272 μg/L. A negative linear association was found between maternal Cu and both the BSID mental scale (beta=−0.051; 95% confidence intervals [CI]: −0.102, −0.001) and the MSCA verbal scale (beta=−0.044; 95%CI:−0.094, 0.006). Boys obtained poorer scores at 12 months than girls, with increasing Cu (interaction p-value=0.040 for the mental scale and 0.074 for the psychomotor scale). This effect modification disappeared at 5 years of age.

Conclusion:
The Cu concentrations observed in our study were within the reference range established for healthy pregnant women in previous studies. The results of this study contribute to the body of scientific knowledge with important information on the possible neurotoxic capability of Cu during pregnancy.

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Chronic arsenic exposure is a critical public health issue. The arsenic metabolism can be influenced by many factors. The scientific literature identifies dosage of arsenic exposure, individual’s ethnicity, age, sex, body mass index, lifestyle and dietary habits, and inherited genetic characteristics as factors related with arsenic methylation capacity. The objective of this study is to verify if these factors influence arsenic metabolism in four Italian areas affected by arsenic pollution.

Univariate analyses were conducted on 267 subjects aged 20-49. Primary Methylation Index (PMI) and Secondary Methylation Index (SMI) were calculated as indicators for metabolic capacity. Factors investigated were derived from the administered questionnaire.

The results showed that, compared to women, men had a higher PMI average value (1.13 vs 0.91; p=0.026) and a lower SMI average value (2.90 vs 3.60; p=0.040). People who drank tap water had a higher PMI average value (1.28 vs 0.94, p=0.003) and a lower SMI average value (2.42 vs 3.80, p=0.007) compared to those who do not drink tap water. Subjects occupationally exposed to chemicals showed a lower PMI average value (0.70 vs 1.05; p=0.041) and a higher SMI average value (6.34 vs 2.96, p<0.001) compared to those not occupationally exposed. The results observed for alcohol consumption are not statistically significant but in line with the scientific literature (i.e. people who were used to drink showed a lower PMI average value).

These results confirm that arsenic methylation is influenced by a variety of factors. In the studied population arsenic methylation is more efficient in women than in men. Furthermore, arsenic exposure and alcohol consumption can reduce the capacity of arsenic methylation. It also seems that occupational exposure somehow enhances arsenic methylation capacity. The results of our study include information on the role of arsenic oxidative methylation to characterize arsenic poisoning process in different contaminated sites.
Exposure to cadmium is associated with impaired fasting glucose

Park C1, Yook J1, Lim H1, Hong Y1,2

1Department of Preventive Medicine, Seoul National University, College of Medicine, 2Institute of Environmental Medicine, Seoul National University Medical Research Center

Background: Cadmium is a widespread environmental pollutant. Evidence suggests an association between exposure to cadmium and impaired fasting glucose. To test the hypothesis that exposure to cadmium is associated with prediabetes, we investigated the relationship between blood cadmium levels and prediabetes in the seventh Korea National Health and Nutrition Examination Survey (KNHANES VII).

Methods: We analyzed data on 2,627 participants aged ≥10 years from the KNHANES VII (2016), a cross-sectional health survey of a nationally representative sample of the Korean population. Participants with overt diabetes, pregnancy, or missing required data were excluded. Prediabetes was defined using the criteria of the American Diabetes Association. To assess the relationship between blood cadmium levels and prediabetes, a logistic regression analysis was performed.

Results: After adjustment for age, sex, education, alcohol consumption, smoking status, and Body Mass Index (BMI), the odds ratio for prediabetes was 2.12 (95% confidence interval (CI): 1.34, 3.37) comparing the highest with the lowest blood cadmium levels quartiles. In a BMI stratified analysis, a significant association was found only in the normal BMI groups.

Conclusions: In this cross-sectional study, blood cadmium levels are significantly associated with prediabetes. This finding, which needs confirmation in prospective studies, suggests that cadmium may be a risk factor for prediabetes.
Cadmium and mammographic volumetric density – preliminary results.

Peplonska B\textsuperscript{1}, Janasik B\textsuperscript{1}, Kałużny P\textsuperscript{1}, Bukowska-Damska A\textsuperscript{1}

\textsuperscript{1}Nofer Institute Of Occupational Medicine

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Cadmium (Cd) is a heavy metal with widespread occurrence in the environment. Food (especially vegetables and offal) and tobacco smoking are the major sources of Cd exposure to the general population. Cd is a potent metalloestrogen, and some epidemiological studies reported link between cadmium exposure and breast cancer risk. Mammographic density (MD) reflects composition of the breast. It is positively associated with collagen, epithelial and non-epithelial cells, and negatively associated with fat. MD has been found to be a strong risk factor for breast cancer, and was proposed to be used as a surrogate marker for breast cancer. Relationship between cadmium and MD was investigated in only one previous study among premenopausal women in US (Adams, et al, 2011). The objective of our study was to examine the association between Cd and mammographic density among both pre- and postmenopausal women.

Methods: The study included 519 women, aged 40-60 undergoing screening mammography at the mammography centers in Łódź (Poland) (116 pre- and 403 postmenopausal). Data were collected through personal interviews, anthropometric measurements, blood and urine collection and mammographies. Cd was determined in spot urine sample (by ICP-MS technique). Digital mammography was performed according to the standards for screening mammography and volumetric mammographic density was analyzed in Volpara software. The potential associations were examined with linear regression model, age and BMI adjusted.

Results: The mean Cd concentration was 0.56 µg/l (SD:0.43)(0.66µg/g creat.) and mean volumetric density 7.8% (SD:4.5) (mean of 4 views: CC- craniocaudal and MLO-medialateral oblique for each breast). The preliminary analysis showed an inverse association of the volumetric density with age and BMI (p<0.001). We did not observe association between cadmium concentration in urine and volumetric density (β-coef.: -0.34, 95%CI:-0.92-.25), neither among pre- nor postmenopausal women.

Conclusion: Our study does not confirm previously reported positive association between cadmium and MD.
Elemental Analysis of Nasal Epithelial Lining Fluid in COPD Patients: A Pilot Study
Rice M1, Zhang C1, Sun W1, Rebuli M2, Jaspers I2
1Beth Israel Deaconess Medical Center, 2University of North Carolina at Chapel Hill

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: The nasal passages are a site of deposition of particles between 1 and 10 microns in diameter, where both upper respiratory exposure and response to particles could be measured. Occupational studies of heavily-exposed workers have found that concentrations of metals in nasal lavage fluid are associated with exposure levels and upper respiratory inflammation. Few have investigated nasal concentrations of metals in community-dwelling adults, possibly due to the discomfort or logistical difficulty of nasal lavage.

Methods: We used an absorbent fibrous matrix (Leukosorb medium), modified for insertion into the nose, to sample the nasal epithelial lining fluid among 10 participants with chronic obstructive pulmonary disease (COPD), with a mean age of 73.7±8.9. Twenty Leukosorb strips (2 per participant) and 4 control strips were prepared by a mixed-acid oven digestion/extraction protocol and elemental composition was determined using inductively coupled plasma mass spectrometry (ICP-MS). We determined the correlation of elements measured in the nasal epithelial lining fluid.

Results: We identified 15 elements with minimal background detection from the blank fibrous matrix. These were: silver, aluminum, arsenic (As), barium, calcium, copper, iron (Fe), potassium (K), magnesium, manganese, sodium (Na), nickel, lead (Pb), sulfur and zinc (Zn). Certain elements that share environmental sources were correlated within the nasal fluid. The Spearman correlation coefficient between Zn and Fe (both components of soil and road dust) was 0.8. As and Pb (both found in cigarettes and water) were correlated (r=0.7). Na and K, whose serum concentrations are tightly regulated, were correlated with each other (r=0.7), but not with the other metals.

Conclusions: In this exploratory work, we demonstrate the feasibility of non-invasively sampling the nasal epithelial lining fluid for elemental analysis among elderly people with COPD. Future research is needed to determine if elemental concentrations by nasosorption are associated with inhaled exposure or upper respiratory response.
The association between in utero and early life metals and early life gut microbiota


1Department of Public Health Sciences, Henry Ford Health System, 2Senator Frank R Lautenberg Environmental Health Sciences Laboratory, Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, 3Department of Epidemiology, University of Michigan, 4Division of Gastroenterology, University of California, 5Department of Environmental Health Sciences, University of Michigan

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim
The early life gut microbiome plays an essential role in health throughout life, as it influences nutrient and energy extraction, physiological growth, and immune development. However, the impact of in utero and early life metal exposure on the infant gut microbiome has not been well-characterized. The aim of this study was to assess the association between fetal and early life metal levels (manganese, lead, and zinc) measured in deciduous teeth and bacterial gut microbiota at 1- and 6-months of age.

Methods
Data were analyzed from the Wayne County Health, Environment, Allergy and Asthma Longitudinal Study (WHEALS) birth cohort (Detroit, USA). Lead, zinc, and manganese were measured via high-resolution microspatial mapping of dentin growth rings during the second and third trimesters and in early postnatal life (birth through 1-year). Stool samples were collected at approximately 1- and 6-months of age; bacterial microbiota was quantified using 16S rRNA (V4 region) sequencing.

Results
A total of 120 children had data on both tooth metals and gut microbiota. A significant positive association was found between early postnatal lead levels and bacterial richness at 1-month of age (regression p=0.042). Second and third trimester lead levels were also positively associated with bacterial richness, although only marginally significantly (p=0.057, 0.074, respectively). Early postnatal lead levels were marginally associated with bacterial composition at 1-month of age (permutational ANOVA p=0.097). Zinc and manganese levels were not associated with bacterial microbiota measures, with the exception of 3rd trimester zinc and bacterial compositional differences at 6-months (p=0.043).

Conclusions
These results suggest that in utero and early life lead burdens may influence infant gut microbiota. These associations will be reevaluated following additional metal measurements and by using metal mixture modeling. Whether these associations are explained by racial, socioeconomic, or lifestyle differences—and the specific taxa contributing to differences—requires further study.
Prenatal manganese exposure and neurodevelopmental effects at 1 year of age in the INMA cohort (Spain)


Background/Aim
Manganese (Mn) is an essential element for humans, its main source being the diet. Some epidemiological studies have found that a prenatal excess of Mn could negatively affect neuropsychological development during infancy. However, the evidence is inconclusive and the shape of this relationship has been scarcely evaluated. The aim of this study was to explore the association between maternal Mn concentrations and child neuropsychological development assessed at 1 year of age.

Methods
Study subjects were 1179 mother–child pairs from two Spanish areas (Valencia and Gipuzkoa) of the INMA (Environment and Childhood) study (recruitment: 2003-2008). Mn was measured in serum samples collected during the first trimester of pregnancy. Children’s neuropsychological development was assessed at around 12–14 months of age using the Bayley Scales of Infant Development (BSID), composed of mental and psychomotor scales. Sociodemographic, lifestyle and dietary information was collected through questionnaires during pregnancy and during the child’s first year of life. Multivariate linear regression models were built. Generalised additive models were used to assess the shape of the relation between prenatal exposure to Mn and the neuropsychological test.

Results
The geometric mean and 95% confidence interval of maternal serum Mn was 1.50 (1.48–1.53) μg/L. Levels of Mn were higher among working mothers and in those with a higher consumption of nuts. No statistically significant association was observed between Mn and the BSID scales. The best shape describing the relationship between Mn and the Bayley scales was a linear relation for both scales.

Conclusions
Maternal serum Mn levels in our population are similar to those observed in other European populations. Results of the present study suggested that early prenatal levels of Mn did not affect neuropsychological development during the first year after birth.

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Background: Previous studies reported metal exposure might (such as chromium, cadmium and lead) associate with immune biomarkers and child allergy. The prevalence of child’s allergic disease, such as asthma, has been increased worldwide. Cord blood immunoglobulin E (IgE) was considered to be a predictor of allergen sensitization in early life stage.

Aim: To investigate the association between maternal exposure to metals and cord blood IgE.

Methods: A total of 426 pairs of pregnant women and their newborns recruited in northern, central, southern, and eastern parts of Taiwan during 2012 to 2013. The questionnaire and specimen were collected from each pregnant woman, and cord blood specimen was collected at the delivery. Maternal urine was used to analyze metal concentration (cadmium, Cd; copper, Cu; nickel, Ni; thallium, Tl) using inductively coupled plasma mass spectrometry (ICP-MS), and cord blood IgE levels was quantified using UniCAP IgE assay system. The high or low cord blood IgE was categorized according to the median concentration of 0.42 kU/L.

Results: A stratification by maternal allergic status, newborns with high cord blood IgE of mother with allergy had significantly lower birth weight. After adjustment for child's sex, maternal education and environmental tobacco smoke (ETS) at pregnancy in statistical model, newborns of mothers with allergy had increased odds ratio of high cord blood IgE when maternal urine metal concentration increased [Cd: OR = 2.92 (95% CI 1.01 – 8.42); Cu: OR = 3.12 (95% CI 1.10 – 8.87); Ni: OR = 1.99 (95% CI 1.00 – 3.95); Tl: OR = 2.58 (95% CI 1.08 – 6.18)]. Newborns of mothers without allergy did not observed similar results.

Conclusion: Offspring of allergic mothers with high exposure to metals have increased odds ratio of high cord blood IgE.
Dietary Counseling on Risks and Benefits of Fish Consumption and Mercury Testing in Reproductive Age Women in a Health Clinic Setting

Turyk M$^1$, Korinek J$^1$, Souther L$^2$, Baker B$^3$, McCann P$^2$

$^1$University Of Illinois At Chicago, $^2$Minnesota Department of Health, $^3$FIM

Consumption of fish low in mercury should be encouraged in reproductive age women because benefits of fish consumption for the fetus, including improved eye and brain development, outweigh risks if fish that are low in mercury are eaten. The Fish are Important for Superior Health Project was designed to intervene with reproductive age women to reduce mercury exposure in an area where elevated exposure in infants has been found.

At a clinic visit, 499 women answered detailed questions on fish consumed in the past year and donated blood for mercury and docosahexaenoic acid (DHA) measurements. A nurse delivered information on risk and benefits of eating fish and tailored advice on fish consumption based on the information reported by the participant in the survey. Laboratory results were reported to participants through letters from the clinics. After six months, all 15 women with blood mercury levels above the level equivalent to the EPA RfD (5.8 µg/L), and 30 with blood mercury below 5.8 µg/L completed a follow-up visit identical to their initial clinic visit. Longitudinal models tested changes in measures of mercury, DHA and fish intake and adjusted for season of assessment, usual fish portion size and omega-3 fatty acid supplement use.

At the 6 month follow up, we found a decline in blood mercury and in consumption of fish species with moderate Hg contamination (>0.22 ppm) that was significantly greater in participants with elevated mercury levels at the initial visit. No change in consumption of low mercury fish or plasma DHA levels was observed in either participant group. This investigation demonstrated the feasibility of administrating a tailored mercury reduction intervention to reproductive age women in a health clinic setting to reduce intake of fish with moderate levels of mercury while maintaining beneficial intake of fish with low levels of mercury.
Estimating effects of soil remediation on children’s blood lead near a former lead smelter in Omaha NE, U.S.


Oakridge Institute for Science and Education, U.S. EPA Office of Research and Development, National Center for Environmental Assessment, National Institute of Environmental Health Sciences, Biostatistics and Computational Biology Branch, SRC Inc

TPS 631: Metals and health 1, August 27, 2019, 3:00 PM - 4:30 PM

Background
Lead is a toxic metal known to affect cognitive development in children even at low exposure levels. We examined the relationship between remediation activities, soil concentrations and children’s blood lead levels among children living near a lead smelter that operated from 1871-1997 in Omaha, Nebraska.

Methods
We assembled a cohort of children with blood lead measurements from a surveillance program and linked them to U.S. Environmental Protection Agency databases having residential soil lead measurements and soil remediation dates. Controlling for temporal trends and children’s demographics, we estimated associations between elevated blood lead (EBL, >3.5 µg/dl) and soil lead concentration using logistic regression accounting for within-child correlations. Analyses comparing children’s pre- and post-remediation EBL to estimate effects of soil lead remediation are underway.

Results
Capillary blood lead samples (n=217,480) were collected from children (n=117,799) in Omaha from 1995-2016. Of these children, soil lead concentrations were available for 44,153 and among these 16,927 had soil remediation. Preliminary analysis indicated that the percent of EBL samples dropped from 58.2% in 1995 to 8% in 2016. We observed a positive association between pre-remediation EBL and pre-remediation soil lead concentration [1.44 (1.39, 1.50), odds ratio (95% CI) per unit increase in log (base e) soil lead concentration]. The association was weaker between post-remediation EBL and post-remediation soil lead concentrations [1.08 (0.99, 1.17), odds ratio (95% CI)].

Conclusions
Our analyses suggest a large decrease in blood lead concentrations over time in children living near a former smelter, which could be associated, in part, with soil remediation.

The views expressed in this presentation are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.
The association of selenium and other metal/metalloids with incident cardiovascular disease in the Strong Heart Study

Zhao D1,2, Domingo-Relloso A2, Kioumourtzoglou M3,4, Tellez-Plaza M3,4, Nigra A2,3, Best L5, Umans J6,7, Howard B6,7, Cole S8, Navas-Acien A2,3

1Nanjing University, 2Columbia University, 3Johns Hopkins University, 4Fundacion de Investigacion Hospital Clinico de Valencia INCLIVA, 5Missouri Breaks Industries Research Inc., 6MedStar Health Research Institute, 7Georgetown/Howard Universities Center for Clinical and Translational Sciences, 8Texas Biomedical Research Institute

Background: Selenium (Se) is an essential element with a narrow safety range. High Se intake has been associated with diverse adverse health effects. The evidence remains inconclusive regarding potential adverse effects on cardiovascular disease (CVD). While Se intake is high in many parts of the US, particularly in the Northern Plains, little is known on the CVD impact of high Se intake in American Indian communities. In this study, we evaluated the association of urinary Se concentrations with CVD incidence and mortality in the Strong Heart Study (SHS). Because other metals/metalloids have been related to CVD in the SHS, we also evaluated the joint effect of Se and other metal/metalloids to incident CVD.

Methods: We estimated multi-adjusted hazard ratios (HRs) for incident CVD among 3348 American Indians adults who participated in the SHS (1989-2008). Models were adjusted for CVD risk factors and arsenic, cadmium, molybdenum, and tungsten. A novel statistical approach, Bayesian kernel machine regression (BKMR) was used to study the joint effect of multiple exposures.

Results: We identified 905 cardiovascular events, including 318 deaths. When the highest and lowest quartiles of urinary Se were compared, fully-adjusted HRs (95% CI) for incident CVD, coronary heart disease, and stroke were 1.24 (95% CI, 1.00-1.54; p-trend=0.002), 1.13 (95% CI, 0.87-1.46; p-trend=0.11), and 1.18 (95% CI, 0.74-1.88; p-trend=0.14), respectively. The corresponding hazard ratios for CVD, coronary heart disease, and stroke mortality were 1.13 (95% CI, 0.79-1.63; p-trend=0.56), 1.02 (95% CI, 0.67-1.54; p-trend=0.77), and 1.81 (95% CI, 0.63-5.20; p-trend=0.25). The associations were similar in most study subgroups. The BKMR model further supported that Se exposure in the context of metal exposure mixtures is a major contributor to incident CVD in the population.

Conclusions: Urinary Se was associated with increased cardiovascular incidence and mortality. The findings support that Se exposure is a cardiovascular risk factor.
TPS 632: Health effects of flame retardants and plasticizers
Health risk assessment of human exposure to phthalates-contaminated indoor dust in the environment of homes
Azuma K\textsuperscript{1,2,3}, Inaba Y\textsuperscript{2}, Kim H\textsuperscript{2}, Bekki K\textsuperscript{2}, Hayashi M\textsuperscript{2}, Uchiyama I\textsuperscript{3}, Kunugita N\textsuperscript{2,4}
\textsuperscript{1}Kindai University Faculty of Medicine, \textsuperscript{2}National Institute of Public Health, \textsuperscript{3}Louis Pasteur Center for Medical Research, \textsuperscript{4}University of Occupational and Environmental Health

Background: Phthalates present in many products in indoor environment. A majority of the phthalates are classified as semi-volatile organic compounds, which are mainly found in both gas and condensed phases. They are easily distributed from their original source over time to indoor air, indoor dust, and other indoor surfaces, including adhesion to foods, toys, or household products. Indoor dust is the main exposure media for low volatile phthalates, such as di-2-ethylhexyl phthalate (DEHP) or di-isononyl phthalate (DINP). Health risk assessment of human exposure to phthalates-contaminated indoor dust is essential to appropriately clarify the risk level of indoor environment.

Methods: Indoor dust in 69 Japanese houses was collected and sieved into two different particle sizes (<100 \(\mu m\) and 100–250 \(\mu m\)). Concentrations of dust were determined for nine phthalates, including diethyl phthalate, dimethyl phthalate (DMP), butyl benzyl phthalate (BBP), DEHP, DINP, di-n-butyl phthalate (DnBP), di-isobutyl phthalate, di-n-octyl phthalate, and di-isodecyl phthalate (DIDP) using LC–MS/MS, and the total amount of intake was estimated through the ingestion and the dermal absorption from indoor dust. Tolerable daily intakes were determined from the hazard data. The deposit ratio on the hands was assumed to be 95:5 for the two particle sizes.

Results: In 11-year-old children, the maximum amount of intake of DEHP (9.70 \(\mu g/\text{kg/day}\)) was noted to be the highest, followed by DINP (1.64 \(\mu g/\text{kg/day}\)) and DnBP (1.06 \(\mu g/\text{kg/day}\)). Similarly, in adults, the maximum amount of intake of DEHP (3.10 \(\mu g/\text{kg/day}\)) was noted to be the highest, followed by DINP (0.52 \(\mu g/\text{kg/day}\)) and DnBP (0.35 \(\mu g/\text{kg/day}\)). The maximum hazard quotients of reproductive effects (DBP, DEHP, and BBP), which could only be estimated via exposure to indoor dust, were 0.44 and 0.14 in 11-year-old children and adults, respectively.

Conclusion: Our results suggested that the risk level of reproductive effects is regarded as "a potential risk".
Maternal Urinary Concentrations of Organophosphate Flame Retardant Metabolites: Effects on Maternal Gestational Weight Gain, Early Life Anthropometry, and Infant Eating Behaviors

Crawford K1, Hawley N2, Calafat A3, Jayatilaka N1, Froehlich R4, Has P5, Gallagher L, Kelsey K6,7, McGarvey S6,8, Phipps M5,6, Savitz D6,8, Braun J6, Werner E5, Romano M1

1Department of Epidemiology, Geisel School Of Medicine At Dartmouth, 2Department of Epidemiology, Yale University School of Public Health, 3Division of Laboratory Sciences, National Center for Environmental Health, Centers for Disease Control and Prevention, 4Department of Obstetrics, Gynecology, and Reproductive Sciences, University of Pittsburgh, 5Department of Obstetrics and Gynecology, Warren Alpert Medical School of Brown University, and Women & Infants Hospital of Rhode Island, 6Department of Epidemiology, Brown University School of Public Health, 7Department of Pathology and Laboratory Medicine, Warren Alpert Medical School of Brown University, 8Department of Anthropology, Brown University

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Organophosphate flame retardants (OPFRs) may interfere with growth and metabolism through endocrine-related mechanisms. OPFRs are associated with adverse pregnancy outcomes such as reduced fertilization and live births and preterm delivery, but there is little data on their potential to cause other adverse health effects. The objective of this pilot study (n = 56 mother-infant pairs) was to evaluate the association between OPFR exposure during pregnancy with maternal gestational weight gain (GWG), infant anthropometry, and infant feeding behaviors.

Methods: We quantified OPFR metabolites (bis-2-chloroethyl phosphate [BCEP], bis(1,3-dichloro-2-propyl) phosphate [BDCPP], and diphenyl phosphate [DPhP]) in pooled maternal spot urine collected throughout pregnancy (~12, 28 and 35 weeks’ gestation). We obtained maternal covariates such as age, body mass index and sociodemographic characteristics from medical records and questionnaires administered at the initial study visit. Trained research assistants measured infant weight, length, head and abdominal circumferences, and skinfold thicknesses. Parents reported infant feeding behavior via the Baby Eating Behavior Questionnaire (BEBQ). We used multivariable linear regression to assess associations of maternal urinary OPFR biomarker concentrations with GWG, gestational age at delivery, infant anthropometry, and BEBQ scores.

Results: We observed positive but statistically non-significant associations between OPFR biomarker concentrations and GWG. BDCPP was significantly positively associated infant length at birth (β = 2.9 cm, 95% CI = 0.3, 5.2). Furthermore, BDCPP was also associated with a significant increase in Food Responsiveness on the BEBQ. However, other OPFRs were not significantly associated with infant anthropometry or feeding behavior.

Conclusion: Collectively, these findings suggest that select OPFRs may affect infant anthropometry and that some OPFRs may also affect feeding behavior.
Urinary biomarkers of phthalates exposure in relation to thyroid hormone levels among thyroid disorder patients

Deng Y

School of Public Health, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, Hubei, PR China

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background: Phthalates exposure has been reported to disrupt thyroid hormone homeostasis. However, the evidence from human studies is inconsistent.

Objective: To investigate the associations between exposure to phthalates and thyroid hormone levels in thyroid disorder patients, a population with potentially increased susceptibility to phthalates exposure.

Methods: We included 214 thyroid disorders population who presented to a hospital in Wuhan, China. High-performance liquid chromatography coupled with tandem mass spectrometry was used to quantify eight phthalate metabolite concentrations in urine samples. Thyroid hormone including serum levels of free thyroxine (T4), total triiodothyronine (T3), thyroid-stimulating hormone (TSH) and parathyroid hormone (PTH) were assessed. Multivariable linear regression models were used to examine the associations between urinary biomarkers of phthalates exposure and thyroid hormone levels.

Results: After adjusting for potential confounder factors, we found that monobutyl phthalate (MBP) was negatively associated with total T3 ($\beta=-0.10$, 95%CI: -0.18, -0.01), and that mono(2-ethyl-5-oxohexyl) phthalate (MEOHP), mono(2-ethylhexyl) phthalate (MEHP) and monobenzyl phthalate (MBzP) had negative associations with T4 ($\beta=-0.30$, 95%CI: -0.59, -0.02; $\beta=-0.41$, 95%CI: -0.72, -0.11; $\beta=-0.19$, 95%CI: -0.34, -0.04, respectively). These negative associations still persisted for phthalates exposure modeled as categorized tertile variables. We did not observe any statistically significant associations of urinary biomarkers of phthalates exposure with TSH and PTH.

Conclusion: The results from our study suggest that exposure to certain phthalates may have adverse effects on thyroid hormone homeostasis in thyroid disorders patients.
Phthalate exposure and stressful life events in pregnancy have a joint effect on preterm birth

Ferguson K\textsuperscript{1}, Rosen E\textsuperscript{1}, Barrett E\textsuperscript{2}, Nguyen R\textsuperscript{3}, Bush N\textsuperscript{4}, McElrath T\textsuperscript{5}, Swan S\textsuperscript{6}, Sathyanarayana S\textsuperscript{7}

\textsuperscript{1}NIEHS, \textsuperscript{2}Rutgers School of Public Health, \textsuperscript{3}University of Minnesota, \textsuperscript{4}University of California San Francisco, \textsuperscript{5}Brigham and Women's Hospital, Harvard Medical School, \textsuperscript{6}Icahn School of Medicine at Mount Sinai, \textsuperscript{7}University of Washington

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background: Urinary phthalate metabolites and psychological stress in pregnancy have been individually associated with preterm birth (PTB), but no study has examined the joint effect of these two environmental exposures. We hypothesized that there would be stronger associations between phthalate exposure and PTB in mothers with higher stress in pregnancy compared to mothers with lower stress. Methods: We addressed this question using data from The Infant Development and the Environment Study (TIDES), a prospective birth cohort conducted at four US sites (N=785). Urinary phthalate metabolite concentrations were measured in samples collected in the first and third trimesters of pregnancy. Stressful life events (SLE) during gestation were assessed by a questionnaire administered in the third trimester. PTB was defined as delivery before 37 weeks completed gestation (n=71). We examined associations between urinary phthalate metabolite concentrations at each visit in association with PTB using logistic regression models adjusted for maternal race, age, pre-pregnancy body mass index, specific gravity, and gestational age at sample collection. Results: Summed di-2-ethylhexyl phthalate (ΣDEHP) metabolites measured in urine samples from the third trimester, but not the first trimester, were associated with an increased odds ratio (OR) of PTB (OR=1.38, 95% confidence interval [CI]=1.01, 1.89). In models stratified by SLE, associations between third trimester ΣDEHP concentrations and PTB were significant only for women experiencing 1 or more SLE during pregnancy (OR: 2.05, 95% CI: 1.28, 3.29) but not for women with no SLE during pregnancy (OR: 0.99, 95% CI: 0.63, 1.55); the interaction was marginally significant (p=0.05). Conclusions: We observed an association between urinary ΣDEHP levels and PTB that was modified by psychological stress in pregnancy. Additional research to understand the joint effects of chemical as well as non-chemical exposures is necessary in order to advance the state of the science on how the environment impacts pregnancy.
Perfluoroalkyl substances (PFAS) exposure associated with immune markers: T & B lymphocytes and natural killer (NK) cells

Fletcher T¹,², Leonardi G²,³, Luster M³, Margolick J⁴, Lopez-Espinosa M⁵
¹London School of Hygiene & Tropical Medicine, London, ²Public Health England, ³West Virginia University, ⁴Johns Hopkins Bloomberg School of Public Health, ⁵Universitat Jaume I−Universitat de Valencia

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background. Perfluoroalkyl substances (PFAS) may be immunotoxic, but evidence on their possible association with counts of peripheral white blood cells (WBCs) and lymphocyte subsets is very scarce. This unique study addresses the association between 4 specific PFAS (PFHxS, PFOA, PFOS, and PFNA) and several immune function indicators.

Methods. Both serum PFAS and White Blood Cells (WBCs) were measured in 42,782 (2005-2006) and 526 (2010) adults in the C8 Study, from an area with PFOA drinking water contamination in the Mid-Ohio Valley (USA). Additionally, the major lymphocyte subsets were measured in 2010. Cell counts were regressed on PFAS, with adjustment for potential confounders.

Results. We found consistent positive and generally monotonic associations between numbers of total lymphocytes and PFHxS, PFOA, and PFOS in both surveys (range: 1.1% to 7.3% per PFAS IQR). Regarding lymphocyte subtypes, PFHxS was positively and strongly associated with T, B, and natural killer (NK) cells (range: 6.2%, 8.6%). PFOA and PFOS were both positively associated with number of CD3+ T and CD3+CD4+ T-helper cells (range: 3.0% to 6.9%), and PFOA with number of CD3+CD4+CD8+ T (‘double positive’) cells (10.5%). For PFOA but not the other PFAS, there were large differences in mean PFOA between water districts, but no exposure response between district was evident. Other cells, particularly neutrophil percentage, showed slightly decreased trends associated with all PFAS (range: -2.8% to -0.6%).
Phthalate exposure in pregnant women with systemic lupus erythematosus (SLE)

Ghassabian A¹, Salmon J², Karthikraj R³, Kahn L¹, Mehta-Lee S¹, Buyon J¹, Trasande L¹
¹New York University School Of Medicine, ²Hospital for Special Surgery, ³New York State Department of Health

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background: Environmental chemicals might contribute to the pathogenesis of autoimmune diseases in combination with established genetic factors. Phthalate exposure in pregnant women may influence fetal growth and birth outcomes. Hence, we assessed phthalate exposure in pregnant women with systemic lupus erythematosus (SLE) and compared levels with nationally-representative and pregnant populations.

Methods: Participants were 50 pregnant women from the New York City (NYC) sample of PROMISSE (2003-2010), a multi-ethnic/racial cohort designed to prospectively assess adverse pregnancy outcomes in SLE women with inactive or mild/moderate disease activity. We measured urinary concentrations of 21 phthalate metabolites during each trimester and compared median concentrations with 1) 15-to-50 year-old women in the National Health and Nutrition Examination Survey (NHANES) 2003-2010; and 2) a contemporary population-based cohort of pregnant women in NYC (n=240).

Results: Intraclass correlations for three measurements across pregnancy varied between r=0 [mono-carboxy isooctyl phthalate (mCIOP)] and r=0.57 [mono-n-butyl-phthalate (mBP)]. Mono-(3-carboxypropyl) phthalate (mCPP), mono-(2-ethyl-5-hydroxyhexyl) phthalate (mEHHP), mono-(2-ethyl-5-carboxypentyl) phthalate (mECPP), mono-(2-ethyl-5-oxohexyl) phthalate (mEOHP), mCIOP, and mono-carboxy isononyl phthalate (mCINP) were detected in all pregnant women, comparable to NHANES. Metabolites of di-(2-propylheptyl) phthalate (DPHP) and 1,2-cyclohexane dicarboxylic acid diisononyl ester (DINCH) were detected in 4-55% of participant.

Compared to NHANES, pregnant women with SLE had higher first trimester concentration of mono-(2-ethylhexyl) phthalate (MEHP) [median=3.9 ng/mL interquartile range (IQR)=6.0 vs 2.5 ng/mL, IQR=5.45], mono-isobutyl phthalate (mIBP) (median=12.8 vs 7.6 ng/mL), mono-isononyl phthalate (mINP) (median=2.7 vs. 0.87 ng/mL), and mCIOP (median=14.9 vs 6.9 ng/mL). Concentrations of other phthalate metabolites were comparable between groups. Pregnant women with SLE had higher phthalate levels than the NYC cohort.

Conclusions: Pregnant women with SLE had higher concentrations of certain phthalate metabolites than controls. This cross-sectional analysis cannot rule out that SLE might influence phthalate metabolism. Sociodemographic and lifestyles factors might also explain the results; therefore, further investigation is needed.
Exposure to Phthalates and Association with Circulating Microparticles in A Young Population
Huang C¹, Su T²
¹Environmental and Occupational Medicine, National Taiwan University and National Taiwan University Hospital,
²Department of Internal Medicine and Cardiovascular Center, National Taiwan University and National Taiwan University Hospital

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background: Phthalates exposure has been documented to increase cardiovascular risks through several pathways, and chronic endothelial dysfunction has been postulated to be a possible one. The aim of the study is to explore the association between urinary phthalate metabolites and surrogate for chronic endothelial dysfunction, endothelial and platelet microparticles, among a young population.

Methods: We conducted a cross-sectional survey on 789 subjects, aged 12–30 years, enrolled from the Young Taiwanese Cohort Study during 2006–2008. Urinary phthalates metabolites including mono-2-ethylhexyl phthalate (MEHP), mono-2-ethyl-5-hydroxyhexyl phthalate (MEHHP), mono-2-ethyl-5-oxohexyl phthalate (MEOHP), mono-methyl phthalate (MMP), mono-ethyl phthalate (MEP), mono-n-butyl phthalate (MnBP), mono-benzyl phthalate (MBzP), and mono-isononyl phthalate (MiNP) were analyzed using liquid chromatography with tandem mass spectrometry. Circulating endothelial microparticles, CD31+/CD42a−, and platelet microparticles, CD31+/CD42a+, were measured by flow cytometry. Multivariate linear regression analysis expressed with least square mean and standard error across four quantiles of microparticles was performed to evaluate the association between phthalates exposure and concentration of circulation microparticles.

Results: Endothelial and platelet microparticles are significantly positive associating with urinary phthalates metabolites, particularly MEHP, ∑DEHP, MnBP, and MiNP. After controlling confounding factors, we observed estimate mean values (95% CI) of endothelial microparticles significantly increased in trend across four quantiles of MEHP (183.0(171.1–194.9), 235.1(216.4–253.8), 279.2(262.4–296.0), 800.1(746.2–854.1)), ∑DEHP (211.0(196.8–225.3), 287.8(262.1–313.4), 449.2(405.0–493.4), 499.2(460.0–538.3)), MnBP (251.1(231.9–270.4), 288.4(262.2–314.6), 347.7(308.2–387.2), 518.7(478.8–558.7)), and MiNP (320.7(298.5–342.9), 278.3(255.8–300.7), 356.1(314.5–397.6), 482.9(433.6–532.1)). Whereas, the corresponding values of platelet microparticles significantly increased in trend across four quantiles of MEHP, ∑DEHP, and MiNP. The positive associations between microparticles and phthalates are significant in subgroup analysis, independent of gender, BMI, hypercholesterolemia, hypertension, alcohol, and household incomes, but only among subjects with aged greater than 20 years-old, and non-smokers.

Conclusions: The findings confirmed a clear relationship between phthalates exposure and circulating microparticles in young population.
The association of brominated flame retardant exposure and semen parameters among men at a fertility clinic

Ingle M\textsuperscript{1}, Mínguez-Alarcón L\textsuperscript{2}, Carignan C\textsuperscript{3}, Stapleton H\textsuperscript{4}, Butt C\textsuperscript{4}, Williams P\textsuperscript{2}, Ford J\textsuperscript{2}, Hauser R\textsuperscript{2}, Meeker J\textsuperscript{1}

\textsuperscript{1}University of Michigan, \textsuperscript{2}Harvard University, \textsuperscript{3}Michigan State University, \textsuperscript{4}Duke University

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background: Fertility of U.S. males has decreased in the last twenty years. Previous studies suggest persistent organic pollutants, such as polybrominated diphenyl ethers (PBDEs), alter semen motility and morphology. Although PBDEs are mostly phased out of production in the US and EU, they are still widely detected.

Methods: A subset of 189 men were recruited from an existing longitudinal cohort from Massachusetts General Hospital fertility clinic between 2005 and 2014. At recruitment, men provided a serum sample where PBDEs: 2,4,6-Tribromophenol (246-TBP), alpha-Hexabromocyclododecane (\(\alpha\)-HBCD), PBDE-47, PBDE-99, PBDE-100, PBDE-153, and PBDE-154 and OH-BDES: 3’OH-BDE47, 6’OH-BDE47, and 4’OH-BDE49 were measured. Semen parameters including count, concentration, motility, and morphology were quantified at the beginning of each cycle (n=427 cycles). Associations with PBDEs and semen parameters were analyzed using multivariable linear mixed models adjusted for lipids, age, BMI, year, intrauterine insemination, smoking status, and days since last ejaculate.

Results: Detection rates varied among PBDEs and OH-BDES (range:38-98%). Congeners 47, 99, and 100 were highly correlated (0.79\(\leq\)r\(\leq\)0.83; p<0.001), while metabolite were slightly weaker (0.15\(\leq\)r\(\leq\)0.62; p<0.001). No associations were observed between PBDE, OH-BDES, and semen parameters. However, when the dataset was stratified by year (2005-2009; 2010-2014), several associations were observed. In samples before 2010, \(\alpha\)-HBCD was associated with decreased motility (\(\beta=-4.10; p=0.03\)) and 3’OH-BDE47 was associated with decreased percentage of morphologically normal sperm (\(\beta=-0.78; p=0.04\)). However, in samples collected \(\geq\)2010, PBDE-47 and PBDE-99 were negatively associated with sample volume (\(\beta=-0.41; p=0.001; \beta=-0.39; p=0.01\), respectively).

Conclusion: Although no longer in production, detection of PBDEs and OH-BDES is widespread. Correlations for PBDEs were stronger than for metabolites. Semen motility and morphology were negatively associated with \(\alpha\)-HBCD in samples before 2010, yet sample volume was negatively associated with later samples (\(\geq\)2010). Thus, associations of PBDEs and semen parameters may be modified by year of sample and merits further investigation.
The associations with thyroid hormone levels according to the urinary concentrations of bisphenol A, F, and S in children.

Jang Y\(^1\), Lim Y\(^2\), Kim B\(^3\), Shin C\(^4\), Lee Y\(^4\), Kim J\(^3\), Hong Y\(^{1,2,3}\)

\(^1\)Department of Preventive Medicine, Seoul National University College of Medicine, \(^2\)Institute of Environmental Medicine, Seoul National University Medical Research Center, \(^3\)Division of Child and Adolescent Psychiatry, Department of Psychiatry, Seoul National University College of Medicine, \(^4\)Department of Pediatrics, Seoul National University College of Medicine

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Bisphenol A is a substance used in the production of polycarbonate and epoxy-phenolic resins. Several studies have revealed the risk of BPA as an endocrine disrupter, and in Europe and elsewhere, the use of BPA has begun to be regulated in baby bottles. This has led to an increase in the use of bisphenol F or bisphenol S. Currently, studies on human health effects of BPF and BPS are very rare. Thyroid hormones were measured in children 6 years of age (68-79 months) including thyroid stimulating hormone, triiodothyronine, and free thyroxine. The concentration distribution of urinary bisphenols in 6-year-old children (N = 574) was described in the children's cohort. The linear correlation with serum thyroid hormone level was analyzed and stratification according to gender was performed. SAS 9.4 was used as the statistical program.

Urinary BPF was detected in 56 boys in the 6-year-old boys (N = 300). As the urinary BPF level increased, FT4 tended to increase and was statistically significant (p-value = 0.0464). On the other hand, 51 children were detected with urinary BPF in the 6-year-old girl (N = 274), and the free thyroxine tended to decrease with increasing urinary BPF (p-value = 0.0064). In the 6-year-old children (n = 574), the free thyroxine tended to increase as the urinary BPF level increased, but not statistically significant (p-value = 0.0580).

In particular, BPS and BPF have been replaced with a known risk for BPA. The thyroid is an important organ that maintains the homeostasis of our body. The endocrine disrupting effects of BPF and BPS have been demonstrated at the molecular level and in animal experiments. Since thyroid function also affects the growth and learning ability of children, multidisciplinary studies are needed on the effect of bisphenols on children.
Prenatal Phthalates Exposure and Childhood Adiposity, Adipokines, and Lipid Profiles at 48 and 72 months

Kupsco A¹, Wu H¹, Calafat A², Tolentino M³, Oken E⁴, Braun J⁵, Téllez-Rojo M⁷, Baccarelli A¹, Just A⁶
¹Department of Environmental Health Sciences, Columbia University Mailman School of Public Health, ²National Center for Environmental Health, Centers for Disease Control and Prevention, ³National Institute of Perinatology, ⁴Division of Chronic Disease Research Across the Lifecourse, Department of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute, ⁵Department of Epidemiology, Brown University, ⁶Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, ⁷Center for Research on Nutrition and Health, National Institute of Public Health

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Prenatal phthalate exposure may impact child adiposity and cardiometabolic risk. However, periods of susceptibility and potential effects on lipid and adipokine profiles remain under explored. We examined associations of phthalate biomarkers at two time points during pregnancy with child adiposity, lipids and adipokines.

Methods: We quantified 15 phthalate metabolites in 2nd and 3rd trimester maternal urine from 626 mother-child pairs in the PROGRESS Cohort of Mexico City. Body mass index (BMI) and percentage body fat (%BF) were assessed at 48 and 72 months. Fasting triglycerides, non-HDL cholesterol, leptin, and adiponectin were measured at 72 months. We generated phthalate biomarker molar sums of metabolites for each parent phthalate and of metabolites of high (ΣHMW) and low molecular weight (ΣLMW) phthalates. We estimated associations using linear mixed-effect models or linear regression then tested for effect modification by sex.

Results: Select positive associations between 2nd trimester phthalates biomarkers sums and child adiposity at 48 and 72 months were observed, while other 2nd trimester phthalates biomarkers were inversely associated with lipids at 72 months. For instance, 2nd trimester ΣHMW phthalates were positively associated with child %BF, while 2nd trimester di-isodecyl phthalate metabolites (ΣDiDP) were inversely associated with BMI. ΣHMW phthalates in the 2nd trimester were inversely associated with non-HDL. 2nd trimester di(2-ethylhexyl) phthalate (ΣDEHP) and monoethyl phthalate were inversely associated with child triglycerides at 72 months. 2nd trimester ΣDEHP was positively associated with adiponectin, while 3rd trimester di-isononyl phthalate metabolites sum (ΣDiNP) was inversely associated with adiponectin. Sex-specific effects of ΣDiDP and select phthalates on all outcomes were observed.

Conclusions: Pre-puberty, 2nd trimester phthalate exposure may be a critical window for childhood adiposity and cardiometabolic risk. Future research will employ mixture methods to examine potential interaction and cumulative effects of individual phthalates.
Exposure to di-(2-ethylhexyl) phthalate and skeletal muscle mass in 6-year-old children

Lee D\textsuperscript{1}, Lim Y\textsuperscript{2}, Shin C\textsuperscript{3}, Lee Y\textsuperscript{3}, Kim B\textsuperscript{4}, Kim J\textsuperscript{5}, Hong Y\textsuperscript{1}

\textsuperscript{1}Department of Preventive Medicine, Seoul National University College of Medicine, \textsuperscript{2}Institute of Environmental Medicine, Seoul National University of Medical Research Center, \textsuperscript{3}Department of Pediatrics, Seoul National University Children’s Hospital, \textsuperscript{4}Department of Psychiatry, Seoul National University College of Medicine, \textsuperscript{5}Department of Psychiatry, Hanyang University Medical Center

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background: Di-(2-ethylhexyl) phthalate (DEHP) is a well-known endocrine-disrupting chemical which has anti-androgenic-like effects. Although there were several studies of the relationship between body composition and DEHP, it has not yet been studied the effects of DEHP on skeletal muscle growth in childhood.

Methods: We analyzed data of 493 mother-and-child pairs enrolled in the Environment and Development of Children (EDC) cohort in South Korea. We examined the association between creatinine-adjusted prenatal and postnatal sum of DEHP metabolites collected during the mid-term pregnancy of mothers and at 6-year old of the offspring, respectively, and the percentage of skeletal muscle mass (%SMM) measured at 6-year old by a bioelectrical impedance analyzer.

Results: We observed statistically significant associations between DEHP exposure and %SMM at 6-year old. Among boys, long-term exposure to DEHP was inversely associated with %SMM after adjusting for education levels of parents, physical activity, and energy intake. Compared to children exposed to lower prenatal and postnatal DEHP (<50th percentile), children exposed to higher level of prenatal and postnatal DEHP (≥50th percentile) showed lower %SMM by -1.12% (p<0.017). However, there were no significant associations among girls.

Conclusions: Our longitudinal study presents that high levels of prenatal and postnatal exposure to DEHP significantly decreased muscle growth among boys. We can postulate that anti-androgenic effects of phthalates may affect male offspring’s muscle growth. More precautionary policy for the potential health hazard of DEHP on children development is necessary to promote healthier development of children.
Sex-specific effects of bisphenol A exposure on adiposity in early childhood: a prospective cohort study

Lim Y¹, Lee Y¹, Shin C¹, Lee D¹, Kim B¹, Kim J², Hong Y¹
¹Seoul National University College Of Medicine, ²Hanyang University

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Exposure to bisphenol A (BPA) may affect obesity development in exposed individuals and/or offspring. Data on the sex-specific effects of BPA on adiposity remain controversial.

Objectives: We aimed to investigate the overall and sex-specific associations between prenatal and postnatal exposure to BPA and children’s adiposity in a prospective cohort study. In addition, we conducted a meta-analysis of the sex-specific effects of BPA on adiposity.

Methods: We recruited midterm pregnant women between 2008 and 2011. In 2012-2017, we measured their children’s BPA levels at ages 2, 4, and 6 years, and assessed their body mass index (BMI) and its Z-scores, as well as the prevalence of overweight. We assessed the association between prenatal mid-term and postnatal exposure to BPA, and anthropometric measurements at each age. The results were also compared to those of previous studies in a meta-analysis.

Results: The overall associations of prenatal and postnatal BPA concentrations with the adiposity measurements at each age were not statistically significant after controlling for covariates. In a sex-stratified analysis, we observed increasing patterns of BMI and its Z-score at 4 and 6 years of age associated with increases in prenatal exposure to BPA among boys; however, the direction of the association was opposite among girls. The meta-analysis also showed similar results, in that increases in maternal BPA concentrations were associated with increases in the BMI Z-scores among boys [0.12 (95% confidence interval (CI), 0.06, 0.18)] and decreases in the same among girls [-0.08 (95% CI, -0.15, -0.01)].

Conclusion: The study supports the sex-dimorphic transgenerational effects of BPA on childhood adiposity.
Prenatal exposure to PFOS and anti-mullerian hormone concentrations in female adolescents

Maisonet M¹, Nayha S², Lashen H³
¹East Tennessee State University, ²University of Oulu, ³Claremont Private Hospital

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim – Exposure to endocrine disrupting chemicals could have a role in dysregulating the number of follicles laid down during fetal development or in promoting depletion of the follicle pool throughout a woman’s lifespan. Circulating anti-Müllerian hormone (AMH) level appears to be a useful surrogate marker of ovarian reserve. This pilot study aimed to determine the association of prenatal exposure to perfluorooctane sulfonic acid (PFOS) with AMH serum concentrations in females at age 15.

Methods – Prenatal concentrations of PFOS were measured in serum collected from pregnant mothers at enrollment (1991–1992) in the Avon Longitudinal Study of Parents and Children (ALSPAC). The median gestational age when the maternal blood sample was obtained was 16 weeks (interquartile range, 11–28 weeks). AMH concentrations were measured in serum obtained from their daughters at 15 years of age. Associations between prenatal PFOS concentrations and reproductive outcomes were estimated using linear regression models (n = 79).

Results – The median PFOS concentration in the analysis group was 19.3 (25th,75th: 15.2,26.1). Unadjusted AMH concentrations were on average 0.47 ng/mL (95% CI: -0.87, 1.81) higher in daughters with prenatal PFOS concentrations in the middle tertile compared with daughters with prenatal PFOS in the lower tertile. Unadjusted AMH concentrations were also higher in daughters with prenatal PFOS concentrations PFOS (β = 0.93; 95% CI: -0.41, 2.29) in the higher tertile when compared to the lower tertile. Further analysis is in progress.

Conclusion – An inverse association between exposure to PFOS and AMH concentrations was assumed. Preliminary results were not consistent with our initial hypothesis.
Prenatal exposure to mixture of bisphenol A and mono(2-ethyl-5-hydroxyhexyl) phthalate increases body mass index of 6 month-age infants

Shah-Kulkarni S1, Kim H, Park H, Hong Y, Ha M, Kim Y, Ha E
2Department of Occupational and Environmental Medicine, College of Medicine, Ewha Womans University, 2Department of Pediatrics, College of Medicine, Ewha Womans University, 3Department of Preventive Medicine, College of Medicine, Ewha Womans University, 4Department of Preventive Medicine, College of Medicine, Seoul National University, 5Department of Preventive Medicine, Dankook University College of Medicine, 6Department of Occupational and Environmental Medicine, University of Ulsan College of Medicine, Ulsan University Hospital, 7Department of Occupational and Environmental Medicine, College of Medicine, Ewha Womans University

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background: Bisphenol A (BPA) and phthalates metabolites have endocrine-disrupting properties that may implicate weight dysregulation even at low doses of exposure. Studies have reported that individual prenatal exposure to BPA and phthalates have been associated with increased body mass index and adiposity while their knowledge gap on effect of co-exposure of BPA and phthalates exists. Thus, in this study we evaluated the exposure of mixture of BPA and phthalates and their influence on physical growth in infants.

Methods: Among the participants (N=399) from the Mothers and Children’s Environmental Health study in South Korea., we evaluated the effect of co-exposure and interaction of first, third trimester of pregnancy and at birth urinary BPA, mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), mono(2-ethyl-5-oxohexyl) phthalate (MEOHP), and mono-n-butyl phthalate (MBP) on z-scores of height, weight and body mass index (BMI) at 6 months using linear regression, generalized additive model and Bayesian kernel machine regression (BKMR).

Results: BPA at birth (β=0.08) and BPA in late pregnancy (β= 0.04) was significantly associated with weight at 6 months of age, while BPA at birth was associated with an increase in BMI at 6 months (β=0.15, p<0.05). Significant interaction (p<0.05) was found for BPA and MEHHP at birth affecting weight and BMI at 6 months. BKMR analysis showed significant effect of mixture of BPA and phthalate exposure (>90 percentile) at birth on weight (estimate= 0.25) and BMI (estimate=0.47) at 6 months. Also, BKMR analysis replicated the results for effect of BPA on weight and BMI at 6 months and for the interaction between BPA and MEHHP.

Conclusion: Our results identified the effect of prenatal exposure to mixture of BPA, phthalates and their interaction on z-scores of weight and BMI at 6 months. Further studies are needed to explore the interaction of BPA and phthalates.

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Prospective evidence for the association between urinary bisphenol A and incidence of metabolic syndrome in Chinese males

Tse L1, Wu S1, Lu S2,3, Chen Y4, Li W5, Li Z6, Zhang L6, Huang H6, Feng W6, Arrandale V7, Evans G7, Wang F1
1JC School Of Public Health And Primary Care, The Chinese University Of Hong Kong, Hong Kong Sar, China; 2School of Public Health (Shenzhen), Sun Yat-Sen University, 3Shenzhen Center for Disease Control and Prevention, 4State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, 5Institute of Environmental Pollution and Health, School of Environmental and Chemical Engineering, Shanghai University, 6Shenzhen Prevention and Treatment Center for Occupational Diseases, 7Occupational and Environmental Health Division, Dalla Lana School of Public Health, University of Toronto

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Objective: Association between environmental bisphenol A (BPA) and metabolic syndrome (MetS) from previous cross-sectional studies was mixed, and the prospective evidence is lacking. This study aims to investigate whether long-term exposure to environmental BPA increases the risk of MetS incidence.

Methods: This is a prospective cohort study among Chinese male population in South China. In the baseline survey of 2013, we recruited 1227 male workers who did not have occupational exposure of BPA and free from MetS, and followed them till 31/12/2017. Modified ATP III criteria were used to identify new events of MetS. Urinary BPA concentration was assessed using high performance liquid chromatography tandem mass spectrometry and was categorized into three subgroups by tertile. Adjusted hazard ratio (aHR) and 95% confidence interval (95% CI) was calculated using multiple Cox proportional hazard model.

Results: The median concentration of urinary BPA at baseline was 4.03 μg/g-creatinine (IQR, 2.17-7.92). By the study end, we observed 200 incident cases of MetS. Compared with the lowest urinary BPA subgroup, a slightly increased risk of MetS was observed among those with middle level (aHR=1.19, 95%CI: 0.84, 1.68) and high level of urinary BPA (aHR=1.18, 95%CI: 0.84, 1.67) and there was no statistical significance; nevertheless, a significant association was restricted primarily to smokers, showing a significantly positive gradient with the increasing level of urinary BPA (moderate level: aHR=2.08, 95% CI: 0.91, 4.73; the highest level: aHR=2.76, 95% CI: 1.27, 6.01; test for trend: p=0.01).

Conclusion: This prospective cohort study demonstrates that environmental exposure to BPA may increase the risk of MetS and the risk was prominent among cigarette smokers. Removal at source of hazardous use of BPA substance and smoking cessation are thus advocated.

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Plasma concentrations of brominated flame retardants and risk of uterine leiomyomata

TPS 632: Health effects of flame retardants and plasticizers, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Polybrominated diphenyl ethers (PBDEs) and polybrominated biphenyls (PBBs) are endocrine disrupting chemicals (EDCs), biologically persistent, and widely detected in the U.S. population. Data suggest links between EDCs and uterine leiomyomata (UL). Few prospective epidemiologic studies have been conducted.

Methods: We used data from a prospective cohort study of Black U.S. women aged 23-35 years who underwent transvaginal ultrasounds at baseline, 20-, 40-, and 60-month follow-ups for the detection of UL. Using a case-cohort study design, we used non-fasting blood samples from a random subcohort of 639 UL-free participants at baseline and all 103 incident cases through 60-months of follow-up (for a total of 742 participants). The CDC assayed samples for PBB-153 and twelve commonly detected PBDEs in plasma. Using lipid-adjusted values, we created quartiles of PBB-153, total PBDEs (ΣPBDEs), and PBDE commercial class groupings (penta, octa, and deca), and age-stratified Cox regression models estimated hazard ratios (HRs) and 95% confidence intervals (CI) for their associations with UL. Models adjusted for education, smoking, alcohol, body mass index (BMI), age at menarche, parity, age at first birth, years since last birth, hormonal contraceptive use, assay batch, and the year blood sample was drawn.

Results: The adjusted HR comparing highest (≥0.9 ng/g lipid) versus lowest (<0.3 ng/g lipid) PBB-153 quartiles was 1.3 (95% CI: 0.9, 2.0), and stronger among women with a BMI ≥30 (N=446; HR=1.8; 95% CI: 1.1, 3.0). The HR comparing highest (≥57 ng/g lipid) versus lowest (<21 ng/g lipid) total PBDE quartiles was 0.9 (95% CI: 0.6, 1.2), and similar across commercial class groupings of penta (HR=0.9; 95% CI: 0.6, 1.2), octa (HR=1.0; 95% CI: 0.7, 1.5), and deca (HR=1.0; 95% CI: 0.7, 1.4).

Conclusions: Plasma concentrations of PBDEs were not appreciably associated with UL risk. PBB-153 was associated with an increased risk of UL among obese women.
TPS 633: Health effects of pesticides

Parental occupational exposure to pesticides and risk of childhood cancer in Switzerland: A census-based cohort study

Coste A1, Bailey H2, Mazzei A1, Berthet A3, Spycher B1

1 Institute For Social And Preventive Medicine, University of Bern, 2 Telethon Kids Institute, the University of Western Australia, 3 Unisanté / Département Santé au Travail et Environnement (DSTE), Centre universitaire de médecine générale et santé publique

TPS 633: Health effects of pesticides, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Pesticide exposure, especially during prenatal period, is a suspected risk factor for childhood cancer. Most research has focused on acute leukemia (AL) with numerous studies finding a positive association with use of home pesticides or maternal occupational exposure to pesticides during pregnancy. Some studies found home and parental occupational exposure to pesticides to be associated with central nervous system tumors (CNS) and lymphoma. The objective of this study was to investigate childhood cancer risks in relation to parents occupationally exposed to pesticides using nationwide data on cancer incidence in Switzerland for the period 1990-2008.

Methods: From a census-based cohort study in Switzerland, we included children aged <16 years at national censuses 1990, and 2000. We extracted parental occupations reported at the census closest to the birth year of the child and estimated exposure to pesticides using a job exposure matrix. Cox proportional hazards models, adjusted for socio-economic factors, were fitted to assess associations between exposures and the following outcomes: any cancer, AL, CNS tumors, lymphoma.

Results: Analyses of maternal (paternal) exposure were based on around 9 (13.2) million-person years at risk and included 1,035 (1,520) cases of cancer, of which 285 (438) had AL, 185 (281) lymphoma, and 227 (339) CNS tumors. The prevalence of high exposure was 4.7% for mothers and 6.8% for fathers. No evidence of an association was found either with maternal or paternal exposure. The hazard ratios comparing high to low exposure ranged from 0.95 [0.71-1.28] (any cancer) to 0.67 [0.30-1.52] (lymphoma) for maternal exposure and 0.93 [0.63-1.37] (CNS) to 0.76 [0.52-1.10] (AL) for paternal exposure.

Conclusions: Our study does not support a link between parental occupational exposure to pesticides and childhood cancer. Further analyses using data up to 2015 are planned to increase the statistical power of our study.
Domestic pesticide use during the perinatal period and risk of testicular germ cell tumor in adulthood: a French case-control study

Danjou A1, Pérol O2, Faure E3, Spinosi J3, Bouaoun L1, Béranger R4, Bujan L5, Charbotel B6, Schüz J1, Fervers B2,7

1International Agency for Research on Cancer, 2Centre Léon Bérard, 3Santé Publique France, 4Institut de recherche en santé, environnement et travail, 5Université de Toulouse 3 et CHU de Toulouse, 6Université Lyon 1, 7Centre de Recherche en Cancérologie de Lyon

TPS 633: Health effects of pesticides, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Testicular germ cell tumor (TGCT) is the most frequent cancer in young men from developed countries and its incidence has doubled in France over the last thirty years. Early-life exposures, including to some pesticides, are suspected to increase TGCT risk. Our research aims at estimating TGCT risk in adulthood associated with parental domestic pesticide usage during the perinatal period.

Methods: We designed a case-control study including 473 TGCT cases, aged 18-45 years old, recruited in 20 French university hospitals, and matched to 683 controls on hospital and year of birth. Information on domestic pesticide use, medical history and lifestyle factors were recorded through telephone interviews. Mothers of participants (50% of respondents) also provided information for pregnancy and birth periods. Domestic use of pesticides (insecticides, herbicides and fungicides) during the perinatal period (one year before to one year after birth) was determined for gardening activities, treatment of indoor plants, animal pets, wood and mold, and pest control. Odds ratios (OR) for TGCT and 95% confidence intervals (CI) were estimated using conditional logistic regression, adjusting for TGCT risk factors and confounders (including family history of TGCT; personal history of testicular trauma; premature birth; family status; incomes).

Results: Prevalence of reported domestic pesticide use during the perinatal period was 78.8% (N=458/581 mothers), and mainly for insecticide applications (97.6% of these). Domestic pesticide use was not found associated with TGCT risk (adjusted OR=1.24, 95% CI=0.74-2.10). A statistically significant positive association was observed for domestic use of fungicides (crude OR=1.70, 95% CI=1.00-2.91), which was not found after adjustment (adjusted OR=1.46, 95% CI=0.80-2.64).

Conclusions: Prevalence of exposure was high in our study population. Overall, after adjustment, no statistically significant increased risk of TGCT associated with domestic use of pesticides during the perinatal period persisted in our analyses. Our results require further investigation.
The association between estimated dietary pesticide residue risk index and mortality in a population-based cohort

Donat Vargas C, Hallström E, Sonesson U, Widenfalk A, Wolk A

1 Cardiovascular and Nutritional Epidemiology, Institute of Environmental Medicine, Karolinska Institutet, 2RISE - Research Institutes of Sweden, 3National Food Agency

TPS 633: Health effects of pesticides, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Pesticides residues are regularly detected in foods and there is a concern that this might pose a risk to the consumer, but epidemiological evidence is almost lacking. The aim of the present study was to assess the association between dietary exposure to pesticide residues and mortality in a large population-based prospective cohort of women and men.

Methods: Food consumption was assessed through a 96-item food frequency questionnaire (FFQ) at baseline (1997) in 69,498 participants (36,546 men and 32,952 women), aged 45–83 years. The pesticide residues measured 1996-1998 in foods on the Swedish market (fruits, vegetables and cereals) were obtained via the monitoring program at the National Food Agency. For each food item, we summed the ratios of each single pesticide residue concentration / acceptable daily intake present in that food, accounting for edible parts and cooking preparations. A pesticide residue risk index was then estimated based on the FFQ for each participant. Multivariable-adjusted hazard ratios (HR) with 95% confidence intervals (CI), were estimated using Cox regression.

Results: A total of 16,776 deaths occurred throughout 2014 of which 5,421 were caused by cancer and 6,338 by cardiovascular disease (CVD). Comparing extreme quartiles, the highest category of the dietary pesticide residue risk index, after confounding adjustments – including the Mediterranean diet score, was not associated with cancer mortality in women, HR, 0.90 (95% CI, 0.79-1.02); while an inverse association was observed among men, 0.85 (0.77-0.98). The corresponding results for CVD mortality were HRs, 0.86 (95% CI, 0.77-0.96) and 0.85 (95% CI, 0.77-0.94), respectively.

Conclusions: We observed no indications that exposure to pesticide residues was associated with increased mortality. The beneficial effect of plant food consumption seems to override any potential negative consequences related to pesticide residues at the exposure levels present during the study period.
Pesticide use and breast cancer risk among farmers’ wives in the Agricultural Health Study

Werder E\textsuperscript{1,2}, Engel L\textsuperscript{1}, Satagopan J\textsuperscript{3}, Blair A\textsuperscript{4}, Koutros S\textsuperscript{4}, Lerro C\textsuperscript{4}, Alavanja M\textsuperscript{4}, Sandler D\textsuperscript{2}, Beane Freeman L\textsuperscript{4}

\textsuperscript{1}University Of North Carolina at Chapel Hill, \textsuperscript{2}National Institute of Environmental Health Sciences, National Institutes of Health, Department of Health and Human Services, \textsuperscript{3}Department of Epidemiology and Biostatistics, Memorial Sloan-Kettering Cancer Center, \textsuperscript{4}Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Department of Health and Human Services

TPS 633: Health effects of pesticides, August 27, 2019, 3:00 PM - 4:30 PM

Background: Some epidemiologic and laboratory studies suggest that pesticides are related to increased breast cancer risk, but evidence is inconsistent. Women engaged in agricultural work or residing in agricultural areas may experience appreciable exposures to a wide range of pesticides, including herbicides, fungicides, and fumigants.

Methods: We examined associations of herbicide, fungicide, and fumigant use with breast cancer incidence among wives of farmers in the prospective Agricultural Health Study. Farmers and their wives provided information on pesticide use, demographics, and reproductive history at enrollment in 1993-1997 and in 5-year follow-up interviews. Cancer incidence was determined via cancer registries. Among 30,594 wives with no history of breast cancer before enrollment, we examined breast cancer risk in relation to the women’s and their husband’s pesticide use, using Cox proportional hazards regression to estimate adjusted hazard ratios (HR) and 95% confidence intervals (CI).

Results: 56% of the women reported ever using pesticides and 1,081 were diagnosed with breast cancer during an average 14.7 years follow-up. We found evidence of elevated risk in relation to ever use of the fungicide benomyl by the women (HR=1.6; 95% CI: 0.9,2.7) and by their husbands (HR=1.5; 95% CI: 0.9,2.5). There were also suggestive increases in risk in relation to ever use of the herbicide 2,4,5-T by the women (HR=1.6; 95% CI: 0.8,3.1) and of the structurally similar herbicide 2,4,5-TP by their husbands (HR=1.5; 95% CI: 0.9,2.7). We observed little evidence of differential risk by tumor estrogen receptor status.

Conclusions: Increased breast cancer risk was associated with use by both the women and their husbands of the fungicide benomyl and the related herbicides 2,4,5-T and 2,4,5-TP. Ongoing cohort follow-up may help clarify the relationship, if any, between individual pesticide exposures and breast cancer risk.
Prenatal organophosphorus pesticide exposure and childhood adiposity in the Mount Sinai Children’s Environmental Health Study

**Etzel T**, Engel S, Wolff M, Quirós-Alcalá L, Buckley J

1Johns Hopkins University Bloomberg School Of Public Health, 2University of North Carolina at Chapel Hill Gillings School of Global Public Health, 3Ichan School of Medicine at Mount Sinai, 4University of Maryland School of Public Health

TPS 633: Health effects of pesticides, August 27, 2019, 3:00 PM - 4:30 PM

Background: Experimental studies suggest that organophosphorus pesticides (OPs) may act as environmental obesogens. Prenatal OP exposures have been associated with altered glucose metabolism in infants, but effects of prenatal OP exposures on pediatric adiposity have not been assessed.

Methods: We examined associations between prenatal maternal OP exposures and childhood adiposity in the Mount Sinai Children’s Environmental Health Study, which enrolled pregnant women between 1998 and 2002 in New York City, USA. Three dimethylphosphate (ΣDMP) and three diethylphosphate (ΣDEP) metabolites were measured in spot urine samples collected from mothers during the third trimester of pregnancy. We determined percent fat mass using bio-electrical impedance analysis and calculated age-and sex-standardized body mass index (BMI) z-scores at ages 4, 6, and 7-9 years (166 children with 323 observations). We used linear mixed models to assess covariate-adjusted associations of prenatal maternal OP metabolite concentrations with repeated measures of child adiposity and assessed effect measure modification (EMM) by PON1 genotypes and child’s sex.

Results: We observed null associations in covariate-adjusted models; differences in fat mass per 10-fold increase in prenatal ΣDMP and ΣDEP concentrations were 0.7% (95% CI: -0.6, 2.0) and 0.8% (95% CI: -0.4, 2.0), respectively. Maternal PON1-108C/T polymorphisms modified relationships of prenatal ΣDMP with percent fat mass (EMM p-value=0.16) and ΣDEP with BMI z-scores (EMM p-value=0.12). For example, ΣDMP was positively associated with fat mass among mothers with the CT or TT genotype (β: 1.3, 95% CI: -0.5, 3.1), but not among those with the CC genotype (β: -0.6, 95% CI: -2.4, 1.3). Sex and maternal PON1 Q192R polymorphisms did not modify associations.

Conclusions: OPs were not associated with child adiposity in the overall population. However, larger studies are warranted to further evaluate differences in associations by maternal PON1 genotype, which regulates OP metabolism and may increase susceptibility to exposure.
Association between urinary triclosan concentration with bone mass density and osteoporosis in the US adult women, 2005-2010

LI Y1, Shaofang S2, Fan C1, Sun L3
1Department Of Epidemiology And Health Statistics, Hangzhou Medical College School Of Public Health, 2Department of Science and Education, Xiamen Second Hospital, Xiamen, 3Centre for Orthopaedic Research, Orthopedics Research Institute of Zhejiang University, Department of Orthopaedics, The Second Affiliated Hospital of Zhejiang University School of Medicine

TPS 633: Health effects of pesticides, August 27, 2019, 3:00 PM - 4:30 PM

Background: Laboratory studies have demonstrated that Triclosan (TCS) could result in significant interstitial collagen accumulation and an increase in trabecular bone. However, little is known about the relationship between TCS exposure and human bone health.

Methods: We used 2005-2010 National Health and Nutrition Examination Survey data to examine the association between urinary TCS concentrations with BMD and osteoporosis in the US adult women (age ≥20 years). Weighted analyses were conducted to account for the complex sampling design and to obtain appropriate standard errors (SE), using the NHANES Analytic and Reporting Guidelines.

Results: After adjustment for other covariates, significantly negative associations were observed between tertile 3 of TCS concentration and BMD in regions of total femur (β=-0.016, 95% CI=-0.032, -0.000), intertrochanter (β=-0.022, 95% CI=-0.042, -0.002), and lumbar spine (β=-0.014, 95% CI=-0.029, 0.001), respectively, relative to tertile 1. Compared with women at tertile 1, those at tertile 3 had significantly elevated prevalence of osteoporosis in intertrochanter [odd ratio (OR)=2.464, 95% CI = 1.190, 5.105].

Conclusions: In conclusion, this is the first epidemiological study to investigate the association between urinary TCS concentration with BMD and osteoporosis in the US adult women. We found urinary TCS concentration was negatively associated with BMD and was positively associated with prevalence of osteoporosis. The evidence was stronger in postmenopausal women than in premenopausal women. Prospective studies are warranted to validate the findings in the future.
Association of Pesticides with Measures of Sex Steroid Hormones in Adult Males: Findings from the 1999-2004 National Health and Nutrition Examination Survey (NHANES)

Madrigal J¹, Persky V¹, Sargis R², Turyk M¹
¹University Of Illinois at Chicago, School of Public Health, ²University Of Illinois at Chicago, Department of Medicine

Background: Organochlorine pesticides are detectable in serum from most adults. Animal studies provide evidence of pesticides effects on sex hormones, suggesting that exposure may impact human reproductive function. Mounting evidence of sex-differences in chronic diseases like diabetes suggest that perturbations in endogenous sex hormones may influence disease development. However, the association between pesticide exposure and sex hormone levels in males across the lifespan is not well understood.

Methods: We evaluated cross-sectional associations of serum concentrations of nine organochlorine pesticides in relation to sex steroid hormone levels [testosterone (ng/dL), sex hormone binding globulin (SHBG; nmol/L), estradiol (pg/mL), androstanedione glucuronide (ng/dL)] in a sample of 743 U.S. males aged 20 years and older from the 1999-2004 cycles of the National Health and Nutrition Examination Survey (NHANES). Survey-weighted linear regression models were performed to estimate beta coefficients and their 95% confidence intervals (CIs), adjusting for age, race, body mass index, serum lipids, smoking, education, and survey year.

Results: Serum β-hexachlorocyclohexane concentration was positively associated with total estradiol (p-trend=0.03) and free estradiol (p-trend =0.02). Hexachlorobenzene concentration was positively associated with total estradiol (p-trend =0.001), free estradiol (p-trend =0.02), and inversely associated with testosterone to estradiol ratio (p-trend =0.01). Serum p,p′-DDT (dichlorodiphenyltrichloroethane) concentration was inversely associated with SHBG (percent change Q4 versus Q1= -17.2, 95% CI=-29.9, -2.31; p-trend =0.01). No associations were observed for dieldrin, mirex, trans-nonachlor, p,p′-DDE (dichlorodiphenyldichloroethylene), oxychlordane, or heptachlor epoxide.

Conclusions: Our findings suggest that pesticides may alter male sex hormone levels. The positive associations with estradiol, and inverse association with SHBG are particularly relevant to diabetes risk, and if confirmed, may implicate sex hormones as a mechanism for disease development among those exposed to pesticides. This highlights the need to prioritize health protection, evaluate these associations prospectively, and further investigate molecular mechanisms related to disease development to mitigate the impact of exposure.
The Effects of Glyphosate Based Herbicides on Rat Sperm Mitochondria

McLeland-Wieser H¹, Mandrioli D², Young H³, Belpoggi F², Neumann L¹, Attene-Ramos M¹, Panzacchi S², Manservisi F², Perry M¹

¹Department of Environmental and Occupational Health, Milken Institute School of Public Health, George Washington University, ²Cesare Maltoni Cancer Research Center, Ramazzini Institute, ³Department of Epidemiology and Biostatistics, Milken Institute School of Public Health, George Washington University

TPS 633: Health effects of pesticides, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: While glyphosate is one of the most widely used herbicides in the world, there are concerns about its health effects. Glyphosate-based propriety formulations, such as Roundup®, contain unknown additives which may modify potential health effects and glyphosate has been classified as probably carcinogenic to humans. There are questions about its role as an endocrine disruptor and its impact on sperm health. We sought to evaluate the impacts of these chemicals on sperm by assessing damage to mitochondrial DNA, which is thought to be essential for sustaining sperm motility and for successful fertilization.

Methods: Epididymal sperm samples were obtained from Sprague-Dawley rats. Eighteen animals were prenatally exposed and then orally dosed with glyphosate. Equal numbers were similarly exposed to Roundup® or served as controls. After weaning, 8 animals per group were treated for 6 weeks and the remaining 10 animals for 13 weeks. Total DNA was extracted from frozen sperm. LA-qPCR was performed to determine mitochondrial and genomic lesions per 10kb. RT-PCR was performed to determine mitochondrial copy number.

Preliminary Results: Mitochondrial copy number averaged 100.14 for controls, 95.94 for glyphosate samples, and 95.36 for Roundup® samples. Compared to controls, relatively fewer lesions were found in animals dosed with Roundup® and relatively more lesions were found in animals dosed with glyphosate. Inferential and parametric statistical comparisons of mtDNA damage per group and according to sperm quality indicators will be presented. The differences between the glyphosate and Roundup® groups are particularly informative for understanding how surfactants and other purported inert ingredients may have a role in toxicity.

Conclusions: These data suggest that there may be differential effects on sperm mitochondria stemming from exposure to glyphosate and its derivatives. These findings are suggestive and can stimulate more hypothesis-driven mechanistic studies in vitro and in vivo, and epidemiologic studies in populations.
Brazil is the country that has used the most pesticides on the planet since 2008. Of these, 25% do not have permits and 30% are already banned in countries of the European community. In Sao Paulo state, aerial spraying reaches 11% of the total area of the state. Legislation related to the levels of pesticides in the water for human consumption have been under review in Brazil for about 2 years, at this time not yet completed. Sao Paulo state has a population of 43 million people and has 645 municipalities. Due to the importance of the impact of pesticides on human health, this study aims at analyzing the identified aerial spraying data in the 20 municipalities with the highest number of flights, pesticides levels present in water for human consumption and profile of morbidity and mortality in the municipalities of Sao Paulo state more impacted. Main objective: To describe hospitalization and hospital admission charts in the 20 municipalities with the highest number of aerial spraying flights. Secondary objective is to analyze the data on the levels of pesticides identified in the water system for human consumption. Data from the national databases (health, water) for the period 2013-2016 will be analyzed. Results: the data found indicate important hospitalization rates and mortality due to pathologies of the ICD group 10 revision referring to the chapters Neoplasia, Congenital Malformation.
Background: Worldwide use of glyphosate, a broad-spectrum herbicide, has exploded since it was introduced in 1974. Most official assessments have disagreed with IARC’s 2015 conclusion that glyphosate is probably carcinogenic to humans (group 2A). In order to assess as directly as possible whether glyphosate is associated with an increased risk of non-Hodgkin lymphoma (NHL) in humans, we conducted a new meta-analysis of the epidemiologic evidence with an a priori focus on high glyphosate exposures.

Methods: Our meta-analysis used six studies, adding the recently published Agricultural Health Study (AHS) results to five older case-control studies. To best address glyphosate’s carcinogenic potential, we focused on the workers in each study with the highest exposure by prioritizing in order: (1) highest cumulative exposure and longest lag; (2) highest cumulative exposure; (3) longest exposure duration and longest lag; (4) longest exposure duration; (5) longest latency or lag; and (6) ever-exposure. This quantification varied by study.

Results: We estimated the overall meta-relative risk of NHL to be 1.41 (95% confidence interval: 1.13–1.75). Due to our focus on the highest exposed workers, this is a stronger effect than previously reported. Findings from various sensitivity analyses are consistent with this result. We describe our concerns with the exposure assessment in the most recent AHS and its potential to bias the inference towards no increased risk. The AHS exposure group we used in our meta-analysis is likely to provide the least biased exposure effect estimate.

Conclusions: Our findings support IARC’s assessment of glyphosate’s carcinogenic potential. There is a lack of human evidence in recent decades when glyphosate sales have been highest. It is quite likely that worker and population exposures are much higher than those that comprise our meta-analysis. These increased exposures may convey meaningful population risk of cancer.
Residential proximity to specific crops and cause-specific mortality in The Netherlands

Simões M1, Huss A1, Marra M2, Brouwer M1, Krop E1, Janssen N2, Vermeulen R1,3

1Institute for Risk Assessment Sciences (IRAS), Utrecht University, 2National Institute for Public Health and the Environment, 3Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht

TPS 633: Health effects of pesticides, August 27, 2019, 3:00 PM - 4:30 PM

Background: There is concern about residential exposure to pesticides and possible associated adverse health effects. Studies on this subject have been scarce with inconsistent results. We explored associations between residential proximity to specific crops, pesticide use and cause-specific mortality in The Netherlands, using individual level exposure and health data.

Methods: From a national registration-based cohort (the Dutch Environmental Longitudinal Study (DUELS)), we selected inhabitants aged >30 living in less urbanized areas, at the same address for 9 years up to baseline (2005). This resulted in a cohort of >2.3 million individuals, followed for cause-specific mortality until 2012. We estimated the amount (kg) of fungicides, herbicides and insecticides used within buffers of 50, 100, 250 and 500 meters around each individual’s residence as well as the area of specific crop groups (maize, grains, potatoes, beets, fruit, flower bulbs and other crops) cultivated within the same buffers for the period 1995-2003. The association between these exposure proxies and 28 mortality causes was investigated using Cox proportional hazards regression, adjusting for individual and area-level confounders.

Results: After Bonferroni Correction we found lower mortality among individuals living close (<500m) to agricultural areas. We found no association between the use of pesticides and mortality. However, the presence of maize was associated with higher mortality from chronic lower respiratory diseases, showing a gradient with distance (HR [95% CI] per hectare of maize in the 50m buffer 1.242, [0.925, 1.667], 100m buffer 1.088, [1.000, 1.184], 250m buffer 1.014, [0.996, 1.032] and 500m buffer 1.006, [1.003, 1.010]). Results were further suggestive for an association between leukemia and the presence of cereals, beets and potatoes crops.

Conclusions: Suggestive associations between crop area and cause-specific mortality emerged, while no associations were found with the amount of pesticides used. The reasons for this discrepancy are as yet unclear.
Agricultural Pesticide Exposure and Congenital Abnormalities (CA) in Mexico: A Systematic Review

Trejo B, Perry M

1Department of Environmental Health, Boston University School of Public Health, 2Department of Environmental and Occupational Health, Milken Institute School of Public Health, George Washington University

TPS 633: Health effects of pesticides, August 27, 2019, 3:00 PM - 4:30 PM

Agricultural Pesticide Exposure and Congenital Abnormalities (CA) in Mexico: A Systematic Review

Authors: Brenda M. Trejo1 and Melissa J. Perry2

Affiliation: 1Department of Environmental Health, Boston University, Boston, MA, USA 2Department of Environmental and Occupational Health, Milken Institute School of Public Health, George Washington University, Washington DC, USA

Background: Pesticide exposure has been associated with congenital abnormalities (CA), which are a public health concern in Mexico.

Objective: This systematic review identified literature that addressed the relationship between parental exposure to agricultural pesticides via agricultural work and CA among infants of Mexican parents. The systematic literature review sought to communicate the findings of the association, identify strengths and limitations, and make recommendations for further research.

Methods: Articles were identified using PubMed with secondary searches of Scopus, PubMed Central, ProQuest Environmental Science, Academic Search Complete, Popline and hand search of references of the identified articles.

Results: Seven studies were identified that investigated the association between agricultural pesticide exposure and CA in Mexico. Six studies observed a positive association; one study found no association. Five studies investigated exposure to specific pesticide(s) and two investigated general pesticide exposure. Five studies relied on self-reporting for ascertainment of exposure and/or outcome. Two studies used more objective methods, such as biomarkers and clinical diagnosis for both the exposure and outcome of interest. Five studies investigated specific CA; two studies investigated CA generally.

Conclusion:
The reviewed literature supported the positive association between pesticides and CA while demonstrating a need for improved exposure and outcome ascertainment.
Impact of Organophosphate Pesticide Exposures on Zika Infection Health Outcomes

Welton M1, Scalabrin D2, Harris E4, Ko A3, Lucía Garcés A5, Garcia R5, Cordero J1

1University Of Georgia, 2Research Center - FIOCRUZ Brazil, 3Yale School of Public Health, 4University of California, Berkley - College of Public Health, 5Instituto de Nutrición de Centroamérica y Panamá

Zika infection during pregnancy is the first identified vector-borne human teratogen. Although causality was established, the rate of affected infants varies geographically, appearing to be higher in the rural areas than in urban settings. Environmental exposures, such as pesticides, may interact with Zika infection to result in different degrees of severity of disease or an increased risk to the infant. Pesticides and other environmental exposures are ubiquitous and some, such as organophosphate pesticides, are endocrine disruptors and have been associated with eliciting oxidative stress, as well as birth outcomes including miscarriages and developmental disabilities in children. The Zika in Infants and Pregnancy (ZIP) study, sponsored by NIH, is an observational cohort study that planned to recruit up to 10,000 pregnant women in 10 sites throughout South America, Central America, and Puerto Rico. Women are recruited on or before 18 weeks of gestation and followed monthly including clinical exams and specimen collection. Additionally, information is collected on health behaviors, home product use, household and occupational characteristics, as well as pesticide exposure laboratory analysis. The pesticide exposure analysis being presented is conducted by the NIEHS Children’s Health Exposure Analysis Resource (CHEAR) laboratory resources. This presentation will communicate the preliminary results of the urinary organophosphate metabolite analysis of over 2000 samples from about 1200 pregnant women in Puerto Rico, Nicaragua, Guatemala, and Brazil. This analysis will provide the first survey of pesticide exposures among pregnant women in several Latin American countries and will further the understanding of cause-effect relationships between pesticides and developmental defects. It is also a unique opportunity to understanding the potential interaction between ZIKV infection and pesticide exposure during pregnancy.
TPS 634: Health effects of pops, voc and other chemicals
Gene-Dioxin Interactions and Time to Pregnancy in the Seveso Women’s Health Study
Eskenazi B1, Rauch S1, Ames J1, Mocarelli P2, Brambilla P2, Warner M1
1University of California, Berkeley, 2University of Milano-Bicocca, Hospital of Desio

Background/Aim
Exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), a widespread environmental contaminant, has been associated with reduced fertility in multiple animal species. TCDD is proposed to impact fertility via altered activity of the aryl hydrocarbon receptor (AhR) pathway, which regulates diverse biological and developmental processes, including xenobiotic metabolism. The Seveso Women’s Health Study (SWHS) followed up 981 women exposed to TCDD in a chemical factory explosion in 1976. Twenty years later, we reported longer time to pregnancy (TTP) associated with individual 1976 serum TCDD levels, but the youngest women had not yet attempted pregnancy. Now, 40 years after the explosion, when most women will have completed their families, we aim to re-examine the relationship of TCDD exposure with TTP and assess whether variations in AhR pathway genes modify this relationship.

Methods
Of 617 women who had attempted pregnancy after the explosion, 367 delivered a live birth not associated with contraceptive failure. We examined the relationship of 1976 serum TCDD levels to TTP (parameterized as the monthly probability of conception within the first 12 months of trying) using discrete-time Cox proportional hazards regression. We also utilized genotype data (87 SNPs across 7 AhR pathway genes) to examine gene-environment interactions between AhR pathway variants and TCDD levels on TTP.

Results
Women averaged 26.7 (±4.3) years at the time of attempting pregnancy. Median TTP was 2 months, with 17.2% taking 12 or more months to conceive. Consistent with our previous findings, a 10-fold increase in serum TCDD was associated with longer TTP (adjusted fecundability odds ratio = 0.80; 95%CI: 0.66, 0.98). In preliminary analyses, we found one SNP in AHRR which adversely modified the association between TCDD levels and TTP, implicating gene-environment interaction.

Conclusions
These results suggest that TCDD exposure is associated with reduced fertility in the Seveso cohort; gene-environment interaction may play a role.
Environmental toxicants in breast milk of Norwegian mothers and gut bacteria composition and metabolites in their infants at one month

Izatt N¹, Jannsen S²,³, Lenters V¹, Dahl C⁴, Stigum H¹, Knight R³, Mandal S⁵, Peddada S⁶, Midvedt T⁷, Eggesbø M¹

¹Norwegian Institute Of Public Health, ²Heinrich-Heine University, ³University of California San Diego, ⁴University of Oslo, ⁵Public Health Foundation of India, ⁶National Institute of Environmental Health Sciences, ⁷Karolinska Institute

TPS 634: Health effects of pops, voc and other chemicals, August 27, 2019, 3:00 PM - 4:30 PM

Background: Early disruption of the microbial community may influence life-long health. Environmental toxicants can contaminate breast milk and the developing infant gut microbiome is directly exposed. A few experimental studies suggest exposure to persistent organic pollutants can affect the gut microbiome. We investigated whether environmental toxicants in breastmilk affect the composition and function of the infant gut microbiome at one month.

Methods: We measured environmental toxicants in breastmilk, fecal short-chain fatty acids (SCFAs), and gut microbial composition from 16S rRNA gene amplicon sequencing using samples from 267 mother-child pairs in the Norwegian Microbiota Cohort (NoMIC). We tested 28 exposures: polychlorinated biphenyls (PCBs), polybrominated flame retardants (PBDEs), per- and polyfluoroalkyl substances (PFASs), and organochlorine pesticides. We assessed chemical exposure and alpha diversity/SCFAs using elastic net regression modelling and generalized linear models, adjusting for confounders; variation in beta diversity (UniFrac), taxa abundance (ANCOM), and predicted metagenomes (PiCRUST) in low, medium and high exposed groups.

Results: PBDE-28 and surfactant perfluorooctanesulfonic acid (PFOS) were associated with less microbiome diversity. Some sub-OTUs of Lactobacillus, an important genus in early life, were lower in abundance in samples from infants with relative “high” (>80th percentile) vs. “low” (<20th percentile) toxicant exposure. Breast milk toxicants were associated with microbiome functionality, explaining up to 34% of variance in acetic and propionic SCFAs, essential signalling molecules. Per one standard deviation of exposure, PBDE-28 was associated with less propionic acid (-24% [95% CI: -35% to -14%] relative to the mean), and PCB-209 with less acetic acid (-15% [95% CI: -29% to -0.4%]). Conversely, PFOA and dioxin-like PCB-167 were associated with 61% (95% CI: 35% to 87%) and 22% (95% CI: 8% to 35%) more propionic and acetic acid, respectively.

Conclusions: Environmental toxicant exposure may influence infant gut microbial function during a critical developmental window and these novel findings require replication.
Context: Declining mitochondrial function, reflected by diminished electron transport chain activity, is related to many common chronic diseases. However, the risk factors of mitochondrial dysfunction are largely unknown. Recently, chronic exposure to low-dose environmental chemicals has been suspected to induce mitochondrial dysfunction in vitro and in vivo settings. We evaluated the relationship between serum concentrations of lipophilic chemical mixtures and mitochondrial function in an apparently healthy population.

Method: Serum concentrations of organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) were measured in 248 Korean adults aged 30-64 years. Platelet oxygen consumption rates (OCRs), measured using the Seahorse XF Analyzer, was used as a biomarker of mitochondrial function in 20-ml samples of fresh peripheral blood.

Results: Mean OCR decreased significantly with increasing serum concentrations of OCPs. Across quartiles of summary measure of OCPs, mean OCRs were 12.4, 11.2, 9.0, and 8.5 (P trend<0.01). When the last quartile of summary measure of OCPs was further categorized according to 90%- and 95%-cutoff points, the linear association became stronger. Similarly, this linear relationship was observed in subgroups stratified according to age, sex, and body mass index. PCBs showed much weaker associations than OCPs.

Conclusion: Considering the current human, in vitro, and in-vivo evidence, we suggest that mitochondrial dysfunction may be a key mechanism that links chronic exposure to low-dose chemical mixtures to common chronic diseases, such as diabetes or dementia. (※ Acknowledgement: This work was supported by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (2016001370002).)
Exposure to chemical and toxic elements following Hurricane Harvey
Tuminello S\(^1\), Lieberman-Cribbin W\(^1,2\), Kerath S\(^3\), Bevilacqua K\(^2,4\), Schneider S\(^2,4\), Guzman M\(^2,4\), Rasul R\(^2,4\), Schwartz R\(^1,2,4\), Taioli E\(^1,2\)

\(^1\)The Institute For Translational Epidemiology At The Icahn School Of Medicine At Mount Sinai, \(^2\)Northwell-Stony Brook—Mount Sinai Center Disaster Health, Trauma, and Resilience, \(^3\)Feinstein Institute for Medical Research, \(^4\)Department of Occupational Medicine, Epidemiology and Prevention, Hofstra Northwell Health School of Medicine

TPS 634: Health effects of pops, voc and other chemicals, August 27, 2019, 3:00 PM - 4:30 PM

Background: Hurricane Harvey caused extensive damage to the Texas coast, particularly to the greater-Houston area, potentially exposing residents to a number of chemical and toxic substances. Houston has numerous industrial plants as well as natural gas and oil refineries. According to the Environmental Protection Agency, at least 13 of 41 Houston Superfund sites were flooded as a consequence of the storm.

Methods: Our research team was in Houston less than 3-weeks after Hurricane Harvey made landfall, with a second team in Houston approximately 5 months later. Convenience sampling was used to recruit participants (> 18 years old), who completed a questionnaire.

Results: A total of 202 Houston residents participated in this study; 41 during the first visit and an additional 161 during the second visit. A total of 27 (13%) reported being exposed to some sort of dirty or contaminated water, with 8 (4%) reporting exposure to gas or petroleum; 52 (26%) participants reported being exposed to debris caused by the storm; 64 (32%) participants reported some type of Harvey related chemical or toxic exposure.

Conclusion: As a consequence of Hurricane Harvey, Houston residents may have been exposed to chemical and toxic agents, the health effects of which still need to be explored. We are currently evaluating saliva samples, also collected during our visits to Houston, for the presence of heavy metals and other carcinogens. As an impact of climate change, future flood events are likely to happen in Houston. This, in combination with the high number of superfund sites and chemical facilities, suggests that actions need to be taken now to prevent any future release of hazardous materials that may harm the public.
Associations between endocrine disrupting chemicals (EDCs) and thyroid hormones: a community-based survey in rural Newfoundland (Canada)

Babichuk N‡, Sarkar A‡, Mulay S‡, Knight J‡

‡Division of Community Health and Humanities, Faculty of Medicine, Memorial University, ‡Primary Healthcare Research Unit, Faculty of Medicine, Memorial University

TPS 634: Health effects of pops, voc and other chemicals, August 27, 2019, 3:00 PM - 4:30 PM

Background:
Exposure to EDCs can lead to thyroid hormone disruption. Seafood is a dominant source of EDC exposure in humans. Serum EDC concentrations in rural communities in the province of Newfoundland where local seafood consumption is frequent have not yet been explored, nor have the corresponding impacts on thyroid hormones.

Aim:
To explore exposure to EDCs in two rural Newfoundland populations, and test for associations with thyroid hormones. Eighty residents from New-Wes-Valley (NWV) on the north-east coast and Burin on the south coast had serum samples tested by gas chromatography mass spectrometry for polybrominated diphenyl ethers (PBDEs), polychlorinated diphenyls (PCBs), polybrominated biphenyls (PBBs) and dichlorodiphenyldichloroethylene (DDE). Thyroid stimulating hormone (TSH), free thyroxine (FT4) and free triiodothyronine (FT3) levels were also measured. Means, 95% confidence intervals (CI) and associations between EDCs and thyroid hormone concentrations were tested in SPSS.

Conclusions:
The rural Newfoundland population is exposed to EDCs and the levels are associated with their thyroid hormone profiles. There were differences in concentrations of contaminants between two locals on different coasts, suggesting that residents around the island may experience difference sources and/or levels of exposure.
Associations of PCB and PBDE congeners with thyroid hormones in Great Lakes sport fish consumers

Turky M, Christensen K, Chen H

1 University Of Illinois At Chicago, 2 University of Wisconsin-Madison

TPS 634: Health effects of pops, voc and other chemicals, August 27, 2019, 3:00 PM - 4:30 PM

Thyroid hormones play an essential role in regulating many physiologic functions including growth, reproduction, and metabolism. Consequently, disruption of thyroid homeostasis by pollutants such as polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) may result in clinical or subclinical disease. Individual congeners of PCBs and PBDEs may show strong correlation with each other given shared chemical structure and usage patterns; consequently, past evaluation of thyroid hormone disruption in Great Lakes sport fish consumers (GLSFC) predominantly focused on summary measures of total PCB body burden. However, newer statistical methodologies can better account for collinearity among exposures. This investigation focused on data collected in 2005 from male GLSFC, and used weighted quantile sum (WQS) regression to investigate associations of PCB congeners, PBDE congeners and DDE, with endogenous thyroid hormones, triiodothyronine (T3), total thyroxine (T4), free forms of T3 and T4 (FT3 and FT4), reverse T3 (rT3), thyroxine binding globulin-bound T4 (TBG-T4), albumin-bound T4 (alb-T4) and thyroid-stimulating hormone (TSH).

The cohort of 367 males were 30 to 81 years of age (mean = 60 years), without diagnosed thyroid disease and were not using thyroid, sex steroid or corticosteroid medications. We found significant associations with many hormone outcomes. Free T4 was inversely associated with PCB congeners, predominately PCB170 and 178, and positively associated with PBDE153 and 99. Similarly, total T4 was inversely associated with PCB146, 170 and 178, and positively associated with PBDE153 and 99. Reverse T3 was positively associated with PBDE47, 99 and 153. Alb-T4 was positively associated with PBDE47 and 100 and TBG-T4 was inversely associated with PBDE47, 100 and 153.

In conclusion, recent developments in the analysis of multiple correlated exposures can expand our understanding of the impact of individual exposures on hormone dysregulation in historical data sets and identify which specific congeners may play a role in determining health outcomes.
Persistent organic pollutants and the association with maternal and child thyroid hormone levels

Vafeiadi M\textsuperscript{1}, Margetaki K\textsuperscript{1}, Roumeliotaki T\textsuperscript{1}, Karakosta P\textsuperscript{1}, Daraki V\textsuperscript{1}, Chalkiadaki G\textsuperscript{1}, Sarri K\textsuperscript{1}, Vassilaki M\textsuperscript{2}, Kogevinas M\textsuperscript{3,4,5}, Chatzi L\textsuperscript{6}

\textsuperscript{1}Department of Social Medicine, Faculty of Medicine, University of Crete, \textsuperscript{2}Department of Health Sciences Research, Mayo Clinic, \textsuperscript{3}ISGlobal, \textsuperscript{4}Universitat Pompeu Fabra (UPF), \textsuperscript{5}CIBER Epidemiología y Salud Pública (CIBERESP), \textsuperscript{6}Department of Preventive Medicine, Keck School of Medicine, University of Southern California

TPS 634: Health effects of pops, voc and other chemicals, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Thyroid hormones regulate a wide array of biological functions in the human body. Exposure to persistent organic pollutants (POPs) has been linked to metabolic disturbances in epidemiological and animal studies, but their effects on thyroid hormone homeostasis remain controversial. We evaluated the association between maternal POPs exposure and thyroid function in 850 mother-child pairs from the RHEA pregnancy cohort in Crete, Greece.

Methods: Concentrations of several PCBs, dichlorodiphenyldichloroethene (DDE), and hexachlorobenzene (HCB) were determined in first trimester maternal serum. Thyroid hormones (thyroid stimulating hormone (TSH), free T(4), and free T(3)) were measured in serum samples collected from mothers (1st trimester) and their children at 4 years of age. Maternal hypothyroxinemia was defined as TSH within the normal range and fT4 below the 10th percentile. Adjusted associations were obtained via multivariable regression analyses.

Results: Elevated prenatal DDE levels (third vs. first tertile) were associated with 14.3% (95% CI: -27.2, 0.9) lower maternal TSH levels. Women in the medium and high tertiles of PCBs, had 18.1% (95% CI: -30.6, -3.4) and 16.61% (95% CI: -31.6, 1.7) lower TSH levels respectively, compared to women in the lowest tertile. Elevated odds of hypothyroxinemia were observed for women in the highest tertile of PCBs exposure (OR=2.5, 95% CI: 1.0, 6.3). Girls born to mothers within the high HCB tertile of exposure had -7.9 ng/dL (95% CI: -15.2, 0.03, p-interaction=0.027) lower mean concentrations of FT4 compared to girls born to mothers in the lowest tertile. We did not observe other associations between maternal POP concentrations and child thyroid hormones.

Conclusions: The present results suggest that low-level exposure to POPs can alter maternal and offspring thyroid homeostasis. Considering the importance of thyroid hormones during gestation and early life stages, further work is needed to examine the underlying mechanisms.
Spatiotemporal distributions of benzene exposure in the inner city, urban fringe and suburban areas over the whole of Bangkok by using Space-time Bayesian maximum entropy method

Watcharavitoon P1,2, Chang-Chuan C2, Kuen-Yuh W2
1Suranaree University Of Technology, 2National Taiwan University

TPS 634: Health effects of pops, voc and other chemicals, August 27, 2019, 3:00 PM - 4:30 PM

Benzene, a widely used industrial chemical and a known human carcinogen, is ubiquitous in the environment and mainly contributed by incomplete combustion of gasoline. The potential health effects due to exposures to benzene have been of great concerns for residents in the megacities of developing countries. The objective of this study was to explore the current available environmental benzene data in the Bangkok Metropolitan Region in Thailand to first assess the spatial and temporal cancer risk on benzene in the whole Bangkok city by applying the space-time Bayesian maximum entropy method. These results will be extremely useful for decision makers to draft policies to protect the public from overexposures to benzene. Monthly benzene concentrations at 11 sampling locations including inner city areas, urban fringe areas, and suburban areas, including one suburban background area in Bangkok were monitored by the Environmental Research and Training Center and, Pollution Control Department Thailand from November 2006 to September 2015 and used for the assessment. The annual average benzene concentrations in the inner city among urban fringe areas, and suburban areas were almost 3.0, 1.9, and 1.4 times higher than those observed in the background areas. The calculated lifetime cancer risk ranged from 9.67E-11 to 2.82E-5 in Bangkok. There may be additional 0–29 cancer cases/million population over a 70-year period among those living and working in different areas, as reflected by the characteristics and traffic volumes in Bangkok.
A prospective study of urinary melamine levels and renal function deterioration in early stages of chronic kidney disease

Wu M1, Hung Y1
1Kaohsiung Medical University, 2Kaohsiung Medical University Hospital, Kaohsiung Medical University

TPS 634: Health effects of pops, voc and other chemicals, August 27, 2019, 3:00 PM - 4:30 PM

Background: Chronic kidney disease (CKD) is a global public health problem. Some cross-sectional studies have associated environmental melamine exposure with renal diseases, but direct evidence of causality remains elusive. This prospective cohort study examined relationship of baseline urinary melamine levels with later renal function deterioration in early-stage CKD patients.

Methods: In 2006-2010, we enrolled eligible patients with CKD stages 1-3 participating in an “Interdisciplinary CKD Care Program” in southern Taiwan. Inclusions were based on estimated glomerular filtration rate (eGFR) ≥ 30 ml/min/1.73 m2 at enrollment, available urinary samples at baseline, a follow-up of > three months, and ≥ three serum creatinine measurements during follow-up. Subjects were followed to the occurrence of doubling of serum creatinine levels, cancer, date that dialysis was initiated, death, last contact, or the end of this study (December, 2016), whichever came first. Exposure was urinary corrected melamine levels (ratio of urinary melamine/urinary creatinine) at enrollment, whereas main renal outcome was doubling of serum creatinine levels.

Results: A total of 293 subjects (115 and 178 CKD stages 1-2 and 3 subjects, respectively) were included for measuring urinary melamine levels by LC-MS/MS. The median (IQR, interquartile range) urinary corrected melamine level was 0.97 (0.43-2.08) μg/mmol. Over a median follow-up period of 7.0 years, serum creatinine levels doubled in 80 patients (27.3%). Patients in the highest tertile (1.47-12.7 μg/mmol) had a 2.18 (95% CI = 1.19-4.00, P = 0.012) hazard risk for doubling of serum creatinine, compared to those in the lowest tertile (0.02-0.58 μg/mmol). Similar significant dose-response results were found in eGFR decline > 3 ml/min/1.73 m2 per year and 30% decline in eGFR in the first two years. The population attributable risk (%) for adverse renal outcomes ranged 27.6%-31.9% across urinary corrected melamine levels.

Conclusions: Urinary melamine level can predict renal function deterioration in early-stage CKD patients.
TPS 651: Air pollution exposure modeling 1
Visualizing and quantifying human internal black carbon load
Bové H$^{1,2}$, Bongaerts E$^1$, Saenen N$^1$, Ameloot M$^2$, Nawrot T$^{1,3}$
$^1$Centre for Environmental Sciences, Hasselt University, $^2$Biomedical Research Institute, Hasselt University, $^3$Department of Public Health and Primary Care, KU Leuven

Background: Despite increased understanding of the health consequences associated with combustion-related air pollution, including black carbon (BC), the most critical obstacle hampering progress in the field of exposure and risk assessment is our limited ability to adequately monitor personalized exposure to those environmental pollutants. Recently, we developed an optical-based method for the label-free and biocompatible detection of BC particulates. The aim of this study was to exploit the applicability of our established detection approach in relevant biological environments such as human liquid biopsies and tissues.

Methods: Our recently established method, which is based on the bright, white-light detection of BC particles under femtosecond pulsed illumination with near-infrared light, was employed. The potential of this method was demonstrated in various biological matrices to show its ability to monitor personalized exposure.

Results: Our novel approach allows readily visualization and quantitative determination of BC particles in complex biological environments such as human lung macrophages, urine and whole peripheral blood. We demonstrated that these particles are omnipresent in the different biological matrices and that its concentration is related to the level of external environmental air pollution. Moreover, using children’s urine (n=289), it was shown that urinary carbon loading can serve as a personalized exposure matrix to combustion-based air pollution while mirroring the accumulation of medium-term to chronic (> 1 month) exposure.

Conclusion: Identifying BC particles in various human matrices proof BC translocation at relatively low concentrations under real life-conditions and open new avenues as a personalized internal exposure marker. The results clearly showed that our technique has numerous advantages, as it is a straightforward, fast and flexible approach without the need for sample pretreatment. Also, the screening tool discriminates background signals from biological components, and allows 3D imaging and high imaging depths, making it also possible to screen at the cellular and tissue level.
To better understand exposure to air pollutants and their potential for adverse health effects, it is important to account for time spent in different indoor and outdoor locations, and the air pollutant concentrations in those locations. Currently available exposure models require substantial technical exposure modeling expertise, and near real-time exposure predictions are not possible since large and diverse input data must be collected, organized, and processed. To address these limitations, we developed TracMyAir, an iPhone application (App) that automatically estimates exposures (24 h average) to ambient PM2.5 and ozone based on several sources of input data available from iPhones, including: near real-time ambient air pollution measurements from local monitors, local weather, user’s locations, and building characteristics of the user’s home. TracMyAir uses an exposure model that accounts for time spent in different indoor and outdoor locations, and building-specific attenuation of ambient PM2.5 and ozone when indoors. In central North Carolina, we evaluated the App’s ability to automatically obtain real-time measurements (1 h averages across previous 24 h) for (1) ambient PM2.5 and ozone concentrations from the nearest official air quality monitoring station, and (2) temperature and wind speed from the nearest weather station. We evaluated the App at various locations across the region, which has four air monitoring stations and two weather stations. The App successfully obtained real-time data from all the stations, and always selected the station closest to the iPhone location. We also performed a sensitivity analysis, which showed that the modeled exposures varied substantially with changes in daily home operating conditions (window opening, air cleaner usage), indoor-outdoor temperature differences, and time spent outdoors. The App is being applied for two epidemiological studies in central North Carolina. TracMyAir could also be used to develop public health strategies for individuals at elevated risk.
Extracellular Vesicles in Saliva as Biomarkers of Exposure and Effect: A feasibility pilot in the context of the New York City Biking and Breathing Study

**Comfort N**, Smith C, Chillrud S, Yang Q, Baccarelli A, Jack D

1* Columbia University, 2* Lamont-Doherty Earth Observatory

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

**Background:** Saliva collection is fast, easy, inexpensive, and non-invasive and saliva is easy to transport, making it an ideal biofluid for epidemiological research. However, there is a relatively low concentration of biomarkers in saliva when compared to other biofluids. Thus, successful measurement of salivary analytes such as extracellular vesicle (EV) microRNA requires optimal collection, processing, and storage procedures. Here, we demonstrate the feasibility of collecting multiple saliva samples from participants in field research and show that we can obtain high-quality molecular biomarkers such as EV microRNA.

**Methods:** Subjects refrained from eating, drinking, or oral hygiene for at least one hour prior to collection. Samples were then collected by passive drool. Saliva was kept on ice and processed within one hour of collection. After removing cells and debris, EVs were isolated from cell-free saliva supernatant using an exosome precipitation solution. Resuspended EVs underwent nanoparticle tracking analysis to assess EV size and concentration. EV total RNA was extracted and RNA quality and yield were assessed using a BioAnalyzer (Agilent).

**Results:** In an initial pilot, we collected five samples from two individuals. Extracted saliva EVs contained up to 90% microRNA. Across participants, saliva EVs had an average concentration of 1.5E+10 particles/mL, with an average size of 363nm (sd: 191nm). Exploratory analyses examining the association between microRNA concentration and personal exposure measurements taken while bicycling outdoors (e.g. particulate matter dose, black carbon dose) suggest that there is a positive association between air pollution exposure while bicycling and saliva EV microRNA concentration.

**Conclusion:** Low volume starting inputs (500uL-1mL) of whole saliva can yield high quality salivary EV microRNA in quantities sufficient for downstream applications such as RNA sequencing. Subsequent analysis of microRNA expression profiles and changes in microRNA levels in saliva may lead to biomarkers of exposure to environmental toxicants.
Opportunities for mobile-phone based air pollution exposure assessment

de Nazelle A, Orjuela J, Avila-Palencia I, Dons E, Int Panis L, Jerrett M, Laeremans M, Nieuwenhuijsen M

1 Imperial College London, 2ISGLOBAL, 3VITO, 4UCLA

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

Background
Ubiquitous sensing technology provides novel opportunities for integrating activity patterns in exposure assessment. Theoretically promising to generate population-wide activity-based exposures, in reality strong limitations to widespread and large-scale use exist. Methods and results from three contrasting studies are presented.

Methods
(1) Mobile phone activity data from 8 million users were obtained from Telecom Italia in 7 cities (aggregate data: presence of users every 15 minutes for 2 months, spatial grid varying from 0.1 to 30km). (2) During one week over a period of 1 year in Barcelona, Spain, 180 commuters were fitted with a smart phone equipped with a geo-tracking and physical activity assessment app. (3) During one week repeated in 3 different seasons, 122 participants from 3 European cities were monitored for BC exposure, geoposition and physical activity. In the first two studies, land use regression air pollution maps were overlaid with the activity data to assess exposures. Activity-weighted exposures were compared to traditional home-based assignments.

Results
The scale of spatial aggregation mattered more than accounting for activity patterns in the first study. In the second study, correlations between home-based and activity-based exposures were moderate to high (0.76 Pearson for PM2.5, 0.84 for NO2); travel microenvironments contributed up to 45% of pollution intake, but only 9% of time. Lower contributions from travel (18% intake, 7% time) were found in the 3rd study.

Discussion
Phone usage data provided by telecom companies has the advantage of enabling representations of movements for broad populations, highlighting exposure hotspots. Aggregated data bypasses issues of privacy which may hinder widespread use of individual phone-based data collection. The level of detail obtained from individual smart phone apps highlights the importance of accounting for activities and intakes, confirmed by much more costly and burdensome air pollution monitoring studies. Methods to bridge approaches need to be investigated.
West Africa-Michigan CHARTER II in GEOHealth: Climate variables, ambient air quality and human exposure to environmental pollutants

Fobil J\textsuperscript{1}, Arko-Mensah J\textsuperscript{1}, Basu N\textsuperscript{2}, Batterman S\textsuperscript{3}, Robins T\textsuperscript{3}

\textsuperscript{1}University Of Ghana, \textsuperscript{2}McGill University, \textsuperscript{3}University of Michigan School of Public Health

The sensitivity of air pollution; and for that matter human exposure to environmental pollutants, to climate change reflects the strong dependence of air quality on weather conditions and climatic factors. There is overwhelming scientific evidence linking human health outcomes to climate variability and climate change influences. Many recent studies have provided evidence of linkage between daily hospitalization and extreme weather events such as heat waves and extreme cold conditions. Whereas past studies have tended to focus on the relationship between climate change on a large scale and long term human health effects, there is a current lack of studies which focus on the association between climate variability over small area (small scale) and short-term human health effects. Moreover, no studies are currently investigating the influence of changes in daily weather conditions such as temperature, humidity and wind speed on daily personal exposures to environmental contaminants such as volatile organic compounds (VOCs) and other chemical mixtures. To fill this research gap, the U01 research agenda of the Michigan-West Africa CHARTER II in GEOHealth focuses on ambient and personal air quality monitoring and in this presentation we describe our approaches to achieving this objective.
Generating Spatiotemporal Records of Exposure for Utilization in Environment Epidemiology

Gouripeddi R, Facelli J, Sward K

1University Of Utah

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

Traditional environmental epidemiology has relied on assessing individual exposures and their effect. Exposure science methods provides opportunities to advance epidemiological studies considering multiple and consequent exposures and over extended periods of time. Materializing the concept of the exposome 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.

In order to address these needs, we are developing a scalable computation infrastructure, the Utah PRISMS Informatics Ecosystem (UPIE). UPIE is a comprehensive, standards-based, open-source informatics platform that provides semantically consistent, metadata-driven, event-based management of exposomic data. It consists of (1) Data acquisition pipeline, (2) Participant facing tools, (3) Computational modeling, (4) Central big data federation/integration platform, and (5) Researcher facing platforms. UPIE uses an event-driven architecture allowing the modeling and storage of all activities related to the study itself and its operations, along with associated metadata in their primitive form on a timeline as events that can be transformed to higher/analytical models based on use-cases. We discuss the architecture of UPIE, and the generalizability of this multi-scale and multi-omics platform for providing robust pipelines for reproducible exposomic research. Here, we present results from a PRISMS pilot and the Environmental Children’s Health Outcomes studies for fifteen and two months, 10 and 28t participants residing in Utah, USA, resulting in a total of 24, 526,659 and 4,358,194 events respectively. This data consists of participant demographics, clinical data, home assessment surveys, asthma symptoms, real-time novel indoor and outdoor air quality sensor readings, weather and detailed sensor deployment data. We conclude on methods we utilize these detailed exposure data for traditional statistical and epidemiological studies, and machine learning and indexed based environmental wide studies.
Background/Aims: Epidemiologic studies on health effects of air pollution usually rely on ambient monitoring data or modelled residential levels. Little is known how well these data estimate residential outdoor and indoor levels. In this study we investigated the agreement of measured residential black carbon (BC) levels outdoors and indoors with modelled by dispersion modelling, and with fixed-site monitoring data.

Methods: Residential outdoor and indoor real-time BC measurements were conducted in 15 families living at addresses predicted to be more exposed to traffic-related air pollution (N=7) or less exposed (N=8), all in central Stockholm. The measurements were performed over one week, which average was also standardized by urban background monitoring levels to reflect an annual average. Dispersion modelling was applied to estimate long-term outdoor residential BC levels. In addition, BC concentrations were retrieved from urban background and street-level routine monitors. Pearson correlation test, and linear regression were applied to study the relationship between measured and modeled BC concentrations at homes and at the fixed-site stations.

Results: Outdoor BC levels were on average 0.51 µg/m³ (range 0.37-0.80 µg/m³) at highly exposed addresses, and 0.40 µg/m³ (0.26-0.53 µg/m³) at the less exposed. The corresponding urban background levels in were 0.31 µg/m³. Urban background BC levels explained 50% of the variation in measured home levels averaged over 24-hours. Modeled annual outdoor BC levels at the home addresses were on average 98% of the standardized measured home outdoor levels, and explained 49% of the variability. Indoor levels were slightly lower, corresponding to on average 90% of those measured outdoors.

Conclusions: Common exposure estimation approaches in the epidemiology of health effects related to BC seemed reasonably valid in central Stockholm. Urban background monitor predicted outdoor BC day-to-day variability at residential addresses. Long-term dispersion modelling predicted differences in outdoor BC levels. Outdoor and indoor concentrations were comparable.
Ambient and Personal PM2.5 Measurements: What’s the Difference When Determining Associations with Individual Health Effects?

Hernandez A\textsuperscript{1}, Zhou Y\textsuperscript{2}, Chen W\textsuperscript{2}, Mandel J\textsuperscript{1}

\textsuperscript{1}University of Minnesota School of Public Health, \textsuperscript{2}Huazhong University of Science and Technology, Tongji Medical College, School of Public Health

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Exposure to fine particulate matter (PM2.5) is a well-established risk factor for adverse cardiovascular and pulmonary health effects. Area-level ambient PM2.5 measurements are often used to assess these associations but the accuracy of this approach is largely unexplored. Among the same individuals, we compared levels of ambient and personal PM2.5 measurements and their associations with lung function tests used for screening from a Chinese cohort.

Methods: Daily average ambient PM2.5 concentrations were collected from area-level monitors in Wuhan and Zhuhai, China. Personal PM2.5 concentrations, lung function, and personal data were collected from 230 participants of the Wuhan-Zhuhai cohort between 2011 and 2012. Percent predicted values for forced expiratory volume per second (FEV1), forced vital capacity (FVC), and the FEV1/FVC ratio were used to assess lung function. Mixed linear models with a random effect for city were used to assess the association between ambient and personal measures of PM2.5 (per 10 μg/m\textsuperscript{3} increase) with lung function. Linear regression was used to analyze the associations for city-specific models (for Wuhan and Zhuhai, separately). All analyses were adjusted for sex, smoking status, and age.

Results: Ambient PM2.5 associations were positive and revealed greater uncertainty compared to using personal PM2.5. As ambient PM2.5 increased, lung function measures increased (FEV1/FVC ratio: β=0.080; 95%CI=-0.524, 0.363; FEV1: β=0.293; 95%CI=-0.240, 0.827; FVC: β=0.727; 95%CI=0.045, 1.409). Conversely, associations between personal PM2.5 and lung function measures were negative and more precise (FEV1/FVC ratio: β=-0.106; 95%CI=-0.297, 0.085; FEV1: β=-0.076; 95%CI=-0.392, 0.241; FVC: β=-0.084; 95%CI=-0.441, 0.274). City-specific associations followed similar patterns for ambient PM2.5 and personal PM2.5; however, greater decreases in lung function were observed in Wuhan than Zhuhai when using personal PM2.5.

Conclusions: This study reveals differences in effects using personal versus ambient PM2.5 and may suggest using personal PM2.5 could be more reflective of expected biological effects.
A Nationwide Land Use Regression Model for Ultrafine Particles

Kerckhoffs J, Hoek G, Vermeulen R

1Institute for Risk Assessment Sciences

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: Ultrafine Particles (UFP) are highly variable in space and time and are therefore difficult to predict on a large scale. Previous modelling studies have been published for single metropolitan areas. National models have not been developed which limits exposure for nationwide cohorts.

Objectives: The aim of the paper is to create nationwide Land Use Regression (LUR) Model for UFP to be used in epidemiological studies.

Method: We used a mobile platform to sample UFP concentrations across the Netherlands for a period of 16 months (2016-2017), with a total of 14,392 road segments sampled 3 times on average. Average concentrations per road segment (~43 seconds of data) and extracted GIS variables were used to develop LUR models using a supervised forward regression approach, as well as a deconvolution, LASSO and random forest algorithm. The deconvolution approach develops separate models for regional, urban and local scales. All models were tested on longer-term UFP measurements in 2014 at 42 sites with an average of 3 times 24 hours of measurements.

Results: Out of the four prediction models, the LASSO model predicted the longer-term UFP measurements best (R² = 0.68). The supervised LUR model, deconvoluted approach and random forest algorithm predicted 51%, 62% and 56% of the variation in the longer-term UFP measurements respectively.

Conclusions: We were able to develop nationwide models for UFP with good performance. The models will be applied in nationwide epidemiological studies. More modelling sophisticated procedures improved predictive power. The deconvoluted approach improved the standard linear model by distinguishing separate spatial scales.
Changes in the air pollution levels during heating seasons in Krakow based on individual measurements of pollutants over the last 15 years

Majewska R\textsuperscript{1}, Sowa A\textsuperscript{1}, Jacek R\textsuperscript{1}, Piotrowicz K\textsuperscript{2}, Perera F\textsuperscript{3}, Spengler J\textsuperscript{4}, Camann D\textsuperscript{5}, Pac A\textsuperscript{1}

\textsuperscript{1}Chair Of Epidemiology And Preventive Medicine, Jagiellonian University Medical College, \textsuperscript{2}Climatology Department, Institute of Geography and Spatial Management, Jagiellonian University, \textsuperscript{3}Columbia Center for Children’s Environmental Health, Mailman School Public Health, Columbia University, \textsuperscript{4}Department of Environmental Health, Harvard School of Public Health, \textsuperscript{5}Department of Analytical and Environmental Chemistry, Southwest Research Institute

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: Epidemiological studies have confirmed the harmful effects of high concentrations of fine particulate matter (PM2.5) and polycyclic aromatic hydrocarbons (PAHs) on health. For many years, Krakow has been struggling with high levels of these pollutants. After 2010, the activities of local authorities were significantly intensified in order to improve air quality.

Objective: The aim was to verify whether in the last 15 years levels of air pollution with PM2.5 and PAH in the heating period (October - April) decreased.

Methods: The level of PM2.5 and PAH air pollutants outside the flats was monitored as part of the cohort study "Environment and child development" in the years 2000-2006 and in the heating season 2015/16. Meteorological conditions such as temperature and wind speed were considered. Generalized estimation equations were used.

Results: In the analyzed period an increase in the level of PM2.5 pollution in 2000-2006 was observed, followed by a drop in the 2015/16 season, also after taking into account meteorological conditions. The estimated PM2.5 level values (for average temperatures of 3.5°C and wind speeds of 1.8 m/s) were 41.0(95%CI: 34.8-43.4)μg/m\textsuperscript{3} in 2000-2004; 55.7(95%CI:48.1-64.4)μg/m\textsuperscript{3} in 2005/06 and 32.5(95%CI: 29.3-36.1)μg/m\textsuperscript{3} in 2015/16. In the case of airborne PAHs, an increase was observed for benzo(k)fluoranthene and benzo(b)fluoranthene. The airborne benzo(a)pyrene has not changed in studied period with values 7.5(95%CI:5.8-9.6) ng/m\textsuperscript{3}.

Conclusions: In the season 2015/16, visible effects of actions aimed at improving the air quality in Kraków in relation to PM2.5 were observed. Unfortunately a disturbing increase in air pollution with fluoranthene compounds was also observed as well as no reduction of benzo(a)pyrene levels. It seems that the actions taken by local authorities bring effects in the case of dust, while they are ineffective in relation to the reduction of PAH levels.
A Low-Cost Passive Monitor for Black Carbon Air Pollution: Initial Testing
Clark L¹, Vakacherla S¹, Baum M², Yang S¹, Marshall J¹
¹University Of Washington, ²Axon Engineering LLC

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: Developing-country households using solid fuels often have high concentrations of black carbon air pollution. Monitoring, especially in rural areas, is expensive, uncertain, and logistically challenging, and often reflects short-term (~hours or ~day) rather than long-term (~months or longer) conditions. We developed a low-cost (<$10) passive sampler for long-term average black carbon concentration.

Method: We tested samplers for multiple months in 20 indoor locations in rural India to determine reproducibility and limits of detection. All locations received duplicate samplers (i.e., two per location). Our approach measures the change over time in sampler filter surface reflectance (pixel intensity [PI]) relative to baseline and to an unexposed reference.

Results: Our study is ongoing: to date (March 2019), samplers have been exposed for ~2 months. All samplers (n=40) experienced a measurable change in reflectance (>1.0% relative to reference); none of the samplers have fully saturated yet. Duplicate samplers’ measurements were highly correlated (r>0.99), suggesting excellent reproducibility. Variability in reflectance among locations suggests strong ability to differentiate between higher versus lower long-term average black carbon concentration: specifically, differences between duplicate samplers averaged 1.1% (range: 0.02% to 2.9%) [720 PI (range: 12 to 1900)], whereas the difference among locations was 73% (range: 1.1% to 74%; mean: 18%) [48,000 PI (range: 730 to 49,000; mean: 12,000)].

Conclusions: Results thus far for 20 locations suggest robust reproducibility and precision. For indoor locations investigated, in a community that uses solid fuels, the minimum time-scale for sampling (which reflects the lower limit of detection) appears to be <2 months; the maximum time-scale for sampling (which reflects the upper limit of measurement) appears to be >2 months. Ongoing work will continue investigating reproducibility and limits of detection.
Personal exposure to black carbon in Stockholm, using different intra-urban transport modes

Merritt A1, Georgellis A1,2, Andersson N1, Bero Bedada G2, Bellander T1,2, Johansson C3,4

1Unit of environmental epidemiology, Institute of environmental medicine, Karolinska Institutet, 2Unit of environmental health, Centre for occupational and environmental medicine, Stockholm county council, 3Department of environmental science and analytical chemistry, Stockholm university, 4Environment and Health Administration

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

The traffic microenvironment has been shown to be a major contributor to the total personal exposure of black carbon (BC), and is key to local actions aiming at reducing health risks associated with such exposure. The main aim of the study was to get a better understanding of the determinants of traffic-related personal exposure to BC in an urban environment.

Personal exposure to ambient levels of BC was monitored while walking, cycling and traveling by bus or car along four streets and while cycling alternative routes simultaneously. Monitoring was performed during morning and afternoon peak hours and at midday, with a portable aethalometer recording one-minute mean values. In all, more than 4 000 unique travel passages were performed. Stepwise Linear Regression was used to assess predictors to personal exposure levels of BC.

The personal BC concentration ranged 0.03-37 µg/m³. The average concentrations were lowest while walking (1.7 µg/m³) and highest traveling by bus (2.7 µg/m³). However, only 22 percent of the variability could be explained by travel mode, urban background BC and wind speed. BC concentrations measured inside a car were on average 33 percent lower than measured simultaneously outside the car. Choosing an alternative bicycle route with less traffic resulted in up to 1.4 µg/m³ lower personal exposure concentrations.

In conclusion, traveling by bus rendered the highest personal BC concentrations. But when taking travel time and inhalation rate into account, the travel-related exposure dose was predicted to be highest during walking and cycling. It is however probable that the benefits from physical activity outweigh health risks associated with this higher exposure dose.

It is clear that road traffic makes an important contribution to personal exposure to BC regardless of mode of intra-urban transport. Our data suggest that commuting along routes with lower BC levels would substantially decrease commuter’s exposure.
NO2 Air Pollution Exposure Assessment in Urban Mysore, India

Nori-Sarma A\textsuperscript{1}, Thimulappa R\textsuperscript{2}, Venkataramana G\textsuperscript{3}, Fauzie A\textsuperscript{3}, Dey S\textsuperscript{2}, Venkareddy L\textsuperscript{4}, Berman J\textsuperscript{5}, Lane K\textsuperscript{6}, Fong K\textsuperscript{1}, Bell M\textsuperscript{1}

\textsuperscript{1}Yale University School Of Forestry & Environmental Studies, \textsuperscript{2}JSS Academy of Higher Education and Research, \textsuperscript{3}University of Mysore, Dept of Studies in Environmental Sciences, \textsuperscript{4}University of Illinois at Chicago (UIC), Dept of Pediatrics, \textsuperscript{5}University of Minnesota School of Public Health, \textsuperscript{6}Boston University School of Public Health

Introduction: In developing countries, rapid urbanization has led to decreased air quality. Few studies have applied spatially heterogeneous sampling to assess ambient air pollution levels in cities in India, to understand the important local predictors of air pollution exposure, which may be unique to Indian urban environments.

Methods: Seasonal sampling was conducted in four campaigns (2016-2017) at 150 sites throughout Mysore, a small and rapidly growing city in south India. Nitrogen dioxide (NO\textsubscript{2}) levels were assessed using passive Palmes tubes and Ogawa badges.

Results: Annual average NO\textsubscript{2} ranged from 0.8 to 31.2ppb (1.5 to 58.7 μg / m\textsuperscript{3}) for the study area, with higher concentrations in the center of the city. In the final Land Use Regression (LUR) model, proximity to major roads, point sources of pollution, and religious complexes, as well as high human activity land uses and population density were positively associated with air pollution, while proximity to minor roads and low human activity land uses were inversely associated with air pollution (R\textsuperscript{2} = 0.535). Cross-validation of the results confirmed the reliability of the model. Kriging improved estimates by accounting for spatial correlation.

Conclusions: The combination of passive NO\textsubscript{2} sampling and LUR / Kriging modeling techniques allowed for characterization of NO\textsubscript{2} patterns in Mysore. While traffic pollution has been indicated in the past as a major contributor to ambient air pollution levels in urbanizing centers of Asia, results indicate that other pollution factors (e.g., point sources), as well as highly localized characteristics of the urban environment (such as proximity to religious buildings), influence air pollution exposure patterns in urban India. Despite a reputation as one of the cleanest cities in India, areas of Mysore consistently experience pollution in excess of WHO health-protective guidelines for NO\textsubscript{2}.
Assessment of automatic geocoding tools in Temuco, Chile: a study using addresses from hand-written hospital record

Quinteros Caceres M¹,², Blazquez C³, Rosas F⁴, Ossa X⁴, Delgado J⁵, Yohannessen K², Harrison R⁶, Ruiz P²
¹Universidad de Talca, ²Universidad de Chile, ³Universidad Andres Bello, ⁴Universidad de la Frontera, ⁵ISGlobal, ⁶University of Birmingham

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

Automatic geocoding process is carried out in many epidemiological studies. However, the quality of the process has been scarcely evaluated. The objective of this work is to compare the performance of three automatic online geocoding tools using addresses from hand-written hospital files. To do this, from an initial set of transcribed addresses a random sample was geocoded using a gold-standard approach, then the same addresses were geocoded using the three automatic approaches.

Analyses were based on a retrospective pregnancy cohort study including 15,500 pregnant women who lived in two cities: Temuco and Padre Las Casas. A sampling design stratified by city was carried out. A sub-sample with 300 random addresses were selected: 200 from Temuco and 100 from Padre Las Casas. The geocoding process of the sub-sample was manually conducted. Every address was located in front of the house using Google Street View. If the address was not found, then a Global Positional System (GPS) receiver was used to obtain coordinates. Then the same addresses were geocoded using the three automatic approaches: Google using Qgis, Google Earth using R and Bing using R. Measures of assessment of performance included completeness, match agreement and positional error.

Analyses showed 90% of manual geocoding success. Automated geocoding completeness were 90% for Google, 57% for Bing and 84% for Google Earth. It was observed differences between cities. Some neighborhoods have completeness lower than 75%. Bing was not able to find addresses in Padre Las Casas. Positional error was estimated 11m (sd:13.9) for Bing; 80m (sd:446.3) for Google Earth, and 83m (sd:364.5) for Google. There are differences between cities: Temuco has the lower positional error.

Analyses showed that quality of geocoding differs by city and neighborhood. Could be advisable to study locally geocoding performance before to apply it to epidemiological studies.
The effect of route selection on PM2.5, particle number count and lung deposited surface area concentrations during bicycle commuting

Siponen T1, Tiittanen P1, Taimisto P1, Niemi J2, Kousa A2, Yli-Tuomi T1, Pulkkinen A1, Okokon E1, Lanki T1,3

1National Institute For Health And Welfare, 2Helsinki Region Environmental Services Authority, 3University of Eastern Finland

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

Aim: The aim was to evaluate the difference in fine particle (PM₂.₅; particles <2.5 µm in diameter), particle number count (PNC) and lung-deposited surface area (LDSA) concentrations during cycling between more and less road traffic-impacted routes to find out whether cyclists can influence their exposure to particulate air pollutants with route selection.

Methods: Measurements were conducted in the Helsinki metropolitan region, Finland, in October/November 2016, March/April 2017 and June 2017, representing autumn, spring and summer. Measurements were done simultaneously on two bicycling routes, which had the same starting and end points and starting time. One route followed busy streets in traffic environments (‘Traffic’) and another utilized side-streets and parks (‘Green’). Seven bicycling route pairs were selected for air pollution measurements conducted during and outside rush hours on weekdays. The cyclist carried portable measurement devices in a backpack. Every route was biked back and forth at least two times both in the mornings and in the afternoons in each season. For each trip, the median of measured concentrations was calculated to represent a typical exposure level during a one-way trip. The Wilcoxon Signed-Rank test was used to compare the concentration ratios of studied air pollutants between Traffic and Green routes.

Results: A total of 173, 145, and 145, pairs of one-way trips were included in the analysis for PM₂.₅, PNC, and LDSA, respectively. Length of Traffic and Green routes ranged between 3.9-5.5 km and 4.7-6.7 km, respectively. Cyclist was exposed on average 1.3-times higher median PM₂.₅ and LDSA concentrations on Traffic route compared to Green route, and 1.4-times higher PNC concentration. The differences between levels in studied route pairs were greater during rush hours.

Conclusion: Cyclists can influence their exposure to air pollution with route selection. Thus, alternative routes further away from busy road traffic should be planned in urban areas.
Novel exposure estimation for assessing the effects of long-term exposure to pollutants in cohort studies.

Wood D¹, Smith J¹, Beevers S¹, Katsouyanni K¹,²
¹King’s College London, ²National and Kapodistrian University of Athens

Background/Aim

Estimations of long-term exposure to air pollution in cohort studies are predominantly based on modelling at the residential address of subjects, or through the use of fixed-site neighbouring monitor measurements. This estimation does not take into account the different time-activity patterns of individuals. In the present study, we incorporated time-activity patterns for London residents of the London Travel Demand Survey (LTDS) data set, implementing the London Hybrid Exposure Model (LHEM).

Methods

We have based our estimates on a combination of dispersion modelling and time-activity information. Specifically, we used the King’s College London Urban (KCLurban) dispersion model to estimate concentrations of four pollutants (PM10, PM2.5, NOx, and NO2) at 20m resolution for London. LHEM activity estimates are then used to update KCLurban concentrations as a reflection of time-activity based on age and residence.

Results

Time-activity patterns differ substantially by age group. For example, participants under the age of 50 spend more than 2.5 times greater the amount of time on the tube in comparison to those younger, highlighting a major source of exposure differentiation. Minimal differences in time-activity patterns are observed between genders. A marked reduction in the contrast between exposure in Central London and suburban populations is observed when accounting for time-activity, with a reduction of 31% and 21% for NOx and NO2 respectively, suggesting that NOx/NO2 exposure variability may be overestimated in London when time-activity patterns are not taken into consideration. A different pattern is observed for PM, with an underestimation observed in some age groups and very little difference in others.

Conclusions

The incorporation of time-activity patterns allows for comparisons with standard exposure techniques often used in similar epidemiological studies, which are shown here to likely better estimate personal exposure.
Land Use Regression models for Ultrafine Particles: development and transferability within a mega-city

Yang Z1, Freni Sterrantino A1, Fuller G2, Gulliver J3

1MRC-PHE Centre for Environment and Health, Department of Epidemiology and Biostatistics, Imperial College London, St Mary’s Campus; 2MRC-PHE Centre for Environment and Health, Environmental Research Group, School of Population Health and Environment Sciences, King’s College London; 3Centre for Environmental Health and Sustainability, University of Leicester

TPS 651: Air pollution exposure modeling 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: A lack of routine monitoring for ultrafine particle (UFP) means that bespoke monitoring (e.g. mobile measurements on vehicles or repeated short-term monitoring over a spatially distributed network of sites) has to be undertaken to develop land use regression (LUR) models. This is especially challenging in mega-cities due to the large spatial area.

Methods: As an alternative to monitoring across a mega-city, we developed single- and two-district models in London, and then tested the transferability (i.e. generalisability) of models between districts. In each district, repeated 30-min monitoring was undertaken at 40 sites in three different seasons (2016-2018) to estimate annual mean UFP (particles cm-3). We constructed ten single- and two-district LUR models by allocating monitoring sites to one of ten groups and then used nine groups of sites to develop each model, iteratively, with the remaining group held-out for model evaluation (e.g. groups 1-9 to predict for group 10; groups 2-10 to predict for group 1, etc.). We assessed model performance by comparing R2 and the variables selected, and pooled the 10% of sites held-out each time to produce an overall R2 to assess model robustness. The transferability of models was tested by applying single- and two-district models to the other districts.

Results: For the ten models for single districts, R2 ranged from 60% to 73% and model variables were similar and all included nearby road traffic. Model performance and structure was different between areas. R2 for two districts ranged from 50% to 68%. Pooled holdout validation had R2 values of 37%- 59%. Performance in transferring models to other districts within London was overall lower with R2 ranging from 10% to 39%.

Conclusion: UFP LUR models may perform well within the confines of a monitoring network but transferring models within a city may have substantially lower performance.
Background: Cognitive decline is a major challenge in aging populations. Older individuals show lower adaptation to changes in outdoor temperature than younger people. Therefore, it is plausible that short-term changes in outdoor temperature may affect cognition.

Objectives: To determine whether cognitive function is associated to recent outdoor temperature among participants in the Normative Aging Study (NAS), a cohort of older males in Eastern New England. Because mitochondria are involved both in energy production and thermal regulation of the human body, we also evaluated whether the abundance of mitochondria (mtDNAcn) modified the association between temperature and cognitive function.

Methods: The analysis included 591 participants in the Normative Aging Study, who underwent multiple visits between 2000-2013. Cognitive function was evaluated through the mini mental state-examination. We used apparent temperature one day before the visit, calculated from daily ambient temperature, dew point temperature, and relative humidity obtained from the National Weather Service Station at Boston Logan Airport. Mitochondrial DNA copy number was measured on buffy coat samples.

Results: We found a significant interaction between temperature and age. Over 84 years of age the effect of decreasing temperature started to be associated with lower cognition (OR=1.1 95%CI 1.04-1.21 for a 1°C decrease in apparent temperature; p=0.002). Also, among individuals with lower mitochondrial DNA copy number we found a stronger association the association with low cognitive score (OR for the interaction=1.10 95%CI 1.03-1.17, p=0.006).

Discussion: Our data show that older individuals were more susceptible to the influences on cognition of recent fluctuation in the low temperature range. Individuals with lower mtDNAcn—which may reflect lower mitochondrial mass—appeared to be less protected from the effects of low temperatures on cognition.
Impact of meteorological variables on physical activity in a sub-tropical city: evidence from mobile app data

Ho J1,2, Chan E1, Goggins W1, Mo P1
1The Chinese University Of Hong Kong, 2Tencent

Background/Aim: Physical activity (PA) maintains health and well-being. Patterns and associations between meteorological variables and PA, however, have rarely been examined in subtropical climate contexts. The study objective was to assess the relationship between meteorological variables and objectively-assessed PA levels in the humid sub-tropical city of Hong Kong.

Methods: Daily step counts from anonymised Hong Kong users of mobile app WeChat’s in-app function WeRun were collected from December 6, 2017 to November 30, 2018 and aggregated to produce daily mean step counts for the city. Daily meteorological and air pollutant data were obtained from the Hong Kong Observatory and Environmental Protection Department. Generalised additive models were used to examine the association of meteorological variables with daily mean step count, adjusting for air pollutants, months, day-of-week, public holidays and typhoons.

Results: The final study sample included a daily average of 419,849 persons and reported an average of 9,034 steps per day. Temperature and relative humidity demonstrated a highly significant inverse U-shaped relationship with daily mean step count, peaking at approximately 22-23°C and 60% relative humidity. Highly significant decreasing trends were also found for rainfall and wind speed.

Conclusions: Weather variables were found associated with objectively-assessed PA levels in the humid subtropical city of Hong Kong. These findings suggest that higher temperatures and increased rainfall due to climate change may lead to a net decrease in PA levels.
Towards the development of a heat-health early warning system for South Africa

Kapwata T\textsuperscript{1,2}, Gebreslasie M\textsuperscript{4}, Scovronick N\textsuperscript{3}, Acquaotta F\textsuperscript{5}, Wright C\textsuperscript{1,2}

\textsuperscript{1}South African Medical Research Council, \textsuperscript{2}University of Pretoria, \textsuperscript{3}Emory University, \textsuperscript{4}University of KwaZulu-Natal, \textsuperscript{5}University of Turin

Climate change has been associated with changes in temperature extremes globally. This includes a higher frequency and severity of hot days and heatwaves. Exposure to high temperatures poses a significant public health concern as people of all ages are at risk of the negative health effects of exposure to heat. These include cramps, fainting, heat exhaustion, heat stroke, dehydration, disease exacerbation and death in some cases. Heat alerts in South Africa are currently based on defined temperature-fixed threshold values for large towns and cities. However, heat-health early warning systems (HEWS) should be based on thresholds that are related to heat-related health outcomes. Therefore, this study aims to contribute towards the development of an evidence-based HEWS for South Africa that incorporates high temperatures and mortality.

Mortality data were provided by Statistics South Africa for 1997 to 2013. Daily minimum, maximum and mean temperatures were obtained from the National Oceanographic and Atmospheric Administration and South Africa’s Agricultural Research Council. The joint CCI/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices has developed a core set of 27 temperature extreme indices that is widely used as a tool to assess and monitor changes in weather and climate extremes. RClimDex developed by Zhang and Feng at the Climate Research Branch of Meteorological Service of Canada was used to calculate monthly extreme temperature indices for each district (n = 52). The random forest (RF) algorithm for regression was used to assess the effect of the calculated indices on mortality by identifying the most significant index in each district using the variable importance score. Sensitivity analysis included tuning parameters within RF. Diurnal temperature range was the index most frequently selected as a top variable. Results are discussed in light of recommendations for HEWS for South Africa with relevance to other southern African and developing countries.
The Health Impact of Air Conditioning Use During the 2018 Heatwave in South Korea
Lee Y\(^1\), Bae S\(^2\), Hwang S\(^3\), Kim J\(^4\), Kim K\(^5\), Lim Y\(^6\), Kim M\(^7\), Jung S\(^3\), Kwon H\(^1\)

\(^1\)Department of Preventive Medicine, College of Medicine, Dankook University, \(^2\)Department of Preventive Medicine, College of Medicine, Catholic University of Korea, \(^3\)Department of Public Health Sciences, Graduate School of Public Health, Seoul National University, \(^4\)Department of Preventive Medicine, College of Medicine, Sungkyunkwan University, \(^5\)Division of Public Health and Preventive Medicine, Seoul National University Hospital, \(^6\)Department of Preventive Medicine, College of Medicine, Seoul National University, \(^7\)Department of Preventive Medicine, College of Medicine, Gyeongsang National University

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

Aim: The purpose of this study is to investigate the health impact of air conditioning use during the 2018 heatwave in South Korea, which is the warmest in Korean weather observation history.

Methods: Participants in this study were 1,000 adults aged >18 who were recruited from across Korea. Participants were asked about the symptoms of various diseases, air-conditioningitis, food poisoning, and whether they had any absences, lateness, or canceling appointments during the heatwave. About their air conditioning use, we questioned whether air conditioning was used in main living space excluding home, had air conditioning at home, and could not use air conditioning because of the electric charges when air conditioning is necessary. Association between air conditioning use and health impacts during the heatwave was analyzed by multiple logistic regression model. Potential confounding factors included age, sex, residential area, occupation, type of house, number of family members, prevalence of chronic diseases, and monthly household income.

Results: When air conditioner was not operated in main living space excluding home, odds ratio (OR) of experiencing symptoms related to cardiovascular diseases and neurological diseases was 8.53, and 2.02, respectively. In the absence of air conditioner at home, OR of experiencing symptoms related to neurological diseases and canceling appointments was 1.64, and 3.43, respectively. When electric charges limit air conditioning use where it is necessary, OR of experiencing symptoms of all diseases, skin diseases, digestive diseases, kidney and urinary diseases, nervous system diseases, mental diseases, sleep disorders, food poisoning, lateness, and canceling appointments was 1.76, 1.92, 1.65, 4.74, 1.52, 1.57, and 1.63, respectively.

Conclusion: When air conditioner cannot be operated in home or main living space, it has a negative health impact during heatwave. And if electric charges limit air conditioning use when it is necessary, the situation also has a negative impact on health.
Lim A¹, Kim J¹, Kim E¹, Cheong H¹, Utiera M², Corbett K², Iotia A², Jang H³, Yoon C³, Kitabatake S³
¹Department of Social and Preventive Medicine, Sungkyunkwan University School of Medicine, ²Ministry of Health and Medical Services, ³World Health Organization Representative Office for the South Pacific

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

Background
Kiribati, an atoll country in the South Pacific, is one of the most vulnerable countries to climate change in the world. Despite the urgent needs to address the impact of climate variability on the population health, there have been few studies on the association between climate variables and health outcomes in the region. We aimed at demonstrating the effect of climate variability on mortality in this country.

Methods
Mortality data including deceased date and causes of death by ICD-10, for the period 2009-2017 and climate indices including monthly mean temperature (Tmean), rainfall, and sea surface temperature (SST) were used. A generalized additive model was used to analyze the non-linear relationship between various climate indices and the mortality stratified by the sub-region of Kiribati and relative risk (RR) was calculated using a generalized linear model.

Results
There were 2,725 deaths for 2009-2017 and cardiovascular deaths contributed a quarter of all deaths of both Gilbert and Line group of Kiribati. For the Gilbert group, an increase of Tmean by 1°C was associated with increased the risk of all-cause mortality to 1.31 (95% CI 1.11 to 1.54) and the risk of cardiovascular mortality to 1.38 (95% CI 1.09 to 1.77). All-cause mortality RR was elevated to 1.14 when SST in the NINO 4 area increased by 1°C (95% CI 1.01 to 1.30). For the Line group, the elevation of all-cause mortality was similar (RR 1.13, 95% CI 0.93 to 1.38) but was not statistically significant.

Conclusions
In spite of low year-round temperature variability from 25 to 30°C in Kiribati, an increase of Tmean was associated with the increase of all-cause and cardiovascular mortality. This implies that even in the tropical region, an elevated risk of mortality could be attributable to global climate change and high ambient temperature.
Seasonality of mortality with temperature adjustment in Japan over 44 years

Madaniyazi L1, Chung Y2, Kim Y3, Hashizume M1

1Department of Pediatric Infectious Diseases, Institute of Tropical Medicine, Nagasaki University, 2Department of Mathematical Sciences, Korea Advanced Institute of Science and Technology, 3Department of Global Environmental Health, Graduate School of Medicine, The University of Tokyo

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

Background: The seasonality of mortality can be a major contributor to a consistent pattern of health-care demands throughout the year. Temperature- one of the key season defining factors, has been consistently linked with increasing mortality. However, little is known about its impact on seasonality of mortality. Investigating seasonality and the effect of temperature on it will provide important information for health risk management in different seasons.

Aims: To assess seasonality of mortality with temperature adjustment in Japan and its temporal changes.

Method: Daily mean temperature and daily death cases for all-cause, circulatory and respiratory mortality from 1972 to 2015 were collected for 47 prefectures in Japan. A generalized linear model with quasi-Poisson distribution was used, with a one-dimensional cyclic spline function with 4 degrees of freedom for the calendar day. The long term trend and day of week were controlled. A cross-basis function, with natural cubic B-spline functions and extended lag period to 21 days, was used for temperature. The ratio of estimated mortality counts of peak versus trough day (RR) was estimated with and without temperature adjustment, by treating trough day as a reference day. RR was estimated for whole country over 44 years first and then for each single year to investigate the temporal changes. All estimates were conducted for all-cause, circulatory and respiratory mortality, respectively.

Results: U-shaped relationships were observed for both adjusted and unadjusted seasonality, with peaks in cold seasons and troughs in warm seasons. Seasonality became less obvious after adjusting for temperature.

Both adjusted and unadjusted RR showed a decreasing trend for all-cause and respiratory mortality. No significant trend was observed for circulatory mortality.

Conclusions: Seasonality risk was higher in cold seasons. Temperature may be an important driver. Additionally, seasonality of mortality decreased over 44 years. Its underlying reasons should be investigated in the future.
Temporal changes in temperature-related hospitalizations in Spain
Martínez-Solanas É, Basagaña X
ISGlobal

Background:
The exposure to extreme ambient temperatures has been reported to increase mortality, although less is known about its impact on morbidity. Heat health prevention plans (HHPP) have been widely implemented to reduce the health burden of heat, however there is limited evidence of their effectiveness in terms of reducing morbidity impacts. We aimed to compare temporal changes in the effects of temperature on cause-specific hospital admissions in Spain, covering a period where a prevention plan was implemented.

Methods:
Daily counts of non-scheduled hospital admissions for cardiovascular, cerebrovascular and respiratory diseases and daily maximum temperature were obtained for each Spanish province for the period 1997-2013. The relationship between temperature and hospitalizations was estimated with distributed lag non-linear models. The risk of hospitalization due to temperatures (cold, heat and extreme heat) was compared in two periods, before (1997-2002) and after (2004-2013) the implementation of the Spanish HHPP.

Results:
Hot temperatures were only associated with higher hospital admissions for respiratory causes. There was a reduction in heat-related respiratory admissions in the second period. By contrast, no heat effects were seen for hospitalizations for cardiovascular and cerebrovascular diseases. Cold temperatures were associated with increased risk of cardiovascular, cerebrovascular and respiratory hospital admissions. Whereas cold-related hospitalizations for cardiovascular and cerebrovascular diseases increased in period 2, a significant reduction for respiratory hospitalizations was reported.

Conclusions:
Our results suggested that heat has an impact on hospital admissions for respiratory diseases, while cold was associated with the three studied cause-specific hospitalizations. Public health interventions should also focus on morbidity effects of temperature.
An integrated heat early warning system for Europe

Martínez-Solanas È\textsuperscript{1}, Rodó X\textsuperscript{1,2}, Herrmann F\textsuperscript{3}, Robine J\textsuperscript{4,5}, Petrova D\textsuperscript{1}, Ballester J\textsuperscript{1}

\textsuperscript{1}ISGlobal, \textsuperscript{2}ICREA, \textsuperscript{3}Division of Geriatrics, Department of Rehabilitation and Geriatrics, Geneva University Hospitals and University of Geneva, \textsuperscript{4}Institut National de la Santé et de la Recherche Médicale (INSERM), \textsuperscript{5}École Pratique des Hautes Études

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

Exposure to heat has been widely associated with an increase in mortality. After the devastating 2003 heatwave, the majority of European countries implemented adaptation strategies to reduce the health burden associated with heat. Heat health early warning systems and prevention plans are useful tools to reduce the impact of heat on human’s health. However, these preventive actions are mainly designed considering only climate parameters, and not including health data. There is also a lack of a unified pan-European service that can be adapted to all European societies and including multiple lead times. In this context, our aim is to implement a prototype of heat health early warning system for nearly 150 regions in 16 European countries. This study is framed within the Blue-Action project, funded by the EU Horizon 2020 Programme.

The heat early warning system is created with the inclusion of both climate and mortality data. We are developing a climate-driven mortality model in Europe, using the distributed lag non-linear models framework. In order to model the temperature-mortality relationship, we use regional daily mortality counts for the period 1998-2012, which represents over 420 million people and includes nearly 60 million counts of death. Different methodological challenges are been considered, such as the inclusion of recent trends in European vulnerability to heat or the management of weather uncertainties to predict the health risks. Weather forecasts are restricted to a range of lead times up to 10 days. Moreover, the climate impact model is also generalized to subseasonal and seasonal climate forecasts in order to help public health authorities to better prepare their response to episodes of heat. The integration of health impacts with the traditional weather forecasts can increase the effectiveness of public health adaptation strategies and reduce the health burden of heat in Europe.
An additive index model for monitoring weather in a health warning system context
Masselot P¹, Chebana F¹, Campagna C¹,², Lavigne É³, Ouarda T¹, Gosselin P¹,²,⁴
¹Institut National De La Recherche Scientifique (INRS), ²Institut National de Santé Publique du Québec (INSPQ), ³University of Ottawa, ⁴Ouranos

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

In the last twenty years, a number of countries implemented heat-health warning systems to monitor heat waves and take action to reduce their impact on the population. Nowadays, several locations, such as the province of Quebec, are also implementing warning systems for other environmental exposures, such as cold spells or air pollution. Such warning systems often rely on two components, indices representing the monitored environmental phenomenon of interest and thresholds above which the phenomenon is considered to induce a high risk on human health. The work presented here focuses on the former (indices).

In this regard, we introduce a novel and general method to construct one or several indices, called additive index models (AIM). It differs from usual indices in that it is data-based and linked to the health issue of interest. The AIM allows to construct indices that are linear combinations of environmental variables such as temperature, relative humidity and diverse pollutants. Indices are constructed in order to make a trade-off between two ideas: maximizing the prediction of the health issue of interest (e.g. mortality or hospital admissions) and comprehensiveness. Prediction is important in order for the warning system to be accurate and only launch relevant alarms. Comprehensiveness is important for public health authorities to communicate using the developed indices. It is achieved through several constraints in the indices construction such as ensuring that the relationship between the index and the health issue is monotonically increasing, i.e. that the highest the index value, the highest the risk on population health. We show the use of the AIM method to construct indices for the health-health warning system of the province of Quebec, and to construct air quality indices. We believe that this method could be of important use for public health authorities around the world.
On the importance of local meteorological data the absolute scale to define heat waves for maximizing public health benefits

Mcelroy S, Schwarz L, Benmarhnia T

University of California San Diego

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

Background: High heat events have been consistently associated with increased risk of hospitalization for various diagnoses. Meteorological variations may occur at a small scale within a city. Defining heat waves is particularly relevant for identifying the set of criteria to activate early warnings systems. Definitions can differ based on severity, length, and temperature thresholds and seasonality. Typically, heat waves are first defined and then associations, relying on relative risks estimates with various health impacts are estimated. We propose a distinct approach in which we first estimate the total burden of hospitalizations attributable to specific heat events, and then identify the heat wave definition that would maximize the health benefits with an effective early warning system. We identified such optimized heat waves in each climate zone within the city of San Diego.

Methods: Sixteen heat wave classifications were created using various combinations of temperature metrics, percentiles, and durations. Propensity score matching and Poisson models were utilized to ascertain the association between heat exposure and risk of hospitalization for heat-related illness (HRI) per relative and attributable risks for a set of definitions for the whole city and in each climate zone.

Results: HRI differs vastly by level (county or zone-specific), definition, and risk measure. We found the county-level definitions to be systematically biased, with the largest discrepancy of 56 attributable hospitalizations. The relative and attributable risks were often minimally correlated which exemplified that relative risks do not account for prevalence of exposure and are thus inaccurate measures of risk.

Conclusions: Definitions based on regionally defined thresholds do not provide a full picture of the observed health effects and will fail to maximize the potential effectiveness of heat warning systems. Absolute and not relative risks should be used to define the set of criteria to activate early warnings systems and maximize public health benefits.
A case-crossover analysis of indoor heat exposure on mortality and hospitalizations among the elderly in Houston, Texas

O’lenick C¹, Baniassadi A², Michael R¹, Monaghan A³, Boehnert J¹, Yu X⁴, Hayden M⁵, Wiedinmyer C³, Zhang K⁴, Sailor D², Wilhelmi ¹

¹National Center For Atmospheric Research, ²Arizona State University, ³University of Colorado-Boulder, ⁴University of Texas - Health Science Center at Houston, ⁵University of Colorado-Colorado Springs

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

Background. Despite the substantial role indoor heat exposure has played in temperature-related mortality, few epidemiological studies have examined the health effects of exposure to indoor heat. As a result, knowledge gaps regarding indoor heat-health thresholds, vulnerability, and adaptive capacity persist.

Methods. We evaluate the role of indoor heat exposure on heat-related mortality and morbidity among the elderly (≥ 65 years) in Houston, Texas. Mortality and emergency hospital admission data from 2004-2013 were obtained through the Texas Department of State Health Services. Indoor heat exposure was estimated at the census block group level using building energy models, outdoor weather data, and parcel data from Houston’s tax assessor database. To assess indoor heat-health associations, we used time-stratified case-crossover models, controlling for temporal trends and meteorology, and matching on census block group of residence, year, month, and day of the adverse health event. Separate models were fitted for three indoor exposure metrics, for lag days 0–6 and for 3-day moving averages. Results. Positive, significant odds ratios (OR) were observed between circulatory and heat-related mortality and maximum indoor Discomfort Index (combined measure of temperature and humidity), suggesting an increase in the odds of death due to exposure to high indoor heat. [e.g., OR per 5°C =1.31 (95% CI: 1.10, 1.57)]. For circulatory deaths, associations were strongest when indoor heat exposure was defined using minimum indoor temperature [e.g., OR per 5°C =1.37 (95% CI: 1.03, 1.82)], suggesting that high nighttime temperatures may play a prominent role in disease processes that lead specifically to circulatory related deaths. At both the individual and neighborhood level, effect modification analyses suggest stronger associations between indoor heat exposure and health outcomes among African Americans compared to Caucasians. Conclusion. These findings underscore the importance of characterizing harmful indoor conditions and including estimates of indoor exposure in population-based health studies.
The influence of apparent temperature on mortality in the middle belt of Ghana
Wiru K¹, Oppong F¹, Agyei O¹, Zandoh C¹, Nettey O¹, Adda R¹, Gasparrini A², Asante K¹
¹Kintampo Health Research Centre, Ghana Health Service, ²London School of Hygiene and Tropical Medicine

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

Background/aim
Globally, studies have shown that diurnal changes in weather conditions and extreme weather events have a profound effect on mortality. This notwithstanding, there is limited evidence of the effect of climatic factors on mortality in resource-poor settings whose populations could be excessively affected; especially in this era of climate change.
The aim of this study was to assess the effect of apparent temperature on all-cause mortality and the modifying effect of sex on the apparent temperature-mortality relationship.

Methods
We employed a retrospective time-series approach to assess the effect of a composite measure of temperature and relative humidity (apparent temperature) on all-cause mortality with over-dispersed Poisson regression and Distributed Lag-Nonlinear Models. Subsequently, we examined the relative risk of mortality at different temperature values over a 10 day lag period. We used daily counts of all-cause mortality archived by the Kintampo Health Research Centre’s Health and Demographic Surveillance System between 2005 and 2015 for the analysis. Besides, we obtained weather data from the Ghana Meteorological Agency and the United States’ National Oceanic and Atmospheric Administration’s National Climate Data Centre.

Results
We observed a non-linear association between mean daily apparent temperature and all-cause mortality. At the lowest apparent temperature of 18 °C, an increased risk of death was observed from lag 2-4 with the highest relative risk of mortality (RR =1.61, 95% CI: 1.2, 2.15, p-value=0.001) occurring 3 days after exposure. At the lowest apparent temperature, the relative risk of death also varied between males (RR=0.31, 95% CI: 0.10, 0.94) and females (RR=4.88, 95% CI: 1.40, 16.99) from lag 0-1 and lag 2-4 respectively.

Conclusions
The population of Kintampo is generally sensitive to both low and high apparent temperatures with males being prone to both temperature extremes whilst females are more susceptible to low temperature-related mortality.
Mortality projections for scenarios of temperature and air pollution in Norway

Rao S¹, Di Ruscio F¹, Aunan K², Gaparrini A³, Lehtomaki H⁴, Sera F³, Schwarze P¹, Vicedo-Carbera A³, Sillmann J², Wisløff T¹

¹Norwegian institute of Public Health, ²Centre for International Climate Research, ³London School of Hygiene and Tropical Medicine, ⁴University of Eastern Finland (UEF), Faculty of Health Sciences, School of Pharmacy, ⁵National Institute for Health and Welfare (THL), Department of Environmental Health

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: This study estimates for Norway, the current temperature and air pollution related mortality and the change in mortality over the century under composite climate and socio-economic scenarios.

Methods: We use a historical dataset (1968-2010) of daily mortality and temperature and perform a time series analysis for four regions in Norway. We apply a distributed non-linear model using cubic splines to model both the exposure-response function and the lagged-response dimensions, accounting for 21 days of lag. We project temperature related mortality for the four regions for the high climate RCP8.5 and low climate RCP2.6 scenarios until the year 2100. Using recently updated estimations of air pollution concentrations, we calculate related mortalities for Norway attributable to PM2.5 and ozone until 2050 using available risk functions.

Results: Under the RCP 2.6 climate scenario, the attributable fraction of deaths due to temperature remains almost constant over time (around 5%), for cold-related deaths, and around 0.3%, for heat-associated deaths. For the RCP 8.5 climate projection: we estimate compared to 2010, a 7-fold increase in the fraction of deaths associated with heat in 2090-2099, and a 2-fold decrease of the fraction of deaths associated to cold temperatures. Assuming a medium population growth of the population, this implies a total of 39300 (95% CI 24200-54400) deaths in 2090-2099 in the RCP 2.6, and 32950 (95% CI 18500-47500) deaths in the RCP 8.5. The attributable fraction of air pollution related mortality is estimated at 3% and remains relatively constant until 2050.

Conclusion: The results indicate that significant temperature related health burdens can be expected in Norway as a result of climate change. The cold related burden dominates over the near-term with heat related impacts gaining significance in the longer term. We identify a need for climate adaptation efforts that can result in co-benefits through reduced air pollution.
Background: Temperature, both elevated and low, has been associated with daily cardiovascular mortality. Most epidemiological studies have measured temperature at a daily (mean, max, min) scale, and much remains unknown about the impacts of temperature extremes at the hourly scale. To comprehensively address this question, we investigated the association between hourly temperature exposure and cardiovascular health.

Methods: We used myocardial infarction (MI) hospitalization and residential address data from the Statewide Planning and Research Cooperative System (SPARCS) dataset of the New York Department of Health for 2000-2015 over New York State. We assumed a 2 hour delay between symptom onset and hospitalization. We linked events to hourly temperature and relative humidity from the North American Land Data Assimilation System (NLDAS) at a 11x14 km2 resolution. We employed a time-stratified case-crossover design—matched by month, day of the week, and hour —coupled with distributed lag models to examine which temperature exposure window(s) were most strongly associated with MI risk. We assessed exposure during the 48 hours prior to event. Hourly temperature and relative humidity were modeled as nonlinear terms to estimate the potentially nonlinear exposure-response relationship at each lag, using natural splines with 4 degrees of freedom. We used natural splines with 6 degrees of freedom to model the lag constraints.

Results: We observed 845,192 MI hospitalizations over the study period. Higher temperatures were nonlinearily associated with MI risk; we found no association for lower temperatures, but an increasing response above ~13 oC. This association was only statistically significant in the 7 hours preceding the event, and null for hours 8 – 48 prior to event.

Conclusion: Our findings suggest that temperature exposure has a very short-term association with MI risk. Studies that focus on daily temperatures, thus, likely provide attenuated effect estimates.
The health burden of fall, winter and spring heatwaves and contribution of Santa Ana Winds in Southern California

Schwarz L¹,², Malig B³, Guzman-Morales J⁴, Guirguis K⁴, Gershunov A⁴, Basu R³, Benmarhnia T¹,⁴

¹Department of Family Medicine and Public Health, University Of California, San Diego, ²San Diego State University, ³Air and Climate Epidemiology Section, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, ⁴Scripps Institution of Oceanography, University of California San Diego

Background: Evidence suggests extreme heat is associated with increased morbidity but most studies examine this relationship in warm-weather seasons. In Southern California, Santa Ana winds (SAWs) are associated with high temperatures during the fall, winter and spring, especially in the coastal region. The association between SAWs, heatwaves and hospitalizations in colder seasons has never been studied. Our aim was to examine the relationship between hospitalizations and extreme heat events in the fall, winter and spring, and explore the potential interaction with SAWs.

Methods: Hospitalizations from 1999-2012 were obtained from the Office of Statewide Health Planning and Development Patient Discharge Data. A time-stratified case crossover design was employed to investigate the association between off-season heatwaves (using maximum, minimum and diurnal temperature) and hospitalizations for 11 diagnoses in the coastal regions of Southern California. We examined the additive interaction of SAWs and heatwaves on hospitalizations.

Results: Approximately 1.5 million hospitalizations for 11 diagnoses of interest occurred in the Southern California coastal region during non-summer seasons. In the fall and spring, risk of hospitalization increased during 1-day heatwaves for dehydration [OR: 1.23, 95% CI: 1.04, 1.45 and OR: 1.47 95% CI: 1.25, 1.71, respectively] and acute renal failure [OR: 1.35, 95% CI: 1.15, 1.58 and OR: 1.39, 95% CI: 1.19, 1.63, respectively]. We also found an association between 1-day heatwaves and hospitalization for ischemic stroke, with the highest risk observed in December. It was revealed that SAWs correspond to maximum temperature heatwaves, particularly in November and January, where 92.8% and 100% of heatwaves occur during SAW days, respectively. Finally, we found no additive interaction with SAWs in the heatwave-hospitalization relationship.

Conclusion: Results revealed that relatively high temperatures in non-summer months are associated with a health burden for several hospital diagnoses. Heat action plans should consider decreasing the health burden of heatwaves all year-round.
INTRODUCTION: Children are often more sensitive than adults to environmental hazards including extreme temperatures, however evidence is limited and inconsistent regarding morbidity. The aim of this study is to assess the association between high temperatures and paediatric hospital admissions (HA) for respiratory disease in Italy.

METHODS: for each of the 8,092 Italian municipalities daily counts of HA for respiratory causes in the population of age 0-14 were retrieved. City specific daily mean air temperature was estimated using satellite land surface temperature (LST), observed temperature data and spatio-temporal land use predictors. Daily time series analyses with Poisson regression were performed on the summer season (May – September) in the period 2001-2010. The DLNM approach was used to account for a delayed effect up to 3 days. The effect was expressed at regional level as the Relative Risk (RR) of HA visits for an increase in mean temperature from the 75th to the 99th percentile of the region specific distribution, on the same range attributable cases were estimated. Results were stratified by age category (0-4, 5-14).

RESULTS: 265,733 HA were analysed. An overall positive effect of high temperatures was estimated, with a RR=1.05 (CI95%:1.01–1.11); the strongest effects were observed in Emilia Romagna RR=1.24 (CI95%:1.20–1.29), Puglia and Campania (RR=1.17, CI95%:1.39–1.21; RR=1.16, CI95%:1.14 –1.19). Although the pooled effect was much higher in the 0-4 population (RR 1.06, compared to no effect in 5-14), for few regions a stronger relationship was observed in the 5-14 age subgroup (peaking in Umbria: RR=2.86, CI95%: 2.62 – 3.14).1,438 paediatric respiratory admissions (CI95%: 952 – 1,909) were attributable to high temperatures, with most of the burden in the 0-4 age group.

CONCLUSIONS: Heat is a risk factor for respiratory morbidity among children, susceptible subgroups need to be defined to better target heat prevention measures among children.
Introduction: Health effects of heat and cold on mortality are well known, however evidence on hospital admissions in suburban and rural areas is scarce.

Aim: To estimate the short-term effects of high and low temperatures on cause-specific hospital admissions nationwide for the period 2001-2010 at municipal level.

Methods: We derived daily mean air temperature with a spatial resolution of 1km² using satellite land surface temperature (LST), observed temperature data and spatio-temporal land use and land cover predictors. We used non-linear distributed lag (DLNM) models, adjusted for temporal trends, PM10 and influenza epidemics to estimate the association between temperature and cause-specific admissions at municipal level. Separate analysis were conducted for winter (October-March) and summer (May-September). The percent change in risk (IR%), for temperature increases between the 75th and 99th percentile (heat) and decreases from the 25th to the 1st percentile (cold) are reported. Effects are reported by age group, gender and degree of urbanization of the municipalities (rural, sub-urban, urban).

Results: We estimated statistically significant effects of heat on respiratory admissions with an overall risk of 1.08% (95%CI:1.06-1.11%) with some heterogeneity among regions. A protective or no effect was observed for cardiovascular admissions in summer. For heat, we found an increasing trend in risk for respiratory admissions by age (75 years: 1.13% (95%CI:1.08-1.16%) and for level of urbanization (urban: 1.11% (95%CI:1.08-1.12%) was observed. In winter, no significant effects of low temperatures were observed on both cardiovascular and respiratory admissions.

Conclusions: Extreme heat has an effect on respiratory hospital admissions in all municipalities, with a greater risk among the elderly living in large metropolitan areas.
Prediction of Microclimates Using Machine Learning

Sippy R\textsuperscript{1,2}, Herrera D\textsuperscript{3}, Gaus D\textsuperscript{3}, Gangnon R\textsuperscript{4}, Osorio J\textsuperscript{4}, Patz J\textsuperscript{4}

\textsuperscript{1}SUNY-Upstate Medical University, \textsuperscript{2}University of Florida, \textsuperscript{3}Salud y Desarrollo Andino, \textsuperscript{4}University of Wisconsin-Madison

Background: Microclimates are an important component of our ecosystem, and can impact the health of humans. Research on microclimates can be difficult to achieve, as precise on-the-ground measurements are required, and our understanding of the temporal variation in microclimates is limited, with most previous research focused on large urban centers. Although we know microclimates can affect or mediate effects on human health outcomes, there have been no attempts to predict microclimates.

Methods: Using microclimate data collected over a twelve-month period in a small community in rural Ecuador, we assessed the variability of microclimate variables across time and urban environments. In addition, we used machine learning approaches to predict these microclimate variables across the entire community.

Results: We found that some microclimate variables were more temporally stable than others, and that urban sites tended to have warmer temperature variables and rural sites tended to have higher relative humidity variables. For prediction, we found that random forest algorithms were the best fit for many of the microclimate variables (temperature mean, median, minimum and relative humidity mean, median), with decent prediction (R\textsuperscript{2}: 0.62, 0.64, 0.62, 0.63, and 0.60, respectively). Generalized boosting models fit temperature and relative humidity variance well, as well as minimum and maximum relative humidity, with good prediction levels (R\textsuperscript{2}: 0.67, 0.72, 0.61, 0.62, and 0.61. respectively). The best fit model for maximum temperature was a support vector machine (R\textsuperscript{2}: 0.53).

Conclusion: Machine learning approaches are a promising option for prediction of microclimates, though additional research with a larger dataset should be conducted.
Evaluation of the ERA5-based UTCI on mortality data in Europe

Urban A¹, Di Napoli C²,³, Aquaotta F⁴,⁵, Cloke H², Kyselý J¹,⁶, Pappenberger F³

¹Institute Of Atmospheric Physics CAS, ²Department of Geography and Environmental Science, University of Reading, ³Forecast Department, European Center for Medium Range Weather Forecast, ⁴NatRisk Center, University of Turin, ⁵Department of Earth Sciences, University of Turin, ⁶Global Change Research Institute CAS

TPS 664: Climate change: temperature effects 2, August 27, 2019, 3:00 PM - 4:30 PM

The study was conducted on behalf of the MCC Collaborative Research Network (http://mccstudy.lshtm.ac.uk/).

Background: ERA5 is a novel climate reanalysis product from the ECMWF (European Centre for Medium-Range Weather Forecasts). It provides estimates of surface and atmospheric parameters at much higher resolution (31 x 31 km) than any previous climate reanalyses.

Methods: From ERA5 parameters the Universal Thermal Climate Index (UTCI) can be computed as a gridded parameter at the ERA5 resolution for the whole European continent. Using daily mortality data from European members of the MCC Collaborative Research Network, we will explore the potential of the ERA5-based UTCI as a health-related tool by evaluating UTCI-mortality relationships in 20 cities across 10 European countries. Distributed Lag Nonlinear Models (DLNM) will be used to analyse exposure-response relationships between mortality and UTCI in selected cities calculated from (i) the ERA5 reanalysis and (ii) station-based data.

Results: Preliminary results suggest that both ERA5- and station-based UTCI explain mortality in European cities in a comparable way.

Conclusions: The comparison of the exposure-response relationships between the ERA5- and station-based UTCI is an important step towards the development of a pan-European health-hazard warning system that would be able to assess thermal conditions in locations where high-quality station data are not available.
Background:
Traffic is a primary source of urban air pollution exposure, and is associated with adverse health outcomes. There is limited information on the impact of exposure to traffic on mortality for individuals with pre-existing disease. We used the EPA CARES resource to examine the relationship between residential proximity to traffic, the distance between the primary residence and the nearest major roadway (DTR), and mortality in heart failure (HF) patients.

Methods:
The study cohort comprised 30,599 North Carolina (NC) residents diagnosed with HF between 2004 and 2016, who did not reside in a group home or institutional residence. Cox proportional hazards models were used to determine the association between all-cause mortality and DTR while adjusting for age, sex, race, and socioeconomic status indicators measured at the census block group: median household income, median home value, urbanicity, percent households below poverty line, and percent households receiving public assistance. Results are given in as the hazard ratio (HR) per 1 km decrease in DTR and the associated 95% confidence interval (CI).

Results:
In the central, more urban counties of NC (Durham, Wake, Orange, and Chatham), DTR was associated with mortality in HF patients (HR = 1.17, CI = 1.01, 1.35). The association was weaker in the entire state (HR = 1.05, CI = 0.95, 1.17), and not observed when restricting to the 96 counties outside of central NC (HR = 0.95, CI = 0.82, 1.11). The association was stronger in men than women, and in Caucasians than African-Americans.

Conclusions:
Residential proximity to traffic may be a significant mortality risk factor for HF patients in urban areas. With increasing urban density and HF prevalence in developed nations, it is important to understand, monitor, and communicate environmental traffic-related environmental health risks. This abstract does not necessarily reflect the policies of the U.S. EPA.
Associations of traffic-related air pollution with cancer and mortality among coronary patients: Using an integrated approach for exposure assessment based on land use regression and dispersion modeling

Cohen G¹, Steinberg D¹, Yuval -², Levy I², Chen S², Kark (deceased) J³, Levin N³, Witberg G⁴, Bental T⁴, Broday D², Kornowski R⁴, Gerber Y¹
¹Tel Aviv University, ²Technion Israel Institute of Technology, ³Hebrew University of Jerusalem, ⁴Dept. of Cardiology, Rabin Medical Center

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background: Moderate correlations were previously observed between individual estimates of traffic-related air pollution (TRAP) produced by different exposure modeling approaches. This may imply an exposure misclassification for a substantial fraction of subjects, which may result in an underestimation of the true association between TRAP and health outcomes in epidemiological studies.

Aim: We integrated individual estimates produced by well-established modeling approaches to reevaluate the association with cancers previously linked to TRAP (lung, breast and prostate), other cancers, and all-cause mortality in a cohort of coronary patients.

Methods: Patients undergoing percutaneous coronary interventions in a major Israeli medical center from 2004-2014 (n=10,627) were followed for cancer and mortality through national registries. Residential exposure to nitrogen oxides (NOx) was estimated by optimized dispersion model (ODM) and land use regression (LUR) (rPearson=0.50). Mutually exclusive groups of subjects classified as exposed by none of the methods, ODM alone, LUR alone, or both methods were created. Associations were examined using Cox regression models.

Results: During follow-up, 741 incident cancer cases were diagnosed (median, 7 years) and 3,051 deaths occurred (median, 9 years). Using a ≥25 ppb cutoff, the multivariable-adjusted hazard ratios (95% confidence intervals) for lung, breast and prostate cancer were 1.56 (1.13-2.15) in doubly exposed, 1.27 (0.86-1.86) in LUR alone, and 1.13 (0.77-1.65) in ODM alone, compared with doubly unexposed subjects. The association of the former category was strengthened using more extreme NOx cutoffs: 1.62 (1.16-2.25), 1.72 (1.21-2.45), and 1.83 (1.26-2.67) for ≥26, ≥27, and ≥28 ppb, respectively. A similar pattern, albeit less strong, was observed for mortality, whereas no association was shown for cancers not previously linked to TRAP.

Conclusions: Integrating TRAP exposure estimates results in a more robust association with outcomes. This novel approach should be further examined in future studies.
Background
India experiences levels of ambient fine particles (PM2.5) and ozone (O3) amongst the highest globally, where exposure is a leading risk factor for human health. Air pollutant emissions are predicted to increase in India. However, Indian air quality remains understudied and knowledge of the sources causing air pollution is limited.

Methods
We quantify the contribution of different sources to the disease burden from ambient air pollution exposure in India and the effects of future air pollution control pathways. We combined high-resolution computer simulations, new observations, and updated exposure-response relationships.

Results
Ambient PM2.5 exposure causes 1 million premature deaths each year in India, where large reductions in emissions will be required to reduce the health burden due to the non-linear exposure-response relationship causing health effects to saturate at high exposures. The disease burden from ambient O3 exposure is 200% larger than previously thought, causing 124,000 premature deaths every year. Residential energy use emissions dominate ambient PM2.5 concentrations (52%) and are attributed to 511,000 premature deaths. However, removing these emissions would avert only 256,000 premature deaths due to the non-linear exposure-response relationship. Emissions from land transport dominate the ambient O3 disease burden (35%), followed by power generation (23%). Under current policies to 2050, annual premature mortality from PM2.5 and O3 exposure will increase by 68% and 204%, respectively, due to population ageing and growth increasing susceptibility. Stringent air pollution control pathways can offset the increase in premature mortality from population ageing and growth by 91% (610,000 deaths) for PM2.5 and 45% (335,000 deaths) for O3, and reduce the overall mortality rate from ambient PM2.5 exposure by 15%.

Conclusions
The disease burden from air pollution exposure in India is substantial and likely to increase unless stringent air pollution management provide large emission reductions. A focus should be to reduce solid fuel combustion.
Traffic-related air pollution and birth weight: the roles of noise, placental function, green space, physical activity, and socioeconomic status (FRONTIER)

Dadvand P¹,²,³, Gomez Roig M⁴, Foraster M¹,²,³, Bustamante M¹,²,³, Torres M¹,²,³, Esnaola M¹,²,³, Moreno T⁵, Basagaña X¹,²,³, Nieuwenhuijsen M¹,²,³, Sunyer J¹,²,³

¹Barcelona Institute of Global Health (ISGlobal), ²Pompeu Fabra University, ³Ciber on Epidemiology and Public Health (CIBERESP), ⁴BCNatal, University of Barcelona, ⁵IDAESA-CSIC

Background: A substantial body of evidence has associated air pollution to impaired fetal growth; however, there are still important limitations in terms of applied exposure assessment methods, disentangling role of co-exposure such as noise, and evaluating the modifiers, mediators, and mitigators of this association.

Objectives: To provide a comprehensive evaluation of the impact of maternal air pollution exposure on fetal growth. Towards this aim, FRONTIER will (i) disentangle the effects of noise; (ii) identify relevant window(s) of exposure; (iii) evaluate its modification by socioeconomic status, stress, and physical activity; (iv) elucidate the mediatory role of placental function; and (v) explore the potential of greenspace to mitigate it.

Methods: FRONTIER is establishing a cohort of 1000 women in Barcelona, Spain. Fetal growth is characterized by newborn anthropometric measures and ultrasound-based trajectories of fetal development. Placental function is evaluated using Doppler ultrasound indicators. Hair cortisol levels will be used as an indicator of maternal stress. Time-activity patterns are objectively characterized using smartphones and personal physical activity monitors. We will develop an innovative exposure assessment framework integrating data on time-activity patterns with a hybrid modeling framework and campaigns of personal and home-outdoor air pollution monitoring to estimate maternal exposure level and inhaled dose of NO2 and PM2.5 (mass and constitutes) at the main microenvironments for pregnant women. We assess maternal exposure to noise by integrating measurements at participants’ home-outdoor together with modeled microenvironmental levels of noise. We will separately characterize the canopy and greenness surrounding maternal residential address using high-resolution maps. We will develop single- and multi-pollutant models to evaluate the impact of air pollution on fetal growth and the mediatory role of placental function.

Expected impact: FRONTIER is now in recruitment phase. It will generate vigorous evidence base for implementing finely-targeted regulations to tackle effects of air pollution on fetal growth.
Exposure to Coarse Particle (PM10-2.5) and Term Low Birth Weight: Who Is More Vulnerable?
Enders C1,2, Pearson D1, Harley K2, Ebisu K1
1OEHHA, CalEPA, 2School of Public Health, University of California, Berkeley

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Numerous studies found associations between particulate matter with an aerodynamic diameter ≤ 10 µm (PM₁₀) or ≤ 2.5 µm (PM₂.₅), and adverse birth outcomes. However, research on the relationship between coarse particulate matter (PM₁₀₋₂.₅) and birth outcome is scarce. Furthermore, results are inconsistent among those limited studies.

Methods: We explored whether PM₁₀₋₂.₅ exposure during pregnancy is associated with increased risk of term low birth weight (TLBW) using California birth certificate data from 2002 to 2013 (N = 2,719,596). PM₁₀₋₂.₅ value was estimated based on co-located PM₁₀ and PM₂.₅ monitors. Averaged gestational and trimester exposures of PM₁₀₋₂.₅ and PM₂.₅ were calculated for mothers whose residential ZIP codes were within a 20km radius of monitors. PM₁₀₋₂.₅ and PM₂.₅ exposures were categorized into quartiles. A logistic regression model was conducted with adjusting for PM₂.₅ level as well as individual, family, and spatio-temporal characters. We further conducted stratified analysis to assess whether associations with PM₁₀₋₂.₅ differed by subgroup in order to identify vulnerable subpopulations and regions.

Results: We found that gestational exposure to PM₁₀₋₂.₅ was associated with an increased risk of TLBW. Compared to the first PM₁₀₋₂.₅ quartile, adjusted odds ratio for TLBW was 1.03 [95% confidence interval (CI): 1.00, 1.06] for the third quartile, and 1.04 [95% CI: 1.01, 1.07] for the fourth quartile. In stratified analysis, associations were strong among Non-Hispanic Black mothers, mothers living in the Central valley, and fathers without a college degree.

Conclusions: Our results suggested that gestational exposure to PM₁₀₋₂.₅ was associated with TLBW even after controlling for PM₂.₅, and these associations were disproportionately worse in regions and/or families with low socio-economic status. To achieve health equity, further understanding of the toxicity and distribution of components for PM₁₀₋₂.₅ is necessary.
Effects of particulate matter and self-reported risk factors on incidence of airway diseases

Fasola S¹, Maio S², Baldacci S², Gariazzo C³, Forastiere F¹, La Grutta S¹, Stafoggia M⁴, Viegi G¹², on behalf of the BEEP collaborative group⁵

¹Institute of Biomedicine and Molecular Immunology (CNR-IBIM), ²Institute of Clinical Physiology (CNR-IFC), ³INAIL-Department of Occupational & Environmental Medicine, Monteporzio Catone, ⁴Department of Epidemiology, Lazio Regional Health Service / ASL Roma 1, ⁵www.progettobeep.it

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: A cross-sectional study on the health effects of air pollution was carried out in Pisa in 1991 by considering distance of home residence from the main road as a proxy of traffic-related exposure. Newly acquired data on air pollution (PM10 and PM2.5) from the BEEP project, as well as a longitudinal approach, may provide new insights about the health effects. We aimed to assess the effects of PM and self-reported risk factors on the incidence of airway diseases in a sample of long-term residents.

Methods: 305 subjects (mean age 47.6 years), living in Pisa at the same address from 1991 to 2011, were selected. Baseline information on risk factors was available from initial interview (at 1991) and new cases of airway diseases were ascertained until 2011. Annual average PM10 and PM2.5 exposures (µg/m³, year 2011) were estimated at the residential address (1-km² resolution) using a combination of satellite data and land use variables (Random Forest Machine Learning Approach). Data were analysed through multivariable logistic regression models; due to the low number of new events, the Firth’s method was used to reduce the bias.

Results: Cumulative incidence of chronic obstructive pulmonary disease (29/282=10.3% overall) was associated with age (years) (OR=1.06 [95% CI: 1.03, 1.12] per unit increase [p.u.i.]), PM10 (OR=2.96 [1.50, 7.15] p.u.i.) and current active smoking (OR=2.99 [1.08, 9.39] vs never smoking). Incidence of rhinitis (90/264=34.1% overall) was associated with increasing PM2.5 (OR=2.25 [1.07, 4.98] p.u.i.). Incidence of chronic phlegm (16/262=6.1% overall) was linked to increasing PM2.5 (OR=4.17 [1.12, 18.71] p.u.i.) and occupational exposure (OR=5.41 [1.88, 21.79] vs not exposed). Gender was not significantly associated with disease incidence.

Conclusions: Linking PM10 and PM2.5 levels, estimated using satellite data and land use variables, to existing longitudinal data may improve the knowledge of respiratory health effects of long-term air pollution exposure.
Global estimation of effect on life expectancy at age of 60 by particulate air pollution

Han C¹, Lim Y²,³, Hong Y¹,²,³

¹Department of Preventive Medicine, Seoul National University College of Medicine, ²Institute of Environmental Medicine, Seoul National University Medical Research Center, ³Environmental Health Center, Seoul National University College of Medicine

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background

Previous studies evaluating the association between particulate matter less than 2.5 μm in diameter (PM2.5) and life expectancy were conducted in single country assuming linear relationship. In our study, we evaluated the association using global country level data accounting for non-linear relationship between PM2.5 concentration and life expectancy.

Methods

A total of 17 years (from 2000 to 2016) of country level population weighted PM2.5 concentration and life expectancy at age of 60 were archived from Global Burden of Disease Study 2017 database and World Health Organization Global Health Observatory. A generalized estimating equation with a compound symmetry covariance structure was used to evaluate the linear association between reduction in annual PM2.5 concentration and increase of life expectancy. Non-parametric analysis using generalized additive mixed model and piecewise linear regression was conducted for repeatedly measured data analysis with non-linear assumption.

Results

A 17 years of data from 176 countries were used in our analysis. With a linear assumption, 10 μg/m³ reduction in annual PM2.5 concentration was associated with 0.34 years (95%CI: 0.20, 0.49) of increase in life expectancy. By assuming non-linear relationship, life expectancy increased by 0.72 years (95%CI: 0.49, 0.96) per 10 μg/m³ reduction on 0-24.0 μg/m³ PM2.5 concentration range. Life expectancy increased by 0.01 years (95%CI: -0.06, 0.08) per 10 μg/m³ reduction on PM2.5 range above 24.0 μg/m³.

Conclusion

There was non-linear relationship between country level population weighted annual PM2.5 concentration and life expectancy at age of 60. Life expectancy gain are expected with decrease of PM2.5 exposure even in very low PM2.5 concentration ranges. Future individual and multi-level studies are needed to confirm our ecologic study findings.
Long-term particulate matter exposure increases the mortality risk of patients with end-stage renal disease

Jung J¹, Park J², Kim Y⁴, Lee H¹, Kim Y⁴, Lee J⁷, Kim H¹

¹Department of Biostatistics and Epidemiology, Seoul National University, ²Department of Internal Medicine, Dongguk University Ilsan Hospital, ³Department of Internal Medicine, Dongguk University College of Medicine, ⁴Department of Internal Medicine, Seoul National University College of Medicine, ⁵Department of Neuropsychiatry, Seoul National University Bundang Hospital, ⁶Institute of Health and Environment, Seoul National University, ⁷Department of Internal Medicine, Seoul National University Boramae Medical Center

Background: Recent studies have identified the effect of particular matter (PM) on kidney which filters toxic substances. However, little is known for relationship between PM and mortality of end-stage renal disease (ESRD).

Methods: We collected ESRD patients who have been dialyzed from 2008 to 2015 in CRC cohort. PM10 was assigned to each patients based on sido of hospital where patients have received dialysis continuously. We used time-varying Cox proportional hazard model including every 3-years PM10, age, sex, smoking and marital status, education, social and family support, and insurance as well as regional variables to identify hazard ratios (HRs) of mortality when exposed to PM10. Stratified analysis was also conducted by potential confounders.

Results: During the follow-up (mean 4.18 years), 1475 deaths occurred among 5041 participants. We found non-linear relationship between mortality of ESRD patients and PM10, showing threshold at 44.15 μg/m³. HRs and 95% confidence interval of lower and upper section than threshold were 0.71 (0.69, 0.74) and 1.25 (1.22, 1.28), respectively. Those who married and highly educated were at high risk in both sections, but opposite tendency was shown in each sections when stratified by population density, family and social support and the number of institutions.

Conclusions: We found that patients with ESRD were affected differently by long-term PM10 concentrations. It may be caused by toxicity of PM and characteristics of behavior at relatively low concentration. Further researches were needed to identify characteristics in lower group.
Introduction: Today, air pollution is one of the major issues in the world's major cities. Accordingly, this study aimed to investigate the relationship between air pollution and the death of the elderly in Kerman.

Materials and Methods: In this ecological study, data on the number of deaths from cardiovascular and respiratory diseases as well as trauma, diabetes and other diseases; in different genders in the ≥60 age group from 2006 to 2013 was inquired from the Deputy of Health at Kerman University of Medical Sciences. Air pollution data including CO, SO2, O3, NO, NO2, NOx and PM10, were inquired from the Kerman Province Environmental Protection Agency. The relation between air pollutants and deaths was calculated using negative binomial regression by STATA13.

Results: During this period, a total of 14,793 deaths occurred at the age of 60 years and older in Kerman. There was a significant relationship between Carbon Monoxide, Nitrogen Oxides and Particulate Matter with death from cardiovascular diseases. Besides, there was a significant relationship between NO and PM10 emissions and total deaths in the elderly. Furthermore, there was a significant relation between PM10 and deaths in elderly men. Similarly, there was a significant relation between NO, O3, SO2 and CO emissions and deaths in elderly women.

Conclusion: The results indicated that there is a significant relation between air pollution and death in the elderly. Accordingly, a warning system to reduce elders’ commuting on high air pollution days is suggested.
Air pollution and incidence of lung cancer by histological type in Korean adults: A Korean National Health Insurance Service Health Examinee Cohort Study

Kim W¹, Moon D¹, Kwon S², Kim S³
¹Kangwon National University, ²Kangwon National University Hospital, ³National Cancer Center

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background: Studies have reported the associations between long-term exposure to ambient air pollution and lung cancer. However, there have been inconsistent reports of associations for lung cancer by histological type. We aimed to assess the association between long-term exposure to particulate matter less than or equal to 10 μm in a diameter (PM10) and nitrogen dioxide (NO2) and lung cancer incidence by histological subtype in South Korea.

Methods: This population-based longitudinal study included 6,567,909 cancer-free subjects from the Korean National Health Insurance Service (NHIS) database for 2006-2007. We linked population data to National Cancer Center cancer registry data to confirm lung cancer incidence for 2006-2013. Individual exposure to PM10 and NO2 were assessed as 5-year average concentrations predicted at subjects’ district-specific home addresses for 2002–2007. We divided these exposures into two categories based on the 75th percentile. Cox proportional hazards models were used to estimate hazard ratios (HRs) of lung cancer incidence for the upper 25% exposure compared to the low 75% by histological subtypes at diagnosis, adjusting for potential confounders.

Results: Incident lung cancer was higher in male (n=21,912) than female (n=5,606). The incidence of lung cancer was higher in males, smokers, frequent exercisers or drinkers, and subjects with chronic obstructive pulmonary disease. Overall, we did not find increased risk of lung cancer with higher exposure of PM10 or NO2. However, a marginal association (P<0.10) was found for non-small cell carcinoma (HR=1.05, 95% CI=0.99-1.11), and high exposure to PM10 was associated with increased risk of adenocarcinoma in comparison with lower exposure in male smokers (HR=1.14, 95% CI=1.03-1.25).

Conclusion: This study showed that long-term air pollution exposures were associated with elevated risk of lung adenocarcinoma in male smokers in Korea.
Air Pollution and Quality of life in Adolescents - Use of KIDSCREEN 27 (K27) Questionnaire in 509 young people living in air-polluted cities in Brazil.

Nery T, Futoshi R, Lopes C, Terra M, Santos U, Stelmach R

1Pulmonary Division - Heart Institute (Incor) Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo

Quality of life (Quol) in young people in Brazil related to health phenomena is little studied. Frequently evaluated by ISAAC. Few are the indicators and instruments of quality of life for general population exposed air pollution seeking to identify predictive respiratory factors. This exploratory analysis aims to identify the quality of life of young people living in high polluted cities, compared with a lower polluted city, all located in the countryside of the State of São Paulo/Brazil. Two cities have high levels of air pollution PM10: 60 to 100 μg/m³. The third one is a touristic city, without PM10 monitoring. 509 volunteers in a transversal study. Age 15-18 yo. The K27, with 5 domains, was answered by the young person himself. 51.9% were women. The questionnaire, added to a simple question “do you need frequent health care or have a serious illness?” 15.3% reported to be ill with 13% indicating atopic disease (AD). We evaluate the use of the K27 in atopic (report isolated or in combination of bronchitis, rhinitis or sinusitis, and dermatitis) and non-atopic.

We use SPSS. Results: K27 population total score in all the dimensions of the polluted cities were inferior to the Brazilian study (Br) and normal range values. Physical Well-being was 41.7 ±10 lower than the Br population (48.1) and the normal range values (50 ±10). Psychological Well Being: 43.8; Br = 47.1 Autonomy & Parent Relation = 42.0; Br = 44.2; Social Support & Peers = 49.3; Br = 49.5; School = 43.0; Br = 51.0. There were no differences among cities. Of them, 94% were residents in polluted cities: K27 for dimension Physical Well-being was 36.6±8, significantly different from non-AD and non polluted city (42.4±10) (p=0.01). Conclusions: K27 might be useful to predict Quol impairment in susceptible adolescents with atopic respiratory diseases living in high polluted cities.
Are the adverse health effects of air pollution modified among those with a more active lifestyle? A review of the literature
DeFlorio-Barker S\(^1\), Boehmer T\(^2\), Lobdell D\(^1\), Stone S\(^1\), Rappazzo K\(^1\)
\(^1\)Us Environmental Protection Agency, \(^2\)Centers for Disease Control and Prevention

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background
Long-term exposure to air pollution is associated with a significant increased risk of morbidity and mortality, while regular physical activity is associated with decreased risk of morbidity and mortality. Air pollution concentrations are often high in major cities worldwide. As such, millions of people engage in regular physical activity in highly polluted outdoor environments. It is unclear if the adverse effects of long-term exposure to air pollutants are modified by regular physical activity.

Methods
To help understand this complex issue, we reviewed the peer-reviewed literature for studies that examined whether the impacts of air pollution exposure are modified by routine physical activity. Articles were identified through PubMed, Science Direct, ProQuest Agricultural & Environmental Science Database searches on terms encompassing air pollution and exercise/physical activity (n=334). After initial screening, 16 papers were initially included in this review. After full review, three studies did not meet the criteria for review and were excluded.

Results
Most studies occurred in Asia (n=5), followed by North America (n=4), and Europe (n=3). Eight studies concluded the risks of exposure to air pollution outweigh the benefits of physical activity especially among children. However, five studies concluded that regular physical activity can negate the negative impacts of long-term air pollution exposure, particularly among healthy adults.

Conclusions
Initial results of this review suggest sensitive groups, such as children, who are routinely physically active in areas with high air pollution levels incur more risk than benefit. Yet, regular physical activity among healthy adults may decrease the negative effects of long-term exposure to air pollution.

This abstract does not necessarily reflect EPA policy.

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention.
Residential traffic exposure and lymphohematopoietic malignancies among young people in the city of São Paulo, Brazil


1University of São Paulo, 2Utrecht University, 3Oregon State University

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Despite widespread evidence (including that from the International Agency for Research on Cancer) that air pollution – particularly that derived from traffic – is carcinogenic to humans, there is a paucity of evidence from low-middle income countries (including those in South America) where socio-economic differences may contribute to differing burdens of disease. Therefore, we examined the role of traffic exposure (via traffic density and ambient NO₂) on lymphohematopoietic malignancies in young people.

Methods: All incident cases of non-Hodgkin lymphoma, lymphoid leukemia, myeloid leukemia, monocytic leukemia, multiple myeloma, and malignant plasma cell neoplasms between 2002 and 2011 were collected from the population-based cancer registry. An annual nitrogen dioxide (NO₂) land use regression model and a traffic density database were used as markers of exposure. We used Poisson Regression models to estimate incidence rate ratios (IRRs) for both the overall population as well as stratifying by socioeconomic status (SES).

Results: Overall, traffic density and ambient NO₂ were both positively associated with all lymphohematopoietic endpoints (albeit to differing degrees of significance). Socio-economic differences in disease burden were also observed where, in general, traffic density had a stronger effect among those in the lower SES and ambient NO₂ had a stronger effect among those in the higher. For example, the IRRs for non-Hodgkin lymphoma in the lower SES group was 1.20 (95% CI: 1.07, 1.35) per 5μg/m³ increase in NO₂ and 1.28 (95% CI: 1.15, 1.44) per 10 m.vehicles.hour/m² increase in traffic density. By contrast, the IRRs in the higher SES group were 1.47 (1.25, 1.72) for NO₂ and 1.10 (1.01, 1.21) for traffic density.

Conclusions: NO₂ and traffic density were positively associated with an increased incidence of lymphohematopoietic malignancies in São Paulo. Differing IRRs by SES group may indicate differences in underlying risk and/or exposure profiles.
Health effects of ambient black carbon and ultrafine particles: review and integration of the epidemiological evidence
Redaelli M1, Sanchez M2, Fuertes E2, Blanchard M3, Mullot J4, Baeza-Squiban A5, Garçon G6, Léger C1, Jacquemin B7
1French Agency for Food, Environmental and Occupational Health & Safety (Anses), 2National Heart and Lung Institute, Imperial College London, 3French National Public Health Agency, 4LASEM, Base Navale De Toulon, 5CNRS UMR 8251, Univ Paris Diderot, 6CHU Lille, Institut Pasteur de Lille, EA4483, Univ Lille , 7Univ Rennes, Inserm, EHESP, Irset, UMRS 1085

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background: The adverse effects of ambient fine particulate matter with diameter <2.5 µm (PM2.5) on mortality and morbidity are well documented. However, the effects of the specific components or fractions of PM2.5 remain mostly unknown. We reviewed the recent epidemiological literature investigating the health effects of two major ambient PM2.5 components: black carbon (BC) and ultrafine particles (UFP).

Methods: We searched the relevant literature published between January 2013 and February 2016 using Pubmed and Scopus. We included 92 (78 for BC, 14 for UFP) human studies investigating the associations between long- and short-term exposure to PM2.5 components and any health outcome (43 outcomes identified). Following the Office of Health and Assessment Translation process, we assessed the risk of bias of individual studies, rated the confidence in the integrated body of evidence for all exposure-outcome combinations, and translated the confidence ratings into levels of evidence for multiple outcomes of the same category (n=10 categories, including cardiovascular, respiratory, all-cause mortality, perinatal...).

Results: There was high confidence that short-term ambient BC exposure is associated with respiratory health, cardiovascular health, and all-cause hospitalizations, leading to a “high” level of evidence for these associations. The same conclusion was drawn for long-term ambient BC exposure and all-cause mortality. The evidence is “moderate” for long-term BC exposure and respiratory and cardiovascular health, as well as for short-term UFP exposure and cardiovascular health. The evidence is “low” for the association between long-term BC and UFP exposure and perinatal and neurological health. Exposure misclassification was the main source of uncertainty.

Conclusions: The recent evidence for the adverse health effects of ambient BC is “moderate” to “high” for most health outcomes. The evidence for UFP is restricted to cardiovascular health due to the limited existing literature. Further well-designed studies are needed to fill the knowledge gaps identified.
Trends in Annual Associations between Ozone and Circulatory Mortality by Age and Sex in Canada for 1984-2012

Shin H1,2, Parajuli R3, Maquiling A1, Smith-Doiron M1
1Environmental Health Science and Research Bureau, Health Canada, 2Dept. of Mathematics and Statistics, Queen’s University, 3Dept. of Biology, University of Ottawa

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background: Considerable research has been conducted on the association between ground-level ozone (ozone) and various mortality causes, but the relationships by age and sex (biological) have been inconsistent and temporal trends remain unexplored.

Objectives: The study goals are to investigate the adverse health effect of short-term exposure to ozone on circulatory mortality by age and sex, and to examine trends in the annual health effects.

Methods: Daily ozone, temperature, and circulatory mortality count (ICD I00-99) were collected for 24 urban cities for 29 years (1984-2012). Associations between ozone and circulatory mortality were estimated by generalized additive Poisson models for season (warm vs cold), age (base vs seniors) and sex, accounting for known confounders. City-specific estimates were pooled to represent national associations through Bayesian hierarchical models.

Results: While cold season returned insignificant estimates, warm season showed statistically significant associations: a 10 ppb increase in ozone was associated with 0.7% increase in circulatory mortality with 95% posterior interval (0.2%, 1.1%). One-day lagged ozone in warm season showed little age difference (0.7% vs 0.8%) but visible sex differences: females at higher circulatory mortality risk than males (1.1% vs. 0.3%). Annual estimates suggest overall up-down temporal changes, a slightly increasing trend until 2002-2004, then a generally decreasing trend thereafter.

Conclusion: This study found noticeable sex-related differences in circulatory mortality attributable to short-term exposure to ozone. Further research is warranted to understand whether sex alone or unknown interactions with other factors derived the differences and to clarify the specific biological mechanisms underlying the sex differences.
Air pollution and cause-specific mortality in Switzerland: results from a large administrative cohort in the ELAPSE project

Viennau D\textsuperscript{1,2}, Samoli E\textsuperscript{3}, Rodopolou S\textsuperscript{3}, Stafoggia M\textsuperscript{4}, Baoelenck M\textsuperscript{5}, Klompmaker J\textsuperscript{6,7}, Andersen Z\textsuperscript{8}, Künzli N\textsuperscript{1,2}, de Hoogh K\textsuperscript{1,2}, Brunekreef B\textsuperscript{7}

\textsuperscript{1}Swiss Tropical and Public Health Institute, \textsuperscript{2}University of Basel, \textsuperscript{3}Department of Hygiene, Epidemiology and Medical Statistics, Medical School, National and Kapodistrian University of Athens, \textsuperscript{4}Department of Epidemiology, Lazio Regional Health Service, \textsuperscript{5}Vrije Universiteit, \textsuperscript{6}National Institute for Public Health and the Environment (RIVM), \textsuperscript{7}Institute for Risk Assessment Sciences, Utrecht University, \textsuperscript{8}University of Copenhagen

TPS 682: Long-term health effects of air pollutants 2, August 27, 2019, 3:00 PM - 4:30 PM

Background / Aim: Long-term exposure to air pollution is associated with risk of mortality, though less is known about potential adverse effects at low ambient levels. To capture a large population and exposure contrast, large administrative cohorts including the Swiss National Cohort (SNC) are investigated in ELAPSE (Effects of Low-Level Air Pollution: A Study in Europe). Here the results for Switzerland are presented.

Methods: European-wide hybrid land use regression models were used to assign long-term NO\textsubscript{2}, PM\textsubscript{2.5}, O\textsubscript{3} and black carbon (BC) concentrations to the home addresses of 4.2 million adults in the SNC. Cox proportional hazard models were used to investigate natural-cause and cardiovascular (CVD) mortality. Following a harmonised protocol, models were adjusted for individual and several area-level indicators of socio-economic status. In addition to linear single and multi-pollutant models, the concentration-response functions were evaluated through subset and threshold analyses and the application of splines.

Results: Mean NO\textsubscript{2}, PM\textsubscript{2.5}, O\textsubscript{3} and BC exposures were 24.0, 16.0, 73.0 µg/m\textsuperscript{3} and 1.7x10\textsuperscript{-5}/m, respectively. During 2000-2016, 661,534 natural-cause and 241,985 CVD deaths were observed. In fully adjusted single-pollutant models, NO\textsubscript{2}, PM\textsubscript{2.5} and BC were associated with a statistically significant increased risk of death from these causes. E.g. Hazard ratios per 0.5x10\textsuperscript{-5}/m BC were 1.06 (95% CI: 1.05-1.07) for natural-cause and 1.04 (1.02-1.05) for CVD mortality. There were no positive associations between ozone and mortality. For natural-cause mortality, BC and NO\textsubscript{2} remained significant after adjusting for other pollutants. For CVD mortality, only BC remained significant after adjusting for other pollutants. The splines indicated no strong deviation from linearity, and no thresholds were identified. Associations remained significant when considering participants with residential exposures <20 µg/m\textsuperscript{3} NO\textsubscript{2} or PM\textsubscript{2.5} and <1.5x10\textsuperscript{-5}/m BC.

Conclusions: Even at these low levels, long-term exposure to NO\textsubscript{2}, PM\textsubscript{2.5} and BC was associated with natural-cause and CVD mortality.
Objective: The objective of this study was to investigate the potential association between air pollutants and respiratory diseases (RDs) as well as risk factors of children’s respiratory symptoms or morbidity.

Methods: With informed consent and written responses, the questionnaire survey concerning children’s personal information, household condition, parents’ behavior, as well as parents’ health history, was conducted in Lanzhou by field investigation. Totally, 2000 local subjects distributing in urban (Chengguan) and suburban (Xigu) communities of Lanzhou were enrolled to participate into the survey. Data on risk factors and on respiratory disease were collected on the basis of double entry and validation of questionnaire. To analyze the effects of various risk factors to children’s respiratory disease, a two-stage regression approach was used in analysis; in the first-stage, the researcher obtained regression logits of community-specific prevalence of asthma, bronchitis, hospitalization, persistent cough and persistent phlegm for respiratory diseases, adjusted for covariates representing personal, family and household variables.

Results: Some of the covariates showed to be risk factors of school children’s respiratory disease. However, there were community differences. The results showed that there were associations between community-specific adjusted prevalence rates and ambient air pollutant, also the positive association between morbidity prevalence and outdoor levels of PM2.5.

Conclusions: It was found that Children’s grade (2nd grade), exclusive breastfeeding, pet (cat) ownership, parent’s smoking behavior, educational level and medical history of bronchitis and average number of cooking days were found to be risk factors of children’s respiratory morbidity. Also, it was found out that at Xigu, asthma was more associated with persistent cough while at Chenggang’s allergic/allergic rhinitis appeared to be more strongly associated.
Background/Aim: As neighbourhood satisfaction has been positively associated with health or health-related outcomes such as mental health, self-efficacy and physical activity, it’s imperative to develop the currently limited understanding of neighbourhood environment influences on neighbourhood satisfaction. This study examined associations between objectively-measured environmental attributes and neighbourhood (dis)satisfaction and the moderating effect of physical function in Hong Kong and Ghent (Belgium) older adults.

Methods: Participants were older adults from comparable epidemiological studies conducted in Hong Kong and Ghent. Participants were recruited from neighbourhoods stratified by socio-economic status and walkability. Environmental characteristics of street-network buffers around participants’ homes were quantified by Geographic Information Systems. Comparable measures of neighbourhood satisfaction, socio-demographics and physical function (objective) were used. Generalised Additive Mixed Models were used to determine associations between neighbourhood environment characteristics and neighbourhood satisfaction as well as moderating effects of physical function and city.

Results: Linear or curvilinear negative associations were observed between neighbourhood dissatisfaction and objectively-assessed density of services, recreational facilities, public transport stops and number of parks (1km buffers). Distance to the nearest park and public transport stop were positively linearly related to neighbourhood dissatisfaction, while intersection density and number of parks within 400m residential buffers were negatively related to neighbourhood dissatisfaction. No significant associations were observed with park area and dwelling density. Most environmental attributes had similar associations across the two study sites, with the exception of recreational facilities and distance to the nearest public transport stop. Physical functionality did not moderate any of these associations.

Conclusions: Objectively-assessed neighbourhood environmental characteristics are important contributors to older adults’ satisfaction with their residential neighbourhoods irrespective of physical functionality levels. Most of these effects seem to be generalisable across very different geographical and cultural contexts.
Association between residential stressors and mental health outcomes in Belgium

De Clercq E¹, Pelgrims I¹, Hautekiet P¹,², Thomas I⁵, Keune H³,⁴, Nawrot T², Remmen R³, Bastiaens H³, Saenen N¹,²

¹Sciensano, ²Hasselt University, ³Antwerp University, ⁴INBO, ⁵Université catholique de Louvain

TPS 701: Spatial determinants of population health, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim
Mental health in a broad sense is defined as the ability to cope with problems and fulfill one’s role in society. In this area, Belgium has a poor record, featuring a high number of depressions and anxiety disorders. The NAMED project aims at exploring different dimensions of mental health in Belgium in relation to the (non)built environment.

Methods
Data from the Health Interview Survey (HIS) 2008 and 2013 was used. Variables describing mental health and annoyance at home (air pollution, noise, smells, ...) for 13,905 participants were analyzed using the R statistical language. Based on mixed factor analysis (FAMD) on mental health variables and environmental stressors, relevant indicators were selected and screened on differences between provinces.

Results
Five indicators were selected for both mental health and environmental stressors based on their contribution to the first four dimensions. The state of mental health was similar in the majority of the provinces, but differences in the dimensions of mental health problems could be seen. Psychological distress was lowest in West-Flanders, and highest in Brussels. Subjective health however was highest in Brabant Walloon and lowest in West-Flanders. Suicidal ideation and depression was observed more often in Namur and Hainaut and less so in Limburg and Antwerp. Brussels performed poorly on nearly all dimensions of mental health.

When looking at residential annoyances, traffic noise and vibrations were mentioned most often, and densely populated provinces were more affected than others. Airplane noise was most prevalent in Brussels and Flemish Brabant. More than 80% of the participants were not at all annoyed by air pollution at home. In Brussels, this drops to 60%.

Conclusions
Provinces with more mention of environmental stressors appear to have more mental health problems, although this association is not always straightforward and depends on the dimension of mental health considered.
Background:
Growing evidence demonstrates the health benefits of natural environments (NE), but the effect of different NE types remains relatively unexplored. This study assesses the association between perceived health and different types of NEs by analysing both access (i.e., living within proximity to a public park) and exposure (i.e., high percentage of NE in residential neighbourhood).

Methods:
We used data from the 2013-2014 Canadian Community Health Survey (n=5,881) on self-reported general and mental health in the last year (5-point ordinal scale from poor to excellent). NE was estimated using a land cover map of Metro Vancouver with 13 classifications, including deciduous trees, conifers, grasses, shrubs, and water. Access was defined as living within 300m of a public park (≥ 1 hectare) and exposure as the percentage of each land cover type within several buffer zones of residential postal codes. Multinomial logistic regression models were used to analyse associations between self-reported general and mental health and access and exposure to NE respectively.

Results:
Exposure to water was significantly associated with a lower odds of self-reported poor general health, adjusted for confounders (OR = 0.98, 95% CI = 0.96, 0.99). A similar association was found for exposure to some vegetation types, but no consistent trends were found across buffer zones for strength of association by vegetation type. No significant associations were found for access to public parks.

Conclusions:
This study confirms previous studies showing health effects of water and that daily life exposure to NE may be more important than access to public parks. Further research is needed to establish causality and to expand the knowledge on different NEs’ effect on human health.
Do area-level factors reduce individual-level socioeconomic mortality disparities associated with particulate matter?

Kim S¹, Kim H¹, Kim H¹, Byun G¹, Choi Y¹, Kim S¹, Lee J¹,²
¹BK21 PLUS Program in ‘Embodiment: Health-Society Interaction’, Department of Public Health Sciences, Graduate School, Korea University, ²School of Health Policy and Management, College of Health Science, Korea University

TPS 701: Spatial determinants of population health, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim
There has been a growing interest in socioeconomic disparities in air pollution-related health risks and role of area-level factors in reducing health inequities. This study aims to investigate whether area-level socioeconomic status (SES) and accessibility to medical care mitigate PM10-related mortality disparities by individual SES in South Korea.

Methods
Education-specific age and sex-standardized mortality rates, annual mean concentrations of PM10, percentage of adults with low education (area-level SES), and health care resource index were computed for each 73 districts in 7 metropolitan cities, during 2008-2012. We used negative binomial regression with city-specific random effects to estimate the association between PM10 and non-accidental mortality according to individual SES level with adjustment for potential confounders and spatial autocorrelation. We then stratified analyses by tertiles of area-level SES and health care resource index to assess three-way interaction among PM10, individual SES, and area-level factor on mortality.

Results
The association between 10μg/m³ increase in PM10 and mortality was stronger for low individual SES (7.01% (95% CI: 1.86, 12.42)) compared to high individual SES (3.98% (95% CI: -0.06, 8.18)). In districts with higher accessibility to medical care, the association did not differ according to individual SES and were close to the null without significance in low and high SES. In districts with lower accessibility to medical care, however, the association was still stronger in low individual SES. The association in low individual SES did not differ according to area-level SES, while the stronger association in high individual SES was associated with higher area-level SES. Area-level SES was negatively correlated with area-level accessibility to medical care.

Conclusions
Area-level accessibility to medical care may reduce socioeconomic disparities in mortality associated with PM10. Effects of area-level SES may be partially explained by relationship with area-level accessibility to medical care.
Cumulative Environmental Quality Associations with Limb Reduction Birth Defects
Krajewski A\textsuperscript{1}, Rappazzo K\textsuperscript{2}, Langlois P\textsuperscript{3}, Messer L\textsuperscript{4}, Lobdell D\textsuperscript{2}
\textsuperscript{1}ORISE/ US Environmental Protection Agency, \textsuperscript{2}US Environmental Protection Agency, \textsuperscript{3}Texas Department of State Health Services , \textsuperscript{4}OHSU-PSU School of Public Health

TPS 701: Spatial determinants of population health, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aims: Individual environmental exposures have been associated with limb reduction, transverse limb reduction and longitudinal limb reduction birth defects. However, environmental exposures often occur simultaneously and the contribution of multiple exposures in association these limb reduction defects is not well understood. Methods: We used the Environmental Quality Index (EQI) and its five domains (air, water, land, sociodemographic, built) to estimate county-level cumulative environmental exposures from 2000-2005. The EQI domains were divided into three exposure categories based on percentiles (<50%, “better” environmental quality; 50-75%, “mid”; >75%, “worst”) and matched to limb reduction, transverse limb reduction and longitudinal limb reduction defects identified from Texas Birth Defects Registry and live birth records from 2000-2006. Associations were assessed using Poisson regression models. Results: There was an increased prevalence of longitudinal limb reduction defects [prevalence ratio (PR) 1.17, (95% confidence interval (CI):1.06,1.29)], but not limb reduction or transverse limb reduction defects comparing the worst environmental quality category compared to the best for overall EQI. The strongest associations were observed in the sociodemographic domain, with worse environmental quality associated with higher prevalence of limb reduction [1.62,(1.45,1.80)], transverse limb reduction [1.46,(1.31,1.62)], and longitudinal limb reduction [1.82,(1.63,2.04)]. In the water domain, associations were non-linear. Compared to better environmental quality, mid and worst environmental quality were associated with higher prevalence of limb reduction [1.61,(1.43,1.81) and 0.56,(0.50,0.62, respectively)]; transverse limb reduction [1.38,(1.24,1.55) and 0.55,(0.49,0.61, respectively)]; and longitudinal limb reduction [1.91,(1.69,2.17) and 0.54,(0.48,0.61, respectively)]. Inverse associations were observed in the air, land, and built domains for all three outcomes (limb, transverse limb, and longitudinal limb reduction defects). Conclusions: When assessing the associations between cumulative environmental exposures and limb reduction defects, strong, positive associations were found with sociodemographic factors and water quality, but not with air, land or built environmental quality. This abstract does not reflect EPA policy.
Built environment survey in a small community: determinants of noise annoyance and sleep disturbance

Lévesque B¹, Huppé V¹, Dubé M¹; Martin R¹

¹Institut National De Santé Publique Du Québec

TPS 701: Spatial determinants of population health, August 27, 2019, 3:00 PM - 4:30 PM

Background/aims: Based on the “Large Analysis and Review of European Housing and Health Status” (LARES), we realized a built environment survey in a small French Canadian community (population: 7000) in 2012. The purpose was to identify health priorities for the local stakeholders. A part of the survey concerning noise exposure is presented here according to two objectives: 1. to determine the prevalence of noise annoyance and sleep disturbances stratified by sources and 2. to describe environmental determinants related to these problems.

Methods: A sample of 200 households was targeted. Finally 161 households (valid questionnaires for 294 people ≥ 5 years old) participated to the survey. Three tools adapted from LARES were mainly used for the collect of data (two questionnaires and one inspection grid). Household’s characteristics and annoyance/sleep disturbances in relation with noise were examined using χ² tests.

Results: We documented proportions of 22.5% and 32% of households with at least one person highly annoyed or disturbed by noise during the last 12 months. The main sources of annoyance and sleep disturbances were transport (annoyance: 15.3%; sleep disturbances: 20.1%) and neighborhood (annoyance:13.5%; sleep disturbances:9.7%). Noise annoyance was related to noisy people, speed limits not respected and dwelling requiring major renovations. Sleep disturbances were related to noisy people, speed limits not respected, living in a detached dwelling and living in a non residential zoning.

Conclusions: Even in a rural setting, noise can be a public health concern. The survey was helpful for local stakeholders to determine the extent of the problem and to identify determinants.
Impact of commuting distance on travel mode choice: active and passive transport

Miskinyte A1, Dedele A1, Andrusaityte S1, Nemaniute-Guziene J1

1Vytautas Magnus University

TPS 701: Spatial determinants of population health, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: People’s travel behaviour is very complex with different aspects and many various factors that have an influence on the individual decision on travel mode choice. The aim of the study was to investigate the choice of travel modes (including active and passive transport) and its associations with commuting distance and individual characteristics among adults.

Methods: A cross-sectional study included 1111 randomly selected adults who were interviewed in 2017 in Kaunas city, Lithuania. Validated questionnaires were used to collect the data about demographic, socioeconomic factors, travel behaviour, health and other factors. Participants were asked to indicate the most commonly used travel mode to and from work or to the other most common locations. Travel modes were classified into four categories: car, public transport, cycling and walking. Network Analyst extension in ArcGIS was used to determine each participant’s average distance between the two most frequently visited locations.

Results: Our findings showed that only 8% of the study population regularly uses active transport modes to commute to work or to other frequently visited locations. People of higher socioeconomic status (SES) were two times more likely to use the car (OR = 2.11; 95% CI 1.27-3.51), on the contrary, people of lower SES were 57 % (OR = 0.43; 95% CI 0.27-0.71) more likely to use public transport. The results showed that the use of active transport decreased by 19% (OR = 0.81; 95% CI 0.71-0.92) and 31% (OR = 0.69; 95% CI 0.59-0.81), respectively for cycling and walking, for every 1 kilometre increase in commuting distance.

Conclusions: Our findings revealed that commuting distance had the greatest impact on the choice of active transport. The evidence from this study suggests that it is important to consider individual characteristics and commuting distance when analysing travel behaviour to promote active transport and physical activity.
The perceived contribution of a biosphere reserve to physical and mental health

Negev M1, Fares N1, Triguero-Mas M2,3,4,5,6,7,8, Nieuwenhuijsen M2
1University of Haifa, 2ISGlobal, 3Universitat Pompeu Fabra (UPF), 4CIBER Epidemiología y Salud Pública (CIBERESP), 5Universitat Autònoma de Barcelona, 6Institute for Environmental Science and Technology, 7IMIM (Hospital del Mar Medical Research Institute), 8Barcelona Lab for Urban Environmental Justice and Sustainability

TPS 701: Spatial determinants of population health, August 27, 2019, 3:00 PM - 4:30 PM

Background: Exposure to natural environments can have a positive impact on physical and mental health. Few studies have examined individuals’ perception of nature’s contribution to their health. Conflicts over conservation versus development exist across stakeholders and ethnicities in the Mt. Carmel Biosphere Reserve. We applied the ecosystem services assessment framework as a tool to identify perceptions of biosphere residents and visitors from different ethnic groups (Jews, Druze, Muslims) regarding health benefits of nature.

Methods: A cross-sectional study was conducted by dissemination of a questionnaire to residents and visitors (N = 703) to examine outdoor activities, attitudes towards ecosystem services, and perceived health benefits (including items from the PHENOTYPE questionnaire, www.phenotype.eu).

Results: Nature’s contribution to health was perceived as significantly higher by residents (2.90±.82 on a 0-4 Likert scale) compared to visitors (2.70±.90) (t(570)=3.81, p<.001). Factor analysis revealed three contributing factors: “passive interaction with nature improves health,” “active interaction with nature improves health,” and “leisure time in nature improves health more than leisure time in the city.” Perceived health benefits corresponded positively with the frequency of visits (rs=0.30, p<.001), and attitudes towards ecosystem services and rural development (rp=0.35, p<.001). Despite the ethnic diversity at the reserve, no correlations were found between health perceptions and demographic variables. In PHENOTYPE questions Israelis’ perceptions of nature’s contribution to health are significantly higher (2.87±.84) than those of respondents in the UK (2.27±.94), Lithuania (2.11±.78), Spain (2.01±1.0), and the Netherlands (1.27±.8) (F(4,3835)=321.49, p<.001).

Conclusions: Respondents across ethnicities reported that nature benefits their health. In the context of land use conflicts, this may be common ground towards participatory reserve management to benefit the health of the general population. The positive perceptions of Israelis compared to European populations may be explained by the contrast between nature and the everyday stressful, urbanized Israeli lifestyle.
Place and air connect through early life stress to affect inflammation

Olvera Alvarez H, Slavich G, Campen M
1University Of Texas At El Paso

TPS 701: Spatial determinants of population health, August 27, 2019, 3:00 PM - 4:30 PM

Background: Near highways, lower property value results in overlapping exposures to air pollution and psychosocial stressors among individuals of low-socioeconomic status (SES). We recently published a model of how stress could sensitize the immune system to air pollutants and increase the risk of chronic illness. In this study, we tested the hypothesis that individuals that experience severe stress in childhood exhibit an increased inflammatory response to air pollution compared to individuals that experience less stress in childhood.

Methods: We compared inflammatory responses to air pollution among 52 healthy individuals with low (Adverse Childhood Experiences [ACE] scores = 0) and high (ACE ≥ 4) exposure to stress in childhood. On separate occasions, participants were exposed to ambient (polluted) and filtered air (control) inside a mobile laboratory located five meters from an eight-lane highway between 7:00am and 9:00am. Inflammation was indexed by exhaled nitric oxide (eNO) and serum levels of interleukin (IL)-1β, IL-6, IL-8, and tumor necrosis factor alpha (TNFα) measured via a multiplex platform. Interactions between ACE, exposure condition, and inflammation were determined via regression models.

Results: Inflammatory reactivity to air pollution varied significantly by sex, childhood adversity, and biomarker. Among males, significant eNO increments were observed one hour post-exposure, whereas among females eNO significantly decreased one-hour post-exposure. Males with an ACE ≥ 4 had higher 24-hour IL-1β and IL-6, reactivity to air pollution than males with ACE = 0. Females with ACE ≥ 4 had lower 1-hour TNFα reactivity to air pollution than females with ACE = 0.

Conclusions: Growing up in low-SES communities - where exposure to stress and air pollution overlaps - might in fact result in cumulative health effects. Our results suggest that stress exposure early in life affects the inflammatory response of the immune system to air pollution. However, this effect seems multi-directional and strongly influenced by sex.
Impact of a riverside accessibility intervention on use, physical activity, and wellbeing: A mixed methods pre-post evaluation

Vert Roca C1,2,3, Carrasco-Turigas G1,2,3, Zijlema W1,2,3, Espinosa A1,2,3,4, Cano-Riu L1,2,3, R. Elliott L5, Litt J6, J Nieuwenhuijsen M1,2,3, Gascon M1,2,3

1Isglobal, 2Universitat Pompeu Fabra (UPF), 3CIBER Epidemiología y Salud Pública (CIBERESP), 4Municipal Institute of Medical Research (IMIM-Hospital del Mar), 5European Centre for Environment and Human Health, College of Medicine and Health, University of Exeter, 6University of Colorado Boulder

Introduction: Access to natural outdoor environments and parks can promote physical activity, social cohesion, and improved psychological well-being. In 2016, an urban riverside regeneration project was conducted in a socioeconomically-deprived neighbourhood in a city near Barcelona (Catalonia, Spain) which aimed to facilitate access to the riverbank for pedestrians and cyclists. The objective of the present study was to evaluate the effect of this intervention in terms of changes in use and physical activity of users over time. We also assessed the local community’s use and perception of the urban riverside, and their corresponding self-perceived health and well-being over time.

Methods: We conducted systematic observations, before and after the intervention, using the System for Observing Parks and Recreation in Communities (SOPARC) to quantify the use and physical activity levels of users and compared them over time. Qualitative assessment consisted of semi-structured face-to-face interviews with the local community [N(pre)=17; N(post)=6].

Results: We observed a 25% increase in users of the renovated area of the river after the intervention. There was an increase in sedentary users and those engaged in moderate levels of physical activity [from 7.7% to 12.0% sedentary users, and from 66.9% to 68.7% moderately active users before and after the intervention respectively, p<0.001]. The growth of users in the renovated area was mainly driven by females, adults, children, and the non-Caucasian population. Resident interviewees, in general, reported to be happy to live near the river and thought it might benefit their health and well-being. Overall, residents seemed satisfied with the intervention.

Conclusions: Nature-based interventions in socioeconomically-deprived neighborhoods might reduce inequalities in access to natural areas for deprived communities, thereby creating attractive destinations for residents, promoting physical activity and/or creating opportunities for social interactions, and thus improving their health and well-being.
Spatio-Temporal Analysis of Ovarian Cancer Mortality in California

Villanueva C1, Chang J2, Bartell S1,3, Ziogas A2, Bristow R4,5, Vieira V1,4

1Program in Public Health, Susan and Henry Samuelsi College of Health Sciences, University of California, Irvine,
2Department of Medicine, School of Medicine, University of California, Irvine, 3Department of Statistics, Donald Bren
School of Information and Computer Sciences, University of California, Irvine, CA, 4Chao Family Comprehensive Cancer
Center, 5Division of Gynecologic Oncology, Department of Obstetrics and Gynecology, University of California, Irvine
School of Medicine

Background: Some evidence suggests spatially-varying environmental exposures may contribute to ovarian cancer (OC) mortality. Geographic location has been associated with OC survival among women diagnosed in advanced-stages, yet little is known about its effect in early stages or over time. Our objective was to examine spatio-temporal trends in OC survival in California (USA) among women diagnosed in all stages.

Methods: We identified women through the California Cancer Registry who were diagnosed with epithelial OC between 1996 and 2014, with follow-up through 2016. Spatio-temporal trends were examined using cox proportional hazards additive models, smoothing for residential location in six time periods that overlapped by 2 years, stratified by stage (early vs. late). All analyses were adjusted for age, socioeconomic status, insurance status, type of treatment, comorbidities, and cancer characteristics such as grade and histology. Additionally, we considered geographic access to care by including the distance traveled to receive treatment and proximity to the closest high quality-of-care hospital.

Results: During the nearly 20-year period examined, 9,734 early and 20,110 late-stage OC cases were diagnosed in California. The median survival time was 34.5 months. Geographic location was significantly associated with survival among women diagnosed in advanced-stages for each time period; however, after we adjusted for covariates, location only remained an independent predictor between 2002-2006 (global p-value: 0.005). Regions of increased risk during that time were observed in the San Francisco Bay area, southern San Diego County and southern Los Angeles County. Residing in northern Los Angeles and western San Bernardino Counties was significantly protective.

Conclusions: The extent to which women’s residential location impacted survival varied throughout California. Although no significant spatial patterns were observed for women in early stages, significant geographic variations existed during one time period for those diagnosed in advanced-stages. Future research should examine potential environmental impacts during that time period.
Urban design and suicide in a megacity: a study on the long-term association

Wang P¹, Goggins W¹, Ren C², Lau K¹, Zhang X²
¹The Chinese University of Hong Kong, ²The University of Hong Kong

Background/Aim
Evidence has shown that access to green space and urban heat island effect are significantly associated with human health. However, the possible influence of other residential environmental factors is poorly understood. In the current study we aimed to explore the association of urban characteristics with suicide in a densely populated Asian city with highly variable geography.

Methods
Counts on suicide in Hong Kong from 2008 through 2014 were obtained. Explanatory variables included age (>19 years), sex, and tertiary planning unit (TPU) specific population data from 2011 census, and TPU level measurements of socioeconomic status, including marital status, household income, and percentage of population with tertiary education. Urban morphological data included Frontal Area Density (FAD), Sky View Factor (SVF), Ground Coverage Ratio (GCR), Street Coverage Ratio (SCR), and Building Volume Ratio (BVR). Poisson regression models with overdispersion were used to assess the association between TPU level parameters and suicide rate, adjusted with population density, greenery and area-specific socioeconomic variables, with generalized estimating equations employed to account for the correlations among suicide counts from the same TPUs.

Results
Overall analysis showed that an increase of 28.6% and a decrease of 9.7% in suicide rate were estimated per interquartile-range increase in GCR and SCR, respectively. These associations were stronger among men and the elderly, particularly for those who aged over 70. After stratified by age, it was easier for people younger than 70 years to commit suicide when SVF or SCR is lower or GCR is higher whereas lower FAD was the most significant factor that was associated with a higher suicide rate among those older than 70 years. After stratified by season, the main effect of GCR and SCR could only be seen during cooler months (Nov-Apr).

Conclusions
Built environment serves as a non-negligible factor for mental health.
Neighborhood Socioeconomic Status and Mortality Among Heart Failure Patients

Weaver A, Pfaff E, Neas L, Devlin R, Cascio W, Diaz-Sanchez D, Ward-Caviness C

1US Environmental Protection Agency, 2North Carolina Translational and Clinical Sciences Institute, University of North Carolina

TPS 701: Spatial determinants of population health, August 27, 2019, 3:00 PM - 4:30 PM

Background Heart failure (HF) is a major public health concern in the USA with high mortality. Although neighborhood-level socioeconomic status (NSES) is associated with adverse health outcomes in the general community, it is unclear if NSES is associated with mortality in HF patients.

Methods We used electronic health records from 30,060 heart failure patients seen at a University of North Carolina-affiliated hospital between July 1, 2004 and December 31, 2016. We created indicators for NSES using Ward’s hierarchical clustering of ten Census-based measures assessed at the block group level, yielding seven neighborhood clusters across North Carolina (NC). We conducted Cox proportional hazards analysis, adjusting for age, sex, and race, to evaluate differential hazards of mortality across the seven clusters.

Results We assigned participants to one of seven clusters based on NSES and urbanicity: urban low-NSES (97% urban, n=3162), urban middle-low-NSES (91% urban, n=5078), urban middle-high-NSES (98% urban, n=2127), urban high-NSES (96% urban, n=5510), rural low-NSES (8% urban, n=2705), rural middle-NSES (13% urban, n=8258), and suburban high-NSES (85% urban, n=3220, referent). Compared to the suburban high-NSES cluster, hazards of mortality for HF patients were elevated in the urban middle-high-NSES (HR 1.14, 95% Confidence Interval [CI] 1.03-1.22), rural middle-NSES (HR 1.13, 95% CI 1.05-1.19), and rural low-NSES (HR 1.11, 95% CI 1.01-1.20) clusters. Hazard ratios were less elevated among urban middle-low-NSES (HR 1.08, 95% CI 0.99-1.15), urban low-NSES (HR 1.06, 95% CI 0.96-1.14), and urban high-NSES (HR 1.06, 95% CI 0.97-1.13) clusters.

Conclusions Among HF patients, hazards of mortality were generally more elevated for residents of traditionally understudied rural neighborhood clusters, compared to more urban clusters. Residents of the urban middle-high-NSES cluster had a more elevated hazard than other urban clusters, suggesting that additional factors in this cluster may contribute to mortality. This abstract does not necessarily reflect EPA policies.
Non-Cancer risk among electronic waste workers due to inhalation of particulate matter emitted from informal electronic waste recycling activities in Ghana

Kwarteng L1, Arko-Mensah J1, Batterman S2, Robins T2, Fobil J1

1University Of Ghana, 2University of Michigan

Background/Aim: Workers in the electronic waste (e-waste) recycling industry are susceptible to adverse health outcomes due to exposure to particulate matter (PM) and other pollutants resulting from e-waste recycling and other activities that generate air pollutants. Monitoring data is necessary to understand exposures and evaluate associated non-cancer risk in such settings. This study collected and analyzed personal exposure data and then evaluated non-cancer risks due to the inhalation of PM among e-waste recyclers at Agbogbloshie, a large informal e-waste recycling site in Ghana in reference to a comparison group living 10 km away.

Methods: A total of 137 participants (92 e-waste recyclers and 45 controls) were recruited for personal air monitoring between March and April 2017. Five participants were monitored per day. Continuous personal level PM2.5 measurements were taken using SKC Leland Legacy pump and PM2.5 Impact sampler held in a backpack which was worn by each participant over a 4-hour period. Results were compared to guideline levels, potential dose to PM 2.5 was calculated, and risk quotient was determined as the ratio to the reference dose (RfD).

Results: E-waste workers had higher average exposures of PM2.5 (161± 26 μg/m3) compared to the control group (41± 3 μg/m3). Estimated potential dose ranged from 3.8- 24.8 μg/kg-day for PM2.5. Risk quotients exceeded 1 for both groups; however non-cancer risks were 2 to 7 times higher on the average among the e-waste workers.

Conclusion: At the Agbogbloshie recycling site, e-waste workers experienced significantly elevated exposure to PM and increased non-cancer risk compared to the control (unexposed) community. PM composition, exposure patterns, and tasks are being studied to understand possible interventions that may reduce exposure and improve health.
Health Status and Occupational Risks in Nepali Informal Waste Workers

**Chaudhuri N**, Fossier Heckman A, Fauvel G, Lee A, Black M, Karki J

1Medecins Du Monde, 2Sheffield University, 3PHASE NGO

TPS 721: Low and middle income countries: e-waste, occupational health, August 27, 2019, 3:00 PM - 4:30 PM

Health Status and Occupational Risks in Nepali Informal Waste Workers

**Objective**
To assess the health needs and occupational risks for informal waste workers (IWWs) in Kathmandu valley.

**Methods**
A cross sectional survey of 1278 informal waste workers using a bespoke standardised demographic health assessment questionnaire was conducted using face to face interviews. A non-probability sampling method was used with a snowball sampling approach. Using standard sampling size calculator, a 4% precision level was used with an anticipated 50% risk factor prevalence with a 50% confidence interval.

**Results**
In 1278 surveyed, 33% reported being ill in the previous three months with respiratory ailments the most common. Respondents identified injury (81.2%), lungs/breathing problems (38.9%) and infections (24.9%) as the main occupational health risks.

Two-thirds of respondents had been injured at work in the past 12 months, with a median of 3 injuries. Most common injuries were glass (44.5%) and metal cuts (44.1%). Less than half had been vaccinated against tetanus and 7.5% for Hepatitis B.

70.3% said they sought treatment as soon as possible but 2% delayed seeking treatment by more than 24 hours.

Twenty five percent did not know how to protect themselves against these risks while 73% said their job was risky.

Males had twice the odds of not using PPE compared to women (OR 2.19; p <0.001). Indian IWWs had 1.35 odds of not using PPE compared to Nepali IWWs (OR 1.35; p=0.018).

The likelihood of not using PPE increased with age: OR of 1.72 (p=0.005) for those aged 40-54 years of age and 2.97 (p=0.007) for IWWs over 55 years old.

**Conclusion**
IWWs had increased injury risk but were poorly protected with regards to vaccine protection and PPE. This study provides a baseline to assess intervention effectiveness and is the largest of its kind.
Disruption of thyroid hormone regulated proteins and gene expression by polychlorinated biphenyls, polybrominated diphenyl ethers, and new flame retardants in residents of an e-waste region

Guo L1, Ma W1, Liu T1
1Guangdong Provincial Center For Disease Control And Prevention

TPS 721: Low and middle income countries: e-waste, occupational health, August 27, 2019, 3:00 PM - 4:30 PM

Background: Polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and new flame retardants (NFRs) are known thyroid hormone (TH) disruptors, though their disrupting mechanisms in humans are not comprehensively understood. This study aims to examine TH regulated proteins and gene expression in human serum and elucidate their TH disrupting mechanisms.

Methods: Adult participants from an e-waste dismantling (exposed group, n = 57) and a control region (control group, n = 57) in south China provided blood samples for the research. Serum PCBs, PBDEs, NFRs were analyzed using gas chromatography-mass spectrometry. Serum triiodothyronine (T3), thyroxine (T4), FT3, FT4, thyroid stimulating hormone (TSH), thyroglobulin (TG) and thyroxine-binding globulin (TBG) were determined by chemiluminescent immunoassay. RNA expression of TH receptor α (TRα) and β (TRβ), iodothyronine deiodinase I (ID1) were determined using real-time polymerase chain reaction.

Results: Some compounds of PCBs, PBDEs and NFRs showed strong binding affinity to TSH, TG, TBG, gene expression of TRα and TRβ, ID1. High exposures to these chemicals can decrease levels of TBG, TSH, expression of TRα, and increased expression of ID1. However, TH levels were not statistically significantly different between the exposed and the control group.

Conclusions: The associations between these chemicals and TH regulated proteins and gene expression indicates that a combination of TH disrupting mechanisms appear crucial to TH disruption. Also, gene expression appears to be an effective approach to research TH disruption and potential health effects.
Occupational dust exposure and lung functions of steel industry workers in Tamilnadu – a cross sectional study

Johnson P1, Venugopal V1, Durairaj N1, Sandeep G2
1Sri Ramachandra Institute of Higher Education & Research, 2Viswabharathi Medical College

TPS 721: Low and middle income countries: e-waste, occupational health, August 27, 2019, 3:00 PM - 4:30 PM

Background: Occupational diseases occur as a result of a pathologic response of the individuals to their work environment. Steel industry workers in developing countries such as India are often exposed to high concentrations of dusts and fumes that affect pulmonary function. Although several cross-sectional studies have reported reduced lung function among steel plant workers, paucity of data on exposure assessment precludes causal inference.

Aim: Hence, this study was conducted to assess the pulmonary functions of the workers in the various sections of the steel plant and to evaluate the relationship between dust exposure and lung function.

Methodology: The pulmonary function tests viz forced vital capacity (FVC), forced expiratory volume in 1st second (FEV1), peak expiratory flow rate (PEFR), were determined using Koko Spirometer. Information regarding dust exposure, work experience, smoking etc were collected using a standardized questionnaire. Secondary data regarding the levels of dust exposure in different sections was collected.

Results: The maximum RSPM level of 3.25 mg/m3 was found at Blast Furnace-1, maximum TSPM of 12.6 mg/m3 at Wagon Tippler area. It was found that FEV1 (2.30 ± 0.40 vs 2.96 ± 0.81), FVC (3.06 ± 0.48 vs 3.87 ± 1.02) and PEFR (6.23 ± 1.78 vs 7.90 ± 1.62) were significantly reduced among workers in Wagon Tippler area compared with workers in other dust exposure areas.

Conclusion: Prolonged and greater exposure to mineral dust in steel plant results in decline of lung function. This stresses the need for periodic assessment of such workers with spirometry to detect it early and to implement appropriate corrective and preventive strategies.

Key words: spirometry, steel industry workers, occupational exposure, lung function
Occupational exposure to pesticides and mental health among smallholder family farmers in Brazil

Buralli R\textsuperscript{1}, Ribeiro H\textsuperscript{1}, Leão R\textsuperscript{2}, Marques R\textsuperscript{3}, Guimarães J\textsuperscript{4}

\textsuperscript{1}Universidade de São Paulo, \textsuperscript{2}Centro de Tecnologia em Nanomateriais - CTNANO, \textsuperscript{3}Universidade Federal do Rio de Janeiro, campus Macaé, \textsuperscript{4}Universidade Federal do Rio de Janeiro

TPS 721: Low and middle income countries: e-waste, occupational health, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Depression and Anxiety are common mental disorders (CMD) that represent a global major public health concern in terms of lost health and burden of disease. However, the lack of epidemiologic data on specific vulnerable populations, such as farmers, hinders the adoption of strategies to protect and promote health locally. We aimed to screen Brazilian smallholder family farmers for CMD, and explore its association with rural work and pesticide exposure. Methods: This cross-sectional study was conducted in São José de Ubá (SJU), where tomato farming is the primary source of income for its 7,000 inhabitants. During the crop season (2014), 42 pesticide applicators and 36 helpers older than 18y were interviewed about socioeconomic factors, pesticide exposure, and prevalence of CMD through the Self-Reporting Questionnaire (SRQ-20), validated in Brazil. SRQ-20 has 20 binary questions (yes/no), and its standard cutoff for probable CMD is ≥6 for man and ≥8 for women. Findings were compared among applicators and helpers, tested for associations through logistic regression, and adjusted by age, BMI, smoking, and gender. Results: Most participants were exposed to pesticides from an early age, worked with lack of appropriate pesticide training and personal protective equipment (PPE), and often mishandle mixtures of highly toxic pesticides. Helpers were mostly women (72%), used less PPE, and compared to applicators, had higher prevalence of positive answers in more questions of SRQ-20, and twice more were above the cutoff limit (P=0.05). Helpers tend to had more depressive thoughts, and significantly higher risk of having poor digestion (OR=14.5; p=0.04); feeling a worthless person (OR=11.2; p=0.01), and getting easily tired (OR=6.0; p=0.01), after adjustment. Conclusions: Participants had high pesticide exposure and symptoms prevalence suggesting CMD, especially helpers. A better occupational and mental health support must be provided to Brazilian family farmers, to protect their lives, families, and our food.
Risk factors associated with self-reported health among waste pickers in landfill sites in Johannesburg Municipality, South Africa

Made F1,2, Ntlebi 1, Kootbodien T1, Wilson K1,2, Tlhotleng N1,2, Mpume N3, Spo K2,3, Naicker N1,2,4
1Epidemiology and Surveillance Section, National Institute For Occupational Health, 2University of Witwatersrand, School of Public Health, Faculty of Health Sciences, 3Occupational Medicine Section, National Institute for Occupational Health, 4Department of Environmental Health, Faculty of Health Sciences, University of Johannesburg

TPS 721: Low and middle income countries: e-waste, occupational health, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Informal workers are exposed to various hazards that have detrimental effects on their health. However, help seeking behaviour is often determined by the individual’s perception of the status of their health. The aim of this study was to find factors associated with self-reported health status among waste pickers in Johannesburg Municipality, South Africa (SA).

Methods: A cross sectional study was conducted among waste pickers aged 18 years or older, working in two major landfill sites in Johannesburg. Self-reported health was defined as “very good”, “good”, “fair”, and “poor”. Ordinal logistic regression was fitted to assess the association.

Results: A total of 361 participants were included in this study. More than 70% of them were males. Their median age was 31 years (interquartile range (IQR): 27-39). Clinic visit was not associated with self-reported health. Ever smoked (OR: 1.72; 95% CI: 1.112-2.665), reported mental ill health (OR: 1.87; 95% CI: 2.849), chronic (OR: 2.34; 95% CI:1.479-3.689) and infectious (OR: 2.07; 95% CI: 1.779-3.635) diseases were all statistically significantly associated with increased odds of reporting poor health. Participants who were injured were less likely to report poor health (OR: 0.53; 95% CI: 0.307-0.911).

Conclusions: Risk factors for reporting poor health among waste pickers were smoking, chronic and infectious diseases, and a history of mental ill health. However, injuries from cuts showed a decreased odd of reporting poor health. Health promotion as well as improving primary health care access may improve perceptions of good health among informal waste pickers in SA.
PM4 exposures and respiratory symptoms in waste reclaimers at a landfill site, Pretoria, South Africa
Maeteletja T1, Manganyi J1, Wichmann J2
1National Institute For Occupational Health, 2University of Pretoria

TPS 721: Low and middle income countries: e-waste, occupational health, August 27, 2019, 3:00 PM - 4:30 PM

Background: Waste reclaimers, a common sight in most cities and municipal landfill sites globally, are of great benefit as they prolong the operational life of landfill sites. These “invisible environmentalists”, as affectionately known, face various hazards as they sought income from reclaiming. This study aimed to determine if there is any association between personal particulate matter(PM4) exposure of waste reclaimers and their respiratory symptoms. Methods: The study had a cross-sectional epidemiology design. Personal PM4 levels were measured for 9 days in April 2016. The site had on average 200 waste reclaimers working daily. 68 personal PM4 measurements of partial shift sampling were collected according to NIOSH 0600 sampling method. A modified European Community Respiratory Health Survey questionnaire was applied. 53 participants completed the interview-administered questionnaire in English or Sepedi. Descriptive and logistic regression analyses were conducted. Results: The majority of participants were female (66%) with an average age of 49.5 years. Participants worked on average 8.7 hours daily and 10.2 years at the landfill. The mean personal PM4 level was 0.44 mg/m³; below the South African occupational exposure limit (OEL) of 5 mg/m³. Three samples were above the more conservative and protective IOM (Institute for Occupational Medicine) OEL of 1 mg/m³. The most reported respiratory symptoms were coughing, sneezing without flu, nasal congestion, wheezing and wet cough. The number of years working at the landfill significantly increased the likelihood of coughing (OR: 6.02; 95%CI: 1.4-24.6) (unadjusted). Men were more likely to experience chronic cough (OR: 3.42; 95%CI: 0.98-11.96) (unadjusted). Conclusions: PM4 levels were not exceeding legislated limits. Associations between personal PM4 levels and respiratory symptoms were not significant; this may be due to the small sample size as there was a reluctance to participate in the study. Further focus should be given to mineral composites and soot exposure.
A National Analysis of Potential Chronic Kidney Disease of Undetermined Causes in Ecuador

Sippy R1,3, Lotto M2, Narsipur S1, Bhargava R1, Thomas S1, Stewart Ibarra A1
1SUNY-Upstate Medical University, 2Salud Comunitaria, 3University of Florida

TPS 721: Low and middle income countries: e-waste, occupational health, August 27, 2019, 3:00 PM - 4:30 PM

Background: Chronic Kidney Disease of Undetermined Causes (CKDu) is an emerging global health epidemic affecting low-income agricultural workers. Comprehensive studies are lacking from many countries where CKDu is suspected, such as Ecuador.

Methods: We analyzed publicly-available data for Ecuador containing morbidity records of hospitalized individuals from 2010-2015 by province (n=24). Province-level records for chronic kidney disease (CKD) (N18, ICD-10) in male working adults (ages 18-45) were matched to age-specific province population projections from 2010-2015 national census data to calculate CKD rates. A national survey of agriculture (2012-2015) was used to calculate the proportion of each province’s working adult population involved in agriculture.

Results: Over 2010-2015, we found an increasing trend in the CKD rate in male working adults (p=0.017). In 2010 and 2011, the highest rates of CKD were observed in Tungurahua (10.5 and 8.5 per 100,000 people, respectively). In 2012, the highest rate was in Galápagos (20.1 per 100,000 people). In 2013 and 2014, the highest rates were in Napo (18.0 and 14.0 per 100,000 people, respectively); in 2015 the highest rate was in Pastaza (19.9 per 100,000 people). The highest proportion of the population involved in agriculture in 2012-2015 was in Bolivar Province (51.3% to 54.8% of the population aged 15-49).

Conclusions: This ecological analysis is the first examination of potential CKDu in Ecuador. Analysis is ongoing and next steps include a spatial autoregressive analysis to study agriculture, temperature and CKD, while adjusting for potential confounders.
Recycling of scrap metal into artisanal cookware: a public health threat?

Street R1, Mathee A2, Stefan Tanda S3, Hauzenberger C3, Naidoo S4, Goessler W3

1South African Medical Research Council, 2South African Medical Research Council, 3University of Graz, 4University of KwaZulu-Natal

TPS 721: Low and middle income countries: e-waste, occupational health, August 27, 2019, 3:00 PM - 4:30 PM

Background

In South Africa, the use of artisanal cookware made from the recycling of scrap metal is widespread. However, the potential of metal exposure from the use of such cookware has not been investigated. The aim of the study was to determine the risk of metal exposure posed by artisanal cookware available in South Africa to end users.

Methods

Twenty cookware samples were purchased from across South Africa. Aluminum and silicon concentrations were determined using XRF and the total content of 18 elements (Ag, As, Ba, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, V and Zn) were determined with ICP-MS. To investigate the leaching of metals, artisanal cookware pieces were boiled in a 3% acetic acid solution over a 2-hour period and each experiment was repeated three times. Post leaching, secondary electron images were obtained with a JEOL Field Emission Electron Probe Microanalyzer.

Results

The total aluminum (Al) content ranged from 67% to 93%. Silicon was the second most abundant element with a mean of 13.8%. The mean Al migration of 509 mg L-1 was over 100 times the maximum permissible level allowed for cookware. Lead was detected in all samples with numerous samples highlighting cause for concern. Cadmium and mercury were detected in all pots across all three migrations. However the levels were low (highest levels detected were 1.6 ug L-1 and 0.26 ug L-1 respectively). Transmission electron microscopy revealed dramatic change in surface structure after leaching of cookware.

Conclusion

Public awareness on multi-metal exposure and related risks from the use of artisanal cookware should be a public health priority in relevant settings.
TPS 732: Neurological effects in adults
Study of mixtures of organic solvent exposures and amyotrophic lateral sclerosis in Denmark

Dickerson A1, Hansen J2, Thompson S3, Gredal O4, Weisskopf M1

1Harvard T.h. Chan School Of Public Health, 2Danish Cancer Society, 3University of Chicago, 4National Rehabilitation Center for Neuromuscular Disorders

TPS 732: Neurological effects in adults, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disease characterized by rapidly progressive loss of motor function. Previous studies of occupational solvent exposure and ALS were conflicting. However, none of these used objective, solvent-specific assessment such as job exposure matrices (JEMs) to estimate cumulative exposures. In this study, we investigate the association between occupational exposures to multiple organic solvents and odds of ALS.

Methods: We conducted a nested case-control study of occupational solvent exposures - benzene, methylene chloride (MCH), toluene, trichloroethylene, perchloroethylene, and 1,1,1-trichloroethane and ALS diagnosis using population-based data from Denmark. We identified ALS cases from 1982 to 2013 and age- and sex-matched controls. Employment history was obtained from the Danish Pension Fund. We estimated cumulative exposure to solvents based on exposure in 1639 ALS cases and 151,974 controls. We used sex-stratified conditional logistic regression to obtain adjusted odds ratios (aOR) and 95% confidence intervals (CI), for exposures categorized into quartiles and adjusting for residential location and socioeconomic status. We used weighted quantile sum (WQS) regression to further explore combined solvent exposures and risk of ALS in men with any solvent exposure.

Results: Analysis for benzene and MCH exposures in men revealed higher adjusted odds for those with the highest quartile exposure unlagged: aOR=1.35 (95% CI 1.02, 1.80) and aOR=1.26 (95% CI: 1.01, 1.58), respectively, compared to those with no exposure. We observed no trends or notable results in women. Our WQS analysis revealed a significant increase for all exposure lag periods of 26 to 28% in odds of ALS for every one-unit increase in the derived solvent mixture index. Interestingly, the weights of MCH predominated the solvent mixture index for all lag periods.

Conclusion: These findings support those of previously reported associations between ALS and solvent exposures and highlight the need to investigate exposure mixtures.
Plasma Extracellular Vesicle microRNA Expression in Amyotrophic Lateral Sclerosis Patients

Garofalo D¹, Re D¹, Kaye W², Brennan K¹, Kioumourtzoglou M¹, Baccarelli A¹, Factor-Litvak P¹
¹Columbia University Mailman School Of Public Health, ²Agency for Toxic Substances and Disease Registry

TPS 732: Neurological effects in adults, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim:
Amyotrophic Lateral Sclerosis (ALS) is a devastating neurological disease that has been linked to environmental exposures such as pesticides, lead, and smoking. Epigenetic marks such as microRNAs (miRNAs) are crucial in modulating gene expression, and evidence has shown global dysregulation of miRNA profiles in ALS patients. Extracellular vesicles (EVs) are membrane-protected compartments released by cells that transport nucleic acids and exogeneous chemicals such as heavy metals around the body. While encapsulated in EVs, miRNAs are highly stable. The stability and relevance to ALS pathology warrants further study of the potential use of miRNAs as biomarkers for diagnosis and progression. We aimed to characterize the circulating EV miRNA profiles of 100 ALS patients derived from the United States ALS Registry.

Methods:
We isolated EV-encapsulated RNA from the plasma of 100 patients using the exoRNeasy Serum/Plasma Maxi kit (Qiagen). We measured miRNA yield/purity on an Agilent Bioanalyzer 2100 small RNA kit. We profiled miRNAs using small RNA deep sequencing on the Illumina Genome Analyzer IIx platform.

Results:
Of the 514 miRNAs detected, 42 were found in 100% of ALS samples. Among these, 24 (57%) were already described to be dysregulated in ALS. Importantly, we confirmed a pro-inflammatory signature previously found in both sporadic ALS patient and SOD1 mouse model monocytes that includes miR-27a, miR-155, miR-146a, and miR-532-33. Three of these miRNAs were detected in 100% of our sample s, with miR-155 detected in 93%.

Conclusions:
In the largest study described so far looking specifically at the EV-miRNA profile of ALS patients, we were able to confirm several miRNAs that have been linked to ALS. Analyses are ongoing to validate these by qRT-PCR. We will also further investigate novel miRNA candidates that are linked to ALS pathogenic progression by stratifying the sample based on the time since diagnosis.
Predictors and long-term neurological effects of pesticide poisonings in smallholder farmers in Costa Rica

Farnham A, Fuhrimann S, Staudacher P, Winkler M, Mora A

Swiss Tropical and Public Health Institute, University of Basel, Utrecht University, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Institute of Biogeochemistry and Pollutant Dynamics, Department of Environmental Systems Science, ETH Zürich, Central American Institute for Studies on Toxic Substances, Universidad Nacional

Background/Aim
Relatively little is understood about the contributing factors and long-term health consequences of occupational pesticide poisoning in low- and middle-income countries. This study identified socio-demographic and occupational predictors of self-reported pesticide poisonings among farmers in Costa Rica and examined the associations of pesticide poisonings with neurological symptoms in the 12 months prior to interview.

Methods
A cross-sectional survey of 300 organic and conventional smallholder farmers was conducted in Zarcero County, Costa Rica, between May and August 2016. Data on socio-demographic characteristics, occupational history, pesticide exposure, farming practices, pesticide poisonings, and neurological symptoms during the year prior to interview were collected via questionnaire. In addition, height and weight were measured and used to calculate body mass index (BMI). Logistic regression models were fitted to examine exposure-outcome associations of interest.

Results
About 14% of farmers reported having had at least 1 pesticide poisoning, whereas 3% reported having >1. Total years of pesticide application (OR per one-year increase: 1.06 (95% CI: 1.04, 1.08)), being a farm owner (OR: 3.58 (1.81, 7.08) vs. being a farmworker), older age (OR per one-year increase: 1.05 (1.03, 1.08)), being born in Costa Rica (OR: 2.47 (1.17, 5.24) vs. Nicaragua), higher BMI (OR per one-unit increase: 1.10 (1.01, 1.20)), and a smaller farm size (OR per one-hectare decrease: 0.94 (0.89, 0.99)) were associated with having had at least 1 pesticide poisoning. Having experienced a pesticide poisoning was associated with fainting (OR: 5.86 (1.86, 18.41)), problems sleeping (OR: 3.10 (1.58, 6.09)), accelerated heart rate (OR: 2.34 (1.10, 4.97)), numb hands and feet (OR: 2.33 (1.19, 4.53), and irritability (OR: 2.22 (1.14, 4.30) in the year prior to interview.

Conclusions
In our study, self-reported pesticide poisonings were associated with long-term neurological symptoms. Certain subgroups of farmers may be at a higher risk of experiencing a pesticide poisoning than others.
Background: Accumulation of amyloid beta (Aβ) proteins are central to development of Alzheimer’s disease (AD). Air pollution has been implicated in AD through its potential to cause neuroinflammation, microglia activation and white matter abnormalities. To date, no epidemiologic studies have examined the association between air pollution and this important biomarker of AD.

Methods: The Ginkgo Evaluation of Memory Study (GEMS) is a longitudinal cohort of older adults (age 75 and older) recruited from four sites across the United States. Fine particulate matter (PM2.5), course particles (PM10) and nitrogen dioxide (NO2) were predicted from a national universal kriging model which estimated annual average pollutant levels at participant’s residential address one years prior to baseline visit. Both Aβ 1-40 and Aβ 1-42 were measured at baseline (years 2000-2001) and again in 2008 in plasma blood samples using ELISA. We modeled Aβ 1-40 and Aβ 1-42 separately and the ratio Aβ 1-42/Aβ 1-40 using linear regression adjusted for age, race, gender, site, education, neighborhood disadvantage, ApoE4 allele and cystatin-c.

Results: Over 2800 participants had valid Aβ data at baseline. Preliminary cross-sectional results suggest an interquartile range (IQR) increase in PM2.5, PM10 and NO2 was associated with higher levels of Aβ 1-40 but not Aβ 1-42. A 3 μg/m3 higher PM2.5 and PM10 was associated with 4.9 pg/ml (95% CI: 1, 8.7) and 3.7 pg/ml (95% CI: 1.3, 6.1) higher Aβ 1-40 level respectively. A 6 ppb higher NO2 was associated with 3.5 pg/ml (95% CI: -0.09, 7.2) higher Aβ 1-40. An IQR higher PM10 was associated with 0.004 pg/ml lower ratio of Aβ 1-42/Aβ 1-40 (95% CI: -0.007, -0.0006). We will also present repeat measures results.

Conclusions: Preliminary findings suggest an association between PM2.5, PM10 and NO2 and the protein Aβ 1-40. Additional toxicological and epidemiologic research can corroborate this novel association.
Air pollution and Parkinson’s disease: A systematic review and meta-analysis up to 2018

Kasdagli M, Katsouyanni K, Dimakopoulou K, Samoli E
1 National And Kapodistrian University Of Athens, 2 King’s College London

TPS 732: Neurological effects in adults, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim:
Recent epidemiological studies investigate the association between air pollution and neurodegenerative disease. We performed a systematic review and meta-analysis to assess the association between exposure to air pollution and Parkinson’s disease (PD).

Methods:
We performed a literature search in PubMed, Google Scholar and conference abstracts until November 2018. We identified 102 unique studies referring to air pollution and PD, from which 15 were included in the meta-analyses. We applied random-effects models to combine risk estimates and investigated between studies heterogeneity. We investigated associations accounting for multi-pollutant exposures as well as effect modification patterns by sex and smoking habits.

Results:
We identified 13 reports investigating associations of long-term exposure to air pollutants and PD while two reported associations for short-term exposure to PM2.5. The pooled relative risk (RR) for PD following an increase in long-term exposure for 10 μg/m3 in PM2.5 was 1.06 (95% Confidence Interval (CI): 0.99, 1.14) and in NO2 1.01 (95%CI: 0.98, 1.03), while for 5 ppb increase in O3 1.01 (95% CI: 1.00, 1.02) and for 1 mg/m3 in CO 1.34 (95% CI: 0.85, 2.10). The pooled RR for hospital admissions due to PD after a 10 μg/m3 increase in PM2.5 short-term exposure was 1.03 (95% CI: 1.01, 1.05). There was high heterogeneity between study-specific results for most of the analyses, attributed to different populations under study. Effects were robust to multi-pollutant adjustment while there were indications of higher particles’ effects among non smokers.

Conclusions:
We found weak evidence for an association between air pollution mostly originating from traffic, and PD. Although meta-analysis increases power to detect small associations in rare outcomes, further research is needed to elaborate our suggestive results. Such associations are of public health significance considering the aging of population in mostly developed countries.
The association between PM10 and Quality of Life (QoL) in South Korea: A Cross-sectional study

Kim S$^{1,2}$, Kim H$^{1,2}$, Kim H$^{1,2}$, Byun G$^{1,2}$, Choi Y$^{1,2}$, Kim S$^{1,2}$, Lee J$^1$

$^1$Korea University, $^2$BK21PLUS Program in ‘Embodiment: Health-Society Interaction’, Department of Public Health Science, Graduate School, Korea University

TPS 732: Neurological effects in adults, August 27, 2019, 3:00 PM - 4:30 PM

Background/aim

There are limited studies about the association between exposure to PM10 and quality of life (QoL). We aimed to investigate the association between exposure to PM10 and perceived QoL index in South Korea.

Methods

In this cross-sectional study, a total of 3,911 adults having no diseases in 73 districts (‘gu’) of 7 major cities were identified in the Korea National Health and Nutrition Examination Study IV (2007-2009). QoL was measured by EQ-5D that comprises descriptive system and EQ-VAS. Descriptive system records condition of five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) which was divided into two categories in this study. The scores on these dimensions are also converted to a single summary index (SI) which was divided into tertiles in this study. EQ-VAS score records self-rated health on a vertical visual analogue scale which was divided into quartiles in this study. Both in SI and EQ-VAS, higher score means good QoL. We analyzed the association between annual average of PM10 concentration and QoL using logistic linear regression. We adjusted for sex, age, health behaviors and individual socio-economic status.

Results

There was a positive association between 10μg/m3 increase in annual average of PM10 and SI (Odds ratio (OR) for lowest tertile vs the highest tertile: 1.24 [95%CI: 1.08-1.42]). In the analysis for each score of 5 dimensions, only pain/discomfort and anxiety/depression were significantly associated with higher concentration of PM10 (OR for good condition vs bad condition: 1.16 [95%CI: 1.02-1.32]; 1.26 [95%CI: 1.08-1.48], respectively). Higher exposure to PM10 was associated with lower EQ-VAS (1st quartile (lowest QoL) 1.25 [95%CI: 1.08-1.44]; 2nd quartile 1.13 [95%CI: 0.99-1.29]; 3rd quartile 1.08 [95%CI: 0.95-1.23], respectively compared with 4th quartile).

Conclusions

This study suggests that higher long-term exposure to PM10 may be associated with lower QoL in general population and PM10 may be an important factor that affects individual’s well-being, even if it is not the point of view of disease.
Long-term Exposure to Ambient Air Pollution, APOE-ε4 status, and Trajectories of Cognitive Decline in an Urban Cohort of Older Adults

Kulick E1,2,3, Bohme A2,3, Joyce N1, Schupf N2,3,4,5, Kaufman J6, Mayeux R3,4,5, Elkind M2,3,5, Manly J3,4,5, Wellenius G1

1Brown University School of Public Health, 2Mailman School of Public Health, Columbia University, 3Vagelos College of Physicians and Surgeons, Columbia University, 4Taub institute for Research on Alzheimer disease and the Aging Brain, Columbia University, 5Gertrude H Sergievsky Center, Columbia University, 6University of Washington School of Public Health

TPS 732: Neurological effects in adults, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim—Age-related cognitive decline is a growing public health issue as increases in life expectancy and the aging of the baby boom generation are expected to raise the prevalence of cognitive impairment and dementia. Evidence suggests that ambient air pollution from traffic and other sources may be an important risk factor for cognitive decline. We evaluated the association between long-term exposure to ambient air pollution and cognitive decline in a cohort of urban dwelling older adults and tested whether this association is modified by APOE-ε4 status, a known genetic risk factor for cognitive decline.

Methods—The Washington Heights Inwood Community Aging Project (WHICAP) is a prospective, community-based study of aging and dementia in older adults in Northern Manhattan, NYC. At baseline, participants underwent neuropsychological testing and medical examinations. Follow-up assessments occur every 18-24 months. We used mixed-effects models to evaluate the association between markers of ambient air pollution (nitrogen dioxide [NO2]), fine [PM2.5], and coarse [PM10] particulate matter) and measures of global and domain-specific cognitive decline, adjusting for sociodemographic factors and temporal trends. Inverse-probability-of-censoring weights were used to account for selective attrition. Interaction terms were included in the models to assess potential effect modification by APOE-ε4 status.

Results—Among 5,330 participants, individuals exposed to higher residential concentrations of NO2 (per IQR) had lower global cognitive scores at baseline (β=-0.13,95%CI -0.19,-0.07) and more rapid decline (β=-0.05,95%CI -0.06,-0.04), equivalent to approximately one year of aging. Results for PM2.5 and PM10 and from individual functional cognitive domains were similar. The effect of NO2 on cognitive function and decline was stronger among APOE ε4 negative individuals compared to those who were APOE-ε4 positive.

Conclusions—These results add to the growing evidence base surrounding the role of air pollution on accelerated cognitive aging and brain health, particularly in aging urban populations.
Prenatal exposure to chemical mixtures and inhibition among adolescents in the New Bedford Cohort

Iokheles A1,2, Bellinger D1,3, Coull B1,4, Weisskopf M1,5, Korrick S1,6

1Department of Environmental Health, Harvard T.H. Chan School of Public Health, 2Population Health Sciences, Harvard Graduate School of Arts and Sciences, 3Boston Children’s Hospital, 4Department of Biostatistics, Harvard T.H. Chan School of Public Health, 5Department of Epidemiology, Harvard T.H. Chan School of Public Health, 6Channing Division of Network Medicine, Brigham and Women’s Hospital, Harvard Medical School

TPS 732: Neurological effects in adults, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Few studies have assessed whether prenatal exposure to chemical mixtures has cognitive impacts in adolescence.

Methods: The New Bedford Cohort (NBC) is a birth cohort of residents near the New Bedford Harbor Superfund site in Massachusetts. Among 528 adolescents from the NBC, we investigated the association of biomarkers of prenatal exposure to organochlorines (OCs: DDE, HCB, PCBs) and metals (Pb, Mn, MeHg, As) with executive function, a cognitive skill that undergoes substantial development in adolescence. This analysis focused on inhibition, assessed with the Delis-Kaplan Executive Function System Design Fluency (non-verbal task) and Color-Word Interference (verbal task) subtests with scores standardized to a mean of 10, SD of 3. Confounder-adjusted associations were examined for individual exposures using generalized additive models (GAMs) and for exposure mixtures using Bayesian Kernel Machine Regression (BKMR).

Results: NBC adolescents are diverse with 31% non-white and 32% in a low-income household at birth. Their biomarker levels of prenatal OC (cord serum) and metal (cord blood or maternal peripartum hair and toenail) levels were generally similar to other birth cohorts. In GAM models of all exposure biomarkers, there were no significant adverse associations with Design Fluency but increasing cord serum PCBs were associated with poorer Color-Word scores (smooth p=0.047) as were linear terms for Mn (β per IQR increase in Mn=-0.30, 95% CI =-0.72, 0.12) and As (β per IQR increase in As=-0.05, 95% CI =-0.23, 0.13), although not statistically significantly. Similarly, in BKMR models of the exposure mixture, there were no significant adverse associations with Design Fluency but suggestive adverse associations with Color-Word scores.

Conclusion: We observed modest adverse associations of individual and joint exposures to metals and OCs with inhibition. Future work will assess associations of prenatal chemical mixtures with other executive functions, with consideration of potential differential sensitivity to verbal versus non-verbal tasks.
Exposure to fine particulate matter and the temporal dynamics of episodic memory and depressive symptoms in older women

Petkus A1, Younan D1, Espeland M3, Widaman K3, Vizuete W4, Serre M4, Wang X1, Manson J5, Resnick S6, Chen J1

1University Of Southern California, 2Wake Forest School of Medicine, 3University of California, Riverside, 4University of North Carolina, 5Harvard Medical School, 6National Institute on Aging

TPS 732: Neurological effects in adults, August 27, 2019, 3:00 PM - 4:30 PM

Background/aim

Older adults with higher PM2.5 (particulate matter with aerodynamic diameter <2.5 μm) exposures have earlier declines in episodic memory (EM), occurring in the preclinical stage of dementias. Emerging data also suggest PM2.5 exposure may increase depressive symptoms. Although late-life depressive symptoms are associated with EM, the inter-relationship between PM2.5, depressive symptoms, and EM is unexamined.

Methods

Older women (n = 2,202; aged 67-83 in 1999) enrolled in the Women’s Health Initiative Study of Cognitive Aging completed up to eight annual assessments of depressive symptoms (15-item Geriatric Depression Scale) and EM (California Verbal Learning Test; scaled on T-score metric). A nationwide spatiotemporal model (1999-2010) estimated 3-year average ambient PM2.5 exposure at residential locations preceding each assessment. Univariate and bivariate latent-change score structural equation models (SEM) examined how exposures affect the temporal dynamics and bidirectional relation of annual changes in depressive symptoms and EM.

Results

In univariate SEMs, one inter-quartile (4.04 μg/m3) greater PM2.5 exposure was associated with accelerated declines (p<.05) in verbal learning (List A trials 1-3: β=-1.477) and free-recall memory (short-delay: β=-1.426; long-delay:β=-1.106), but not with change in depressive symptoms (β=.119; p=.709). In bivariate SEM, elevated PM2.5 exposures also accelerated the declines in EM measures (β=-1.443 to -1.985; p<.05), which subsequently increased depressive symptoms (β=-.078 to -.053; p<.05), resulting in significant indirect PM2.5 effects on changes in depressive symptoms (β=.077 to .095; p<.05). In contrast, there was no appreciable association between PM2.5 and change in depressive symptoms and no association between depressive symptoms with subsequent EM decline. Findings remained after adjusting for multiple demographic, lifestyle, and clinical factors.

Conclusions

Findings suggest that PM2.5 neurotoxicity may damage brain areas implicated in EM, followed by manifestation of depressive symptoms. Our data did not support depressive symptoms as the neuropsychological mediator of accelerated brain aging associated with PM2.5 exposure.
Long term fine particulate matter exposure and cerebrospinal fluid markers of vascular injury, oxidative stress, and neurodegeneration

Shaffer R\textsuperscript{1}, Li G\textsuperscript{1,3,4}, Peskind E\textsuperscript{2,3}, Zhang J\textsuperscript{5}, Montine T\textsuperscript{6}, Sheppard L\textsuperscript{1,7}

\textsuperscript{1}Department of Environmental and Occupational Health Sciences, University of Washington, \textsuperscript{2}Northwest Network Mental Illness Research, Education, and Clinical Center, VA Puget Sound Health Care System, \textsuperscript{3}Geriatric Research, Education, and Clinical Center, VA Puget Sound Health Care System, , \textsuperscript{4}Department of Psychiatry and Behavioral Sciences, University of Washington, \textsuperscript{5}Department of Pathology, University of Washington, \textsuperscript{6}Department of Pathology, Stanford University, \textsuperscript{7}Department of Biostatistics, University of Washington,

TPS 732: Neurological effects in adults, August 27, 2019, 3:00 PM - 4:30 PM

Background: Growing evidence links air pollution to adverse neurological outcomes, such as cognitive decline and dementia. Biomarkers in the cerebrospinal fluid (CSF) can be utilized to evaluate pathological changes such as cerebrovascular damage and Alzheimer’s disease (AD). Limited studies have probed the association between air pollution and CSF biomarkers in children and young adults; however, no studies have evaluated the association between fine particulate matter (PM2.5) and CSF biomarkers of vascular injury, oxidative stress, and AD in adults.

Methods: CSF was collected from 159 cognitively normal community volunteers (ages 21-100) at VA Puget Sound during 2001-2009. PM2.5 exposure was assigned based on annual average exposure predictions linked to participant address. We conducted adjusted multivariate linear regression to evaluate associations between: 1-year PM2.5 exposure and vascular injury biomarkers (primary: VCAM; secondary: e-selectin); 1-year PM2.5 exposure and oxidative stress biomarkers (F2-IsoPs); and 10-year PM2.5 exposure and AD biomarkers (primary: p-tau; secondary: Aβ1-42, t-tau). Sensitivity analyses considered alternative exposure periods.

Results: In analyses of vascular injury biomarkers, we estimated that a 5 μg/m3 increase in 1-year PM2.5 exposure was associated with a 52.73 (2.12, 103.33) ng/ml increase in VCAM and a 48.33 (1.44, 95.23) pg/ml increase in e-selectin. No associations were found between 1-year PM2.5 exposure and F2-IsoPs. In analyses of AD biomarkers, we estimated that a 5 μg/m3 increase in 10-year PM2.5 exposure was inversely associated with Aβ1-42 (-83.53 (-160.90, -6.17) pg/ml.) No associations were found for p-tau or t-tau. Results were robust to sensitivity analyses.

Conclusions: These novel results indicate associations between long term PM2.5 exposure and CSF biomarkers of vascular damage and AD in cognitively normal adults. These results are aligned with prior studies linking PM2.5 to vascular damage in other biofluids as well as emerging evidence on the role of PM2.5 in neurodegeneration.
Social Networking Site use in young adolescents: association with health-related quality of life and behavioural difficulties

Jenkins R¹⁴, Shen C¹, Dumontheil I², Thomas M³, Röösli M³, Elliott P¹, Toledano M¹
¹ MRC-PHE Centre for Environment and Health, Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, ²Department of Psychological Sciences, Birkbeck, University of London, ³Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, ⁴Public Health Policy Evaluation Unit, Department of Primary Care and Public Health, School of Public Health, Imperial College London

Background/Aim: Despite Social Networking Sites (SNS) having a minimum age of 13, adolescents younger than this age are using SNS. In this study, we aim to examine the association between SNS use and health-related quality of life (HRQoL) and behavioural difficulties.

Methods: We analysed baseline data from a large cohort of 5,229 adolescents from 39 schools in and around London, United Kingdom, participating in the Study of Cognition Adolescents and Mobile Phone. Participants reported the duration of SNS use on mobile phones and other devices as well as night-time SNS use. HRQoL was measured by KIDSCREEN-10 whilst behavioural difficulties were measured by Strengths and Difficulties Questionnaire.

Results: Two thirds of the study population used SNS for more than a minute a day. Weekday and weekend SNS use on both mobile phones and other devices was significantly associated with lower HRQoL in females (all p-values for trend < 0.005) but not males (p-value for interaction by gender <0.01). Using SNS during the night was also significantly associated with lower HRQoL in females (adjusted β coefficient=-2.199 (95% CI -3.175, -1.223)) but not males (β=-0.904 (95% CI -1.941, 0.133)). Higher weekday and weekend use of SNS on both mobile phones and other devices was associated with greater behavioural difficulties (p-values for trend <0.001). Similarly, night-time SNS use was associated with greater behavioural difficulties (β=2.536 (95% CI 2.094, 2.979)).

Conclusions: We would argue that this is an issue that should be considered by policy-makers and SNS providers, as we have shown potential relationships between SNS use and HRQoL and behaviour in 11-12 year olds, despite age restrictions on SNS.
The association of short-term effects of air pollution and sleep disorders among elderly residents in China

Tang M\textsuperscript{1}, Li D\textsuperscript{1}, Liew Z\textsuperscript{2}, Chen K\textsuperscript{1}, Ritz B\textsuperscript{3}

\textsuperscript{1}Zhejiang University, \textsuperscript{2}Department of Environmental Health Sciences, Yale School of Public Health, \textsuperscript{3}Department of Epidemiology, Fielding School of Public Health, University of California, Los Angeles (UCLA)

TPS 732: Neurological effects in adults, August 27, 2019, 3:00 PM - 4:30 PM

Background: Sleep disorders are a main symptom of mental and neurological disorders in elderly and have been previously linked to short-term exposures to air pollution. Here we assessed such associations in China where air pollution exposures are high and the proportion of elderly in the population is growing. We assessed association between short-term air pollutants exposures and hospital visits for sleep disorders among elderly Chinese in Ningbo, China.

Methods: We utilized a regional health information database in China (2008-2017) that collected information on hospital visits for sleep disorders among the elderly (age 60+). Measures of daily air pollution concentrations including nitrogen dioxide (NO\textsubscript{2}), sulfur dioxide (SO\textsubscript{2}), ozone (O\textsubscript{3}), inhalable particles (PM10), and ambient fine particulate matter (PM2.5) were generated from seven environmental air quality monitoring sites in the study area. We used a generalized additive model to evaluate associations between hospital visits for sleep disorders and short-term air pollution exposures for up to 7 days prior to a hospital visit.

Results: Short-term exposure to multiple air pollutants was associated with hospital visits for sleep disorders in an elderly population; with the strongest associations during 2-3 days prior to a clinic visits for traffic-related pollutants including air quality index (AQI), PM2.5, PM10, and NO\textsubscript{2} and for SO\textsubscript{2} and O\textsubscript{3} for 5 days prior to the visits. Effect estimates for females and younger residents (<75 years) were somewhat stronger.

Conclusions: Our study based on large health care record system suggested that short-term air pollution exposures are associated with sleep disorders in the elderly. Future studies with individual level data and an ability to evaluate the severity of sleep disorders and their relation to mental and physical health in general and air pollution are needed.
Ambient Air Pollution and Daily Hospital Admission Risk of Depression in 75 Cities in China
Gu X¹, Guo T¹, Zhang W², Deng F¹, Lin S², Guo X¹, Wu S¹
¹Department of Occupational and Environmental Health Sciences, School of Public Health, Peking University,
²Departments of Environmental Health Sciences, University at Albany, State University of New York

Background/Aim: Depression, as one of the most common mental disorders, is highly prevalent in the population and has been identified as an essential contributor to global disease burden. Previous studies have reported an association between exposure to ambient air pollution and onset and exacerbation of depression, but research evidence in highly-polluted areas is limited. We aimed to investigate the association between ambient air pollution and daily hospital admission risk of depression in urban population during 2013-2017 in 75 cities of China based on the national medical insurances databases — the Urban Employee Basic Medical Insurance (UEBMI) database and the Urban Residence Basic Medical Insurance (URBMI) database.

Methods: We identified hospital admissions for depression during 2013-2017 in the national databases. We examined the associations between ambient air pollutants—fine particles (PM2.5), inhalable particles (PM10), nitrogen dioxide (NO2), sulfur dioxide (SO2), ozone (O3), carbon monoxide (CO) and daily hospital admission of depression in each city using the time-series analysis method and combined the city-specific estimates for each air pollutant by meta-analysis. Meanwhile, we conducted subgroups, sensitivity, two-pollutant model and exposure-response curve analyses.

Results: We included 111,620 hospital admissions for depression in 75 Chinese cities during 2013-2017. For an increase of 10 μg/m³ in PM2.5, PM10, NO2, SO2, O3 and an increase of 1 mg/m³ in CO, we found maximum increases of 0.60% (lag02, 95%CI: 0.11-1.09%), 0.52% (lag03, 95%CI: 0.06-0.99%), 2.18% (lag04, 95%CI: 0.50-3.89%), 1.04% (lag0, 95%CI: 0.09-2.00%) and 4.85% (lag07, 95%CI: 0.72-9.15%) in hospital admissions for depression in the study population, respectively. Subgroups, sensitivity and two-pollutant model analyses highlighted the robustness of risk estimates for NO2.

Conclusions: The study results suggest that increased levels in major ambient air pollutants were associated with increased daily hospital admission risk of depression in the general urban population in China.
Association of Ambient Air Quality with Hand Grip Strength of Korean Elderly

Yook J, Choi H, Hong Y

1Department of Preventive Medicine, College of Medicine, Seoul National University, 2Department of Occupational and Environmental medicine, Seoul St. Mary's Hospital, 3Institute of Environmental Medicine, Seoul National University Medical Research Center

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Background/Aim:
Hand grip strength is an important measure to assess neuromuscular health status of the elderly. We aimed to evaluate the association between ambient air quality and hand grip strength of older population of Korea.

Methods:
We used nationwide cross-sectional survey data of the elderly living in Korea [i.e., the 2008 National Survey of Korean Elderly]. Maximum hand grip strength (in kilograms) among four measurements was used as an outcome variable. We used nationwide outdoor air quality data of AIRKOREA which can be accessed by the general public. Three-year average values of five pollutants [i.e., PM₁₀(Particulate Matter), O₃(Ozone), CO(Carbon monoxide), SO₂(sulfur dioxide), NO(nitrogen monoxide)] of each participant’s address were used in the analysis. We included potential effect modifiers such as sex, age, lifestyle, socioeconomic status in the statistical models.

Results:
We found negative associations between hand grip strength and two air pollutants level(PM₁₀ and CO) in female participants. Each 10μg/m³ increase in three-year average PM10 concentration corresponded to 0.28 kg (95% CI: -0.48, -0.08) lower hand grip strength. Each 100 ppb increase in three-year average CO concentration accord with 0.16 kg (95% CI: -0.25, -0.07) lower hand grip strength. There were no statistically significant association between the rest three pollutants(O₃, SO₂, NO) and hand grip strength of female participants. We found no significant associations in male participants.

Conclusion:
This study suggests that poor ambient air quality might be risk factors for decrease of hand grip strength in elderly women, which is an objective component of frailty syndrome. Further works are needed to ascertain this association and understand the mechanisms.
Adverse birth outcomes in Suriname related to maternal iron intake through consumption of leafy vegetables

Abdoel Wahid F1,2, Hindori-Mohangoo A3,4, Harville E2, Zijlmans W1,5, Lichtveld M2

1Scientific Research Center Academic Hospital Paramaribo, Suriname, 2Tulane University School of Public Health and Tropical Medicine - Global Environmental Health Sciences, 3Perisur (Perinatal Interventions Suriname) Foundation, 4Netherlands Organization for Applied Scientific Research, TNO Healthy Living, 5Faculty of Medical Sciences, Anton de Kom University of Suriname

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background
One in five pregnancies ends in at least one adverse birth outcome in Suriname. Low maternal iron (Fe) intake is associated with adverse birth outcomes, especially low birth weight (LBW). This research represents the first environmental epidemiological investigation in Suriname designed to assess the relationship between maternal intake of Fe, based on the three most frequently consumed leafy vegetables, and birth outcomes. This study is embedded in the Caribbean Consortium for Research in Environmental and Occupational Health, a cohort study that examines associations between environmental exposures and birth outcomes in Surinamese mother-child dyads (n=1150).

Methods
Intake rates of the three most consumed vegetables were identified through a dietary survey of 1038 participants. Fe intake rates were calculated by using intake rates and Fe contents of these three vegetables. Low Fe intake rate (<25th percentile), was the main determinant. Associations with LBW, preterm birth (PTB), and 5 minutes Apgar score <7 were examined using the Chi-square test (birth outcomes’ N=491).

Results
The top three most consumed were Xanthosoma brasiliense (tannia), Cestrum latifolium (bitter greens) and Amaranthus dubius (spleen amaranth) for which low Fe intake rates defined as <0.17 mg/day, <0.45 mg/day and <0.33 mg/day, respectively. Women with low Fe intake rates related to tannia consumption had higher proportions of adverse birth outcomes (28.0 vs. 22.3%; p=0.298), more PTB (20.8 vs. 17.6%; p=0.514), more low Apgar score babies (6.8 vs. 4.3%; p=0.351) and significantly more LBWs (20.8 vs 11.8%; p=0.039). No significant associations were found between low Fe intake rates through consumption of bitter greens and spleen amaranth and adverse birth outcomes.

Conclusions
The findings related to tannia consumption, linking a low Fe intake with especially LBW, are conform previous studies. Analyses examining the association of other nutrients and chemicals in Surinamese vegetables and birth outcomes are ongoing.
Prenatal Exposure to organophosphate and pyrethroid pesticides and birth outcomes in two Urban cohorts of Pregnant Women

Balalian A\textsuperscript{1}, Liu X\textsuperscript{2}, Whyatt R\textsuperscript{3}, Herbstman J\textsuperscript{3}, Daniels S\textsuperscript{4}, Factor-Litvak P\textsuperscript{1}

\textsuperscript{1}Columbia University Mailman School Of Public Health, \textsuperscript{2}Department of Biostatistics, Mailman School of Public Health, Columbia University, 722 West 168th street, New York, NY 10032, USA, \textsuperscript{3}Columbia Center for Children’s Environmental Health, Mailman School of Public Health, Columbia University, 722 West 168th street, New York, NY 10032, USA, \textsuperscript{4}Department of Public Health, Faculty of Health Sciences, Ben-Gurion University,

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

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 birth outcomes. We aimed to investigate the effect of five urinary metabolites of pyrethroid and organophosphates among healthy pregnant women aged 16-35 living in New York City on the birth outcomes of their children.

Methods: Urinary biomarkers of 273 women from two cohorts of a) Thyroid Disruption and Infant Development (TDID) and b) Sibling/Hermanos cohort (S/H) were measured. We imputed the c<sub>LOD</sub> values of the metabolites and missing values of the outcomes and covariates using log-probit regression method and multiple imputation methods, respectively. Linear regression models were used to evaluate the association between the ln-adjusted pesticide concentration and birth length, birthweight and head circumference. The association was assessed in multivariable linear regression models adjusting for season of birth, delivery mode, ethnicity, home ownership, marital status, education, income, employment, gestational age, maternal age and pre-pregnancy BMI separately for each cohort.

Results: In TDID cohort, among boys, for each log unit increase in cpm (urinary metabolite of chlorpyrifos) in maternal urine, there was a 1.30 cm decrease in head circumference (95% CI: -2.41, -0.19). There was a positive association between urinary concentration of 2,4-dichlorophenoxyacetic acid and birthweight (grams) (b=99.7, 95% CI: 5.83, 193.57) in boys. Among girls, for each log unit increase in urinary level of OPM (urinary metabolite of permethrin), there was a 0.70 cm increase in head circumference (95% CI: 0.13, 1.27). In S/H cohort we only found a positive association between urinary level of OPM and birthweight (grams) (b=183.99, 95% CI: 14.08, 353.9) among boys.

Conclusions: Chlorpyrifos metabolites appeared to inversely affect the head circumference of the boys while permethrin metabolites appeared to increase the head circumference among girls.
Associations between ambient air pollutant concentrations and birth weight: a quantile regression analysis

Strickland M², Lin Y¹, Darrow L², Warren J³, Mulholland J⁴, Chang H¹
¹Emory University, ²University of Nevada, Reno, ³Yale University, ⁴Georgia Institute of Technology

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

BACKGROUND: We investigated the extent to which associations of ambient air pollutant concentrations and birth weight varied across birth weight percentiles.

METHODS: We analyzed singleton births ≥27 weeks gestation from 20-county metropolitan Atlanta with conception dates between 1 January 2002 and 28 February 2006 (N=273,711). Trimester-specific and total pregnancy average concentrations for 10 pollutants, obtained from ground observations that were interpolated using 12-km Community Multiscale Air Quality model outputs, were assigned using maternal residence at delivery. We estimated associations between interquartile range (IQR) increases in pollutant concentrations and changes in birth weight using quantile regression.

RESULTS: Gestational age-adjusted associations were of greater magnitude at higher percentiles of the birth weight distribution. Pollutants with large vehicle source contributions (carbon monoxide, nitrogen dioxide, PM2.5 elemental carbon, and total PM2.5 mass), as well as PM2.5 sulfate and PM2.5 ammonium, were associated with birth weight decreases for the higher birth weight percentiles. For example, whereas the decrease in mean birthweight per IQR increase in PM2.5 averaged over pregnancy was -7.8g (95% CI: -13.6g, -2.0g), the quantile-specific associations were: 10th percentile -2.4g (-11.5g, 6.7g); 50th percentile -8.9g (-15.7g, -2.0g); and 90th percentile -19.3g (-30.6g, -7.9g). Associations for the intermediate and high birth weight percentiles were not sensitive to gestational age adjustment. For some pollutants we saw associations at the lowest quantile (10th percentile) when not adjusting for gestational age.

CONCLUSIONS: Associations between air pollution and reduced birth weight were of greater magnitude for newborns at relatively heavy birth weights.
Background: Bisphenol A (BPA) is mainly used to produce polycarbonate (PC) and epoxy resins. It exerts estrogenic and antiandrogenic effects by interacting with estrogen receptors (ERs) and antagonizing the androgen receptor (AR). However, the findings of prenatal exposure and birth outcomes in human epidemiologic study are inconsistent.

Methods: Five hundred and fifty-five pregnant women without adverse pregnancy outcomes were enrolled from Taiwan island-wide and maternal urine was collected in the third trimester. Generalized additive model-penalized regression splines and a multivariable regression model were employed to determine the effects of BPA exposure on birth outcomes.

Results: The detection rate was 83.1%; geometric mean of BPA levels for maternal urine was 0.95 μg/g cre. A significant negative association was found between the natural logarithm of pregnant women’s BPA levels and the Z-score of neonatal head circumference ($\beta = -0.05$cm, p value = 0.03). Pregnant women in the group with BPA above medium had a significantly longer anogenital distance (AGD, the distance from the center of the anus to the underside of the scrotum; $\beta = 2.06$ cm, p = 0.03) in boy.

Conclusion: This study revealed the significant association between maternal BPA exposure and birth outcomes.
Higher Neonatal Blood Pressure in Association with Air Pollution Exposure During the Last Weeks of Pregnancy: an ENVIRONAGE birth cohort study

Cox B1, Madhloum N1, Gyselaers W1,2,3, Roels H1,4, Vanpoucke C5, Lefebvre W6, Janssen B1, Nawrot T1,7

1Centre For Environmental Sciences, Hasselt University, 2Department of Obstetrics, East-Limburg Hospital, 3Biomedical Research Institute, Hasselt University, 4Louvain Centre for Toxicology and Applied Pharmacology, Université catholique de Louvain, 5Belgian Interregional Environment Agency, 6Flemish Institute for Technological Research (VITO), 7Department of Public Health & Primary Care, Occupational & Environmental Medicine, Leuven University

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background:
Elevated blood pressure (BP) in early life may lead to cardiovascular morbidity and mortality in adulthood. Air pollution exposure has been associated with increased BP in adults and children. The contribution of in utero air pollution exposure, however, has been rarely assessed. We investigated the association between newborn BP and prenatal air pollution, traffic and land use indicators.

Methods:
We used data from 427 mother-newborn pairs from the ENVIRONAGE birth cohort. Daily maternal residential air pollutant exposures during pregnancy, including particulate matter with an aerodynamic diameter ≤ 2.5 µm (PM2.5) and ≤ 10 µm (PM10), nitrogen dioxide (NO2), and black carbon (BC), were modelled using a high-resolution spatial-temporal model. The association between newborn BP and air pollution during the last 15 weeks of pregnancy was assessed using distributed lag models.

Results:
Each 5 μg/m3 increment in prenatal PM2.5 exposure was associated with a 2.4 mm Hg (95%CI, 0.5 to 4.2) higher systolic and a 1.8 mm Hg (0.2 to 3.5) higher diastolic BP at birth. Overall (15-week) estimates for PM10 were similar but those for NO2 and BC did not reach significance. Associations between newborn BP and exposures during the last 4 to 5 weeks of pregnancy were significant for all pollutants. An IQR (20.3%) increment in percentage residential greenness in a 5 km radius was associated with a 1.2 mmHg (-2.5 to 0.1, p = 0.07) lower systolic and a 1.2 mm Hg (-2.4 to 0.0, p = 0.05) lower diastolic BP. An IQR (4.1%) increment in percentage industrial area in a 5 km radius was associated with a 1.0 mm Hg (0.1 to 2.0) higher diastolic BP. Residential traffic indicators (distance to major roads and distance-weighted traffic density) did not significantly associate with newborn BP.

Conclusions:
Prenatal air pollution exposure may induce BP elevations from birth onwards.
Associations between psychosocial stress and oxidative stress during pregnancy in Puerto Rico

Eick S1, Meeker J2, Brown P3, Swartzendruber A1, Shen Y1, Milne G4, Alshawabkeh A5, Cordero J1, Ferguson K2,6
1University of Georgia, College of Public Health, 2Department of Environmental Health Sciences, University of Michigan School of Public Health, 3Social Science Environmental Health Research Institute, Northeastern University, 4Division of Clinical Pharmacology, Vanderbilt University Medical Center, 5College of Engineering, Northeastern University,
6Epidemiology Branch, National Institute of Environmental Health Sciences

Background/Aim: Psychosocial stress during pregnancy has been associated with adverse birth outcomes including preterm birth. While hypothalamic-pituitary-axis activation is thought to be the primary driver, oxidative stress and inflammation may also be involved mechanistically. We used data from the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) cohort (N=476), which examines environmental risk factors for preterm birth in the Northern Karst region of Puerto Rico, to examine associations between psychosocial stress measures, demographic characteristics, and urinary oxidative stress biomarker concentrations.

Methods: Perceived stress, depression, negative life experiences, neighborhood perceptions, and social support were self-reported in questionnaires administered during pregnancy. Responses were grouped into tertiles for analysis, where the highest tertile corresponded to highest level of psychosocial stress. Urinary concentrations of 8-iso-prostaglandin F2α (8-iso-PGF2α), its primary metabolite, and prostaglandin F2α (PGF2α) were measured at three study visits (median 18, 24, 28 weeks gestation) and averaged to reflect oxidative stress or inflammation across pregnancy. Geometric means and standard deviations were used to examine distributions of biomarkers across demographic characteristics. Linear models were used to examine adjusted associations between tertiles of psychosocial stress and oxidative stress biomarkers.

Results: Average levels of 8-iso-PGF2α, its metabolite, and PGF2α were higher among pregnant women who were between 18-24 compared to 25-29 years of age, who had public compared to private insurance, and who were unemployed compared to employed (p-value<0.05). However, no associations were observed between tertiles of psychosocial stress measures and biomarker concentrations. Notably, compared to other populations, there are relatively low levels of psychosocial stress in PROTECT.

Conclusions: Psychosocial stress during pregnancy, as indicated by self-reported questionnaire measures, was not associated with biomarkers of oxidative stress and inflammation in the PROTECT population. However, results from our study suggest that these biomarkers are elevated among women of lower socio-economic status, which is typically associated with stress.
Background/Aim: Accumulating evidence suggests that air pollution increases pregnancy loss; however, most previous studies have focused on spontaneous pregnancies where the date of conception and implantation is unknown.

Methods: We included 275 women (345 human chorionic gonadotropin (hCG)-confirmed pregnancies) undergoing assisted reproduction at a New England fertility center. We estimated daily nitrogen dioxide (NO2), ozone (O3), fine particulate matter <2.5 µm (PM2.5), and black carbon (BC) exposures using validated spatiotemporal models from first positive hCG test until day of failure or live birth. Air pollution exposures were averaged over the past week and the whole pregnancy. Adjusted Cox proportional hazards models were used to model time to pregnancy loss (post-implantation days) to estimate hazard ratios (HRs) corresponding to an interquartile range (IQR) increase in pollutant concentration. We tested for violation of proportional hazards by considering an interaction between post-implantation days (<30 days vs. ≥30 days) and air pollution.

Results: The incidence of pregnancy loss was 29% (n=99) with a median (IQR) time to loss of 21 (11, 30) days post-implantation. Average past week exposures to NO2, O3, PM2.5, and BC were not associated with time to pregnancy loss. Overall pregnancy exposure to NO2 was not associated with pregnancy loss; however, there was a statistically significant interaction with time (p-for-interaction=0.01). Specifically, an IQR increase in exposure to NO2 was positively associated with pregnancy loss after 30 days (HR=1.23, 95% CI: 1.09, 1.41), but not in the first 30 days post-implantation (HR=0.84, 95% CI: 0.66, 1.08). Overall pregnancy exposure to O3, PM2.5, and BC were not associated with pregnancy loss regardless of timing. Models evaluating joint effects of all pollutants yielded similar findings.

Conclusion: Higher exposure to NO2 during pregnancy was associated with increased risk of pregnancy loss after 30 days post-implantation. Timing of exposure to pregnancy loss is important to consider.
Oil and gas development activity and spontaneous preterm birth risk in California

Gonzalez D\textsuperscript{1}, Sherris A\textsuperscript{1}, Yang W\textsuperscript{1}, Burke M\textsuperscript{1}, Cullen M\textsuperscript{1}, Shaw G\textsuperscript{1}

\textsuperscript{1}Stanford University

Background: Recent studies have found associations between adverse birth outcomes, including preterm birth, and maternal residence proximity to oil and gas wells. Most attention has focused on unconventional natural gas developments, with little attention to conventional oil and gas extraction. Both conventional and unconventional drilling produce ambient air pollution. In the U.S., conventional drilling is more common than unconventional extraction. Our objective was to determine whether maternal residence proximity to oil and gas drilling activity was associated with increased risks of spontaneous preterm birth in an area with predominantly conventional drilling.

Methods: We conducted a case-control study to examine the association between drilling activity and spontaneous preterm birth risk. The study population comprised 225,374 live singleton births between 1998 and 2011 in eight counties in the San Joaquin Valley, California. Drilling data came from the California Department of Conservation and DrillingInfo, a private data aggregator. We assessed exposure for each birth using inverse square distance weighting for all oil and gas drilling activity within 10 km of the maternal residence. We defined three preterm birth categories based on gestational length (in weeks): 20-27 (very early), 28-31 (early), and 32-36 (moderate). Logistic regression was used to estimate odd ratios (OR) and 95% confidence intervals (CI). We also conducted a sensitivity analysis using a fixed effect for a within-mother sibling analysis.

Results: We found a significant association between exposure to oil and gas drilling and risk of preterm birth for the 28- to 31-week group, robust to adjustment for observed covariates (OR = 1.27, 95% CI = 1.07, 1.50). Significant associations were not observed for the other gestational age categories.

Conclusions: Exposure to oil and gas drilling activity was associated with increased risk of some preterm birth phenotypes in the San Joaquin Valley, California, an area with predominantly conventional drilling.
Background/Aim:
Evidence of the harmful effects of air pollution during pregnancy is mounting. Nevertheless, little is known about its potential effects on fetal mortality an increasingly important component of mortality in childhood, which is still insufficiently known, valued and studied as a public health problem, especially through approaches that integrate the biological and epidemiological dimensions. The proposed project aims to contribute to decreasing fetal mortality by increasing understanding of the complex network of causation related to fetal death, using a multidisciplinary approach.

Methods:
A case-control study with 415 cases (stillbirths) and 415 controls (randomly selected live births) in hospitals in the Metropolitan Region of São Paulo is underway. Mothers will be interviewed, hospital records abstracted, maternal and umbilical cord blood collected and placenta stored for investigation of serum and tissue markers of angiogenesis (vascular endothelial growth factor (VEGF), placental growth factor (PlGF), and fms-like tyrosine kinase receptor-1(sFlt-1)). In addition, DNA methylation and DNA-PAH adducts will be examined together with different measures of ambient and traffic-related air pollution. Non invasive autopsy will be conducted in all stillbirths, by imaging and histopathology guided by image as well as traditional autopsy.

Results:
Analysis will identify environmental, clinical and epidemiological risk factors for stillbirth, investigate their interrelationships and estimate the individual contributions to fetal mortality in this setting. Innovative statistical approaches for mapping the multicausal etiology of fetal deaths will be employed such as causal models and generalized spatial structural equation models with Bayesian inference.

Conclusions:
This research project aims to articulate the epidemiological and clinical frontiers and search for new knowledge to fill important gaps in our understanding of fetal mortality since previous studies have not included the environmental dimension. This will allow the design of effective prevention strategies.
Effects of maternal exposure to neonicotinoid pesticide and oxidative stress on birth outcomes

Huang Y¹, Huang Y¹, Chen M²
¹Department of Safety, Health and Environmental Engineering, National United University, ²Institute of Environmental and Occupational Health Sciences, National Yang Ming University

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Neonicotinoid (NEO) is an environmental pollutant and few studies have been reported on biological monitoring and health effects. The study aims to explore the associations among NEO exposure, oxidative stress, and neonatal birth outcomes. A total 260 mother-infant pairs were selected in Taipei, Taiwan, during 2014-2016. Maternal urine samples were collected during the 3rd trimester of pregnancy, and the information of birth outcomes was retrieved from the medical records. We developed an isotope-dilution high performance liquid chromatography coupled with tandem mass spectrometry (HPLC-MS/MS) method to simultaneously quantify seven neonics, including acetamiprid, clothianidin, dinotefuran, imidacloprid, thiacloprid, thiamethoxam and nitenpyram in urine. Urinary oxidative stress biomarkers (8-hydroxy-2'-deoxyguanosine (8-OHdG), 8-nitroguanine (8-NO2Gua)) and lipid peroxidation (8-iso-prostaglandin F2a (8-isoPF2a), 4-hydroxy-2-nonenal-mercapturic acid (HNE-MA)) were analyzed by HPLC-MS/MS. All infants born to mothers with urinary 8-OHdG levels above the median exhibited a significantly shorter gestational duration. We anticipate this research will help to elucidate the mechanisms and the health effects by which NEO exposure affect and provide the finding to guide future policy for management and control of NEO.
Maternal factors and risk of spontaneous preterm birth due to high ambient temperatures in New South Wales, Australia

Jegasothy E¹,²,³, Randall D²,⁴, Morgan G¹, Nippita T²,⁴,⁵, Ford J²,⁴

¹School of Public Health, University of Sydney, ²Clinical and Population Perinatal Health Research, Kolling Institute, Northern Sydney Local Health District, ³Biostatistics Training Program, New South Wales Ministry of Health, ⁴Sydney Medical School Northern, University of Sydney, ⁵Department of Obstetrics and Gynaecology, Royal North Shore Hospital

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background
Exposure to high ambient temperatures increases the risk of spontaneous preterm delivery. Determining which maternal factors increase or decrease this risk will provide targets for climate adaptation strategies.

Methods
We used quasi-Poisson distributed lag non-linear models to estimate the effect of high temperature – measured as daily minimum, mean and maximum – on risk of spontaneous preterm delivery (23-36 weeks of gestation) in pregnant women in New South Wales, Australia. We estimated the cumulative lagged effects of daily temperature and analyses on subgroups of the population to assess increased or decreased vulnerability to this effect.

Results
Among 916,678 pregnancies, compared with the median daily mean temperature (17°C), pregnant women exposed at the 95th percentile of daily mean temperatures (25°C) had an increased risk of preterm delivery (RR = 1.14, 95% confidence interval 1.07-1.21). Similar effect sizes were seen for the 95th percentile with median of minimum and maximum daily temperatures. This risk was higher among women with diabetes, hypertension, chronic illness and women who smoked during pregnancy.

Conclusion
Higher temperatures increase the risk of preterm delivery and women with pre-existing health conditions and who smoke during pregnancy are more vulnerable to these effects.
Organophosphate pesticide exposure during pregnancy associated with total gestational weight gain: preliminary results from the New York University Children’s Health and Environment Study

Kahn L1, Ghassabian A1,2,3, Afanasyeva Y2, Naidu M1, Mehta-Lee S4, Brubaker S4,5, Trasande L1,2,3

1 New York University School of Medicine, 2 Department of Population Health, New York University School of Medicine, 3 Department of Environmental Medicine, New York University School of Medicine, 4 Department of Obstetrics and Gynecology, New York University School of Medicine, 5 NYC Health + Hospitals/Bellevue

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Gestational weight gain (GWG) among pregnant women has been increasing globally. Excessive GWG is a potentially modifiable risk factor for medical complications of pregnancy as well as adverse postnatal maternal and child health outcomes. Endocrine disrupting environmental chemicals such as organophosphate (OP) pesticides, which are commonly applied to food crops, are potentially obesogenic. We hypothesized that prenatal exposure to OP pesticides would increase total GWG.

Methods: Three dimethyl (DM) and three diethyl (DE) OP metabolites were measured in spot urine samples collected at <18, 18-25, and >25 gestational weeks among participants in the New York University Children’s Health and Environment Study, an ongoing pregnancy cohort. Individual metabolite concentrations were summed to create DM, DE, and total dialkyl phosphate (DAP) metabolite groups. GWG was calculated as the difference between first measured prenatal weight and weight at delivery, extracted from the electronic medical record. We selected potential covariates that were associated with both exposure and outcome, then used backward selection to arrive at the most parsimonious regression models.

Results: Among 147 women with exposure and outcome measures, early pregnancy DAP metabolite concentrations were generally correlated (significant Spearman coefficients ranged from 0.23 to 0.69); concentrations of individual metabolites across pregnancy were not. Total DE metabolite concentration, both measured in early pregnancy and averaged across pregnancy, was associated with increased GWG, as was mean total dialkyl phosphate concentration across pregnancy, although the magnitude of the associations was not clinically significant (each 0.02 kg per 10-fold increase in exposure).

Conclusions: We found a slight but statistically significant association between prenatal OP pesticide exposure and GWG in this preliminary analysis, which was conducted in a limited sample of participants with available measures. Future analyses will utilize samples from a larger group of participants and explore both trimester-specific exposure and trajectories of exposure across pregnancy.
Association of exposure to particulate matter with adverse birth outcomes in the Panel Study on Korean Children

Kim H1, Lamichhane D2, Lee S3, Hong S3, PSKC study group

1Department of Occupational and Environmental Medicine, College of Medicine, Inha University, 2Department of Social and Preventive Medicine, College of Medicine, Inha University, 3Department of Pediatrics, Asan Medical Center, College of Medicine, University of Ulsan

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim

Previous studies have examined associations between air pollution and pregnancy outcomes, but most have reported inconsistent results. We aimed to investigate the association between maternal exposure to particulate air pollution and low birth weight (LBW) and preterm birth (PTB) using a representative data from South Korea.

Methods

We analyzed a representative sample of 2,072 delivered live births between April and July, 2008, using data from the Panel Study on Korean Children (PSKC). During each trimester of gestation and entire pregnancy, the effect of NO2, PM10, and PM2.5 exposure on PTB and LBW was explored. The exposures were assessed by Land Use Regression (LUR). We extracted odds ratio (OR) and 95% confidence intervals (CIs) using logistic regression analyses.

Results

In fully adjusted model, a significantly increased risk of PTB (per 10 μg/m³) increase in PM10 (OR=1.031; 95% CI 1.001, 1.063) and PM2.5 (OR=1.037; 95% CI 1.001, 1.074) exposure during entire pregnancy was observed. Highest ORs were observed during trimester 1 (1.043; 1.010-1.077). Exposures to PM2.5 during trimester 1, trimester 2, and the whole pregnancy were associated with increased risk of LBW increase in PM2.5 [OR with 10 μg/m³ and 95% CIs: 1.044 (1.011, 1.078), 1.034 (1.004, 1.064), and 1.039 (1.003, 1.076), respectively].

Conclusions

This study, based on a representative data from South Korea, provides further evidence linking particulate matter and adverse pregnancy outcomes.

Acknowledgement: This work was supported by a grant from the National Research Foundation of Korea (NRF-2017R1D1A1B03035917) and the National Institute of Environmental Research (NIER) funded by the Ministry of Environment (MOE) of the Republic of Korea.
Modeling of Nitrogen Oxide Exposure during Pregnancy on Birthweight using Generalized Additive Model: A Case of MACE Birth Cohort Study in Durban, South Africa

Mitku A, Zewotir T, Naidoo R, North D

University Of Kwazulu-natal

Background. Birthweight is strongly associated with infant mortality and is a major determinant of infant survival. Several maternal, environmental and social factors determine birthweight. Different statistical techniques provide an opportunity to further explore these relationships.

Aim. To investigate the dependence of birthweight on prenatal maternal exposure to nitrogen oxide and socio-demographic factors, using Generalized Additive Model (GAM) model.

Methods. Data was obtained from the Mother and Child in the Environment (MACE) birth cohort study in Durban South Africa, with pregnant females recruited in early pregnancy from public sector antenatal clinics. Exposure characterization was performed using land use regression techniques. Generalized additive model with Gaussian distribution and identity link function has been introduced to analyze birthweight. Continuous covariates were modelled by the penalized splines were smoothed by the two dimensional p-spline.

Results. A total of 685 births were analyzed. The mothers in the cohort had mean birthweight of 3106.5 grams with standard deviation of 538.2 grams and mean age of 26 years with standard deviation of 5.7 years. The mean annual prenatal nitrogen oxide exposure was found 31.5µg/m3 with standard deviation of 8.6 µg/m3. A change in slope for prenatal NOx concentrations was linearly associated with a change in birthweight (p<0.01). Female child gender (p=0.037) and current smoker (p=0.037) mother were significant linear predictors of child birthweight. The generalized additive model adjusted maternal age (p=0.02) and maternal weight gain (p<0.01) as a significant non-parametric smoothing terms.

Conclusion. The study found support for the flexible modeling of some covariates that clearly have nonlinear influences. Findings from this study provide further evidence of the need for developing strategies to reduce air pollution in order to prevent risks to fetal health and development.
Nitrogen Dioxide pollutant exposure and Birthweight among HIV exposed Newborns within the MACE Birth Cohort

Naidoo R¹, Jeena P², Asharam K¹, Mitku A¹, Muttoo S¹, Tularam H¹
¹Occupational and Environmental Health, University of KwaZulu-Natal, ²Paediatric Pulmonology, University of KwaZulu-Natal

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background. Ambient exposure to nitrogen dioxide has been associated with adverse birth outcomes. This effect, within a population with a high prevalence of HIV, an established driver of birth outcomes, has been inadequately investigated.

Aim. To determine whether the association between antenatal exposure to nitrogen dioxide and birthweight is modified by maternal HIV status

Methods. Pregnant females from public sector antenatal clinics in Durban, South Africa were recruited into the Mother and Child in the Environment (MACE) Birth Cohort. Pregnant females are routinely subjected to voluntary HIV tests as part of antenatal care. Land use regression models were developed to characterise household level exposure. Birth data was obtained at the time of delivery.

Results. The mean age of mothers was 26.2 years (SD: 5.9). A third of the mothers were infected with HIV (31.7%) and all were receiving antiretroviral therapy. Of the 760 live births, 16.4% and 13.5% were preterm (PT) and low birth weight (LBW), respectively, with mean gestational age of 38.8 weeks (SD: 2.0) and mean birthweight of 3.1kg (SD: 0.5). Median NO2 exposure among these participants was 34.3ug/m³ (range: 2.5ug/m³ - 45ug/m³). Although in regression models, adjusting for maternal and passive smoking and maternal alcohol consumption, HIV positive status contributed to a 3g loss in birthweight and one day loss in gestational age, this was not statistically significant. In these same models, exposure to the median NO2 contributed to a non-significant two days less gestational age. There was no evidence of effect modification between NO2 and HIV.

Conclusion. NO2 did not predict birthweight, but may have contributed to a lower gestational age. HIV status does not seem to significantly influence these outcomes. These findings may be an indicator of the low levels of NO2 exposure and the successful anti-retroviral therapy programme in antenatal care in South Africa.
Prenatal Exposure to Organophosphate Pesticide Metabolites Associated with Reductions in Gestational Age and Birth Weight: Results from a population-based cohort study in New York City

Naidu M1, Ghassabian A2, Kahn L1, Afanasyeva Y4, Mehta-Lee S3, Brubaker S3, Liu M4, Trasande L2

1Department of Pediatrics, New York University School of Medicine, 2Departments of Pediatrics, Population Health, and Environmental Medicine, New York University School of Medicine, 3Department of Obstetrics and Gynecology, New York University School of Medicine, 4Department of Population Health, New York University School of Medicine

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background: Exposure to Organophosphate (OP) pesticides, a widely used class of pesticides, have been associated with adverse birth outcomes, shorter gestational age, and low birth weight. The present analysis is designed to examine the relationship of mean prenatal OP exposure across pregnancy measured using urinary levels of six dialkyl phosphate (DAP) metabolite concentrations with gestational age and birth weight among offspring of women in New York City.

Methods: Urinary concentrations of six DAP metabolites, the main urinary metabolites of OP pesticides, were measured in three maternal spot urine samples collected at <18, 18-25 and >25 weeks of pregnancy among participants in the New York University Children’s Health and Environment Study (NYU CHES), an ongoing population-based cohort. Using covariate-adjusted linear regression models, we examined associations between the sum of six DAP (ΣDAP) concentrations with gestational age and birth weight extracted from the participants’ electronic medical record.

Results: Among 157 pregnant women in the NYU CHES birth cohort with available biomarker and outcome measures, a 10-fold increase in mean ΣDAP concentration across pregnancy was associated with a decrease in offspring gestational age at birth and reduction in birth weight, adjusting for covariates. The DAP metabolite concentrations were mostly correlated, with Spearman correlation coefficients ranging from 0.27 to 0.89. Sums of the three dimethyl and three diethyl metabolites were also associated with lower birth weight and gestational age.

Conclusions: We identified associations between the prenatal OP pesticide exposures and gestational age and birth weight in this preliminary analysis. Given how widespread OP exposure is and the urgent need to identify and mitigate causes of preterm birth, further investigation is warranted.

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Prenatal exposure to ambient PM2.5, roadway proximity, pre-term birth, and effect modification by socioeconomic indicators and infant sex

Quraishi S1, Hazlehurst M1, Loftus C1, Karr C1, Tylavsky F2, LeWinn K3, Bush N3, Sathyanarayana S1,4, Szpiro A1, Enquobahrie D1

1University Of Washington, 2University of Tennessee Health Science Center, 3University of California San Francisco, 4Seattle Children’s Research Institute

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background:
While mounting evidence suggests that maternal exposure to ambient air pollution is associated with preterm birth (PTB), few studies examined smaller biologically relevant exposure windows or the role of potential modifiers such as socioeconomic indicators and infant sex.

Methods:
Participants of two cohort studies in the ECHO-PATHWAYS consortium, CANDLE and TIDES, comprised the analytic population (N=1,882). Trimester-specific and biologically relevant windows (0-2 and 10-12 weeks of gestation, and last month of pregnancy) of exposure to particulate matter ≤2.5 (PM2.5) was estimated using a well-validated national spatiotemporal model. In addition, we characterized near road residence as <150m from an A1, A2, or A3 road. PTB was defined as birth <37 weeks completed gestation. Adjusted modified Poisson regression models were used to estimate relative risk (RR) and 95% confidence intervals (CI). Effect modification (EM) by SES indicators (maternal education, household income, neighborhood deprivation index) and infant sex was examined using interaction analyses.

Results:
Among participants, 8.8% had PTB. Median PM2.5 level during pregnancy was 10.3 µg/m3 (interquartile range=1.7), while 35.6% of participants had a near road residence. PM2.5 exposure was not associated with PTB in this population. Near road residence was associated with a higher risk of PTB (RR:1.40; 95%CI:1.03-1.92). We also found suggestive evidence for interactions between near road residence and maternal education and infant sex (p-interaction 0.039 and 0.062, respectively). Associations were larger in those with lower education compared to those with some graduate education. Associations were present in males (RR:1.58; 95%CI:1.04-2.41), but not females (RR:1.21; 95%CI:0.75-1.95).

Conclusions:
Study findings suggest that residence near road is associated with higher risk of preterm birth, particularly among male infants and with lower maternal education. Further studies are needed to improve our understanding of associations of air pollution exposure and birth outcomes and identify vulnerable subpopulations.
Maternal gestational exposure to di-butyl phthalate (DBP) from medications and birthweight of progeny
Rotem R\textsuperscript{1,2}, Chodick G\textsuperscript{2}, Shalev V\textsuperscript{2}, Hauser R\textsuperscript{1}, Nguyen V\textsuperscript{1}, Weisskopf M\textsuperscript{1}
\textsuperscript{1}Harvard T.H. Chan School Of Public Health, \textsuperscript{2}Maccabi Institute for Research and Innovation

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background
Birthweight, an important predictor of long-term morbidity, is affected by several environmental factors. Thus, birthweight can be used as an early indicator for adverse health conditions that are linked with suboptimal in-utero development, including those possibly caused by gestational exposures to environmental toxicants. Di-butyl phthalate (DBP) is used as an excipient in some mesalamine medications prescribed for treatment of inflammatory bowel disease (IBD), leading to extremely high exposures among patients. DBP is an endocrine disruptor, yet its effects on birthweight have not been conclusively elucidated. We evaluated whether maternal gestational use of DBP-containing medications is linked with alterations in birthweight of progeny.

Methods
We conducted a population-based analysis of 546,432 singletons born in 1999-2015 in a large Israeli health fund. Medication dispensing, birthweight, and demographic data were abstracted from electronic medical records. Analyses were performed using generalized estimating equation (GEE) and generalized additive linear regression models.

Results
2,276 singletons were exposed to mesalamine medications during gestation, of which 162 were exposed to a mesalamine formulation with DBP. In models adjusted for sociodemographic factors and other known predictors of birthweight, maternal gestational use of DBP-containing mesalamine formulation was associated with a reduction of 132.0g [95% C.I.: -240.8, -23.1] in birthweight, whereas use of non-DBP mesalamine formulations was associated with a decrease of 77.8g [95% C.I.: -104.7, -51.0] as compared to singletons from mothers not treated with mesalamine. Additional adjustment for gestational age did not alter results.

Conclusions
Maternal gestational use of DBP-containing mesalamine medications was associated with a reduction in birthweight, although some of the effect is likely attributed to the underlying IBD. Subsequent analyses will examine longer-term adverse developmental outcomes possibly associated with gestational pharmaceutical exposure to DBP and other phthalate congeners. Future studies should evaluate whether similar findings are observed with less extreme exposures that more closely reflect background environmental levels.
Ambient Air Pollution Exposure During Pregnancy and Neurobehavioral Status at Birth

Savitz D1, Wellenius G1, Eliot M1, Marsit C2
1Brown University, 2Emory University

Toxicant exposure during pregnancy is recognized as causing adverse effects on infant neurodevelopment, with growing research implicating community air pollution. For many indicators of neurodevelopment, assessment can only be made as the infant progresses, with subtle deficits typically not measurable at birth. The Neonatal Intensive Care Unit Network Neurobehavioral Scale (NNNS) was developed to assess the infant’s status shortly after birth and has been shown to be a sensitive indicator with predictive validity for future status. The NNNS provides quantitative results for 13 scales: orientation, habituation, hypertonicity, excitability, arousal, lethargy, non-optimal reflexes, asymmetrical reflexes, stress, self-regulation, quality of movement, and handling. Data from the Rhode Island Child Health Study, a cohort of term births 2009-2013 in Providence, Rhode Island, US was analyzed to assess the association between estimated ambient air pollution during gestation and infant neurobehavioral health. We estimated trimester-specific residential ambient levels of black carbon and PM2.5 using satellite imaging and land-use regression models, as well as distance to major roadways. The NNNS assessment was conducted by trained research staff shortly after delivery and covariate data were collected from maternal interviews. A cohort of 309 infants with complete data on exposure, outcome, and covariates was analyzed. Adjusted odds ratios were calculated relating estimated air pollution to dichotomized NNNS scale scores. Results for all scales except attention response, arousal level, and habituation response were essentially null. There was little consistency in which pollutant and trimester were associated with these scales. These largely null results suggest that within the range of air pollution of this northeastern US city, there is unlikely to be a substantial broad impact on infant neurobehavioral health, but more selective associations between specific pollutants, times in gestation, and neurobehavioral functions are possible.
Climate has been reported to affect birthweight and few studies have been conducted in the Pacific region where influence of climate change can be reflected to health status directly. This study aimed to investigate the association between climate variability including El Niño Southern Oscillation (ENSO) and birthweight in Tuvalu, a Polynesian atoll island country located beneath the tropical Pacific Ocean. Data of all newborns born in Tuvalu between January 1980 and August 2018 were obtained from Ministry of Health (n = 7,528). Oceanic Niño Index (ONI) which is used for operational definitions of ENSO events and sea surface temperature measurement including NINO3, NINO3.4, and NINO4 together with local temperature and precipitation were used as climate variables. The average ONI and sea surface temperatures during full gestational period and each trimester of pregnancy were calculated for each newborn. Generalized additive model (GAM) was used to analyze the relationship between the average ONI and sea surface temperatures during each period of pregnancy and birthweight. Logistic regression model was also used to analyze the relationship between the average ONI and sea surface temperatures and low birthweight (LBW) birth defined as less than 2,500 grams according to the criteria of World Health Organization. Both models were adjusted for sex, birth islands, mother’s age group, marital status, and GDP per capita in the year of birth. GAM analyses demonstrated a negative relationship between birthweight and ONI. However, above a certain temperature, NINO4 and birthweight showed a positive relationship. The odds ratios of LBW birth were 0.93 (95% confidence interval (CI), 0.79-1.11), 1.05 (95% CI, 0.90-1.23), 0.93 (95% CI, 0.80-1.08), and 0.86 (95% CI, 0.73-1.01) for a unit increase of average ONI during full gestational period and each trimester of pregnancy. In conclusion, birthweight of Tuvalu was partly affected by climate variability.
A National Study of Maternal and Paternal Occupational Exposure to Endocrine Disrupting Chemicals and Pregnancy Outcomes


1The Hebrew University of Jerusalem, 2Ministry of Health, 3Hebrew University-Hadassah, 4Bar Ilan University

TPS 742: Adverse birth outcomes 1, August 27, 2019, 3:00 PM - 4:30 PM

Background:
Endocrine disrupting chemicals (EDC) are substances that can alter the endocrine system function. EDC may affect fetal growth and other pregnancy outcomes.

Aim:
This study aims to assess whether maternal and paternal occupational exposure to EDC are associated with pregnancy outcomes.

Methods:
This study was based on a national birth retrospective cohort registry of the entire Israeli population, 2000-2014. A total of 2,048,191 maternal and paternal job titles for singleton live births without congenital malformations, were coded according to SOC2000 and linked to a job exposure matrix that assessed occupational exposure to 10 EDC groups. Exposure to EDC was estimated for maternal and paternal job titles (628,350 and 595,824 births, respectively). Multiple linear and logistic regression were used to evaluate the associations between overall EDC exposure and specific EDC groups and pregnancy outcomes, adjusted for socio-demographic variables.

Results:
Maternal occupational exposure to EDC was associated with increased mean birth weight (13.07 gr, 95%CI: 8.47, 17.67), increased odds for macrosomia, large for gestational age newborns and reduced odds for low birth weight (LBW) and small for gestational age (SGA) newborns. The main exposure effects were due to exposure to metals.

Paternal occupational exposure to EDC was associated with decreased mean birth weight (-5.14 gr, 95%CI: -7.59, -2.70) and increased odds for SGA and preterm delivery. Paternal occupational exposure to polychlorinated organic compounds and brominated flame retardants were associated with increased mean birth weight and reduced odds for LBW.

Conclusion:
The results of this national-scale study suggest that parental occupations classified as exposed to EDC are associated with adverse pregnancy outcomes. These associations differed between maternal and paternal exposures.

This study directs further research and provides a unique platform for future studies on occupational legislations that will protect newborns health and will improve public health.
Prenatal exposure to phenolic compounds, widely used in many consumer products, can alter lung development and increase the risk of respiratory disorders in the offspring. However, evidence is scarce and mostly focused on bisphenol-A (BPA), although there are other substitutes that could also interfere with the developing respiratory system. We aim to estimate the association between exposure to 5 phenols during pregnancy (BPA, BPAF, BPB, BPF, and BPS) and lung function, wheeze, and asthma in school-age children. We included 2685 mother-child pairs from 8 European birth cohorts. Phenols concentrations were determined in urinary maternal samples collected during pregnancy (1999-2010). Between 6 and 10 years of age, spirometry was performed, and wheeze and asthma were assessed from questionnaires. Adjusted multivariable linear regression and logistic regression models were used to assess the associations. We performed meta-analyses of cohort-specific estimates.

We observed widespread prenatal BPA exposure with 79% of the samples above detectable limits; the other phenols were detected in fewer samples. Median BPA concentrations ranged from 1.04 to 9.54 µg/g of creatinine. Increasing BPA concentrations during pregnancy tended to be associated with lower forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) and were associated with increased odds of wheezing between ages 6 and 10 years (adjusted odds ratio=1.09; 95% CI=0.96, 1.24), but not with asthma. Final results including associations of the other phenols with respiratory outcomes including wheezing patterns from birth will be presented.

Preliminary results showed that prenatal exposure to BPA might increase the odds of wheezing in school-age children.
Short-term exposure to air pollution and pollen and associations with lung function in French children from the PARIS birth cohort

Amazouz H\(^1\), Bougas N\(^1\), Momas I\(^1,2\), Rancière F\(^1,2\)

\(^1\)Univ Paris Descartes, Faculté de Pharmacie de Paris, \(^2\)Inserm, UMR1153-CRESS, team HERA, \(^3\)Mairie de Paris, Direction de l’Action Sociale, de l’Enfance et de la Santé

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim:
The relation between short-term exposure to both air pollution and pollen and lung function has been rarely studied. Therefore, we aimed to investigate this association in the PARIS cohort.

Methods:
This study was conducted among 977 children from the PARIS birth cohort, who performed lung function testing at 8-9 years. Data on exposure to pollen and air pollution were collected up to 4 days prior the visit from the French Aerobiological Surveillance and the Paris air quality monitoring networks, respectively. We estimated the daily total concentration of 19 species of pollen allergen, a weekly pollen risk index for 9 types of pollen and mean daily concentrations of pollutants (PM10, NO2, O3). Children with similar exposure patterns were grouped into profiles using multidimensional longitudinal cluster analysis. Associations between these profiles and respiratory parameters (FVC, FEV1, FeNO) were studied by multivariable, linear and logistic regression models, adjusted for potential confounders.

Results:
Four distinct exposure profiles were identified: (1) with no pollen and low air pollution exposure, (2) exposed to both grass pollen and O3, (3) exposed to birch, ash, plane tree pollen, and (4) exposed to the highest levels of PM10, NO2, alder, cypress, hazel and poplar pollen. Compared to children in the "weakly exposed" cluster, children in the "grass pollen" cluster had a decreased FVC and FEV1 (adjusted \(\hat{\beta} = -49.9\)ml, 95%CI: -91.6; -8.3 and \(a\hat{\beta} = -29.9\)ml, 95%CI: -64.8; 4.9, respectively) whereas children in the “PM10” cluster tended to have an increased risk of FeNO>20 ppb (aOR=1.83; 95%CI: 0.97; 3.42). A significant interaction with allergic status was found (p=0.04), the negative effect of “grass pollen” and “PM10” clusters on lung function being stronger in allergic children.

Conclusions:
These results suggest a joint effect of short-term exposure to air pollution and pollen on a decrease in lung health, especially in allergic children.
Interaction between air pollution and pollen seasons on allergic rhinitis control

Bédard A\textsuperscript{1,2,3}, Bousquet J\textsuperscript{4,5}, Antó J\textsuperscript{1,2,3}, García-Aymerich J\textsuperscript{1,2,3}, Arnavelhe S\textsuperscript{6}, Laune D\textsuperscript{6}, Sofiev M\textsuperscript{7}, Basagaña X\textsuperscript{1,2,3}

\textsuperscript{1}ISGlobal Barcelona, \textsuperscript{2}Universitat Pompeu Fabra (UPF), \textsuperscript{3}CIBER Epidemiología y Salud Pública (CIBERESP), \textsuperscript{4}MACVIA-France, Fondation partenariale FMC VIA-LR, \textsuperscript{5}INSERM U 1168, VIIMA, \textsuperscript{6}Kyomed, \textsuperscript{7}Finnish Meteorological Institute

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

A few studies have suggested an interaction between air pollution and pollen exposure on allergy symptoms but more research is needed. As part of the POLLAR (Impact of Air Pollution in Asthma and Rhinitis) project, we investigated the associations between major air pollutants (ozone and PM 2.5) and allergic rhinitis control, during grass and birch pollen seasons, using the Allergy Diary app (a validated mHealth tool for allergic rhinitis management). The daily impact of allergic symptoms was recorded, using visual analogue scale (VAS), by 3,328 geolocated app users in 2017 and 2018 in Northern Europe, representing 36,523 VAS days. Uncontrolled allergic rhinitis was defined either as 1) VAS≥50, 2) VAS≥35 with intra-nasal corticosteroids or azelastine-fluticasone propionate use or 3) VAS≥20 and use of ≥3 allergic rhinitis medications.

For each VAS recorded with geolocation, pollutants levels were assessed using the SILAM (System for integrated modelling of atmospheric composition) database, and pollen seasons were assessed by regions using Google Trends. Generalized estimating equation models were used to account for repeated measures per user, adjusting for gender, age, treatment and country. Positive associations were found between ozone and uncontrolled allergic rhinitis during the grass pollen season only (ORs=1.25 [1.11; 1.41] and 1.14 [1.04; 1.25], per interquartile range increase in ozone, for 2017 and 2018 respectively). A similar trend was found for PM 2.5 levels in 2017 while results for 2018 did not suggest any effect modification by pollen seasons. These results show the importance of air pollution and allergen concentrations, and their interaction, as predictors of allergic rhinitis control.
Sensitization profiles at age 8-9 years in the PARIS birth cohort and related environmental risk factors
Berroua M1,2, Momas I1,2,3, Rancière F1,2
1Université Paris Descartes, 2Inserm, UMR1153 - Team HERA, 3Mairie de Paris, Direction de l’Action Sociale, de l’Enfance et de la Santé

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: The prevalence of allergic diseases has increased over the past decades, especially in developed countries, and environment may contribute to this increase. From a preventive perspective, it is essential to identify the environmental risk factors of allergic diseases in childhood. The aims were to determine the prevalence of allergic sensitization at 8-9 years in the PARIS (Pollution and asthma risk: an infant study) birth cohort, to identify different profiles of allergic sensitization, and to highlight their environmental risk factors.

Methods: Allergic sensitization was assessed at 8-9 years by two techniques (specific IgE levels and skin prick tests (SPT)) for 10 allergens. The children’s environment and way of life were evaluated using self-administered questionnaires regularly completed by the parents. Different sensitization profiles were identified by cluster analysis and the environmental risk factors were studied by multivariable multinomial logistic regression models.

Results: 943 children were included in this study and 34.7% were sensitized mainly to airborne allergens. Three sensitization profiles were identified: a "no or pauci-sensitized" group, a "house dust mite" group and a "grass and birch pollen" group.

Girls were less likely to be sensitized: aOR=0.5 (95% CI: 0.3-0.8) for the "house dust mite" group and aOR=0.5 (95% CI: 0.3-0.9) for the "grass and birch pollen" group. The risk of belonging to the "house dust mite" group was increased by age (aOR=1.6; 95% CI: 1.1-2.4), parental history of allergy (aOR=1.7; 95% CI: 1.1-2.7), floor carpeting in the child’s room at birth (aOR=1.7 ; 95% CI: 1.0-2.7 ) and the use of gas for cooking (aOR=1.6; 95% CI: 1.0-2.5). A running mechanical ventilation in the dwelling increased the risk of belonging to the "grass and birch pollen" group (aOR=1.8; 95% CI: 1.0-3.2).

Conclusions: This study showed two sensitization profiles at age 8-9 years which differ in terms of environmental risk factors.
Use of cleaning agents at home and respiratory and allergic symptoms in adolescents: the PIAMA birth cohort study.

Bukalasa J1, Brunekreef B2, Koppelman G3, Vonk J4, Gehring U5

1Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands, 2Institute for Risk Assessment Sciences, Utrecht University, Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht, The Netherlands, 3University of Groningen, University Medical Center Groningen, Beatrix Children’s Hospital, Department of Pediatric Pulmonology and Pediatric Allergology, University of Groningen, University Medical Center Groningen, Groningen Research Institute for Asthma and COPD (GRIAC), Groningen, The Netherlands, 4Department of Epidemiology, Groningen Research Institute for Asthma and COPD (GRIAC), University of Groningen, University Medical Center Groningen, Groningen, The Netherlands, 5Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: It has been suggested that adults, who use cleaning agents in their homes have a higher risk of asthma and allergic symptoms. The associations of asthma and allergic symptoms with household use of cleaning agents in adolescents have not been investigated yet.

Objectives: To examine the associations of household cleaning agents use with the prevalence of asthma, rhinitis and eczema in adolescents.

Methods: In this cross-sectional analysis, we included participants of the PIAMA birth cohort study with data on household use of 10 types of cleaning agents and information on asthma, rhinitis and/or eczema from parent-completed questionnaires at age 14 (N = 2,333). For cleaning agents, we developed a composite score ranging from 0 (no exposure) to 30 points (household use on 4-7 days per week for all 10 types of cleaning agents). Logistic regression was used to analyse associations between household cleaning agents use and outcomes, adjusting for potential confounders.

Results: Seven, 13 and 11% of the participants had asthma, rhinitis and eczema, respectively, at age 14. Household use of cleaning agents was not associated with asthma, rhinitis and eczema. For instance, adjusted odds ratios (95% confidence interval) for the prevalence of asthma, rhinitis and eczema comparing those with the highest use of cleaning agents (≥ 10 points) to those with never/seldom use (0-4 points) were 0.95 (0.56, 1.63), 1.23 (0.82, 1.82) and 0.95 (0.56, 1.63), respectively. For individual cleaning agents, we only found the use of ammonia to be significantly associated with a lower risk of rhinitis [0.60, (0.44, 0.82)].

Conclusions: There was no indication of an increase in prevalence of asthma, rhinitis or eczema among adolescents living in households within the highest category of cleaning agents use.

Keywords: Cleaning agents, Asthma, Rhinitis, Eczema, Birth cohort, Adolescence.
Determinants of airborne rodent allergens in Dutch households: a pilot study

Burt S1, Parramon Dolcet L1, Wouters I1

1Utrecht University, IRAS

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: Exposure to airborne rodent allergens in homes may sensitize people, particularly children, and predispose to allergies and asthma. Little research has been conducted in Europe regarding indoor exposure to airborne rodent allergens. The aims of this study were: to gain insight into the prevalence of mouse and rat allergens in airborne dust in Dutch households, to assess whether there is a relationship between rodent sightings and detectable allergens, and to identify risk factors associated with the presence of rodent allergens.

Methods: Passive sampling using electrostatic dustfall collectors was carried out to collect dust from 80 randomly selected households in the Netherlands. The samples were analysed for mouse (Mus m 1) and rat (Rat n 1) allergens. Participants completed a questionnaire on building characteristics, household pets, cleaning habits and ventilation. Presence of allergens was analysed by logistic regression analysis and level of allergens by linear regression analysis.

Results: Almost half of the dust samples from homes contained detectable levels of mouse allergen and 8% contained rat allergen. Mouse sightings within the past year more than doubled the odds of detectable mouse allergen (univariable OR = 2.2; 95% CI, 0.90 – 5.55). Proximity to green areas (multivariable OR = 0.18; 95% CI, 0.05 – 0.63), ventilation through an open window (multivariable OR = 6.10; 95% CI, 1.89 – 19.71) and insulation under the living room floor (multivariable OR = 3.28; 95% CI, 1.04 – 10.36) promoted detectable mouse allergen. Conversely, proximity to surface water was protective (multivariable OR = 0.24; 95% CI, 0.07 – 0.84). No significant association was found between asthma prevalence and detectable mouse allergen.

Conclusions: The passive EDC sampling method was used successfully to detect mouse allergens in Dutch homes. Risk factors and protective factors associated with the presence and levels of mouse allergen have been identified.
Is childhood asthma associated with biological aging markers?

Casas M¹,²,³, Guzmán A¹,²,³, Maitre L¹,²,³, Bustamante M¹,²,³, Siroux V⁴, Granum B⁵, Agier L⁴, Guerra S⁶, Nawrot T⁷, Vrijheid M¹,²,³
¹ISGlobal, ²Universitat Pompeu Fabra (UPF), ³CIBER Epidemiología y Salud Pública (CIBERESP), ⁴Team of Environmental Epidemiology applied to Reproduction and Respiratory Health, Inserm, CNRS, University Grenoble Alpes, Institute for Advanced Biosciences (IAB), U1209 Joint Research Center, ⁵Norwegian Institute of Public Health, ⁶Asthma and Airway Disease Research Center, University of Arizona, Tucson, ⁷Center for Environmental Sciences, Hasselt University

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Asthma is an inflammatory disease of the airways that can lead to the production of reactive oxygen species. Therefore, asthma could be associated with an accelerated biological aging. We explored whether wheezing and asthma in school-aged children could affect telomere length (TL), mitochondrial DNA content (mtDNA), and DNA methylation age.

We used data from 1,623 children from six European birth cohorts. At 6-11 years of age, a blood sample was collected and parents reported the occurrence of wheezing and asthma. We defined active wheezing as having had any episode of wheezing or having taken medication for asthma in the last year. Asthma was defined as asthma ever diagnosed by a doctor. Relative TL and mtDNA were determined by quantitative real-time polymerase chain reaction and methylation age using 450k methylation data and the Horvath and Hannum algorithms. Linear regression models adjusted for confounders including smoking and air pollution were applied.

Prevalence of wheezing and asthma was 17% and 10%, respectively. Asthma was borderline statistically significantly associated with a decrease of 3.0% [95%CI: -6.5%; 0.5%] in mtDNA, compared with children without asthma. mtDNA also decreased in children with wheezing compared with no wheezers but results did not reach significance. Wheezing and asthma were associated with borderline increase in Hannum methylation age (β 0.28; -0.13, 0.68 for wheezing and β 0.18; -0.30, 0.67 for asthma). Neither wheezing nor asthma was associated with TL.

We found little evidence of associations of school-age wheezing and asthma with three aging markers. The overall lack of molecular damage indicates that there is a chance for treatment and prevention for asthmatic children at school-age to diminish damages due to asthma related oxidative stress.
The body of evidence on pollen-related asthma exacerbations in children in the climate change era

De Sario M\textsuperscript{1}, Falcone E\textsuperscript{1}, de'Donato F\textsuperscript{1}, Scortichini M\textsuperscript{1}, D'Ovidio M\textsuperscript{2}, Davoli M\textsuperscript{1}, Michelozzi P\textsuperscript{1}

\textsuperscript{1}Department of Epidemiology Lazio Region - ASL Roma 1, \textsuperscript{2}Department of Occupational and Environmental Medicine, Epidemiology and Hygiene, Italian Workers’ Compensation Authority (INAIL)

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background/aim
Climate change poses a risk to both respiratory and children’s health. Flowering is starting earlier, pollen species moving from north to southern regions, and pollens in urban areas becoming more allergenic due to air pollution. The respiratory health of the most vulnerable such as children need to be protected from these multiple risks. We quantified the health burden related to pollen in children with asthma, considering the potential interaction with air pollution.

Methods
A systematic literature review was carried out using both indexed and free terms in Embase and Medline (Ovid) since 1999 to date. We included studies evaluating the short-term effect of pollens on asthma hospital admissions (HA)/emergency visits (EV) or asthma symptoms in time series/case-crossover or panel study designs and long-term effects in birth cohort studies. When number of effect estimates was 3 or more a meta-analysis was done with evaluation of heterogeneity and publication bias. Risk of bias is assessed using instruments for non-randomized studies (ROBINS-I).

Results
A total of 21 studies was included. Birth cohorts provide contrasting results about exposure to pollens at birth and development of asthma or symptoms later in life. For grass pollen, the Mantel-Haenszel pooled estimate for the risk of asthma HA or EV is 1.9% (95%CI 1.2-2.6 for 10 grains/cbm; Higgins I\textsuperscript{2}=14.9%, p-value Egger’s test=0.70) (lag 0 to 6 days). A smaller number of studies evaluated weed (e.g. Ambrosia) and tree families. Three studies provided mixed results on interaction between pollens and air pollution. Risk of bias assessment is ongoing.

Conclusions
There is a growing body of evidence on adverse effects of pollens on asthmatic children, even at age younger than 4. Cities need to become resilient to climate, urban spaces (e.g. green spaces) well managed, air quality improved and vulnerable individuals such as children protected from all these risks.
Assessment of Airborne Fungal Spores in a tertiary care hospital in South Western Nigeria
Fakunle A¹, Jafta N¹, Naidoo R¹
¹University of Kwazulu-natal

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim
Increasing evidences show that exposure to indoor fungal spores has resulted in increased prevalence of hospital-acquired infections. This study aimed to determine the burden of airborne fungi species in the indoor environments of a tertiary hospital in South Western Nigeria.

Methods
Air samples were collected in the dry (January–April) and raining (June-September) seasons from four categories of wards viz; surgery (8 wards), obstetrics/gynecology (5 wards), medical (8 wards) and paediatric (6 wards). Air samples were collected using a two-stage Anderson sampler at a flow rate of 15L/min for 15 minutes in the morning (8:00-11:00) and evening (13:00-16:00) hours over a 3-day period. A total of 966 air samples were cultured each on Potato-dextrose agar (PDA) and Sabouraud-dextrose agar (SDA) and incubated at 25°C for 7-10 days. Total fungi count (TFC) was presented in colony-forming unit per cubic meter (CFU/m3) and compared to recommended concentration of fungal spores in hospital air (≤ 25CFU/m3). Analysis was performed using t-test and ANOVA at p<0.05.

Results
Majority, 930 (96.3%) and 934 (96.7%) of the samples were positive for fungi on PDA and SDA respectively. In both seasons, the paediatric wards recorded the highest mean TFC on PDA (dry:38.33 ± 30.41CFU/m3; raining:44.78 ± 40.16CFU/m3,p<0.05) and SDA (dry:48.22 ± 33.17CFU/m3; raining:52.00 ± 36.76CFU/m3) while the surgery wards had the least TFC on PDA (dry:28.40 ± 21.37 CFU/m3; raining:32.77 ± 29.95CFU/m3) and SDA (dry:42.70 ± 19.44 CFU/m3; raining:39.44 ± 29.61CFU/m3). The mean TFC in each ward was above the recommended concentration of 25CFU/m3. The most frequent occurring fungal species was Aspergillus spp. constituting about 30.5% of the total isolates.

Conclusions
This study revealed high fungal contamination in the wards. The presence of Aspergillus spp. pose great threat to immunocompromised patients. Therefore, periodic survey and efficient ventilation system are necessary to prevent possible hospital-acquired infections.
Role of timing of exposure to pets and dampness or molds on asthma and sensitization in adolescence
Milanzi E1, Koppelman G2,6, Smit H4, Wijga A4, Vonk J3,6, Brunekreef B1,5, Gehring U1
1Institute For Risk Assessment Sciences (iras), 2Department of Pediatric Pulmonology and Pediatric Allergology, 3University Medical Center Groningen, 4National Institute for Public Health and the Environment (RIVM), 5Julius Center for Health Sciences and Primary Care, 6Groningen Research Institute for Asthma and COPD (GRIAC)

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: It is unclear whether timing of exposure to pets, dampness or mold during the lifecourse is differentially associated with risk of asthma and sensitization in adolescence. We investigated the relevance of timing of exposure because understanding this role is essential to build targeted prevention strategies.

Methods: We used data from 1871 participants of the Dutch Prevention and Incidence of Asthma and Mite Allergy (PIAMA) cohort. Data on residential exposure to pets, dampness or molds was obtained by repeated parental questionnaires. We used asthma data from the 17-year questionnaire and sensitization data from the medical examination follow-up at 16 years. We characterized timing using longitudinal exposure patterns from pregnancy till age 17 using latent class growth modelling. We used logistic regression models to analyze associations of exposure patterns with asthma at age 17 and sensitization at age 16.

Results: Pet and dampness or mold exposure during any period was not associated with asthma at age 17, but lower sensitization risk at age 16 was suggested, e.g. [odds ratio (OR) (95% confidence interval (CI)) of sensitization;[0.58 (0.33 to 1.02)] and [0.67 (0.43 to 1.05)] for early life and persistently high pet exposure respectively, compared to very low exposure. The inverse association was also suggested for moderate late childhood dampness or mold exposure, [0.62 (0.36 to 1.06)].

Conclusion: Different timing of pet or dampness or mold exposure was not associated with asthma, but lower risk of sensitization in adolescence was suggested, which could be partly attributable to reversed causation.
Cross-sectional associations between per- and polyfluoroalkyl substances and asthma in children.

Jackson-Browne M\(^1\), Eliot M\(^1\), Spanier A\(^2\), Braun J\(^1\)

\(^1\)Brown University, \(^2\)University of Maryland

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Per- and polyfluoroalkyl substances (PFAS) are a class of persistent chemicals used as industrial surfactants, fire-fighting foams, and textile treatments. Early childhood exposure to perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), perfluorononanoic acid (PFNA), and perfluorohexane sulfonic acid (PFHxS) may affect the immune system to increase the risk of allergic and respiratory diseases. Thus, we examined the cross-sectional associations of serum PFOA, PFOS, PFNA, and PFHxS concentrations with childhood asthma.

Methods: We used data from 607 US children aged 3-11 years who participated in the National Health and Nutrition Examination Survey (2013-2014). PFAS concentrations were measured in serum using analytical chemistry methods. Asthma was assessed by parent-reported, doctor-diagnosed, asthma using a standardized questionnaire. Using logistic regression, we estimated odds ratios for asthma per standard deviation increase in ln-transformed PFAS concentrations after adjusting for age, sex, race, ethnicity, poverty-income ratio, and serum cotinine concentrations. We also examined effect measure modification by child sex.

Results: The mean age of children included in analysis was 7.1 years. Approximately 51\% (n=324) were male, 13\% (n=150) were black, 25\% (n=207) were Hispanic, and 13\% (n=93) had parent-reported, doctor-diagnosed, asthma. After covariate adjustment, PFOA (1.07; 95% CI: 0.85, 1.34), PFOS (1.15; 95% CI: 0.8, 1.65), PFNA (1.12; 95% CI: 0.76, 1.66), and PFHxS (1.08; 95% CI: 0.89, 1.34) were weakly associated with increased odds of asthma. While there were more boys with asthma compared to girls (17\% vs. 10\%, respectively), child sex did not modify the association between PFAS levels and asthma (sex x PFAS interaction term p-values>0.47).

Conclusion: In this cross-sectional study, we observed some evidence that serum PFAS concentrations were weakly associated with increased asthma prevalence in US children. Prospective studies are necessary to determine if exposure to PFAS during other potential periods of heightened susceptibility increase the risk of childhood respiratory diseases.
Breathe Easy Dallas: Measuring the Impact of School-Based Interventions on Air Quality and Daily Asthma Exacerbations at High Risk Schools

Khreis H¹, Jack K², Johnson J³, Vallamsundar S⁴, Dadashova B⁵, Nieuwenhuijsen M⁶
¹Texas A&M Transportation Institute, ²The Nature Conservancy, NA Cities Program, TX Chapter, ³Texas A&M Transportation Institute, ⁴Texas A&M Transportation Institute, ⁵Texas A&M Transportation Institute, ⁶ISGlobal, Centre for Research in Environmental Epidemiology (CREAL)

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Dallas County leads the region for childhood asthma hospitalizations and respiratory diseases are a leading cause of absenteeism in the Dallas Independent School District (DISD). Poor air quality is linked to asthma exacerbations, but research is limited in evaluating impact of local interventions in mitigating acute effects. Breathe Easy Dallas is a collaborative project bringing together The Nature Conservancy, Texas A&M Transportation Institute, City of Dallas, DISD, North Central Texas Council of Governments, public health and community leaders to improve the health for Dallas children at high risk for asthma-related exacerbations/absenteeism. This project investigates the impact of select interventions on air quality, asthma-related exacerbations/absenteeism in a sample of school children.

The project will collect local data to study impact of selected interventions on daily air quality and asthma exacerbations, including absenteeism, at nine high-risk schools. Each intervention: reduced idling, school-based health initiatives, or tree plantings will be carried out at two schools, while two schools will serve as control sites and one school receives all interventions. Calibrated air quality monitors (AQY1) measuring ozone (O3), nitrogen-dioxide (NO2), particulate matter of varying sizes (PM2.5, and PM10) will continuously record concentrations at 1-min intervals 1 year before and 1 year after interventions. Information on nurse visits for asthma exacerbations, emergency medical services used, and absenteeism will be collected and timestamped. Changes in air quality and associated exacerbations attributable to the interventions will be determined.

Using a highly iterative process including stakeholder’s engagement and implementation considerations for each intervention, we selected nine schools from 228 potential sites, also accounting for factors which explained the variation in number and prevalence of asthmatic students. These factors are number of students, poverty, distance to industry, distance to major highways, and functional system of highways. Study design and preliminary air pollution and childhood asthma measurements will be presented.
Prenatal exposure to perfluoroalkyl substances and children’s allergic diseases
Liu T¹, Chen M², Tsai M¹, Lin C¹, Chen P¹
¹National Taiwan University, ²National Health Research Institutes

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim
Perfluoroalkyl substances (PFASs) are widely present and previous studies showed their association with allergic diseases. The purpose of this study is to explore the relationships between prenatal exposure to PFASs and allergic diseases in childhood.

Methods
The participants were 486 mother-infant pairs from Taiwan Birth Panel Study. During the follow-ups, we collected the information on allergic diseases using the International Study of Asthma and Allergies in Childhood questionnaires when they were two, three and nine years old. PFASs in cord blood were analyzed by ultra-high-performance liquid chromatography/tandem mass spectrometry.

Results
Among 282 study children, the mean concentrations of PFAS including perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), perfluorononanoic acid (PFNA) and perfluoroundecanoic acid (PFUA) in cord blood were 2.49, 5.67, 6.91, and 15.92 ng/mL, respectively. Proportions of children with allergic diseases including atopic dermatitis, asthma, and allergic rhinitis were 22.3% in two years old, 11.7% in three years old, and 38.3% in nine years old. There was a significant association between PFUA and atopic dermatitis at the age of three, and a similar association between PFOS and asthma in nine-year-old children.

Conclusions
Our study shows that PFOS and PFUA may be associated with occurrences of allergic diseases. Further mechanistic investigations are needed.
Prenatal exposure to phthalate esters and its associations with childhood allergies (TMICS Study)
Lu C1, Tsai T2, Su P3, Sun C2, Wen H2, Wang C1, Wang S2
1National Chung Hsing University, 2National Health Research Institutes, 3Chung Shan Medical University Hospital

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim:
The relationships between prenatal exposure to specific phthalate and childhood allergies were inconsistent in previous epidemiologic studies. Various exposure levels may explain it. The Taiwanese reduced phthalates exposure after the food scandal in 2011. We aimed to examine the associations between prenatal exposure to selected phthalates and childhood allergies.

Methods:
The Taiwan Maternal and Infant Cohort Study (TMICS) enrolled pregnant women at third trimester in 2012-2015. Data for maternal urinary phthalate metabolites and health conditions in 3-year-old child were collected from 213 singleton-and-mother pairs. Eight phthalate metabolites in maternal urine were measured by liquid chromatography/electrospray tandem mass spectrometry (LC–ESI-MS/MS). Level of di-2-ethylhexyl phthalate (DEHP) was sum of nanomolar concentration of mono-(2-ethylhexyl) phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), and mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP). Titers of total immunoglobulin E (total IgE) in children were measured by paper radio immuno-sorbent test (PRIST). Sociodemographic characteristics, delivery records, and living environment information were collected via questionnaire. Allergic symptoms and diagnoses were self-reported by mothers in the questionnaire developed by International Study of Asthma and Allergies in Childhood (ISAAC). Binary logistic regression model and linear regression model were used to examine relationships between childhood allergies and dichotomized phthalate metabolites (> 2nd tertile vs. <=2nd tertile).

Results:
After adjustment for potential confounders, increased risk of symptomatic rhinoconjunctivitis in children was associated with higher prenatal exposure to monoethyl phthalate (adjusted odds ratio [95% confidence interval]): 0.34[0.12-0.93], symptoms and diagnoses of eczema were both positively associated with MEHP (3.32 [1.05-10.53] and 3.93 [1.20-12.89], respectively) and MEOHP (3.93 [1.26-12.24] and 4.14 [1.34-12.79], respectively). None of eight phthalates was associated with total IgE concentration in children.

Conclusions:
According to exposure level in TMICS, prenatal exposure to MEHP and MEOHP were still related to increased risk of eczema; however, prenatal exposure to MEP may be associated with decreased risk of rhinoconjunctivitis in toddlers.
Improving Indoor Microbiological Measurements for Health Protection
Mendell M¹, Adams R¹ ²
¹California Department Of Public Health, ²University of California, Berkeley

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: Dampness and mold (D/M) in buildings are consistently linked to poor respiratory health of occupants, including development of asthma, asthma exacerbations, respiratory infections, and upper and lower respiratory symptoms.¹ However, the specific agents that cause the health effects have still not been identified. In order to set evidence-based protective threshold levels, we need to identify measurable D/M factors showing “dose-related” associations with adverse health effects. These factors could be the dampness-related causal agents or indicators strongly associated with the causal agents. What is needed to achieve this goal?

Methods: This presentation summarizes prior epidemiologic findings on D/M and adverse health effects, for three studied categories of D/M assessment: (1) quantitative microbiological measurements; (2) moisture measurements in building materials; and (3) observed D/M factors (e.g., visible mold, mold odor, water damage, and moisture/dampness). We graphically summarize the strongest relationships reported for each category of assessment, as odds ratios (ORs) or risk ratios (RRs).

Results: The non-microbiological assessments of D/M (measured moisture and observed D/M) achieved much stronger associations with health effects (OR or RR estimates up to 14) than did the microbiological measurements studied (all estimates below 3).

Discussion: Currently, observed D/M factors are the closest to providing practical strategies for estimating dampness-related health risks, although these semi-quantitative assessments need further refinement for setting explicit health-relevant guidelines. In contrast, no specific quantitative microbiological measurement predicts adverse health effects nearly as strongly and consistently. These results define a goal for microbiological methods development: to identify microbial agents that identify elevated health risks at least as strongly as non-microbiologic D/M factors currently do. In addition, microbiologic measurements suitable for setting health-protective thresholds should be dose-related to key health effects, practical, and reproducible.

Infections, Respiratory Symptoms, and Allergy in Relation to Rice Cereal Consumption in a United States Cohort

Moroishi Y¹, Signes-Pastor A¹, Li Z², Cottingham K¹, Enelow R¹, Madan J¹, Nadeau K³, Karagas M¹

¹Dartmouth College, ²University of Florida, ³Stanford University

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Inorganic arsenic is found in rice products marketed in the US at concentrations that raise serious concerns about potential health consequences for infants as they transition to solid food. We sought to determine whether introduction of rice cereal influences occurrence of infant infections, allergy and respiratory symptoms in 488 infants from the New Hampshire Birth Cohort Study (NHBCS).

Methods: Infant intake of rice cereal and timing of introduction of rice cereal were obtained along with infant infection, allergy and respiratory outcomes from quarterly telephone surveys in the first year of life and at approximately one and a half years of age. Association with rice cereal intake and occurrence of infection, allergy, and respiratory outcomes was determined using generalized estimating equations (GEE), adjusted for maternal smoking during pregnancy, marital status, education attainment, pre-pregnancy body mass index, maternal age at enrollment, infant birth weight, and breastfeeding history.

Results: Longer exposure to rice cereal was associated with increased risk of subsequent allergy diagnosed during a doctor’s visit (RR = 1.15, 95% CI: 1.02-1.31), acute respiratory symptoms including wheeze, difficulty breathing, and cough (RR = 1.16, 95% CI: 1.03-1.31), and fever (RR = 1.28, 95% CI: 1.03-1.60) requiring a prescription medicine. Associations with gastrointestinal symptoms were less consistent.

Conclusion: Our findings suggest that consumption of rice cereal during infancy may influence infants’ immune response early in life.
Air microflora study of selected offices in Elizade University, Ilara-Mokin

Osuolale O¹, Ekpemiata E¹, Odiwe A²
¹Elizade University, ²Obafemi Awolowo University

Introduction
Indoor environments are factors that do impact health. Air quality of indoor environments is a main factor affecting human health, well-being and productivity. A main problem of indoor air quality which people hardly pay attention to is the effect of the presence of diseases causing microorganisms.

Methods
The indoor air microflora of 40 staff’s office in Elizade University was studied taking into consideration the number of occupants in the offices, gender, age, the number of windows, temperature, relative humidity and pressure, to know the microbial load and the type of organisms present. Isolation of microbes was done using the settle plate method, using Nutrient Agar (NA) for bacterial isolation and Sabouraud Dextrose Agar (SDA) for fungal isolation. The NA and SDA agar plates were incubated at 37 °C for 24 hours for bacteria and 25 °C for 3 days for fungi.

Results
Bacterial counts ranged from 12 cfu/m³ – Numerous and fungal counts ranged from 1 cfu/m³ – Numerous. Bacterial isolates were purified from the nutrient agar and further identification of bacteria was done by coagulase test, catalase test and gram staining. While for fungal identification, lactophenol test was done. The CDC MicrobeNet was used to confirm the isolates. The bacteria identified found were Staphylococcus spp., Klebsiella spp., Micrococcus spp., Rhodotorula spp. and Streptococcus spp., while for fungi Fusarium spp., Aspergillus spp., Penicillium spp. and Rhodotorula spp. were identified.

Conclusion
While it is generally known that indoor microorganisms can be potentially a health hazard, there is no agreed upon level of airborne organism that signifies contamination for indoors and no health-based guidelines exist. In absence of guidelines it is recommended that more indoor study need to be done to understand the dynamics of airborne organisms in Nigeria from which health-based guidelines can be developed.
Background. Exhaled nitric oxide tests are useful in the management of eosinophilic asthma. It may be useful in identifying those with airway inflammation at risk for the development of asthma. Its use to identify at risk children exposed to elevated ambient pollution is limited.

Aim. To investigate the prevalence of airway inflammation as determined by exhaled nitric oxide among atopic and non-atopic schoolchildren from high ambient pollution exposed communities in South Africa.

Methods. Primary schools in six towns in the Highveld Air Pollution Priority Area in Mpumalanga province, South Africa with defined exposure profiles were selected for this study. From within each of these schools 100 Grade 4 pupils were selected to participate in a broad respiratory health repeated measures study. Full spirometry, exhaled nitric oxide, atopy assessments and interviews were conducted according to internationally standardised methods.

Results. The mean age of the participants (n=611) was 10.2 (SD: 0.9), with 53.8% males. There was a low prevalence of doctor diagnosed asthma (2.2%), or reported wheeze in the absence of a cold (2.8%). The mean FeNO level was 19.7ppb (SD: 19.3), with median IgE levels of 0.3 PAU/L (range: 0.2-96 PAU/L). These findings varied across schools. Regression models, adjusting for IgE levels, age, height and weight, showed higher levels of FeNO at schools in comparison with the reference (lower exposed) school, with some schools showing a 10 fold greater level.

Conclusion. Despite the preliminary analysis, there is evidence to suggest that exposure to ambient pollutants may increase the risk for airway inflammation, adjusted for atopy. This finding in view of the low prevalence of doctor diagnosed asthma or reported wheeze, suggests that schoolchildren in high exposed communities need greater investigation for respiratory health.
Investigation of the Association between Adult Wheeze and Household Beta(1→3)-glucan Exposures in First Nations Communities in Canada

Rennie D1, Kirychuk S1, Anwar N1, Karunanayake C1, Thompson B1, Russell E2, Seeseequasis J3, Dosman J1, Pahwa P1

1University Of Saskatchewan, 2Suncor Energy, 3Beardy’s and Okemasis Cree Nation

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: In Canada, damp housing conditions in First Nations communities continues to be a major concern for respiratory health. In this context, no studies have reported the role of household beta glucans. We examined the association between $\beta(1\rightarrow3)$-glucans in household dust and reports of wheeze.

Methods: As part of the First Nations Longitudinal Respiratory Health Study initiated in 2012, participating adults who completed a respiratory and environmental questionnaire volunteered to partake in a home environmental assessment that included collection of settled dust for $\beta(1\rightarrow3)$-glucan analysis. Information was obtained about housing conditions including water leaks/floods and subsequent damage in the past 12 months, mold or mildew odor and visible signs of mold. Dust samples were collected from floors of common living areas following the International Study of Asthma and Allergy in Children (ISAAC) protocol. Prior to laboratory analysis, dust was sieved and stored at -20ºC. Analysis for $\beta(1\rightarrow3)$-glucan was performed using Glucatell assay according to manufacturer’s specifications. Wheeze was defined as any wheeze without colds or wheezing most days or nights. Logistic regression with generalized estimating equations were used to examine associations between wheeze and $\beta(1\rightarrow3)$-glucan (log transformed) adjusting for current smoking, damp housing, mildew odor, pets, age and sex.

Results: Of the 874 participants, there were 317 adults living in 144 homes who participated in the home assessments. Of these, 293 adults had valid household $\beta(1\rightarrow3)$-glucan results. The prevalence of wheeze was 47.0%. The mean (standard deviation) levels of soluble $\beta(1\rightarrow3)$-glucan were 33.1(22.76) pg/mL. While reports of damp housing were associated with increased wheeze ($p < 0.05$), higher $\beta(1\rightarrow3)$-glucan levels in the home were associated with lower wheeze ($p < 0.05$).

Conclusion: The inverse association between household beta glucans levels and wheeze found in this study adds to the controversy regarding the varying role of $\beta(1\rightarrow3)$-glucans for human respiratory health.
Exposures and respiratory health among children in an ongoing birth cohort in Puerto Rico

Rosario-Pabon Z1,2, Ayala I1,2, Velez Vega C2, Huerta-Montanez G2,4, Watkins D3, Suh H5, Betancourt G2, Alshawabkeh A4, Cordero J1, Meeker J3

1University of Georgia, 2University of Puerto Rico Medical Sciences Campus, 3University of Michigan, 4Northeastern University, 5Tufts University

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: Puerto Rico has the highest asthma prevalence in children aged 0-4 years of all United States jurisdictions (18% vs 3.8%), imposing a heavy burden on their health, families and the overall health system on the island. Causes for this marked disparity are not completely understood but environmental exposures have been suggested as one explanation. Since 2015 the Center for Research Early Childhood Exposure and Development (CRECE) has been investigating how environmental exposures and other factors affect the health and development of infants and children living in the heavily contaminated island of Puerto Rico.

Methods: Babies born to mothers in the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) study are recruited and followed from 2 weeks after birth to 4 years. A maximum of 7 visits at approximately 6-month intervals are performed and incremental history of respiratory illnesses, as well as possible exposure factors, is collected through maternal report at every visit.

Results: Currently, 429 infants have completed at least one visit with a median age at recruitment of 6 months. More than half (53%) of participants live in houses built after 2000, 39% report water damage in the house, and 33% indicate presence of mold in the house in places other than the bathroom. In addition, 36% of mothers reported that their child had symptoms of asthma, including wheeze and shortness of breath, during a cold, 23% had asthma symptoms without a cold, and 21% have presented allergies.

Conclusions: Analysis of a number of environmental exposures and respiratory illnesses is in progress. This work provides the first look at characteristics related to respiratory illness in this population and will help guide future research and strategies to minimize the impact on babies in Puerto Rico.
Respiratory health outcomes associated with different grass taxa in the UK

Rowney F1, Potter C2, Brennan G3, Osborne N4, Economou T5,6, McInnes R6,1, Creer S3, de Vere N7,2, Skjøth C8, Wheeler B1

1European Centre For Environment And Human Health, University Of Exeter Medical School, 2Aberystwyth University, 3Molecular Ecology and Fisheries Genetics Laboratory, School of Natural Sciences, Bangor University, 4School of Public Health, Faculty of Medicine, The University of Queensland, 5Department of Mathematics, University of Exeter, Exeter, 6Met Office, 7National Botanic Garden of Wales, 8School of Science and the Environment, University of Worcester

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Grass (Poaceae) pollen is the most significant outdoor aeroallergen, and is linked to asthma exacerbations and respiratory allergic response. Understanding of the relative contributions of different grass taxa to respiratory health outcomes is currently unknown. We investigate associations between a range of grass genera and proxies of both asthma exacerbation (hospital admissions) and respiratory allergic response (prescribing rates). A better understanding of allergenic exposures will allow better disease management by patients and healthcare providers. This work forms part of the PollerGEN Project.

Methods: Combining metagenomics and pollen count data, we produced semi-quantitative estimates of concentrations of the pollen of 14 grass genera and undifferentiated (i.e. unidentified) Poaceae, at six sites across the UK during the pollen season (May to September) of 2016. Using a series of generalised additive models (GAMs), these data are being combined with hospital admissions and prescribing datasets (and various confounding datasets) to assess associations between different types of grass pollen with serious asthma exacerbations and respiratory allergic response at a population level.

Results: Preliminary GAMs, adjusted for weather, air pollution, rural-urban status, deprivation, health organisation and time period, explain >95% of variation in health outcome variables (adjusted R² = 0.912). Notably, they suggest a potential positive relationship between respiratory antihistamines and concentrations of Holcus pollen during the 2016 UK pollen season (F = 25.9, P = 2.41 x 10^-8), whereas overall grass pollen concentrations (i.e. standard pollen ‘counts’), did not provide significant correlation.

Conclusions: Our preliminary results suggest that certain grass taxa may contribute more than others to respiratory health outcomes in the UK, including contributing more than overall grass pollen concentrations. This may be due to pollen grains of certain grass taxa containing proteins which are more allergenic or greater concentrations of allergenic proteins, greater sensitisation, or greater levels of exposure to these taxa.
Relative influence on childhood allergic diseases of meteorological factors and air pollutants in Shanghai, China

Hu Y¹, Xu Z², Li S³, Yin Y⁴, Jiang F⁵, Liu S¹, Wu M⁶, Yan C⁶, Tan J⁷, Yu G⁸, Tong S¹,²,⁹

¹Department of Clinical Epidemiology and Biostatistics, Shanghai Children’s Medical Center, School of Medicine, Shanghai Jiaotong University, ²School of Public Health and Social Work, Institute of Health and Biomedical Innovation, Queensland University of Technology, ³School of Public Health, Shanghai Jiaotong University, ⁴Department of Respiratory, Shanghai Children’s Medical Center, School of Medicine, Shanghai Jiaotong University, ⁵Department of Developmental and Behavioral Pediatrics, Pediatric Translational Medicine Institution, Shanghai Children’s Medical Center, School of Medicine, Shanghai Jiaotong University, ⁶Shanghai Key Laboratory of Environmental and Child Health, Xinhua Hospital, School of Medicine, Shanghai Jiaotong University, ⁷Shanghai Climate Center, ⁸Shanghai Children’s Hospital, ⁹School of Public Health, Institute of Environment and Population Health, Anhui Medical University

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Objectives: This study aims to identify the relative influence on childhood allergic diseases of meteorological factors and air pollutants in Shanghai, China.

Methods: We obtained the data on childhood allergic diseases (asthma, allergic rhinitis and allergic dermatitis), meteorological factors (daily mean temperature, air pressure, precipitation, humidity, sunshine and wind speed) and air pollutants (PM10, PM2.5, NO2, SO2 and O3) from January 1, 2007 to December 31, 2017. Quasi-Poisson regression with distributed lag non-linear models was used to assess the relative influence on childhood allergic diseases of meteorological factors and air pollutants. Data analysis was conducted using R software 3.5.1 in which “dlnm” and “splines” packages were used.

Results: A total of 2,410,392 cases were analyzed, including 975,771 asthma, 646,975 rhinitis, and 787,646 dermatitis. Most of environmental factors were significantly associated with childhood allergic diseases. All three diseases were inversely associated with daily mean temperature, precipitation, relative humidity and wind speed, but positively associated with daily air pressure. The relative risks of these allergic diseases elevated with the increasing air pollution. The lag effects of various environmental factors on children’s allergic diseases were also found. In addition, daily mean temperature (the standard β and 95%CI for asthma was -0.07608(-0.08579,-0.06636) and air pressure (0.07465(0.06759, 0.08171)) seemed to play more important role than other environmental factors in these allergic diseases where their standard regression coefficients were larger than other indicators. The numbers of these allergic diseases attributable to harmful meteorological factors also appeared to be greater than those attributable to high air pollutants. Conclusions: Both climatic variation and air pollution were associated with childhood allergic diseases, but the former appeared to play more important role in the occurrence of clinical visits for these diseases. These findings may have implications for the development of effective strategies to prevent and treat these rapidly-increasing diseases worldwide.
The association between pediatric asthma and body composition in Lima, Peru
Underhill L¹, Romero K¹, Pollard S¹, Johnson C², Hansel N¹, Checkley W¹
¹Johns Hopkins School of Medicine, ²University of Washington

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: The link between adiposity and asthma development is of growing concern in low-and-middle-income countries where pediatric asthma prevalence is high and childhood obesity rates are rising. Some adiposity phenotypes and body composition measures may be more strongly associated with asthma than others, yet most existing studies have focused only on body mass index (BMI) in adults. Our objective was to explore the association of body composition measurements with current asthma in children in a low-resource, urban setting in Peru. Methods: We evaluated 447 children aged 9-19 years, with persistent asthma over a period of 12 months. Asthma Control Test (ACT) was administered monthly. Uncontrolled asthma was defined as having an ACT ≤ 19. We measured adiposity at baseline using objective measures: body mass index (BMI), body fat percentage (BF), calculated lean muscle (LM), and calculated fat mass (FM) using bioimpedance (BIA) with the TANITA device. We used multiple logistic regression to analyze associations between body composition measures and asthma control, adjusted by sex, age, SES, site, baseline lung function, and temperature. Results: At baseline, 13% of asthmatics had uncontrolled asthma. In bivariate analyses, we measured greater adiposity for children with uncontrolled vs. controlled asthma for all body composition measurements; however, results were only significant for BF measurements (mean [sd]: 28% [8.9] vs. 26% [9.6], p<0.05). In multivariable analyses, an increase in adiposity was not significantly associated with any measures of uncontrolled asthma. Conclusions: In longitudinal analysis, we found no association between asthma control and body composition variables. These results highlight the importance of examining the relationship between multiple adiposity measures and controlled asthma.
In 2018, asthma affected approximately 339 million people worldwide, of which 2.7 million people live in Australia (11.2% of Australia’s population). It is a chronic lower lung disease resulting from airway inflammation and narrowing resulting in periods of chronic or acute episodes of wheezing, breathing difficulties or cough. In the financial year 2015-16 it resulted in 39,448 hospitalisations in Australia at an estimated cost of $28 billion in 2015. It accounts for an average 2.1% of all GP encounters per year and both prevalence and incidence increase with remoteness and disadvantaged socioeconomically status. Asthma attacks have many possible triggers including atmospheric conditions, respiratory infections, dust mites, mould, dust and pollen.

Thunderstorm asthma, results in an increased number of acute bronchospasm presentations following a thunderstorm. In Melbourne, Australia, on the 20-21 November 2016, approximately 10,000 people presented to emergency departments (ED) with acute asthma onset following a thunderstorm. This was a 992% increase compared to the expected number of exacerbated asthma cases for an average November. Ten people died. Of those that presented at ED, only 28% had been previously diagnosed with asthma but almost all were sensitized to ryegrass pollen (lolium grass pollen). It is suspected that grass pollen has caused several thunderstorm asthma incidents in Australia. Thus, modelling the flow of pollen across Australia during flowering season is critical in enhancing our understanding of the thunderstorm asthma risk. The project aims to develop a weather research forecasting (WRF), and using a hybrid single particle Lagrangian integrated trajectory (HYSPLIT) model, simulate grass pollen aerobiology and dispersion over the complex topography of the Great Dividing Range. Pollen traps will provide atmospheric concentrations of grass pollen which will be used to validate the model. Assessing the risk of thunderstorm asthma in Sydney will help develop a thunderstorm asthma response policy for NSW.
Association between Chemical Components of PM2.5 and Children’s Primary Care Night-time Visits due to Asthma Attacks: a Case-crossover Study

Yamazaki S\(^1\), Yoda Y\(^2\), Shima M\(^2\)

\(^1\)National Institute for Environmental Studies, \(^2\)Hyogo College of Medicine

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: Few papers have examined the association between the chemical components of PM2.5 and health effects. The existence of an association is now under discussion.

Methods: This case-crossover study aimed to examine the association between the chemical components of PM2.5 and night-time primary care visits (PCVs) due to asthma attacks. The subjects were 1,251 children aged 0–14 years who received medical care for asthma at a municipal emergency clinic. We measured daily average concentrations of hydrogen ion, sulfate ion, nitrate ion and water-soluble organic compounds (WSOCs), which are components of PM2.5. We estimated the odds ratios (ORs) of PCVs per unit increment (inter quartile ranges) in each chemical component of PM2.5 for the subgroups of warmer months and colder months separately.

Results: No association was seen between PCVs and PM2.5 mass concentrations the day before the PCVs in either warmer or colder months. In the warmer months, an association was seen with the concentrations of WSOCs and hydrogen ion the day before the PCVs (OR=1.33; 95% CI: 1.00 – 1.76, OR=1.18; 95% CI: 1.02 – 1.36, respectively). Furthermore, a negative association was seen between sulfate ion and PCVs (OR=0.85; 95% CI: 0.74–0.98). No associations were observed in the colder months.

Conclusions: We observed a positive association between PCVs and certain concentrations of WSOCs and hydrogen ions in warmer months. In contrast, sulfate ion showed a negative association.

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Association of airborne endotoxin concentrations with pulmonary function and airway inflammation among students

Yoda Y¹, Takagi H², Wakamatsu J², Ito T³, Shima M¹
¹Hyogo College Of Medicine, ²National Institute of Technology, Yuge College

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: Few studies have evaluated the short-term effects of airborne endotoxin on respiratory health. We evaluated the relationship between exposure to airborne endotoxin and pulmonary function and airway inflammation among healthy students.

Methods: A panel study was conducted in 41 healthy students aged 16 years, for about 1 month in May 2015, in a school on an isolated island in the Seto Inland Sea, Japan. Daily measurements of peak expiratory flow (PEF) and forced expiratory volume in 1 s (FEV1) were performed. Fractional exhaled nitric oxide (FeNO) was also measured once a week during the study period. Coarse (PM10-2.5) and fine (PM2.5) particulate matter samples were collected every 24 h from inside and outside the classroom, and endotoxin concentrations in both fractions were measured using the kinetic Limulus Amebocyte Lysate assay. The associations of pulmonary function and FeNO with 24-h endotoxin concentrations before each measurement were analyzed using mixed-effects models.

Results: A decrease in FEV1 was significantly associated with endotoxin concentrations in outdoor PM2.5 (-0.03 L [95% confidence interval (CI): -0.05, -0.01] for an interquartile range (IQR) increase of 0.07 EU/m³). Neither PEF nor FeNO was associated with endotoxin concentrations in any fractions. Among subjects with wheezing during or after exercise, the increase in FeNO was significantly associated with endotoxin concentrations in indoor and outdoor PM10-2.5 (4.4 ppb [95% CI: 0.2, 8.5] and 7.4 ppb [95% CI: 0.3, 14.4] for each IQR increase of 0.12 and 0.19 EU/m³, respectively). Indoor and outdoor mass concentrations of each fraction were associated with neither pulmonary function nor FeNO.

Conclusions: These results suggest that endotoxin in outdoor PM2.5 may affect pulmonary function among healthy students. Additionally, endotoxin concentration in PM10-2.5 was significantly associated with FeNO in students with wheezing during or after exercise, indicating the potential of endotoxin to cause airway inflammation.
Association between early life indoor environment factors and prevalence and onset of asthma/allergic disease among preschool children in Taiyuan

Zhang X, Zhao Z, Norback D

1Institute of Environmental Science, Shanxi University, 2School of Public Health, Fudan University, 3Department of Medical Sciences, Occupational and Environmental Medicine, Uppsala University

TPS 752: Respiratory effects and allergies, August 27, 2019, 3:00 PM - 4:30 PM

Background: Indoor environment factors can influence asthma and allergic disease in preschool children but few studies are available on associations between early life exposure and incidence/remission of children’s disease in their early childhood.

Methods: Data on children’s symptoms and home environment factors were collected from questionnaires completed by parents of children from 10 kindergartens in Taiyuan, China. Binary logistic regression models and reduced regression models were used to analyze associations between indoor environment factors and children’s symptoms (wheeze, rhinitis and eczema).

Results: Visible mold [OR=1.60(1.24, 2.07)], window pane condensation [OR=1.22(1.02, 1.47)], moldy odor [OR=1.90(1.34, 2.87)], air dryness [OR=1.40(1.15, 1.71)] and stuffy odor [OR=1.53(1.24, 1.88)] were associated with prevalence of rhinitis. Visible mold [OR=1.53(1.12, 2.11)], air dryness [OR=1.42(1.11, 1.83)] and stuffy odor [OR=1.58(1.23, 2.04)] have association with prevalence of wheeze. Stuffy odor [OR=1.39(1.03, 1.88)] and pets [OR=1.73(1.20, 2.49)] have association with eczema in the first 2 years. Comparing the prevalence of children’s symptoms in the first 2 years and last year, visible mold [OR = 1.51(1.08,2.91), 1.63(1.22,2.18), 1.92(1.13,3.24)], air dryness [OR=1.78(1.39,2.28), 1.46(1.18,1.81), 2.10(1.37,3.21)] and new furniture or renovation [OR=1.37(1.07,1.75), 1.31(1.07,1.61), 1.65(1.08,2.54)] have positive associations with the onset of children’s wheeze, rhinitis and eczema symptoms from first 2 years to last year of children, respectively.

Conclusion: The results showed that exposure to visible mold can be a risk factor for both prevalence and incidence of children’s asthma/allergic symptoms. Indoor air quality (air dryness, moldy odor, stuffy odor and new furniture or renovation) can influence childhood asthma later in life. Early life exposure to mold and dampness should be avoided at home. Chemical emissions during early life from new furniture or renovation can also be a health problem.
Epidemiological studies have demonstrated cardiovascular health effects of environmental noise exposure with some showing different effect estimates for males and females. However, results are far from being consistent. There is a need to disentangle the impact of biological sex and gender including social role or cultural norms and the interplay of both.

Our objective is to evaluate the current state of integrating sex/gender into environmental noise epidemiology and to quantify the sex/gender specific effects of noise from different sources on cardiovascular health outcomes.

We conducted a systematic literature search using the electronic databases PubMed and Web of Science (WoS). Publications in English or German between 2000 and 2019 which provide sex/gender specific effect estimates for short- and long-term associations between noise and ischemic heart disease (IHD) as well as blood pressure and hypertension were screened. We will review the studies concerning conceptualization and operationalization of sex/gender, report male and female specific baseline characteristics, exposure and health data as well as discuss the sex/gender specific results. After study quality rating sex/gender specific effects will be quantified by applying meta-analytic tools.

Of 247 and 194 identified articles in Pubmed and WoS, respectively, 33 studies met our inclusion criteria, of which 12 studies deal with IHD, 19 studies with hypertension and 8 studies with blood pressure. The studies cover noise from road (N=24), aircraft (N=8) and railway traffic (N= 4) as well as community noise (N=6). Preliminary results show that studies generally used a dichotomous category “male/female”, did not contain information on a clear conceptualization and missed a gainful discussion of their sex-specific results. In the next steps we will continue with the extraction of necessary information and preparation of meta-analysis where possible.
Long-term exposure to road traffic noise, air pollution and adiposity markers: a joint analysis of HUNT3, Lifelines and UK Biobank

Cai Y1, Zijlema W2, Pettersen Sørgjerd E3, Doiron D4, de Hoogh K5, Hodgson S1, Wolffenbuttel B6, Nieuwenhuijsen M2, Hansell A7, Kvaloy K3

1MRC-PHE Centre for Environment and Health, Imperial College London, 2Barcelona Institute for Global Health (ISGlobal), 3HUNT Research Centre, Norwegian University of Science and Technology, 4Swiss Tropical and Public Health Institute, 5Research Institute of the McGill University Health Centre, 6University Medical Center Groningen, University of Groningen, 7Centre for Environmental Health and Sustainability, University of Leicester

Background/Aim
The role of road traffic noise on adiposity remains understudied. We aimed to investigate long-term exposure to road traffic noise, air pollution and adiposity in three European cohorts.

Methods
HUNT3, Lifelines and UK Biobank were established in 2006-2013. For all three cohorts, residential road traffic noise (Lden) for 2009 was modelled from a standardised European noise assessment framework. Exposures to PM10 for 2007 and PM2.5 for 2010, were estimated from land use regression models. Adiposity markers including body mass index and waist circumference were measured at baseline. Obesity and central obesity status was subsequently derived. Regression models were fitted in each cohort, adjusting for the same set of demographic and lifestyle covariates including education, with further adjustments for air pollution in the main model.

Results
The main analyses included 25,629 participants of HUNT3, 61,032 of Lifelines and 404,863 of UK Biobank, with a mean age of 43-56 years and mean Lden of 49-56 dB(A) across cohorts. 15% of Lifelines participants were obese, comparing to 24% in the other two. 34% of UK Biobank and Lifelines participants had central obesity and 47% in HUNT3. In UK Biobank, per 10 dB(A) higher of Lden: BMI was higher by 0.144 (95%CI: 0.110-0.178), waist circumference higher by 0.271 (95%CI: 0.187-0.355), odds of obesity was 1.059 (95%CI: 1.041-1.077) and of central obesity was 1.051 (1.035-1.068). These associations were independent of air pollution, and stronger among females and those with low physical activity. No associations were found in the other two cohorts, except for central obesity in males (1.094, 95%CI: 1.000-1.207) in HUNT3. In both UK Biobank and Lifelines, significant positive associations were observed between PM and central obesity, independent of noise exposure.

Conclusions
Higher exposure to road traffic noise and/or air pollution was independently associated with higher adiposity. Longitudinal analyses are currently being conducted to help with causal inference.
Health effects of exposure to aircraft noise: a cross-sectional study on adult residents near the Orio al Serio International Airport, Italy

Carugno M1, Imbrogno P2, Zucchi A2, Ciampichini R2, Tereanu C2, Sampietro G2, Barbaglio G2, Pesenti B2, Pesatori A1,3, Consonni D3

1Department of Clinical Sciences and Community Health, University of Milan, 2Agenzia di Tutela della Salute (ATS) Bergamo, 3Epidemiology Unit, Fondazione IRCCS Ca’ Granda Ospedale Maggiore Policlinico

Background and Aims: Noise pollution is an increasing problem in modern society and several studies have documented non-auditory health effects of aircraft noise. We performed a cross-sectional study in June-September 2013 among adults living near the Orio al Serio International Airport (Italy), to investigate the effects of aircraft noise on annoyance, sleep disorders, blood pressure levels, and hypertension. Methods: Residential addresses of subjects aged 45-70 years were geocoded and classified in three categories of noise levels: Reference Zone (<60 dBA), Zone A (60-65 dBA), Zone B (65-75 dBA). Enrolled subjects underwent a personal interview (on demographics, clinical history, drug use, annoyance, sleep disorders, and noise exposure from different sources) and blood pressure (BP) measurements. We applied multivariable linear and robust Poisson regression models, adjusted for gender, age, education, BMI, cigarette smoking, last occupation, airport-related job, annoyance from road traffic noise, and anti-hypertensive drug use (analyses on BP only). Results: We enrolled 166 subjects in the Reference Zone, 164 in Zone A, and 70 in Zone B. Average levels of annoyance (either at day or night) from airport-related activities were higher than those from other sources and showed a trend across acoustic zones (+2.7 in Zone A, +4.0 in Zone B, p-trend < 0.001). Compared to referents, subjects in Zones A and B reported a greater frequency of sleep disorders in the month before the interview as well as in general (prevalence ratio: 1.34 in Zone A, 1.82 in Zone B, p-trend = 0.01). We did not highlight a relationship with BP levels or prevalence of hypertension across zones. Conclusions: The findings on noise-related subjective disorders suggest the need of further preventive actions, including structural interventions in houses (where needed), increased efforts to reduce aircraft noise, and the implementation of periodical monitoring programs of residents’ health (adults and children).
Associations between exposure to road traffic noise and particles and the prevalence of renal dysfunction in Taichung, Taiwan

Chang T¹, Lee A¹, Li T¹, Liu C², Lin C¹

¹China Medical University, ²China Medical University Hospital

Background/Aim: Few studies have reported the association between exposure to particles and chronic kidney disease, but no researches investigated the relationship between road traffic noise exposure and renal dysfunction. This study aimed to examine the association between exposure to road traffic noise and particles and the prevalence of renal dysfunction, and to determine the potential interaction.

Methods: This cross-sectional study recruited 888 inhabitants as study subjects during 2017-2018. The land-use regression models were developed to estimate the annual mean levels of road traffic noise at octave-band frequencies and particulate matter with diameter less than 10 μm (PM10) for exposure assessment. The renal dysfunction was defined as estimated glomerular filtration rate <90 ml/min/1.73 m² or subjects who had been diagnosed with chronic kidney disease. The multivariate logistic regression was applied to analyze the associations.

Results: Participants exposed to noise levels >=30 A-weighted decibel (dBA) at 31.5 Hz had a higher risk of renal dysfunction (AOR=2.29, 95%CI: 1.19-4.39) compared with those exposed to <30 dBA at 31.5 Hz. Per 0.8-dBA (1 interquartile range) increase at 31.5 Hz was associated with the elevated risk of renal dysfunction (AOR=1.35, 95%CI: 1.05-1.75). Subjects exposed to PM10 >=76 μg/m³ had a higher risk of renal dysfunction (adjusted odds ratio [AOR]=1.97, 95% confidence interval [CI]: 1.02-3.81) than those exposed to <76 μg/m³. Co-exposure to 31.5-Hz noise >=30 dBA and PM10 >=76 μg/m³ had the highest risk of renal dysfunction (AOR=4.02, 95%CI: 1.59-10.17), but no significant interaction was observed.

Conclusions: Exposure to high levels of 31.5-Hz noise or PM10 may be associated with the increased risk of renal dysfunction, but no synergistic interaction is determined.
Road traffic noise and markers of adiposity in the Danish Nurse Cohort: a cross-sectional study

Cramer J1, Thermoing Jørgensen J1, Sørensen M1-3, Backalarz C4, Elgaard Laursen J4, Ketzel M5,6, Hertel O5, Solvang Jensen S5, Vaclavik Braeuner E7, Jovanovic Andersen Z1,8
1University Of Copenhagen, 2Raskilde University, 3Danish Cancer Society, 4DELTA Acoustics, 5Aarhus University, 6Global Centre for Clean Air Research (GCARE), University of Surrey, 7Juliane Marie Center Department of Growth and Reproduction, Rigshospitalet, 8Nykøbing F Hospital

Background: Studies have suggested that traffic noise is associated with obesity markers. We investigated the association of road traffic noise exposure with body mass index (BMI) and waist circumference in the Danish Nurse Cohort.

Methods: We used data on 15,501 female nurses (aged > 44 years) from the nationwide Danish Nurse Cohort who, in 1999, reported information on self-measured height, weight, waist circumference, socioeconomic status, lifestyle, work, and health. Road traffic noise at the most exposed façade of the residence was estimated using Nord2000 as the annual mean of a weighted 24-h average (Lden). We used multiple linear regression models to examine associations of road traffic noise levels in 1999 (1-year mean) with BMI and waist circumference, adjusting for potential confounders, and evaluated effect modification by degree of urbanization, air pollution levels, night shift work, job strain, sedative use, sleep aid use, and family history of obesity.

Results: We did not observe associations between road traffic noise (per 10 dB increase in the 1-year mean Lden) and BMI (kg/m2) (β: 0.00; 95% confidence interval (CI): -0.07, 0.07) or waist circumference (cm) (β: -0.09; 95% CI: -0.31, 0.13) in the fully adjusted model. We found significant effect modification of job strain and degree of urbanization on the associations between Lden and both BMI and waist circumference. Job-strained nurses were associated with a 0.41 BMI-point increase, (95% CI: 0.06, 0.76) and a 1.00 cm increase in waist circumference (95% CI: 0.00, 2.00). Urban-area residing nurses had a statistically significant positive association of Lden with BMI (β: 0.26; 95% CI: 0.11, 0.42). No association was found for suburban- and rural-residing nurses.

Conclusion: We suggest that road traffic noise exposure in nurses with susceptibilities, such as those with job strain, or living in urban areas, may lead to increased BMI, an adiposity marker.
Introduction: Road traffic noise pollution increases risk of mortality from ischemic heart disease (IHD). Noise pollution is highly localized, so high resolution mapping of the exposure surface is a key concern. For health impact assessments optimally the data on exposure and health outcomes would both be available at small-area level. However, in Australia IHD deaths data are only easily accessed at low resolution, aggregated to local government areas (LGA, mean ~130,000 people). Our method utilizes low-resolution health data with high spatial resolution noise mapping for producing health risk maps at the mesh-block level (MB, ~75 people).

Methods: We used a noise contour map for Melbourne, Australia from 2011 based on a spatial predictive model to estimate population exposures at the MB level. We used the non-linear exposure–response function for traffic noise and IHD as recommended by the World Health Organization to calculate attributable fractions of deaths for MBs. LGA-level IHD rates were then downscaled to MBs using publicly available data to estimate attributable numbers.

Results: Average noise exposures for MBs was 35 dB and peaked at 72 dB. Approximately 5% of the population was exposed to traffic noise above the threshold of 55 dB. Attributable rates of IHD deaths due to noise were generally very low but in some MBs was as high as 5-10 per 100,000 and in extreme cases can represent more than 8% of the total expected burden of IHD death.

Conclusion: Road traffic noise is a public health concern because it increases risk for IHD death. We present a method that does not require high resolution health data and can be used with high resolution exposure data to provide estimates of health risk. This method could be applied in a wide range of other environmental health settings.
Depression as an effect modifier of an association between outdoor and indoor traffic noise and cognitive function - Results from the Heinz Nixdorf Recall study

Tzivian L¹,², Soppa V², Jokisch M³, Winkler A³, Weimar C³, Moebus S⁴, Hoffmann B¹
¹Faculty of Medicine, University of Latvia, ²Institute of Occupational, Social and Environmental Medicine, Centre for Health and Society, ³Department of Neurology, University Hospital of Essen, University of Duisburg-Essen, ⁴Centre for Urban Epidemiology, Institute for Medical Informatics, Biometry and Epidemiology, University of Duisburg-Essen

TPS 781: Health effects of noise, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aims: Exposure to traffic noise is proposed to be associated with cognitive function. One possible contributor to impaired cognitive function is depression, which is in turn associated with high levels of noise. We studied the role of depression as a possible effect modifier of the association between outdoor and indoor traffic noise and cognitive function.

Methods: Cognitive function and depressive symptoms (Centre for Epidemiologic Studies Depression Scale, CES-D) were assessed during the first follow-up examination of the German Heinz Nixdorf Recall study. Five cognitive subtests (verbal fluency, immediate and delayed recall, labyrinth test and clock-drawing test) were used for the assessment of cognitive function and further summarized to a global cognitive score (GCS).

Long-term outdoor exposure to traffic noise was modeled as weighted 24-h mean (LDEN) at the baseline address of participants and corrected for indoors (LDEN_IN). We used multiple linear models adjusted for individual-level characteristics to check cross-sectional associations of traffic noise assessed outdoors and indoors with cognitive function. We investigated the effect modification role of moderate (CES-D≥17) and severe depressive symptomatology (CES-D≥21) on these associations.

Results: In the study population of 2748 participants, we observed adverse associations of LDEN, LNIGHT, LDEN_IN and LNIGHT_IN with all cognitive outcomes. Associations were stronger for indoor exposures and GCS (for example, LDEN and LDEN_IN point estimates (β) were -0.18 [95% confidence interval -0.39; 0.04] and β=-0.34 [-0.49; -0.18]) per10 dB(A), respectively). The associations were stronger in participants with severe depressive symptomatology (β=-0.41 [-0.67; -0.16]) and (β=-0.55 [-1.21; -0.12]) for the association with LDEN and with LDEN_IN, respectively).

Conclusions: Depressive symptoms might be an effect modifier in the association between noise and cognitive function. Indoor noise can be a more appropriate measure of exposure for studies on noise effects on health.
Can vegetation cover and traffic noise exposure be differentiated at residential address-level in UK Biobank?

Roscoe C1, Hodgson S1, Vineis P1, Gulliver J1,2, Fecht D1
1MRC-PHE Centre for Environment and Health, Imperial College London, 2University of Leicester

TPS 781: Health effects of noise, August 27, 2019, 3:00 PM - 4:30 PM

Background: Exposure to traffic noise and greenspace have been associated with health outcomes, including cardiovascular disease (CVD), with traffic noise observed to increase CVD risk, and greenspace reduce risk. Given that greenspace is typically characterised by low vehicle through-flow, hence lower traffic-related noise, our ability to differentiate vegetation cover and traffic-noise exposure is essential if we are to understand the mechanisms via which these exposures impact health.

Methods: We explored associations of modelled traffic noise (LAeq,24 h, Lden, LAeq,16 h, Lnight) and measures of greenspace coverage (total vegetation cover, ground cover and tree cover, in multiple circular buffers at 50m, 500m and 1000m) from residential addresses for ~60,000 UK Biobank participants in Greater London. Traffic noise was modelled following the Common NOise aSSessment MethOdS (CNOSSOS) protocol. We analysed noise and vegetation correlations at the individual address level, and stratified analyses by neighbourhood level deprivation quintiles.

Results: Across all addresses, we observed statistically significant low-to-moderate correlations of modelled traffic noise and vegetation cover (Spearman’s rho range: -0.05 to -0.20, p=<0.001). Correlations, however, varied considerably depending on vegetation type and scale of analysis: total vegetation cover in the smallest buffer size (50 m) showed the strongest correlation with noise (Spearman's rho: -0.20) and, irrespective of buffer size, tree cover showed the weakest correlation with noise (Spearman's rho range: -0.05 to -0.08). Vegetation cover was significantly lower, and noise exposure significantly higher, at addresses in the most deprived compared with the least deprived areas.

Conclusions: Associations of vegetation cover and traffic-related noise need to be carefully considered in epidemiological analysis of greenspace and/or noise and health outcomes. However, the relatively low correlations between these exposures suggest that independent effects of vegetation cover and traffic noise can be reliably determined in the Greater London UK Biobank sub-cohort.
Aircraft noise exposure assessment for a case-crossover study in Switzerland

Saucy A\textsuperscript{1,2}, Tangermann L\textsuperscript{1,2}, Vienneau D\textsuperscript{1,2}, Schäffer B\textsuperscript{3}, Wunderli J\textsuperscript{3}, Röösli M\textsuperscript{1,2}

\textsuperscript{1}Swiss Tropical and Public Health Institute (Swiss TPH), \textsuperscript{2}University of Basel, \textsuperscript{3}Empa, Swiss Federal Laboratories for Materials Science and Technology

TPS 781: Health effects of noise, August 27, 2019, 3:00 PM - 4:30 PM

Background:
The long-term effects of transportation noise on sleep quality, annoyance and cardiovascular diseases (CVDs) are being increasingly recognized. However, little is known about the triggering effects of noise on CVDs. To investigate the acute effects of aircraft noise on CVD mortality by means of a case-crossover study, a reliable and detailed noise exposure assessment is required.

Methods:
Individual aircraft noise exposures were assessed for a selected population from the Swiss National Cohort (SNC) residing around Zürich Airport in Switzerland. Outdoor noise was estimated at participants' home addresses for case and control events, combining modeled aircraft noise with all registered flight movements between 2000 and 2016. Different noise metrics including equivalent continuous sound pressure level (LAeq), maximum sound pressure level (LAmax) or number above threshold 55 dB (NAT55) were used to quantify and characterize the noise impact during different night-time exposure windows.

Results:
Aircraft noise levels were generally highest during the evening time window (19 to 23) and lowest during the core night (23:30 to 06). Average LAeq were 46, 38, 21, 38 and 33 dB for the different time windows (19-23, 23-23:30, 23:30-06, 06-07 and 23-07 respectively). Average LAmax were 65, 53, 46, 53 and 58 dB and average NAT55 19, 1, 0, 2 and 4 for the same intervals. Average LAeq, LAmax and NAT55 during the two hours preceding night-time deaths for all case and control events were 34 dB, 52 dB and 3, respectively.

Conclusion:
This study is the first to provide individual aircraft noise exposures with high temporal resolution, using a list of movements and previously calculated aircraft noise footprints for different aircraft types and air routes at various times. The choice of the exposure events is flexible and precise, making this approach attractive for conducting a case-crossover study investigating short-term effects of noise on health.
Aim: Communities with lower socioeconomic status and high racial/ethnic minority populations are often more exposed to environmental pollutants. While studies have shown an association between aviation noise and property values, little is known about whether aviation noise exposures are sociodemographically patterned. Our aim was to describe the characteristics of populations exposed to aviation noise across race/ethnicity, income, and racial and economic segregation metrics in the U.S.

Methods: Aviation noise contours characterized as day-night average sound level (DNL) were developed for 90 airports throughout the U.S. in 2010 (>45 dB DNL in 1 dB increments). We linked DNL levels to the centroid of U.S. Census block groups to compare characteristics of exposed (≥55 dB and ≥65 dB) versus unexposed block groups near study airports (<50 km). Comparisons were made across block group race/ethnicity and income categories, as well as established measures of racial (RRS) and economic (ERS) residential segregation. We used Wilcoxon rank sum tests and stratified by U.S. region.

Results: At the 55-dB exposure threshold, Hispanic populations were significantly more exposed to aircraft noise than non-Hispanic populations (at similar distances from the airport) in all regions of the U.S. (p<0.001). This trend was greatest in the Northwest and West where median RRS values decreased the most for exposed block groups. Similar trends were observed using the 65-dB exposure threshold, but the differences were not significant, likely due to smaller sample sizes. In the South and West regions, block groups with low-income segregation (i.e., negative ERS) were significantly more exposed to aviation noise at both the 55-dB (p<0.001) and 65-dB thresholds (p<0.030). In the Northwest and Midwest ERS values were close to zero, but were significantly higher with the 55-dB exposed group (p>0.001).

Conclusions: These results suggest strong sociodemographic patterns of civil aviation exposures, where the key drivers vary regionally.
Long-term Exposure to Road Traffic Noise, Air Pollution and Incidence of Atrial Fibrillation: A Danish Nurse Cohort Study

T. Jørgensen J1, Dehlendorff C2, Ketzel M3, Brandt J3, Hertel O3, Backalarz C4, Amini H1, V. Braüner E5, Loft S1, J. Andersen Z6

1University Of Copenhagen, 2Danish Cancer Society Research Center, 3Department of Environmental Science, Aarhus University, 4Delta Acoustics, 5Department of Growth and Reproduction, Rigshospitalet, University of Copenhagen, 6Centre for Epidemiological Research, Nykøbing F Hospital

TPS 781: Health effects of noise, August 27, 2019, 3:00 PM - 4:30 PM

Background: It has been suggested that exposure to air pollution and road traffic noise may increase risk of atrial fibrillation (AF), although evidence is sparse. Here, we examined the association between long-term exposure to air pollution and road traffic noise and incidence of AF.

Methods: We used the data from a nationwide Danish Nurse Cohort on 28,608 female nurses (age > 44 years) who at recruitment in 1993 or 1999 reported information on AF risk factors. We obtained data on incidence of AF from the Danish National Patient Register until the end of 2014. Annual mean concentrations of PM2.5 and NO2 at the nurses’ residence since 1970 (1990 for PM2.5) were estimated using Danish THOR/AirGIS dispersion model, while road traffic noise levels since 1970 were estimated using Nord2000 model, as the annual mean of a weighted 24h average (Lden). We used time-varying Cox regression models to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for the association between 1- and 3-year moving averages of PM2.5 and 1-, 3-, 10-, and 23-year moving averages of NO2 and Lden with AF incidence.

Results: Of the 28,608 women, 2,021 developed AF during a mean follow-up of 18.3 year. We found a statistically significant and positive association between 1-year mean of Lden preceding AF diagnosis in a fully adjusted model (Lden > 58dB: HR: 1.30; 95% CI: 1.12-1.51; Lden 48-58dB: HR: 1.12; 95% CI: 0.98-1.28 compared to Lden < 48 dB), which remained unchanged after adjusting for air pollutants. Similar results were observed for 3-year mean of Lden, and no association with 23-year Lden. We found no association between PM2.5 or NO2 with AF.

Conclusion: Long-term exposure to road traffic noise was associated with AF incidence while no association were detected with air pollution.
Leisure noise exposure and its association with tinnitus among adolescents


1 Bavarian Health And Food Safety Authorities, 2 Comprehensive Cancer Center, Ludwig-Maximilians University, 3 University Hospital Regensburg, Department of Otorhinolaryngology, 4 Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine, Clinical Centre of the Ludwig-Maximilians University

TPS 781: Health effects of noise, August 27, 2019, 3:00 PM - 4:30 PM

Background
Tinnitus is a major health issue, which affects many people, (5.1% to 42.7% of adults worldwide). The association with leisure noise exposure has been investigated but reveals inconsistent results. Beyond the scope of the Ohrkan-study (leisure noise and hearing; funded by the Bavarian State Ministry for Health and Care) this analysis aims to investigate the long-term impact of leisure noise exposure on tinnitus among adolescents as a very vulnerable population.

Methods
In 2009-2011, 2,149 students of grade nine (mostly aged 15-16 years) in the City of Regensburg were recruited. After 7.5 years, the baseline survey and three follow-ups have successfully been conducted (O-I – O-IV). The exposure to leisure noise and the occurrence of tinnitus were assessed by a self-administered questionnaire. Tinnitus was defined as ringing or buzzing in the ears for more than five minutes (acute), longer than three months (chronic) since the last survey, respectively. The participants were also asked to rate the severity of the tinnitus (from “no impairment” to “very strong impairment”). A longitudinal analysis of these data by generalized linear models (GLM) is in progress to determine the long-term effects of total leisure noise exposure on tinnitus.

Results
Up to now, data from more than 1,000 students are available. Among the study population the number of students reporting tinnitus varied from 61.0% in O-I to 27.6% in O-IV throughout the surveys. The study methods including the statistical model as well as the latest results using 7.5-year follow-up data will be presented.

Conclusions
Tinnitus is a health issue which can lead to serious impact on daily life. The conclusions will be drawn from the results of the longitudinal analysis with respect to the burden of leisure noise exposure and the association with tinnitus among adolescents. Possibilities regarding prevention and regulatory measures will also be discussed.
Pesticides are well-known chemicals that can increase the risk to develop cancer by induction of DNA damage and oxidative stress, especially in populations with chronic exposure. Bolivian farmers have been increasing their use of pesticides during the last decades to increase their production and economy. Chronic exposure to these chemicals, their combined effects and genetic polymorphisms can increase the risk of genotoxic damage, mutagenicity and development of chronic diseases.

A cross-sectional study in 297 volunteers from three different Bolivian agricultural communities was conducted. Exposure and handling of pesticides were assessed by a questionnaire and urinary pesticide metabolite analysis. Genotoxic effects were evaluated in collected blood samples by Micronucleus and Comet assay. Frequency of glutathione transferase (GST) null genotypes (GSTM1 and GSTT1) was determined to evaluate the impact on DNA damage levels.

The results showed that only 17% of the farmers used recommended protection equipment. In agreement, they were highly exposed to chlorpyrifos, pyrethroids and 2,4-D, and men generally more highly compared to women. Higher frequency of micronuclei (MN) was found in women compared to men (4.52 vs 3.55, \(p<0.05\)). Farmers active >8 years had higher frequency of MN compared to farmers active <8 years (4.23 vs 2.94, \(p<0.05\)). Surprisingly, a null GST genotype (GSTM1 and GSTT1: 84% and 24% null, respectively) was associated with lower levels of DNA damage. High levels of exposure to tebuconazole, 2,4-D or cyfluthrin was associated with high levels of DNA strand breaks (\(p<0.05\)-0.01). After adjustment for confounding factors (e.g. gender, age, GST genotype), a significant increased risk of DNA strand breaks was found for exposure to 2,4-D (OR=1.9, CI=1.0-3.8, \(p=0.049\)).

In conclusion, agricultural Bolivian population, especially men are highly exposed to mixtures of pesticides causing genotoxic effects in lymphocytes and which constitutes an increased risk of developing cancer in the future.
Oxidative Stress Profile of workers exposed to formaldehyde in the hospital

Bellisario V¹, Squillacioti G¹, Ghelli F¹, Bono R¹
¹University Of Turin

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim
Formaldehyde (FA) is still commonly used for fixing biologic specimens. Hospital workers are exposed to FA because of this practice, by pouring liquid FA in containers (3-5 litres) or using prefilled vials (50-100 ml). Since FA is known as a human carcinogen and an inducer of genotoxic and oxidant activity, the aim of this study was to analyse the intensity of an oxidative stress (OS) profile in correlation to FA exposure levels.

Methods
107 hospital workers of the Molinette hospital in Turin (Italy) variously exposed to FA were recruited. Each subject filled out a standardised questionnaire for general informations, wear a personal air-FA sampler for 1 working shift (8h) and provided a blood and urine sample for the quantifications of the OS profile biomarkers by means of isoprostane (15-F2t-Isop, malondialdehyde (MDA), oxidized glutathione (GSSG) and inflammatory mediators (MIP, VEGF, FGF, CD23, CD27, CD30, TNF, IL-6, IL-10).

Results
A positive correlation between FA level improvements and pro and anti-oxidants (15-F2t-Isop, MDA, GSSG, FGF2, LDH, VEGF, CD27, TNFR1) was found. A Multivariate analysis was calculated considering Ln FA as the dependent variable. The model was positively correlated with pro-oxidants (Ln 15-F2t-Isop B=0.463 p<0.001; Ln MDA B=0.380 p<0.001; Ln GSSG B=0.374 p<0.001) and inversely correlated with anti-oxidants (Ln LDH B= -0.117 p=0.007; Ln IL6 B= -0.086 p=0.017; Ln VEGF B= -0.148 p=0.004; Ln CD27 B= -0.077 p=0.011; LnTNFR1 B= -0.075 p=0.003). Finally, a Risk Index (RI) was calculated for pro oxidants and anti-oxidants in a multivariate analysis with LnFA. Pro-oxidant RI increased 34% (B=8.172 p<0.001) while anti-oxidant RI decreased 8% (B=-3.335 p=0.003).

Conclusions
FA exposure influences OS profile. In particular, FA is confirmed as an inductor of oxidative stress and inflammation, simultaneously activating pro and anti-oxidant pathways. Moreover, FA stronger modulates the pro oxidants, with higher activation of 15-F2t-Isop, MDA and GSSG.
Oxidative stress induction in woodworkers exposed to wood dust and formaldehyde
Ghelli F1, Squillacioti G1, Bellisario V1, Bono R1
1University Of Turin

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Background / goal
Environmental quality may influence public health also in the workplaces. Many workers are exposed to wood dust (WD) and formaldehyde (FA), known for their potential carcinogenic activity, which are supposed to be oxidative stress-mediated. This study aims to assess exposure to WD and FA and its role in the induction of OS in a population of woodworkers.

Methods
Sample includes 128 woodworkers, enrolled in 4 manufactories, and 117 controls in Piedmont, Italy. Each subject received two personal air samplers (passive by FA, active for WD), completed a questionnaire and provided a urine sample to quantify the OS by 15-F2t-Isoprostane and 8-oxo-dG, and exposure to tobacco smoke by cotinine.

Results
WD and FA are higher in wood workers than controls (p<0.001), although no significant difference in OS biomarker levels were detected among exposed and controls. By splitting the dust exposure into tertiles, the levels of 15-F2t-Isop and 8-oxo-dG are higher in the 2nd tertile compared to the first (p=0.001 and p=0.035, respectively). 8-oxo-dG levels are positively correlated with WD exposure (p=0.014). The same result is observed for the concentrations of 15-F2t-Isop, only after adjustments of age and working years (p=0.002). Furthermore, 15-F2t-Isop is also correlated with cotinine levels (p=0.001). Finally, no significant correlations were found between biomarker levels and FA concentration.

Conclusions
Findings show a measurable effectiveness of prevention programs: environmental pollution does not seem sufficient to determine a significant alteration of OS biomarkers. The two biomarkers provide different results because they measure different aspects of the OS: 15-F2t-Isop reveals the exposure of the previous weeks; 8-oxo-dG shows an immediate effect. Data support the influence of both environmental quality and lifestyles in OS induction: indeed, lower WD concentrations do not necessarily imply lower OS levels, whereas TS significantly increases the levels of OS biomarkers.
Longitudinal study of effects of welding fumes on the cardiovascular system
Taj T\textsuperscript{1}, Wahlberg K\textsuperscript{1}, Hedmer M\textsuperscript{1}, Assarsson E\textsuperscript{1}, Lundh T\textsuperscript{1}, Tinnerberg H\textsuperscript{2}, Albin M\textsuperscript{1,3}, Broberg K\textsuperscript{1,3}
\textsuperscript{1}Div. of Occupational and Environmental Medicine, Lund University, \textsuperscript{2}Section of Occupational and Environmental Medicine, Sahlgrenska Academy, Gothenburg University, \textsuperscript{3}Institute of Environmental Medicine, Karolinska Institutet

Background/aim: Welders are exposed to particle levels many times higher than the general public, but there is lack of evidence that welding causes cardiovascular disease (CVD). The aim with this study was to investigate if moderate exposure to welding fumes is associated with adverse effects on the cardiovascular system.

Methods: We performed a longitudinal analysis of 78 welders and 96 controls examined twice (cycle 1 and 2), six years apart. We also performed a cross-sectional study of 90 welders and 69 controls that were examined only once. Study subjects (all male and non-smoking at recruitment) filled in questionnaires, and we measured blood pressure, endothelial function, and established risk markers for CVD (LDL, homocysteine, and C-reactive protein). Exposure to welding fumes was assessed using questionnaires and respirable dust measurement in the breathing zone. Linear mixed effect and linear regression models were used for the longitudinal and cross-sectional analyses, respectively.

Results: Median respirable dust concentrations in the welders were 1.1 (0.2-4.2) and 0.5 (0.1-1.9) mg/m\textsuperscript{3} in cycle 1 and 2, respectively. There was a statistically significant increase in systolic (4.48 mmHg, p=0.007) and diastolic (2.61 mmHg, p=0.032) blood pressures among welders compared with controls over the 6-year follow-up period (mixed effect models adjusted for age, BMI, physical activity, smoking, alcohol intake, vegetable consumption, and family history of CVD). Diastolic blood pressure increased with 0.25 mmHg with every year of welding. In the cross-sectional analyses, welders showed on average 6.08 mmHg higher systolic blood pressure compared with controls (p=0.018). Cumulative dose (welding year x respirable dust) was associated with higher diastolic pressure (0.072 mmHg). There were no significant associations between exposure and endothelial function, LDL, homocysteine, or CRP.

Conclusion: Exposure to welding fumes at moderate levels are associated with increased blood pressure and further reduction of the occupational exposure limit is warranted.
Occupational Risk Factors for Health Disparities among Latina Farm Workers in Southern Idaho
Curl C1, Torres C1, Som Castellano R1, Meierotto L1
1Boise State University

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Latina farm workers may experience a unique intersection of social and environmental factors that are known to affect health. The disadvantages inherent in their gender, race and social class may be compounded by their immigration status, rural location and the hazards of farm work. We propose to identify the most critical risk factors for poor health facing this underserved and understudied population.

Methods: Our study uses a mixed-methods approach that combines qualitative data from focus groups (n=3 groups of 10 participants each) and semi-structured interviews (n=15) with quantitative and qualitative survey data (n=100) and biological monitoring (n=45). The study includes six domains of inquiry: sociodemographics, food security and food access, housing conditions, social isolation, access to medical care and occupational hazards. Urinary biomonitoring is used to assess exposure to common agricultural pesticides.

Results: All study participants identify as Latina or Hispanic and, among those recruited to date (n=25), range in ages from 25 to 71 and report an average of 12 years working in agriculture. While sample and data collection is in progress, preliminary analysis indicate that these participants spend an average of 7.5 months per year employed in agricultural work. Participants report working with a range of crops common in Southern Idaho, including onions, sugarbeets, peas, corn, grapes, and hops. More than 25% of the study participants report that their employers do not provide water, cups and hand washing facilities on a daily basis. Participants report use of backpack and air blast sprayers, and approximately one-third report receiving training from their employers on the use of pesticides.

Conclusions: This research will assess the prevalence of social and environmental risk factors among Latina farm workers using an interdisciplinary approach that combines surveys, in-depth interviews and focus groups, biological monitoring and field observations.
Differences in physical activity between employed and unemployed individuals: a cross-sectional study

Dedele A¹, Miskinyte A¹, Andrusaityte S¹, Nemaniute-Guziene J¹, Cesnakaite I¹

¹Vytautas Magnus University

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Introduction: Physical activity (PA) has a health benefit that influences people quality of life. However, according to the World Health Organization (WHO), 1 in 4 adults is not active enough, more than 80% of the world’s adolescent population is insufficiently physically active. The decrease in PA is partially related to sedentary behaviour at job and at home, also to inactive leisure time. Several epidemiological studies have showed that insufficient PA is associated with sociodemographic and socioeconomic factors.

Methods: The aim of the study was to determine the differences in PA levels between employed and unemployed individuals. A cross-sectional study was carried out in Kaunas city, Lithuania, which included 1,111 randomly selected adults who were willing and able to participate in the study and complete a questionnaire. Data about demographic, socioeconomic, employment, physical activity, health and other factors were collected. Participants were classified into two groups of PA: lower PA level and higher PA level.

Results: The results of the study showed that unemployed individuals (18.4 %) were more likely to be physically active compared to employed individuals (3.5 %). The prevalence of obesity was significantly higher among adults of lower PA group in both employed and unemployed individuals by 5.5 % and 18.1 %, respectively. Our findings showed that such factors as educational level and car disposal were also associated with differences in PA.

Conclusions: The results of our study are actual for all urban populations in European countries.
Validity of Retrospective Occupational Exposure Estimates of Lead and Manganese in a Case-Control Study

Friesen M1, Sauve J1, Ramsay J1, Cantor K1, Karagas M2, Hosain G3, Schwenn M4, Johnson A5, Koutros S1, Silverman D1

1National Cancer Institute, 2Geisel School of Medicine at Dartmouth, 3Department of Health and Human Services, 4Maine Cancer Registry, 5Vermont Department of Health

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Background: The validity of surrogate measures of retrospective occupational exposure in population-based epidemiological studies has rarely been evaluated. Using toenail samples as indicators of biologic exposure, we assessed whether work tasks and expert assessments of occupational metal exposure obtained from personal interviews were associated with lead and manganese concentrations.

Methods: We selected 609 controls from a case-control study of bladder cancer in New England who had held a job for ≥1 year 8-24 months prior to toenail collection. We evaluated associations between toenail metal concentrations and five tasks extracted from occupational questionnaires (grinding, painting, soldering, welding, working near engines) using linear regression models. For 139 subjects, we also evaluated associations between the toenail concentrations and exposure estimates from three experts.

Results: We observed a 1.9-fold increase (95% confidence interval (CI) 1.4-2.5) in toenail lead concentrations with painting and a 1.4-fold increase (95%CI 1.1-1.7) in manganese concentrations with working around engines and handling fuel. We observed significant trends with increasing frequency of both activities. For lead, significant trends were observed with the ratings from all three experts. Their average ratings showed the strongest association, with subjects rated as possibly or probably exposed to lead having concentrations that were 2.0 and 2.5 times higher, respectively, than in unexposed subjects (Ptrend<0.001). Expert estimates were only weakly associated with manganese toenail concentrations.

Conclusions: Our findings support the validity of surrogate measures to assess occupational exposure in epidemiologic studies. The stronger associations with task frequency and expert assessments support using refined exposure characterization whenever possible.
Background/Aims: Respiratory status in early life may be associated with adult occupational exposures. This has been hypothesized to create a “healthy worker” bias, where persons with better respiratory status may be more likely to self-select into and remain in jobs with more adverse occupational exposures. We evaluated associations between childhood respiratory function and occupational exposures in early adulthood in a longitudinal respiratory birth cohort.

Methods: The Tucson Children’s Respiratory Study (CRS) enrolled participants at birth in the 1980s. At age 11, pre- and post-bronchodilator measures of FEV1, FVC, FEV1/FVC Ratio, & FEF25-75% were assessed. We used the Global Lung Function Index to calculate percent predicted values, which account for race, sex, height, and age. At age 26, participants self-reported dust, smoke, and/or fume/gas exposures (binary) at current and prior jobs. We used logistic regression to evaluate whether percent predicted pre- and post-bronchodilator lung function at age 11 was associated with self-reported occupational exposures at first job (N=384). We also examined modification by length of time at job (binary, >= 12 months, alpha=0.15). We controlled for maternal education, smoking during pregnancy, participant smoking at age 22, and Hispanic ethnicity.

Results: Post-bronchodilator measures of percent-predicted FEV1/FVC Ratio and FEF were associated with occupational dust (OR-FEV1/FVC ratio for 1% increase=1.03, 95%CI=1.00-1.07; OR-FFE=1.01, 95%CI=1.00-1.02), while FEV1 and FVC were associated with occupational smoke (OR-FEV1=1.03, 95%CI=1.01-1.06; OR-FVC=1.03, 95%CI=1.01-1.06). In interaction models, among participants employed in first job >=12 months (N=314), post-bronchodilator FEV1, FEV1/FVC ratio, and FEF, were associated with dust (OR-FEV1=1.03, 95%CI=1.01-1.06; OR-Ratio=1.05, 95%CI=1.01-1.09; OR-FFE=1.02, 95%CI=1.00-1.03; p-interactions all<0.10), and FVC was associated with smoke (OR-FVC=1.05, 95%CI=1.02-1.07, p-interaction=0.12). Estimates were similar for pre-bronchodilator values.

Conclusions: These results support the premise of the healthy worker effect hypothesis. Better lung function, as early as age 11, is associated with greater adverse occupational exposures in this general population cohort.
Self-reported health status of tour managers leading tours to different geographic areas
Lan F\textsuperscript{1,2}, Guo H\textsuperscript{1,2}, Tseng Y\textsuperscript{3}
\textsuperscript{1}National Cheng Kung University, \textsuperscript{2}National Cheng Kung University Hospital, \textsuperscript{3}Chang Jung Christian University
TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aim: Tourism is rapidly developing worldwide, and many worker engaged themselves in this growing industry. Tour managers are frequently exposed to various health hazards associated with travel, but data on the health conditions of this working population are limited. We conducted a survey on health conditions of tour agency employees in Taiwan. Methods: We recruited tour managers and office staff in tour agencies and sent anonymous questionnaires to the participants, which collected data on demographic characteristics, medical history, and recent symptoms. In addition to uni-variate analyses, we used logistic regression models to evaluate relationship between touring areas and health outcomes. Results: A total of 390 workers, including 238 office staff, 95 part-time tour managers, and 57 full-time tour managers participated in this study. We found tour managers were more likely to have gastroesophageal reflux disease (GERD) (odds ratio [OR]: 3.8, 95\% confidence interval [CI]: 1.2-11.7) and lower back pain (OR: 6.1, 95\% CI: 1.6-23.9), after adjusting for sex, age, education level, and alcohol consumption. In further analyses of data on tour managers, we found those who managed tours to North-East Asia reported more recent coughs (OR: 14.8, 95\%CI: 3.1-70.7), after adjusting for multiple tour-leading areas, sex, age, body mass index, educational level, smoking, and alcohol consumption. Conclusions: We observed higher prevalence of self-reported GERD and lower back pain among tour managers compared to office staff. We also found that tour managers managing tours to North-East Asia reported more coughs in the past three months.
The Association of Sleep Disorder and PTSD Symptoms by Work Tasks in Firefighters
Kim Y¹, Kim C¹, Bae M²
¹Department of Preventive Medicine, Yonsei University, ²Department of Occupational & Environmental Health, Yonsei University

the post-traumatic stress disorder (ptsd) and sleep disorder were known to be common mental disorders in firefighters, but few studies on mental health according to the detailed work tasks of firefighters are insufficient, although the occupational environment exposed by work tasks would be very different. this study aims to compare the difference in relations between ptsd symptoms and sleep disorder by work tasks in firefighters. the 1,022 firefighters surveyed in 2016 and 20 were excluded because of missing in work tasks. the ptsd checklist specific (pcl-s), was used for assess ptsd. ptsd symptoms were as re-experience, avoidance and hyperarousal. sleep quality was examined by pittsburgh sleep quality index (psqi). the sleep disorder was defined as having 5 or more in psqi score. the firefighter’s work tasks were divided into the recruits, fire suppression, rescue, office administration and retiree. this study is a cross-sectional study, the associations of sleep disorders and ptsd symptoms were expressed in odds ratio (or) estimated by logistic regression. in recruit (n = 95), there is no statistically significant between ptsd symptoms and sleep disorders. however, in fire suppression (n = 441), only hyperarousal (or:2.20, 95% ci:1.45-3.35, p=.0002) was significant. in rescue (n = 211), re-experience (or:8.87, 95%ci:1.25-63.19 p= 0.0293) and hyperarousal (or:2.17, 95%ci:1.07-4.39, p= 0.0293) were significant. in contrast, avoidance (or:3.39, 95%ci:1.12-10.28 p= 0.0307) was significant in office administration (n = 182). in retiree (n = 73), hyperarousal (or:3.20, 95%ci:1.17-8.76, p= 0.0239) and avoidance (or:0.55, 95%ci:0.32-0.95, p = 0.0316) were significant. the results suggest that, even in the same firefighter, the symptoms of ptsd associated with sleep disorders may vary depending on the detailed work environment, and the need systematic and distinct mental health care.
The association between salivary cortisone level and structural change of Limbic system based on differences in blood heavy metal concentration among Korean firefighters: a cross-sectional study

KIM W1, Bae M2, Noh J1, Choi J1, KIM Y1, KIM C1,3
1Dept. of Preventive Medicine, Yonsei University College of Medicine, 2Dept. of Occupational & Environmental Health, Graduate School of Public Health, Yonsei University, 3Institute of Human Complexity and Systems Science, Yonsei University

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Introduction: The limbic system is an anatomical structure that plays a pivotal role in motivation, emotion, learning and memory. Firefighters are chronically exposed to violence, trauma and other threats. They are also constantly exposed to a variety of environmental hazardous substances. This study focused on the association of limbic system atrophy and salivary cortisone known as stress hormone. Finally, we analyzed whether there is a difference in the relationship between cortisone level and the structural change of the limbic system among the subgroups with different concentrations of heavy metals.

Methods: Subjects from Firefighter Research Enhancement of Safety&Health (FRESH) cohort in South Korea were used in analysis. Saliva sample was collected at 1:00 pm on all participants. Of the total subjects, 349 measured cortical thickness, and brain volume for all areas of the brain by brain 3T MRI. We divide the subjects into two subgroups each based on the median value of the heavy metal-lead and cadmium-concentration in the blood. Furthermore, to show a correlation between salivary cortisone and structural change of the limbic system, the generalized linear models was used.

Results: In both groups with lower blood lead concentrations (under 1.900ug/dL) and lower cadmium (under 0.793ug/L), there was no statistically significant association between salivary cortisone and the limbic structure. In group with higher blood lead concentrations, higher salivary cortisone showed a decline left ($\beta$=-45.3316, p=0.0044) and right ($\beta$=-35.2435, p=0.0232) hippocampus, and left ($\beta$=-0.0115, p=0.0395) and right ($\beta$=-0.0126, p=0.0201) cingulate gyrus. In group with higher blood cadmium concentrations, higher salivary cortisone showed a decline left ($\beta$=-45.1016, p=0.0032) and right ($\beta$=-37.1952, p=0.0081) hippocampus, left ($\beta$=-19.3342, p=0.0076) and right ($\beta$=-18.1622, p=0.0129) thalamus, and right cingulate ($\beta$=-0.0113, p=0.0245).

Conclusions: The results of this analysis indicate that salivary cortisone level was partially related with volume and thickness of some limbic system structure in subjects with relatively high blood heavy metal concentration even within normal levels.
Exposure to styrene and styrene-7,8-oxide among workers in the glass fibre-reinforced plastics industry

Kirkeleit J1,2, Hollund B1,2, Fustinoni S3,4, Frigerio G3,4, Campo L3,4, Nedeljkovic S2, Bråtveit M1,2
1Department of Occupational Medicine, Haukeland University Hospital, 2Department of Global Public Health and Primary Care, University of Bergen, 3Department of Clinical Sciences and Community Health, University of Milan, 4Fondazione IRCCS Ca’Granda Ospedale Maggiore Policlinico

Background/Aim: We aimed to characterize the exposure to styrene and styrene-7,8-oxide (StyOx) among Norwegian workers in the glass fibre-reinforced plastic (GRP)-industry, and to assess their biological uptake of styrene by determination of the metabolites mandelic acid (MA) and phenylglyoxylic acid (PGA) in urine.

Methods: Thirty workers from two GRP-companies participated, comprising repeated full-shift personal samples of styrene and StyOx (n = 58) using organic vapour passive dosimetry badges (3M 3500®), and urinary samples for determination of MA+PGA post-shift (n = 55). Styrene and StyOx were determined by gas chromatography-mass spectrometry (GC-MS). Urinary MA+PGA was assayed by liquid chromatography with tandem mass spectrometry (LC-MS/MS). Association between styrene exposure and urinary concentration of MA+PGA was described by Pearson’s correlation coefficients.

Results: GRP-workers overall geometric mean exposure to styrene and StyOx were 34.8 mg/m3 (geometric standard deviation (GSD) 2.7) and 128.3 µg/m3 (3.8), respectively. The exposure to styrene in the foundry (n=23), assembly (n=21) and vacuum (n=14) departments were 39.2 mg/m3 (2.9), 40.3 mg/m3 (1.8) and 22.9 mg/m3 (3.7), respectively. Overall mean concentration of urinary MA+PGA was 121.1 mg/g creatinine (2.0, max.494). The highest mean urinary concentration of MA+PGA were measured in the foundry department in company A (110.7 mg/g creatinine; GSD 2.4) and assembly department in company B (191.5 mg/g creatinine; GSD 1.5) in company B. Despite use of personal protective equipment (PPE) the correlation between styrene exposure and urinary concentration of MA+PGA was high with a correlation coefficient of 0.71 (p<0.001).

Conclusions: GRP-workers’ geometric mean styrene exposure was in compliance with the Norwegian occupational limit value of 105 mg/m3, but with the potential for exceeding the limit for all processes. The correlation between styrene in the breathing zone and its’ metabolites in urine indicates that PPE did not protect the workers from uptake of styrene, and that improvement of control measures is needed.
Professional Drivers Exposure to Black Carbon in London; the Diesel Exposure Mitigation Study
Lim S¹, Barratt B¹, Holliday L², Griffiths C², Mudway I¹
¹Environmental Research Group, MRC-PHE Centre for Environment and Health, King’s College London, ²Centre for Primary Care and Public Health, Queen Mary University of London

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Background: Despite the established health risks of diesel engine exhaust, minimal research has been undertaken to quantify the exposures of professional drivers. We therefore sought to characterise exposures for professional drivers under a range of occupational settings, vehicle types and driving conditions and to identify and evaluate intervention methods to reduce drivers’ exposures.

Method: GPS-linked black carbon (BC) sensors were provided to 150 drivers (taxi drivers, couriers, heavy freight, waste removal and emergency services) working predominantly within London’s M25. Each driver was monitored for 96 continuous hours at one-minute resolution. Drivers also completed a questionnaire, detailing their ventilation preferences, vehicle type and their number of working hours per day.

Preliminary Results: Average driver exposure to BC was over 3 times higher at work (3.5 ± 2.9 µg/m³) compared to periods at home (1.1 ± 0.7 µg/m³). During work, drivers experienced high spikes in exposure, often exceeding 100 µg/m³. The highest exposed drivers were taxi drivers (6.0 ± 4.6 µg/m³), while the lowest were those in emergency services (2.0 ± 0.7 µg/m³). Window position influenced BC exposures, with concentrations being 2.5 times higher for drivers with windows open versus closed. Across the same monitoring period ambient BC concentrations were 2.5 ± 1.8 µg/m³ at a London roadside and 0.8 ± 0.7 µg/m³ at the London background, indicating these sites are largely unsuitable as a proxy for driver exposure.

Conclusion: We have performed the largest study of driver exposures to a proxy of diesel exposure (BC) in an urban environment. These data confirm the very high exposures experienced by professional drivers in their working lives, but also indicate that simple measures, such as closing vehicle windows can significantly reduce exposures.
Evaluation of the reliability and convergent validity of a monitoring battery including three Screening Test (CDT, FAB and TMT) of neuropsychological outcomes on agricultural and non-agricultural workers from Chile

Lucero B¹, Ceballos P¹, Muñoz-Quezada M¹

¹The Neuropsychology and Cognitive Neurosciences Research Center, Faculty of Health Sciences, Universidad Católica del Maule, Talca, Chile.

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Background: In all regions of Chile, the acetylcholinesterase inhibitor pesticides such as organophosphates (OP) are the most utilized. Neurocognitive effects include impairments of the non-verbal abilities, processing speed and executive functions. Experts have stressed that it is necessary to apply test and re-test on health surveillance, in order to establish early monitoring in occupational populations regarding the neurotoxic effect. Currently, there are no monitoring instruments validated in Chile in this area, so the purpose of this work is to evaluate a monitoring battery with regard to their reliability and convergent validity on agricultural workers from Maule Region of Chile.

Methods: The battery was administered to 234 agricultural workers (20.5% female, mean age=42.5 years old, SD=11.2, median=43) and 305 non-agricultural workers (6.2% female, mean age=40 years old, SD=13). The analysis included test re-test correlations, Cronbach’s alpha for internal consistency and interscale correlations.

Results: There is a test re-test positive correlation for the Clock Test (rho= 0.55, p=0.05), also for the test re-test FAB (rho=0.51, p=0.05), and a strong positive correlation for the TMT-A (rho=0.70, p=0.05), and TMT-B (rho=0.70, p=0.05). The consistency was good or very good for the three screening test of the battery, with alpha values of 0.60 and above. The convergent validity correlations showed that the CDT has a significant (p=0.05) positive correlation with the FAB (rho=0.20); the CDT has an inverse correlation with TMT-A(rho=-0.26), and with the TMT-B (rho=-0.25); the FAB with the TMT-A has also an inverse correlation (rho=-0.43), and with the TMT-B(rho=-0.54). The inverse correlations are explained because the TMT score consists of reaction times (lower score, better performance). The TMT-A is strongly correlated with TMT-B (rho=0.70).

Conclusion: The battery has a good psychometric performance, so its application provides reliable screening measures for the monitoring of cognitive functioning in agricultural and non-agricultural workers in Chile.
Environmental risk factors for acute kidney injury in agricultural workers in Spain

O’Callaghan-Gordo C1,2,3, Caplin B4, Mahalingasivam V4, García R5, Arjona L1,2,3, Brocal F5, Ronda E1,2,3, Pearce N6, Kogevinas M1,2,3

1Isglobal, 2Universitat Pompeu Fabra (UPF), 3Consortium for Biomedical Research in Epidemiology and Public Health (CIBER Epidemiología y Salud Pública-CIBERESP), 4Centre for Nephrology, University College London Medical School, 5Universidad de Alicante, 6Department of Medical Statistics, London School of Hygiene and Tropical Medicine

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

A high burden of kidney diseases, including acute kidney injury (AKI), has been reported among agricultural workers in tropical areas. Dehydration caused by strenuous work at high temperatures has been suggested as a risk factor for AKI. In the Mediterranean region, agricultural workers are exposed during the summer months to temperatures similar to those observed in tropical latitudes. The aim of the study is to evaluate if agricultural work during the summer months in Spain is a risk factor for AKI.

Seventy-four agricultural workers were enrolled in two provinces of Spain: 57 were enrolled in Alicante during the grape harvest season (summer months) and 17 were enrolled in Tarragona during the citrus harvest (winter months). From each participant we obtained the following information before and after the work-shift: i) blood and urine samples to analyze creatinine serum levels and creatinine, albumin and neutrophil gelatinase-associated lipocalin (NGAL) urine levels; ii) anthropometric measurements; and iii) information about life-style and working conditions. Temperature and humidity were measured at the workplace to estimate the wet-bulb globe temperature (WBGT).

Age and sex distribution were similar between regions (% of men: 84% in Alicante, 94% in Tarragona, p-value= 0.294; mean (SD) age: 41 (1.7) in Alicante, 43 (2.1) in Tarragona, p-value=0.386). There were no differences in mean NGAL levels between provinces before the work-shift [Alicante=2.7 (0.4), Tarragona=3.5 (0.8), t-test p-value=0.347] or after it [Alicante=7.7 (0.9), Tarragona=5.9 (1.3), t-test p-value=0.321]. NGAL levels were higher after work-shift in workers from Alicante (Wilcoxon matched-pairs p-value<0.001) but no differences were observed in workers from Tarragona (Wilcoxon matched-pairs p-value=0.166).

Results are in concordance with the hypotheses under study. These results have to be verified with measurements of serum and urine creatinine levels, urine albumin levels, and estimates of WBGT. These data will be available before the ISEE conference.
Measurement of urinary 1-hydroxy pyrene in a pilot study of airport workers exposed to jet fuel

Rashid A1, Rafique M1

1EcoHealth Research Group, PMAS Arid Agriculture University

TPS 792: Occupational health 2, August 27, 2019, 3:00 PM - 4:30 PM

Background/Aims: Aviation industry is rapidly growing in Pakistan, with huge number of workers and technicians performing various occupational assignments at the airports. Several among them are less educated and low-income workers who have limited access to health care, labor protections, and chemical health and safety information. Since they are routinely exposed of jet fuel, we predicted this occupational group to be a uniquely exposed and vulnerable to polycyclic aromatic hydrocarbons (PAHs). Methods: We collected post-shift urine samples from 29 workers to characterize PAH exposure in this subpopulation at Benazir Bhutto International Airport, Islamabad. We analyzed the urine samples for primary urinary metabolite 1-hydroxy pyrene (1-OHP) using a modified method after validated from existing literature. Estimates of urinary 1-OHP were compared with our findings to the 2013 petrol filling workers. The concentration of naphthalene and pyrene in the blood samples was also detected to establish the correlation between serum PAH concentration and respective metabolite in urine. Results: Airport worker geometric means for each 1-OHP was higher than population averages of petrol filling workers and unexposed control cohort and some of the differences were statistically significant. We found 1-OHP, to be 1.9 (p<0.0001), 1.3 (p<0.001), and 0.35 (p=0.224) times higher than in unexposed group, petrol filling workers and airport workers with rotating jobs. Additionally, our results show that some workers are exposed to very high PAH levels, well above the 95th percentile of unexposed urban population. Conclusions: Findings of this pilot study has enabled us to conclude that airport workers may be disproportionately exposed to jet fuel driven PAHs, demands further investigation by taking into account health symptoms and disease vulnerability analysis.
Occupational exposure to n-hexane is associated with reduced gonadotropins and with prolonged menstrual cycles in Mexican workers of reproductive age

Ruiz-García L1, Figueroa-Vega N1, Malacara-Hernández J1, Carrieri M2, Salamon F2, Jiménez-Garza O1

1Universidad De Guanajuato, 2Padua University

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Introduction. Former studies in rodents and cell lines have demonstrated ovarian toxicity caused by n-hexane and/or 2,5-hexanedione (2,5HD). In women occupationally exposed to solvents, variables “menstrual cycle period” and “time to get pregnant” was longer compared with controls, without identifying a compound responsible for those effects.

Material and methods. We studied a group of Mexican women labouring in a shoe Factory (n=32). Individual environmental levels for seven compounds, included n-hexane, were measured. Also, urinary 2,5HD and gonadotropins (FSH and LH) and oestradiol as potential biomarkers of ovarian toxicity were measured, in addition to a gyneco-obstetric history were obtained. We performed all tests and questionnaires in a reference group as well (n=32).

Results. Mean exposure levels to n-hexane (49.2 ± 39.6 mg/m3) and toluene (30.8 ± 24.5 mg/m3) were the highest observed. There were no significant differences in serum FSH and AMH concentrations between groups (p >0.05). Exposed group showed prolonged menstrual cycles (p = 0.007) and longer time to get pregnant compared with controls (p = 0.007). Also, in the exposed group, significant correlations were observed between FSH levels and n-hexane (r = -0.34, p = 0.028) as well as FSH and 2,5HD (r = -0.33, p = 0.029) and LH and n-hexane levels (r = -0.36, p = 0.033)

Conclusions. N-hexane exposure may be responsible for a prolonged menstrual cycle. As judged by the correlations between FSH with n-hexane and 2,5HD and LH correlations with n-hexane levels. This affection could be in the endocrine pathway rather than in the ovary itself. N-hexane could act as an endocrine disruptor in women of reproductive age.
Background/Aim: Prenatal fine particulate matter (PM2.5) exposure is linked with adverse pregnancy outcomes and developmental problems in children; PM2.5-induced changes to maternal immune activity may underlie these relationships. We examined maternal prenatal PM2.5 exposure in relation to inflammatory signals using a targeted proteomics approach.

Methods: Analyses include 373 pregnant women enrolled in a prospective study in the northeastern United States between 2011 and 2015. We estimated daily residential PM2.5 exposure using high-resolution satellite data combined with ground monitoring measures and spatiotemporal predictors. We analyzed 92 inflammatory proteins in mid-pregnancy serum using a novel multiplex proximity extension assay. To explore the influence of exposure timing, we examined PM2.5 averaged across the previous 3 months, 1 month, or week of blood draw. We regressed PM2.5 on each inflammatory marker in separate models adjusting for week of gestation, maternal age, and season. For associations with a Bonferroni-adjusted p-value <0.05, we next used multivariable logistic regression to examine continuous PM2.5 exposure in relation to high (highest 20%) versus low (lowest 80%) inflammatory marker levels.

Results: Mothers were primarily minorities (60% black or Hispanic). After Bonferroni correction, monocyte-chemotactic protein-3 (MCP-3), interleukin-8 (IL-8), and oncostatin M (OSM) were (p<0.001) positively associated with PM2.5 for one or more exposure interval. The odds of having high MCP-3 levels increased per unit (µg/m3) increase in PM2.5 when averaged across the previous 3 months (OR=1.48, 95% CI=1.22,1.80), 1 month (OR=1.30, 95%CI=1.12,1.51), or week (OR=1.18, 95% CI=1.06,1.31). Parallel findings were true for OSM (1 month: OR=1.24,95%CI=1.08,1.44; 1 week: OR=1.22, 95% CI=1.10,1.35) and IL-8 (1 month: OR=1.27,95%CI=1.10,1.46; 1 week: OR=1.23, 95% CI=1.11,1.37) for more recent exposure only.

Conclusions: These data link increased prenatal PM2.5 with markers of enhanced inflammation. Future analysis in this longitudinal cohort will examine whether identified markers (MCP3, OSM and IL8) mediate associations between PM2.5 and maternal-child health outcomes.
Per- and polyfluoroalkyl substance concentrations during pregnancy and post-pregnancy biomarkers of cardiometabolic health in Project Viva

Mitro S1, Sagiv S2, Rifas-Shiman S3, Fleisch A4, Jaacks L5, Williams P6, Oken E3, James-Todd T7
1Population Health Sciences Program, Harvard University, 2Department of Epidemiology, University of California, Berkeley School of Public Health, 3Division of Chronic Disease Research Across the Lifecourse, Department of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute, 4Pediatric Endocrinology and Diabetes, Maine Medical Center; and Center for Outcomes Research and Evaluation, Maine Medical Center Research Institute, 5Department of Global Health and Population, Harvard T.H. Chan School of Public Health, 6Department of Biostatistics and Department of Epidemiology, Harvard T. H. Chan School of Public Health, 7Department of Environmental Health and Department of Epidemiology, Harvard T.H. Chan School of Public Health; and Division of Women’s Health, Department of Medicine, Connors Center for Women’s Health and Gender Biology, Brigham and Women’s Hospital and Harvard Medical School

OPS 20: Chemicals, biomarkers, omics, Room 110, Floor 1, August 27, 2019, 16:30 - 17:30

Background/Aim: Per- and polyfluoroalkyl substances (PFAS) are persistent chemicals linked to weight gain and type 2 diabetes. We tested whether PFAS concentrations during pregnancy are associated with postpartum biomarkers of cardiometabolic disease.

Methods: We studied 1,631 women recruited 1999-2002 in the Project Viva cohort with pregnancy (median 9.7 weeks, range 4.8-21.4) plasma measurements of 6 PFAS, including perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and 2-(N-ethyl-perfluorooctane sulfonamide) acetic acid (Et-PFOSA-AcOH). PFAS were log2-transformed. At 3 years post-pregnancy we measured anthropometry and, in a subset, serum biomarkers including sex hormone binding globulin (SHBG), interleukin-6 (IL-6), and hemoglobin A1c (HbA1c). We excluded women who were pregnant within the last 6 months (n=193); the analysis sample was n=831 after loss to follow-up. We used multivariable regression, adjusting for age, pre-pregnancy body mass index, marital status, race/ethnicity, education, income, smoking, and parity. We multiply imputed missing covariates and adjusted for loss to follow-up using inverse probability of censoring weights.

Results: PFAS exposure was associated with greater triceps skinfold thickness (0.69 [95%CI: 0.10, 1.28] mm per doubling in PFOS and 0.72 [95%CI: 0.06, 1.38] mm per doubling of PFOA) and greater subscapular skinfold thickness (0.53 [95%CI: -0.03, 1.09] mm per doubling in PFOA and 0.42 [95%CI: 0.02, 0.82] mm per doubling of Et-PFOSA-AcOH). PFAS were also associated with greater mid-upper arm circumference (0.27 [95%CI: -0.01, 0.54] cm per doubling of PFOA and 0.18 [95%CI: -0.01, 0.36] cm per doubling of Et-PFOSA-AcOH) and greater waist circumference (0.55 [95%CI: 0.06, 1.05] cm per doubling in Et-PFOSA-AcOH). Finally, each doubling of Et-PFOSA-AcOH was associated with lower log-SHBG (-0.06 mg/L [95%CI: -0.11, -0.00]), higher log-IL-6 (0.11 pg/mL [95%CI: 0.04, 0.18]) and higher HbA1c (0.030% [95%CI: 0.01, 0.05]).

Conclusions: Though effect sizes are small, the direction of associations taken together suggests PFAS exposure is associated with an unfavorable cardiometabolic profile.
Distribution of polybrominated diphenyl ethers (PBDEs) in Newfoundland seafood and associations with human serum thyroid hormone concentrations

Babichuk N1, Sarkar A1, Mulay S1, Knight J1,2, Bautista J3, Young C4
1Department of Community Health and Humanities, Memorial University, 2Primary Healthcare Research Unit, Memorial University, 3Department of Chemistry, Memorial University, 4Department of Chemistry, York University

OPS 20: Chemicals, biomarkers, omics, Room 110, Floor 1, August 27, 2019, 16:30 - 17:30

The marine ecosystem around the island portion of the province of Newfoundland and Labrador is contaminated with PBDEs from the St Lawrence River and the Labrador Current. Newfoundland has a long history of fishing and of consuming local seafood, therefore exposure to PBDEs through local seafood consumption could present a widespread health issue for the province. The aim of this study was to explore local seafood consumption as a possible PBDE exposure source in Newfoundland. Cod and turbot livers from Newfoundland were tested for PBDEs by gas chromatography mass spectrometry (GC-MS). Eighty residents from two communities on the north and south coasts of the island were surveyed for local seafood consumption, and tested for serum PBDE concentrations (GC-MS). ∑PBDE (28, 47, 99, 156, and 209) levels were higher in cod (38.7 ng/g) than in turbot (10.4 ng/g). ∑PBDEs from fish livers from the north (37.36 ng/g) and south (34.27 ng/g) coast of Newfoundland were not significantly different. Newfoundland residents consumed local cod more than any other species, and older participants ate more cod than younger participants (p=0.000). Participant serum concentrations of PBDEs were 0.03 mmol/g (PBDE-28), 1.04 mmol/g (PBDE-47), 0.03 mmol/g (PBDE-99), 0.40 mmol/g (PBDE-100), 2.99 mmol/g (PBDE-153) and 4.78 mmol/g (∑PBDEs). Concentrations of PBDE-153 (p=0.018) and ∑PBDEs (28, 33, 47, 99, 100, and 153; p=0.010) were positively associated with local cod consumption. Residents of the island Newfoundland show evidence of PBDE exposure, with possible local seafood consumption as a source. Associations between seafood consumption and PBDE levels were found, but associations were congener-specific. Further studies are needed using larger population in other parts of the province, and exploring other possible sources of exposure.
Prenatal phthalate exposure and cord blood methylation: an epigenome-wide association study in the Mexico City PROGRESS cohort


1Department of Environmental Medicine and Public Health, Icahn School Of Medicine At Mount Sinai, 2Department of Health Sciences, Karlstad University, 3Center for Nutrition and Health Research, National Institute of Public Health, 4National Institute of Perinatology, 5Centers for Disease Control and Prevention, 6Department of Environmental Health Sciences, Mailman School of Public Health, Columbia University

OPS 20: Chemicals, biomarkers, omics, Room 110, Floor 1, August 27, 2019, 16:30 - 17:30

Background: Phthalates, ubiquitous chemicals used in many household and personal care products, act as endocrine disruptors interfering with normal child development. DNA methylation may be a mechanism involved as previous studies have linked prenatal exposure to altered DNA methylation in cord blood, but independent validation is necessary.

Methods: We conducted a hypothesis-free epigenome-wide discovery of associations between prenatal phthalate exposure and cord blood DNA methylation in a pregnancy cohort in Mexico City (PROGRESS). Spot urine samples from mothers were collected at 2nd and 3rd trimester of pregnancy. Urinary concentrations of seven phthalate metabolites were quantified using high performance liquid chromatography tandem mass spectrometry. Metabolite concentrations were summarized and averaged between timepoints to estimate exposure to four common parent phthalate diesters: diethyl phthalate, di-n-butyl phthalate (DnBP), butylbenzyl phthalate (BBzP), and di(2-ethylhexyl) phthalate. Concentrations of mono-n-butyl phthalate (a DnBP metabolite) were higher than seen in the United States but similar to other studies in Mexico. Umbilical cord blood samples were collected at delivery and assayed on the Infinium MethylationEPIC microarray querying methylation levels at 865,859 loci.

Results: Data were available for 442 mother-child dyads. Out of the 4 × 865,859 potential associations screened using adjusted robust regression, 157 reached significance at a global false discovery rate of 15%, of which 19 loci formed 8 regions (as they were located within 10,000 base pairs of each other), or were associated with more than one phthalate diester. Regions overlapped several genes with expression almost exclusively in brain or testes: TMEM239 (×DnBP), FSTL5 (×BBzP,DnBP), EFNB3 (×DnBP), or STK32C (×DnBP).

Conclusions: Our results add to the evidence that DNA methylation is a mechanism through which prenatal exposure to select phthalates might affect child development. Phthalates have been associated with neuro- and reproductive toxicity which is consistent with our findings.
Background: Previous epidemiologic studies suggest that phthalates, ubiquitous synthetic chemicals, may adversely impact neurodevelopment. However, data are limited on how prenatal phthalate exposure impacts behavioral outcomes into childhood and adolescence.

Methods: We examined associations between maternal prenatal urinary phthalate metabolite concentrations, measured twice during pregnancy, and performance-based and parent-, teacher-, and self-reported behavioral outcomes from ages 9 through 16 years in the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) birth cohort (n=332). We used generalized estimating equation models to assess longitudinal effects and examined differences by sex.

Results: Higher prenatal concentrations of the sum of metabolites of low molecular weight (ΣLMW) phthalates were associated with more self-reported problems for the hyperactivity (β per 2-fold increase in ΣLMW phthalates=0.5; 95% CI: 0.0, 0.9), attention (β=0.8; 95% CI: 0.3, 1.2), depression (β=0.5; 95% CI: 0.0, 1.0), and anxiety (β=0.5; 95% CI: 0.0, 1.0) scales of the Behavior Assessment System for Children, 2nd edition (BASC-2). Similar, albeit weaker, trends were observed for parent-reported results; however, associations with most teacher-reported behaviors were null or in the opposite direction of parent- and self-reported results. ΣLMW phthalates were also associated with greater errors of omission (β per 2-fold increase in ΣLMW phthalates=0.9; 95% CI: 0.0, 1.8) on the Conners’ Continuous Performance Test II (CPT-II). BASC-2 and CPT-II data were examined as age- and sex-standardized T-scores. We observed largely null associations for biomarkers of exposure to di(2-ethylhexyl) and high molecular weight phthalates. We did not observe consistent sex-specific associations.

Conclusion: We observed modest associations between prenatal ΣLMW phthalate biomarkers and internalizing, externalizing, and attention problems in childhood and adolescence. No previous studies have examined the impact of prenatal phthalate exposure on neurodevelopment into adolescence, an important time for manifestations of effects.
Exposure to per- and polyfluoroalkyl substances in association with autism spectrum disorder: a case-control study

Shin H¹, Bennett D², Calafat A³, Tancredi D², Hertz-Picciotto I²
¹University of Texas, ²University of California, ³Centers for Disease Control and Prevention

OPS 22: Behavioral effects of chemical exposures, Room 117, Floor 1, August 27, 2019, 16:30 - 17:30

Background/Aim: Per- and polyfluoroalkyl substances (PFAS), a group of synthetic compounds widely used in industrial and consumer products, have shown neurologic or neuro-developmental toxicity in experiments with laboratory animals. In humans, associations between exposures to PFAS and neurodevelopmental or behavioral problems are somewhat inconclusive. The goal of this study was to determine whether in utero exposure or child’s early life exposure to PFAS was associated with an increased risk of autism spectrum disorder (ASD).

Methods: Participants were 453 mother-child pairs from CHARGE (CHildhood Autism Risk from Genetics and Environment), a population-based case-control study. Children were clinically confirmed for ASD (n = 239) or typical development (TD, n = 214). As a proxy for in utero or child’s early life exposures, we quantified nine PFAS in maternal serum samples collected when their child was 2 to 5 years old and used the ln-transformed concentrations to reduce the influence of outliers. We used logistic regression to evaluate the association of maternal PFAS concentrations with ASD.

Results: Perfluorohexane sulfonate (PFHxS) was statistically significantly associated with an increased risk of ASD (per natural-log nanogram per milliliter increase: odds ratio (OR) = 1.48; 95% confidence interval (CI): 1.03, 2.12). When concentrations were categorized by quartile and compared to the lowest quartile (reference category), we observed positive associations with ASD risk for being in the highest quartile of perfluorooctane sulfonate (PFOS) and PFHxS with ASD risk (OR = 2.06; 95% CI: 1.00, 4.26 [PFOS]; OR = 1.97; 95% CI: 1.09, 3.58 [PFHxS]).

Conclusions: In this study, we found that in utero exposure or child’s early life exposure to PFAS might increase the risk of ASD. Further studies will be useful to confirm these findings with direct exposure measures prospectively collected from mothers and children at an earlier developmental stage than the current study.
Role of genetic predisposition to neurobehavioural deficits from prenatal exposure to methylmercury

Grandjean P1,2, Julvez J3, Davey Smith G4, Ring S4, Budtz-Jørgensen E5
1 University of Southern Denmark, 2 Harvard T.H. Chan School of Public Health, 3 ISGlobal, 4 Bristol University, 5 University of Copenhagen

OPS 22: Behavioral effects of chemical exposures, Room 117, Floor 1, August 27, 2019, 16:30 - 17:30

Background: Some common heterogeneities are thought to affect methylmercury kinetics in the body and perhaps also neurodevelopmental outcomes of prenatal methylmercury exposure. If true, proper dose-dependence of adverse effects should consider vulnerable subpopulations and not rely on average population data only.

Methods: We examined suspected heterogeneities for modification of exposure-related cognitive development in 2,172 children from the Avon Longitudinal Study of Parents and Children (Bristol, UK) (ALSPAC). Prenatal methylmercury exposure was determined from the total mercury concentration of cord tissue. Neuropsychological function was reflected by the Wechsler Intelligence Scale for Children Intelligence Quotient (IQ) score at age eight years. Data was available on 247 single-nucleotide polymorphisms (SNPs) within relevant genes. We then assessed the most relevant SNPs in a more highly-exposed cohort from the Faroe Islands, where cord-blood mercury and neuropsychological function at age seven years were available from 649 cohort members.

Results: In the ALSPAC population with low-level methylmercury exposure, the mercury concentration appeared to be positively associated with IQ, although adjustment for cofactors attenuated this association. Among four SNPs found in a pilot study to exhibit interaction with methylmercury, one was replicated, the minor allele of rs1042838 (progesterone receptor, PGR), with a beta (95% confidence Interval) of -11.8 (-23.0, -0.7) (p for interaction, 0.004) for a 10-fold increased exposure. At the higher exposures in the Faroes, other heterogeneities, especially in superoxide dismutase 2, seemed to play a greater role.

Conclusions: Genetic predisposition can impact strongly on the neurotoxic effects associated with elevated prenatal methylmercury exposure. Somewhat different results in the two cohorts suggest that the effect of genetic variants on neurotoxic responses may depend on the level of exposure. Overall, studies of exposure-dependent neurobehavioral deficits should take into account the possible presence of genetic disposition.
Prenatal and postnatal polycyclic aromatic hydrocarbons (PAH) exposure and behavioral development in early adolescence.

Pac A\textsuperscript{1}, Sochacka-Tatara E\textsuperscript{1}, Majewska R\textsuperscript{1}, Perera F\textsuperscript{2}

\textsuperscript{1}Chair of Epidemiology and Preventive Medicine, Jagiellonian University Medical College, \textsuperscript{2}Columbia Center for Children’s Environmental Health, Mailman School of Public Health, Columbia University

OPS 22: Behavioral effects of chemical exposures, Room 117, Floor 1, August 27, 2019, 16:30 - 17:30

Background/Aim: Exposure to polycyclic aromatic hydrocarbons (PAHs) has been linked with neurodevelopment outcomes in children. The aim of our study was to assess the relationship between exposure to PAHs in prenatal period as well as in early childhood and behavioral outcomes during the early adolescence.

Methods: 168 adolescents (girls: 51.2\%) from birth cohort, for whom PAHs exposure data (both prenatally and age of 3 years) were available and Child Behavioral Checklist (CBCL) was completed by mother between ages of 12 and 15 years. The multivariable Poisson regression model was used to estimate the betas for the association between the raw score for all CBCL outcomes and PAH exposure dichotomized according to median.

Results: The median PAH exposure levels in the population under the study were 21.6 ng/m\textsuperscript{3} in prenatal period and 22.8 ng/m\textsuperscript{3} for the assessment in age of 3 years. Adolescents below the median for total prenatal PAH exposure compared to those above, were more likely to be withdrawn/depressed (beta=0.30; p=0.016), have somatic complaints (beta=0.44; p=0.002), present Rule-breaking (beta=0.65; p<0.001) and Aggressive behaviors (beta=0.29; p=0.001) as well as both summary outcomes - externalizing (beta=0.39; p<0.001) and internalizing problems (beta=0.27; p<0.001). While the highest exposure to PAHs at age of 3 years was related to Rule-Breaking (beta=0.55; p<0.001) and Aggressive behaviors (beta=0.26; p=0.003) and Externalizing problems (beta=0.33; p<0.001).

Conclusions: The high exposure PAHs in prenatal period as well as during early childhood was related to higher likelihood of aggressive and rule-breaking behaviors during early adolescence.
OPS 28: Green space and biomarkers

Neighbourhood green space and allostatic load in school-aged children. Findings from the Generation XXI birth cohort.

Ribeiro A1,4, Tavares C2, Guttentag A3, Barros H1,4

1EPIUNIT - Public Health Institute University Porto (ISPUP), 2Unidade de Saúde Pública do ACeS Entre Douro e Vouga I – Feira/Arouca, 3College of Global Public Health, New York University, New York City, NY, USA, 4Department of Public Health, Forensic Sciences and Medical Education University of Porto Medical School.

Background: Whilst the literature on the psychological and behavioural benefits of green space is considerable, less is known about the health-promoting effects of green space on biological markers. Incorporating biomarkers into pediatric research studies may help to elucidate the links between exposure to environmental stressors and lifelong health. We evaluated the association between the geographical accessibility to green spaces and the allostatic load (AL), a measure of biological multi-system dysregulation, among children aged 7 years.

Methods: We used data from 3108 children enrolled in Generation XXI, a population based birth cohort from Porto Metropolitan Area. We computed an AL index based on seven biomarkers representing four regulatory systems: immune/inflammatory system (high sensitivity C-reactive protein); metabolic system (high density lipoprotein; total cholesterol; glycated haemoglobin; waist-hip ratio) and cardiovascular system (systolic and diastolic blood pressure). Measures of accessibility to green spaces were calculated using a Geographic Information System and crude/adjusted associations were estimated using Mixed-effects regression models.

Results: Among the 3108 children (51.7% male; mean age 87.3 months), the mean AL index was 0.00 (standard deviation 2.94). Adjusted models revealed that having a green space at 400 m and 800 m from the school was inversely associated with AL (400 m: exp beta 0.74 95% CI 0.58-0.94; 800 m: 0.79 95% CI 0.64-0.96). Accordingly, as the distance from the school to the nearest green space increased, there was a 10% increase in the AL index (1.10 95% CI 1.01-1.21). No significant associations were observed with the residential accessibility to green space.

Conclusions: Greater accessibility to green space around schools was associated with reduced AL in children, corroborating previous studies among adult populations. Our findings suggest that the provision of green space may be an effective strategy to improve population health in early life stages.
Exposure to Greenspace and Telomere Length in Preschool Children

de Prado Bert P1,2, Miri M3, Alahabadi A3, Rad A4, Moslem A4, Agah J4, Aval H4, Nawrot T5,6, Sunyer J1,2,7, Dadvand P1,2,7

1Institute of Global Health (ISGlobal), 2Pompeu Fabra University (UPF), 3Cellular and Molecular Research Center, Department of Environmental Health, School of Public Health, Sabzevar University of Medical Sciences, 4Cellular and Molecular Research Center, Sabzevar University of Medical Sciences, 5Centre for Environmental Sciences, Hasselt University, 6Department of Public Health & Primary Care, Leuven University, 7Ciber on Epidemiology and Public Health (CIBERESP)

OPS 28: Green space and biomarkers, Room 417, Floor 4, August 27, 2019, 16:30 - 17:30

Background: Greenspace exposure has been associated with improved health and wellbeing; however, the available evidence on the impact of this exposure on telomere length (TL), an early marker of aging, is still scarce. The aim of the study was to evaluate the association of exposure to greenspace with TL in preschool children.

Methods: This cross-sectional study was based on samples from 200 preschool children (aged 5 to 7 years), Sabzevar, Iran (2017). We characterized different aspects of greenspace exposure including total surrounding greenness (the average of satellite-derived Normalized Difference Vegetation Index within 300m around home and kindergarten), residential and kindergarten distance to green spaces, time spent in private and public green spaces, and the number of plant pots at home. Blood samples were taken to measure leukocyte relative TL. Linear mixed effects models were developed with PCR plate and kindergartens as random effects, to estimated association of each indicator of greenspace exposure with TL, controlled for relevant covariates.

Results: Total surrounding greenspace at 300m buffer was associated with longer TL. We also observed an inverse association between distance from home and kindergarten to green spaces with area larger than 5000 m² and relative TL. Moreover, longer time spent in the public green spaces was associated with longer TL. The associations for residential and kindergarten distance to any green space (regardless of the size), time spent in private gardens, and number of plant pots at home were not statistically significant. The 13.8% (95%CI -137.9, 206.4) of the association between total surrounding greenspace and TL could be explained by the exposure to PM2.5.

Conclusions: Overall, our findings were supportive for a direct association between greenspace exposure and TL in preschool children. Further studies are needed to confirm these findings in other settings and populations.
Greater residential tree-cover and time spent outdoors are associated with reduced allostatic load in residents of central North Carolina

Egorov A1, Griffin S2, Styles J3, Sams E1, Hudgens E1, Klein E4, Wickersham L4, Ritter R4, Jackson L1, Wade T1

1US Environmental Protection Agency, 2US Environmental Protection Agency, 3University of North Carolina at Chapel Hill trainee at US Environmental Protection Agency, 4ORAU Student Services Contractor at US EPA

OPS 28: Green space and biomarkers, Room 417, Floor 4, August 27, 2019, 16:30 - 17:30

Background. Greater vegetated land cover in urban areas has been linked to reduced morbidity and mortality. Our previous research showed that residential vegetated land cover was associated with reduced allostatic load, a biomarker-based measure of chronic stress-related physiological dysregulation. The objectives of the current study are to further explore pathways linking contacts with nature to health benefits.

Methods. This cross-sectional study involved 335 adults residing in the Raleigh-Durham-Chapel Hill, NC urban area. Weighted measures of tree cover within 500 m of residence were estimated allowing for an exponential decay with distance. Blood samples were tested for biomarkers of immune, neuroendocrine, and metabolic functions. Allostatic load indices were estimated as sums of biomarkers dichotomized at distribution-based cut-offs. Regression models adjusted for socio-demographic and behavioral covariates, body mass index, waist-to-hip ratio, sleep problems, and cytomegalovirus seropositivity.

Results. An allostatic load index based on inflammation biomarkers (interferon (IFN)-γ, interleukin (IL)-1β, IL-4, IL-6, IL-8, IL-10, IL-17, tumor necrosis factor (TNF)-α, C-reactive protein, myeloperoxidase, serum amyloid A, chromogranin A, vascular cell adhesion molecule (VCAM)-1, intracellular adhesion molecule (ICAM)-1, eosinophils, monocytes, and neutrophils) was reduced by 17% (5%; 28%) per interquartile range increase in tree cover in participants who reported spending at least 30 min per day outdoors (N=271). There was no effect in individuals spending less than 30 min per day outdoors. In a sub-population with tree cover above the median, time spent outdoors was linked with allostatic load reduction by 62% (33%; 79%) in individuals spending 3 hours per day or more, 43% (19%; 60%) for 1 to 3 hours group, and 37% (12%; 54%) for 0.5 to 1-hour group compared to controls spending less than 30 min outdoors.

Conclusions. Exposure to the natural living environment in residential settings may alleviate physiological dysregulation and reduce chronic inflammation. This abstract does not represent EPA policy.
Neighborhood characteristics may impact inflammation-related epigenetic loci in a concerted manner

Dhingra R\textsuperscript{1,2,3}, Mirowsky J\textsuperscript{4}, Kwee L\textsuperscript{5}, Hauser E\textsuperscript{5}, Neas L\textsuperscript{3}, Devlin R\textsuperscript{3}, Ward-Caviness C\textsuperscript{3}, Diaz-Sanchez D\textsuperscript{3}, Olden K\textsuperscript{6}

\textsuperscript{1}Institute for Environmental Health Solutions, University of North Carolina at Chapel Hill, \textsuperscript{2}Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill, \textsuperscript{3}National Health and Environmental Effects Research Laboratory, US Environmental Protection Agency, \textsuperscript{4}Department of Chemistry, SUNY College of Environmental Science and Forestry, \textsuperscript{5}Duke University School of Medicine, Duke Molecular Physiology Institute, \textsuperscript{6}National Center for Environmental Assessment, US Environmental Protection Agency

OPS 28: Green space and biomarkers, Room 417, Floor 4, August 27, 2019, 16:30 - 17:30

Background/Aim. Neighborhood characteristics have been shown to impact cardiometabolic risk, yet few studies have examined the relationship of residential area to the cardiometabolic epigenome. Using DNA methylation data, geocoded residence, and medical history from a cohort of patients referred for cardiac catheterization, we examined the cross-sectional relationship of neighborhood with residents’ epigenome.

Methods. Using 11 U.S. Census socioeconomic variables, we used hierarchical clustering to group 444 block groups in Wake, Durham & Orange counties (North Carolina, USA) into 5 clusters. We randomly selected ~112 participants from each cluster for DNA methylation analysis of blood (N=563). Candidate loci were previously associated with high sensitivity C-reactive protein (hsCRP; 218 loci), a cardiometabolic biomarker. For each locus, we carried out an analysis of variance comparison of full and reduced mixed models, including and excluding a categorical term for cluster, respectively. Models were adjusted for age, sex, race, smoking, blood cell counts, and technical covariates. In sensitivity analyses, we also assessed independence from cardiometabolic outcomes. The relationship of each census variable with loci, found to be associated with neighborhood cluster, were assessed via linear mixed models. P-values were multiple test corrected using false discovery rate (FDR).

Results. Of 218 candidate loci, 10 and 39 were associated at FDR<0.10 and p<0.05, respectively, with neighborhood cluster in a concerted pattern. Further, univariate analysis of census variables with these 39 candidate loci revealed that increased urbanicity, decreased owner-occupied housing, and increased poverty at the block group level were associated with a DNA methylation profile that is consistent with increased expression of hsCRP.

Conclusion. Our results suggest that neighborhood socioeconomic profile may shape a remarkably lock-step profile of inflammatory DNA methylation. This abstract does not necessarily represent EPA policy.
OPS 36: Health effects of dietary exposures

Fluoride Exposure from Infant Formula and Child IQ in a Canadian Birth Cohort

Till C1, Green R1, Flora D1, Hornung R2, Martinez-Mier E3, Blazer M1, Farmus L1, Ayotte P4, Muckle G5, Lanphear B6

1Faculty of Health, York University, 2Cincinnati Children’s Hospital Medical Center, 3School of Dentistry, Indiana University, 4Centre de Recherche du CHU de Québec, Université Laval, 5Department of Social and Preventive Medicine, Laval University, 6Faculty of Health Sciences, Simon Fraser University

OPS 36: Health effects of dietary exposures, Room 210, Floor 2, August 27, 2019, 16:30 - 17:30

Background: Consumption of infant formula reconstituted with fluoridated water can lead to excessive intake of fluoride in infants. We examined the association between water fluoride concentration and intellectual ability (IQ) among preschool children who lived in fluoridated or non-fluoridated cities in Canada and were either formula-fed or breastfed during the first six months after birth.

Methods: We measured water fluoride concentration using municipal water reports matched to the child’s birthdate to six-months of age. We restricted our analyses to 398 mother-child dyads enrolled in the Maternal-Infant Research on Environmental Chemicals (MIREC) cohort who reported drinking tap water. We evaluated Full Scale IQ (FSIQ) using the Wechsler Primary and Preschool Scale of Intelligence-III at 3 to 4 years. We used multiple linear regression analyses with an interaction to examine how the covariate-adjusted association between water fluoride concentration and FSIQ scores differs according to feeding status. In secondary analyses, we controlled for prenatal fluoride exposure.

Results: Thirty-eight percent of mother-child dyads lived in communities supplied with fluoridated municipal water. An increase of 0.5 mg/L fluoride concentration (the difference between fluoridated and non-fluoridated region) corresponded to a drop of 4.4 FSIQ points (95% CI: -8.34, -0.46, p=.03) in the formula-fed group. In contrast, this relationship was not significant in the breastfed group (B=1.34, 95% CI: -5.04, 2.38, p=.48). Controlling for prenatal fluoride exposure weakened the association between water fluoride concentration and FSIQ in the formula-fed group (B=-3.88, 95% CI = -8.12, 0.37, p=.07).

Conclusions: The results, which indicate that fluoride concentration in drinking water was associated with lower FSIQ in children who were formula fed, underscore the need to reduce the use of fluoridated water to reconstitute formula during infancy.
Maternal lean fish intake during pregnancy is associated with child growth in the Norwegian Mother and Child Cohort Study (MoBa)

Papadopoulou E1, Botton J2, Caspersen I1, Eggesbø M3, Iszatt N1, Knutsen H1, Meltzer H1, Stratakis N3, Sengpiel V4, Brantsæter A1

1Department of Environmental Exposure and Epidemiology, Norwegian Institute Of Public Health, 2Department of Epidemiology of Health Products, French National Agency for Medicines and Health Products Safety, 3Department of Preventive Medicine, Keck School of Medicine, University of Southern California, 4Department of Obstetrics and Gynecology, Sahlgrenska University Hospital Östra

OPS 36: Health effects of dietary exposures, Room 210, Floor 2, August 27, 2019, 16:30 - 17:30

Background: Norwegian pregnant women have among the highest fish intakes in Europe. In MoBa, almost half the population consumes the recommended intake (2-3 servings of fish/week), and maternal lean fish intake has been associated with lower preterm delivery and higher birth size.

Methods: We explored the association between maternal total, lean and fatty fish intake, child growth trajectories and risk of overweight from birth to 8 years in 51,952 mother-child pairs in MoBa. Maternal blood arsenic (As), mercury (Hg) and 25-hydroxyvitamin D (25(OH)D) concentrations were measured in a subsample (n=2,264).

Results: 67% of the mean fish consumption was lean species, but fatty fish contribution increased with total fish consumption. Lean and fatty fish intakes correlated with blood As and Hg (correlation coefficient range: 0.19-0.25), but not with blood 25(OH)D. Lean fish intake of 2-3 servings/week, but not higher, was significantly associated with an increased BMI trajectory from 3 years onwards compared to lower intakes. Lean fish intake of 2-3 servings/week was associated with overweight at 3 years (adjusted Odds Ratio (aOR)=1.14, 95% Confidence Intervals (CI)=1.04,1.24). Higher intakes (>3 servings/week) were associated with overweight at 3 (aOR=1.36, 95%CI=1.00,1.84) and 8 years (aOR=1.52,95%CI=1.00,2.31). For children with high (>median) prenatal Hg and As, maternal lean fish intake was still associated with increased child growth and and overweight, though non-significantly. No association was found between fatty fish consumption and increased growth or overweight risk.

Conclusion: Maternal lean fish consumption may modify the child’s BMI growth trajectory from early childhood onwards and increase the risk of childhood overweight. High prenatal exposure to arsenic and mercury may mediate these effects but more evidence is needed. Consuming a variety of fish species may be advisable for pregnant women to lower the later health risks for their children.
Fish consumption during pregnancy, exposure to mercury, and child metabolic syndrome

Stratakis N1, Conti D1, Maitre L2, Papadopoulou E3, Sabidó E4, Slama R5, Thomsen C3, Wright J6, Vrijheid M2, Chatzi L1, on behalf of the Human Early-Life Exposome (HELIX) project

1Department of Preventive Medicine, Keck School of Medicine, University of Southern California, 2ISGlobal, 3Department of Environmental Exposure and Epidemiology, Norwegian Institute of Public Health, 4Proteomics Unit, Centre de Regulacio Genomica, Barcelona Institute of Science and Technology, 5Team of Environmental Epidemiology applied to Reproduction and Respiratory Health, Inserm, CNRS, University Grenoble Alpes, Institute of Advanced Biosciences, Joint research center (U1209), 6Bradford Institute for Health Research, Bradford Teaching Hospitals NHS Foundation Trust

OPS 36: Health effects of dietary exposures, Room 210, Floor 2, August 27, 2019, 16:30 - 17:30

Background/Aim: The balance of exposure to heavy metals and nutritional benefit from fish consumption in pregnancy for offspring metabolic health is unknown. We aimed to assess the association of fish intake in pregnancy with child metabolic syndrome after taking into account concomitant maternal exposure to mercury and arsenic.

Methods: We studied 805 mothers and their children (mean age 8.4 years) from five European countries. Fish intake during pregnancy was estimated with validated food frequency questionnaires. Mercury and arsenic levels were measured in maternal whole blood samples. We calculated a metabolic syndrome (MetS) score in childhood by combining z-scores for waist circumference, blood pressure, lipids, and insulin levels, with higher MetS scores indicating poorer metabolic health. A structural integrated analysis was performed for the identification of clusters of children with differing MetS scores based on maternal fish intake and mercury levels in pregnancy, and child serum inflammatory markers (c-reactive protein, interleukin-6, interleukin-1β, and tumor necrosis factor-α).

Findings: Fish consumption during pregnancy according to recommendations (≥1 time/week but ≤3 times/week) was associated with one-unit decreased MetS score (95% CI -1.5, -0.4) compared to low fish consumption (<1 times/week), after adjusting for maternal mercury and arsenic blood levels, and other covariates. Each doubling in maternal mercury concentrations was associated with a 0.2-unit increase in MetS score (95% CI 0.01, 0.35), while no association was found for arsenic. The integrated analysis identified one noteworthy group of children having higher MetS score (β= 3.1) that was characterized by increased levels of inflammatory markers and was associated with a combination of high blood mercury and high fish consumption in pregnancy. Fish consumption within recommendations combined with low mercury levels was negatively associated with this high-risk group.

Conclusions: Consumption of fish with lower mercury content in pregnancy might decrease the risk of metabolic syndrome in childhood.
Ingested nitrate and nitrite and bladder cancer in Northern New England

Ward M1, Barry K2, Jones R1, Cantor K1, Beane Freeman L1, Wheeler D3, Johnson A4, Schwenn M5, Karagas M6, Silverman D1

1U.S. National Cancer Institute, 2University of Maryland School of Medicine, 3Virginia Commonwealth University, 4Vermont Department of Health, 5Maine Cancer Registry, 6Geisel School of Medicine at Dartmouth

OPS 36: Health effects of dietary exposures, Room 210, Floor 2, August 27, 2019, 16:30 - 17:30

Background/Aim: N-nitroso compounds (NOCs) are hypothesized human bladder carcinogens. Nitrate and nitrite are NOC precursors; sources include contaminated drinking water and diet. We examined nitrate and nitrite ingestion and bladder cancer risk in the New England Bladder Cancer Study, a population-based case-control study in Maine, New Hampshire, and Vermont.

Methods: Using historical nitrate measurements for public water supplies, measured and modeled values for private wells and self-reported water intake, we estimated average nitrate concentrations (NO3-N mg/L) and average daily nitrate intake (mg/day) from 1970 to diagnosis/reference date for 987 cases and 1180 controls. We also estimated source-specific (animal, plant, processed meat) dietary nitrate and nitrite intakes using a food frequency questionnaire (1037 cases and 1225 controls). We used unconditional logistic regression to estimate odds ratios (OR) and 95% confidence intervals (CI) adjusting for age, gender, smoking, disinfection by-products, and other factors. We evaluated interactions with factors affecting NOC formation (i.e., red and processed meat, vitamin C, smoking).

Results: Average drinking water nitrate concentration above the 95th percentile (>2.07 mg/L) compared with the lowest quartile (<=0.21 mg/L) was associated with bladder cancer risk (OR=1.50, CI: 0.97-2.32; p-trend=0.01); the association was similar for average drinking water nitrate intake. We observed positive associations for dietary nitrate and nitrite intakes from processed meat (highest vs. lowest quintile OR=1.42, CI: 1.01-1.98; p-trend=0.04; OR=1.48, CI: 1.04-2.09; p-trend=0.04, respectively), but no trends for other sources. Risk was highest among those with >2.07 mg/L NO3-N and >median red or processed meat intake vs <0.21 mg/L NO3-N/<median intakes (OR=2.61, CI: 1.33-5.11 and OR=3.47 CI: 1.75-6.87; p-interaction=0.05 and 0.07, respectively). We observed no interaction with vitamin C or smoking.

Conclusions: Our results suggest the importance of both drinking water and dietary nitrate sources as risk factors for bladder cancer especially among those with high red or processed meat intake.
OPS 38: Effects of metals on child health

Prenatal Metal Mixture Concentrations and Reward Motivation in Children

de Water E1, Curtin P1, Bixby M1, Gennings C1, McRae N1, Svensson K1, Chelonis J2, Schnaas L3, Pantic I3, Téllez-Rojo4 M4, Wright R1, Horton M1

1Icahn School Of Medicine At Mount Sinai, 2U.S. Food and Drug Administration, 3National Institute of Perinatology (INPer), 4National Institute of Public Health (INSP)

OPS 38: Effects of metals on child health, Room 114, Floor 1, August 27, 2019, 16:30 - 17:30

Background
Altered reward motivation in childhood has been linked to hyperactivity and to an increased risk for substance abuse later in life. In children, exposure to neurotoxic metals has been linked to hyperactivity and changes in morphology and connectivity of brain areas supporting reward motivation (i.e., the basal ganglia). The association between metal exposure and reward motivation in children has not been studied. We examined associations between prenatal exposure to a mixture of neurotoxic metals and reward motivation in children using a Progressive Ratio (PR) test.

Methods
The PR test was administered to 271 children (132 girls; 6-8 years) from the PROGRESS Study (Programming Research in Obesity, Growth, Environment and Social Stressors) in Mexico City. Children were asked to press a response lever for a nickel reward, one response was required to earn the first nickel and each subsequent nickel required an additional 10 responses. Outcomes included the number of times the lever was pressed and the mean time between lever presses. Maternal blood concentrations of 6 neurotoxic metals (manganese, lead, selenium, cadmium, zinc, arsenic) were measured using inductively-coupled plasma mass spectrometry (ICP-MS) during the 2nd trimester of pregnancy. We performed Weighted Quantile Sum (WQS) regression analyses, stratified by sex, to examine associations between the metal mixture and reward motivation, adjusting for child age and maternal IQ.

Results
A higher prenatal metal mixture was associated with more lever presses (ß = 2.85, p = 0.03) and a shorter time between presses (ß = 0.07, p = 0.04) among girls only. Cadmium (~35%), selenium (20%), and manganese (17%) were the largest contributors to these associations.

Conclusions
Prenatal exposure to a mixture of neurotoxic metals is associated with increased motor responses to obtain rewards in girls. These may be indicative of hyperactivity and heightened reward sensitivity.
Blood Lead Level in Infants and Subsequent Risk of Malaria: A Prospective Cohort Study in Benin, Sub-Saharan Africa
Garrison A1,2, Khoshnood B2, Courtin D3, Milet J3, Garcia A3, Massougbodji A4, Ayotte P5, Cot M3, Bodeau-livinec F1,2
1Ecole Des Hautes Etudes En Santé Publique, 2INSERM UMR1153 Equipe de recherche en Epidémiologie Obstétricale, Périnatale, et Pédiatrique (EPOPé), Center for Epidemiology and Statistics, Sorbonne Paris Cité (CRESS), 3Mère et enfant face aux infections tropicales (MERIT), l’Institut de Recherche pour le Développement (IRD), Université Paris 5, Sorbonne Paris Cité, 4Institut de Recherche Clinique du Bénin, 5Institut National de Santé Publique du Québec

OPS 38: Effects of metals on child health, Room 114, Floor 1, August 27, 2019, 16:30 - 17:30

Background/Aim Lead exposure and malaria both present significant health risks to children in Sub-Saharan Africa. Two previous cross-sectional studies have shown that high blood lead levels in children may act as a protective factor against subsequent malaria incidence. The main objective of this study was to investigate associations between blood lead level and malaria outcomes prospectively in Beninese children from 12 to 24 months of age.

Methods Two-hundred and four children were assessed for lead at 12 months and closely followed until 24 months for malaria; symptoms and parasite density were recorded in positive cases. Univariate and multivariate negative binomial and linear regression models tested associations between blood lead level quartile and total episodes of malaria (including symptomatic and asymptomatic episodes) and parasite density, respectively. Iron deficiency was included as a potential confounding factor, and was further tested as a potential effect modifier of these associations.

Results Median blood lead level among children measured at 12 months was 56.50 (4.81-578) µg/L. During the 12-month follow-up, 172 (84.31%) children had at least one malaria episode. Univariate and multivariate negative binomial and linear regressions did not reveal significant associations between blood lead level quartiles and any malaria outcomes. A non-significant trend was seen between increasing blood lead level quartile and decreasing asymptomatic malaria episodes in univariate analyses. Iron deficiency was not found to be an effect modifier.

Conclusions Results from this prospective child-cohort study investigating associations between blood lead level and malaria did not confirm results from previous cross-sectional studies. These results indicate a strong effect of lead on malaria in children at 12 months of age, when parasite density is highest in exposed children, which is no longer seen in a prospective follow-up. Further research is needed to further explore this relationship and other co-morbidities due to malaria and lead.
Exposure to metal mixtures and growth-related traits in Bangladeshi children aged 5-7 years

Shih Y1, Shahriar M1, Islam T2, Ahmed A2, Sarwar G2, Persky V1, Ahsan H3, Argos M1

1University of Illinois At Chicago, 2UChicago Research Bangladesh, 3University of Chicago

Background: Health effects of toxic and trace metal mixtures in children have not been well characterized. Previous studies suggest associations between exposure to certain metals and growth-related traits, however, most of the associations remain suggestive and have not been replicated. Furthermore, studies to date have focused primarily on single metal analyses without considering the potential for co-exposure and interdependence among metals.

Objectives: We evaluated the cross-sectional association of exposure to metal mixtures and anthropometric measures in 491 children aged 5-7 years from the Bangladesh Environmental Research in Children’s Health cohort.

Methods: For anthropometric measures, including height, weight, body mass index (BMI), and waist circumference, z-scores adjusted for child’s age and gender were calculated and modeled as continuous variables. Weighted quantile sum (WQS) regression analysis was conducted using a panel of 17 metals measured in children’s toenails to generate positive and negative metal mixture indices in a training dataset (n = 196, 40%), and the effects of the indices on anthropometric measures were tested in a validation dataset of 295 children (60%), adjusting for confounding variables.

Results: An index predominated by uranium, cadmium, and lead, was inversely associated with z-score of height (β = -0.21, 95% confidence interval (CI) = -0.35, -0.07). We also identified an index, predominated by arsenic, cadmium, and uranium, inversely associated with z-score of weight (β = -0.14, 95% CI = -0.28, 0.00).

Conclusions: Our results suggest associations between exposure to metal mixtures in early life and growth-related traits in children. Analyses using other statistical approaches to characterize metals mixtures will be conducted.
A Prospective Study of Methylmercury Exposure and Prepulse Inhibition Deficits in Children and Adolescents: The Early Life Exposures in Mexico to Environmental Toxicants Birth Cohort

Kponee-Shovein K¹, Grashow R¹, Tutino R², Schnaas L³, Hernández-Chávez M³, Peterson K², Hu H⁴, Hernandez-Avila M⁵, Téllez-Rojo M⁵, Weisskopf M¹

¹Harvard T.H. Chan School Of Public Health, ²University of Michigan School of Public Health, ³Instituto Nacional de Perinatología Isidro Espinosa de los Reyes, ⁴University of Washington School of Public Health, ⁵National Institute of Public Health

OPS 38: Effects of metals on child health, Room 114, Floor 1, August 27, 2019, 16:30 - 17:30

Background: Methylmercury (MeHg) exposure has been associated with severe and subtle neurodevelopmental deficits, especially in children. Pre-Pulse Inhibition (PPI), an indicator of adequate sensorimotor gating processing is a neurological biomarker that may be useful for identifying neurodevelopmental deficits earlier and more objectively than behavioral ratings. Furthermore, PPI may be more cost-effective than current brain imaging techniques for assessing the effects of neurotoxicants such as MeHg.

Objective: This study examined the association between MeHg exposure and PPI deficits in a prospective cohort of children and adolescents from Mexico City.

Methods: We obtained venous whole blood samples and scalp hair samples at two time points from 176 offspring from the Early Life Exposures in Mexico to Environmental Toxicants (ELEMENT) birth cohort; the PPI evaluation was completed at the second time point, approximately 18 months after the first time point. PPI recording and analysis occurred in an isolated clinical setting and eye blink responses were assessed using electromyography. We used ordinary least squares regression models adjusted for maternal education, maternal IQ, birthweight, child’s sex, and child’s age (predictors of PPI and MeHg) to assess the relationship between earlier and concurrent MeHg concentrations on PPI deficits.

Results: The spearman correlation coefficient for blood- and hair-MeHg levels was 0.68 (p < .0001) and 0.73 (p < .0001) at the two visits, respectively. In adjusted models, one µg/L increase in earlier blood-MeHg concentrations was significantly associated with a 0.22 point decrease in PPI (95% CI: 0.07, 0.37). We observed no associations between concurrent blood-MeHg, hair-MeHg concentrations and PPI deficits.

Conclusions: In our study population, blood-MeHg concentrations were associated with PPI deficits, which is consistent with MeHg’s known neurotoxicity. Our results underscore the potential utility of PPI as an objective and cost-effective adjunct screening tool for assessing neurotoxicant effects on the brain.
OPS 43: Noise, stress and mental health

Association of exposure to road traffic noise with cognitive function in elderly women

Wigmann C¹, Fuks K¹, Altug H¹, Schikowski T¹

¹IUF - Leibniz Research Institute For Environmental Medicine

Background: Adverse effects of traffic noise on cognition have been found in children, but only few studies investigated the (long-term) health effects of noise exposure in adults. However, large parts of the population are exposed to high levels of road traffic noise at the residence. This study on the long-term association of road traffic noise with cognition includes day- and nighttime noise exposure simultaneously, and investigates self-reported noise annoyance in addition to modeled residential noise levels.

Methods: In a cohort of 288 elderly women from the longitudinal Study on the influence of Air pollution on Lung function, Inflammation and Aging (SALIA) in Western Germany we investigated the association of residential exposure to road traffic noise and annoyance due to road traffic noise with cognitive performance. Residential noise levels – weighted 24-hour mean and nighttime noise – were modeled for the exposed facade of dwellings. Traffic noise annoyance (day and night) was estimated by questionnaire. Cognitive function was assessed using the Consortium to Establish a Registry on Alzheimer’s Disease (CERAD-Plus) Neuropsychological Assessment Battery. The probability of impaired cognition (cognitive score < 0) was modeled using logistic regression adjusted for potential confounders.

Results: While objective noise exposure was associated with impaired total cognition (OR 1.69, p<0.1) and constructional praxis domain (OR 2.72, p<0.05), subjective noise exposure exhibited inverse associations with better performance in semantic memory (OR 0.52, p<0.05) and in the constructional praxis domain (OR 0.56, p<0.1). The findings were independent of air pollution levels, and, although modeled noise levels and noise annoyance were associated, their health effects seemed mutually independent.

Conclusions: The relationships between noise exposure, annoyance, and cognitive performance in the elderly turned out complex and could be examined more deeply by incorporating additional factors such as window opening habits, hearing ability, etc., in future studies.
Traffic noise and mental illness – a systematic review

Seidler A1, Schubert M1, Romero-Starke K1, Freiberg A1, Zeeb H2, Riedel-Heller S3, Hegewald J1

1TU Dresden, 2Leibniz-Institute for Prevention Research and Epidemiology – BIPS GmbH, 3University of Leipzig

OPS 43: Noise, stress and mental health, Room 217, Floor 2, August 27, 2019, 16:30 - 17:30

Background/Aim: Chronic exposure to traffic noise may provoke complex stress reactions. So far, the relationship between traffic noise and mental health problems is unclear. In a systematic review with meta-analysis we examined the relationship between exposure to traffic noise and depression, anxiety disorders, and attention deficit disorders among children.

Methods: An electronic database search was conducted in MEDLINE, Embase, PsycINFO and PSYNDEX. A total of 3165 publications were included in the title-abstract review which was done independently by two authors. 258 publications for full-text screening remained from the database and hand search. Two reviewers independently assessed the risk of bias of the included 28 publications. If more than two studies were available for a specific outcome, a meta-analysis was conducted.

Results: Two studies found an association between high levels of traffic noise and hyperactivity or attention deficit in children. The depression risk increased by 15% per 10 dB LDEN aircraft noise (pooled risk estimate of 4 studies = 1.15, 95% confidence interval CI 1.12-1.18). For road traffic noise, the meta-analysis of 6 studies revealed a risk increase of 4% per 10 dB LDEN (pooled risk estimate 1.04, 95% CI 1.03-1.06). The results of the studies (n=7) on anxiety disorders were heterogeneous. Two studies found a negative impact of high traffic noise on cognition. The exclusion of high risk of bias-studies did not substantially change the results.

Conclusions: Our systematic review points to an increased depression risk of aircraft noise, less pronounced also of road traffic noise. For other psychological diseases there are only few conclusive studies. These studies are indicative of an association between traffic noise and hyperactivity among children, the onset of a dementia or of cognitive decline, and the intake of psychotropic drugs.

We would like to thank the German Environment Agency (UBA) for the financial support.
Green space, air pollution, traffic noise and saliva cortisol in children aged 12 years: the PIAMA birth cohort

**Bloemsma L**1,2, Wijga A1, Klompmaker J1,2, Hoek G2, Janssen N1, Oldenwening M2, Lebret E1,2, Brunekreef B2,3, Gehring U2

1National Institute for Public Health and the Environment (RIVM), 2Institute for Risk Assessment Sciences (IRAS), 3Julius Center for Health Sciences and Primary Care

OPS 43: Noise, stress and mental health, Room 217, Floor 2, August 27, 2019, 16:30 - 17:30

Background: Green space, air pollution and traffic noise may be associated with stress levels in children. Secretion of the stress hormone cortisol is characterized by a peak in the early morning, followed by declining cortisol levels throughout the day. A slower rate of decline in cortisol across the day has been related to chronic psychosocial stress.

Aim: To examine the associations of green space, air pollution and traffic noise with the diurnal change in saliva cortisol levels in children aged 12 years.

Methods: We used data of 1061 participants aged 12 years of the Dutch PIAMA birth cohort. Children collected saliva samples during a single day: 30 minutes after awakening and at 20.00hr (in the evening). We calculated the change between evening and morning saliva cortisol levels (in ng/ml per hour). We estimated residential exposure to green space (i.e. the average Normalized Difference Vegetation Index (NDVI) and percentages of green space in circular buffers of 300m and 3000m), air pollution and traffic noise. Associations of these exposures with the diurnal cortisol change were assessed by multiple linear regression, adjusted for potential confounders. Associations are presented for an interquartile range (IQR) increase in exposure.

Results: The average NDVI, total percentage of green space and percentage of agricultural green space in a buffer of 3000m were associated with a stronger diurnal decrease in cortisol levels (adjusted difference -0.05ng/ml/hr [95%CI -0.08, -0.01ng/ml/hr] per IQR (0.13) increase in the average NDVI; adjusted difference -0.05ng/ml/hr [95%CI -0.09, -0.01ng/ml/hr] per IQR (31.1%) increase in the total percentage of green space). We found no associations of air pollution or traffic noise with the diurnal cortisol change.

Conclusions: This study indicates that residential exposure to green space may be associated with lower stress levels in children aged 12 years.
Environmental factors affecting stress in children: interrelationships between traffic-related noise, air pollution, and the built environment

Franklin M1, Yin X1, Urman R1, Fruin S1, McConnell R1
1University Of Southern California

OPS 43: Noise, stress and mental health, Room 217, Floor 2, August 27, 2019, 16:30 - 17:30

Background
A growing body of research suggests that stressors such as traffic-related noise, air pollution and artificial light at night may be directly and indirectly associated with decrements in children’s mental health. On the other hand, living near greenspace can reduce stress and provide other health benefits for children.

Methods
When aged 13-14 and 15-16 years, participants in the Southern California Children’s Health Study responded to four questions pertaining to stress. An individual’s combined responses to these questions resulted in scores ranging from 0 to 16 on the Perceived Stress Scale (PSS-4). Residential exposures of noise were derived from the U.S. Traffic Noise Model, NOx from the Caline line dispersion model, artificial light at night from satellite observations in the day-night band, and greenspace from satellite observations of enhanced vegetation index (evi). We assessed the marginal and joint associations of these exposures on stress using mixed effects models with adjustments for subject-specific characteristics.

Results
Overall, PSS-4 is significantly higher (p<0.001) for girls [mean (s.d.) = 5.8 (3.4)] than boys [4.9 (3.2)], and over time it increased for girls [5.6 (3.3) to 6.0 (3.4)]. Marginally, all of the environmental factors are significantly associated with stress after adjustment for sex, height and weight. Jointly, we found a -0.27 (95% CI: -0.47, -0.06) decrease in PSS-4 per iqr increase in evi, together with a 0.16 (95% CI: 0.04, 0.28) increase in PSS-4 per iqr increase in freeway NOx.

Conclusions
The physical environment consists of a complex mixture of factors that both positively and negatively affect health. We find evidence that residential greenspace may mitigate the impact of traffic-related pollution on perceived stress in a cohort of children in Southern California.
Background: Changing climatic scenario with rising temperatures will potentially subject millions of workers to risks of heat stress in tropical settings. Heat stress not only imposes a physiological strain on the exposed workers but also makes subcellular level changes including DNA damage in workers exposed to chronic high-heat environments. We explored the physiological and molecular level changes among such workers.

Methodology: We used a cross-sectional study design and profiled the heat stress of about 1000 workers from 7 sectors viz., steel, garment, tire, brick, construction and agriculture and used a Quest Temp WBGT monitor to evaluate heat exposures and quantified heat strain indicators viz., Core Body Temperature, Sweat Rate and Urine Specific Gravity. We studied the DNA damage by enumerating the Micronuclei (MN) encountered in 120-steel industry workers exposed to chronic high-heat.

Results: Heat stress was high in almost all the workplaces especially during summer months. Steel industry had the highest level of Wet Bulb Globe Temperature (WBGT) (Avg. 31.1±3.2°C) with ~90% workers having higher heat exposures above safe limits. A significant association was observed between the exposures to heat stress and heat strain (X²=4.45; p=0.035) and a significant increase in the MN-frequency was observed in exposed workers compared to the unexposed workers (X²=47.1; p<0.0001). The exposed workers had 23.3 times higher risk of DNA damage (OR=23.3; p<0.0001) compared to the unexposed workers even after adjusting for potential confounders. Years of exposure increased the risk of DNA damage (OR=15.5; p=<0.0001) and high-heat exposed workers had 81-times higher risk of DNA damage compared to the medium-heat exposed workers.

Conclusion: Risks of exposures to chronic heat stress induces damages at a sub-cellular level. Further in-depth research studies are warranted and developing protective interventions to reduce exposure is imperative to avert health risks in the climate change scenario to protect millions of workers.
Chronic Kidney Disease of undetermined cause (CKDu) is affecting agricultural communities in Central America, South Asia, and possible other parts of the world. Various possible causes have been suggested, including heat/dehydration, pesticides, infections, and water contamination/heavy metals. In particular, it has been suggested that CKDu is an occupational disease caused by various working conditions (heat stress, pesticides), and that there is a global epidemic. The debate has become increasingly polarised, since most of the various protagonists are arguing in a data-deficient vacuum. We still don’t know, at least on a global level, who gets this disease, or if the disease is the same in different parts of the world. However, evidence is beginning to emerge, based on studies that we are conducting in Nicaragua, Peru, Malawi, India, and Sri Lanka. These new findings indicate that: (i) the disease does not exist globally, but appears at this stage to be confined to Central America and South Asia (India, Sri Lanka) – there are other regions of the world which are also hot and use large amounts of pesticides where the disease does not occur; (ii) it is more common in agricultural areas, but is not confined to sugar cane workers, and also occurs in women, albeit at a lower rate; (iii) there is a very clear distinction between community members who experience marked declines in kidney function and those who do not. Taken together, this emerging evidence indicates that CKDu may be an environmental rather than an occupational disease, and that the environmental cause(s) are unknown at this time. This has important implications in terms of what research we do next to try and find the cause(s) of this condition.
Background/Aim: Chronic Kidney Disease of unknown etiology (CKDu) was firstly reported among male paddy farmers in North Central Province (NCP), Sri Lanka (SL). This is a cross sectional study which focused to assess the association of Albumin: creatinine (ACR), dipstick proteinuria, gender, age, diabetes mellitus (DM), hypertension (HTN) and lifestyle habits with reduced estimated glomerular filtration rate (eGFR) in fishing and farming communities in SL.

Methods: Overall 564 individuals were participated for the study including 103 fishermen (FM), 125 sugarcane farmers (SF), 226 paddy farmers from two locations (PF1 and PF2) and 70 estate workers (EW). Nonfasting blood samples and early morning urine samples were collected for the analysis. On site dipstick analysis were done by using Combina 13 dipstick reader. Clinical parameters were measured by using biochemistry analyzer (Humaratr100). eGFR was calculated by using CKD-EPI creatinine equation (2009). Binary logistic regression was performed to assess the association between reduced eGFR and other factors.

Results: According to the results, the highest odds ratio (OR), 8.657 (95% CI, 0.346-216.72) for gender-eGFR model was recorded from EW, but in the age-eGFR model the highest OR, 2.384 (95% CI, 0.796-7.138) was found in PF1. When consider the association of lifestyle habits with reduced eGFR, the highest OR for smoking (9.71) was detected from FM and the highest OR for alcohol consumption, 1.78 (95% CI, 0.283-11.26) was observed from PF1. Crude OR was not found for SF in HTN-eGFR, DM-eGFR and ACR-eGFR models. However, the highest crude OR for HTN, 2.76 (95% CI, 0.306-24.85), and GLU (negative), 8.876 (95% CI, 0.302-261.23) were found in EW.

Conclusion: In conclusion, reduced eGFR was not significantly (p>0.05) associated with any of the factors (age, gender, smoking, alcohol consumption, HTN, DM, ACR and dipstick proteinuria) in any study location.

Key words: reduced eGFR, fishermen, farmers, Sri Lanka
Genomic instability reflected by elevated Alu retroelement copy-number among workers exposed to diesel engine exhaust

Wong J¹, Cawthon R², Vermeulen R³, Bassig B¹, Hu W¹, Zheng Y⁴, Silverman D¹, Rothman N¹, Lan Q¹
¹Division of Cancer Epidemiology and Genetics, National Cancer Institute, ²Department of Human Genetics, University of Utah, ³Institute for Risk Assessment Sciences, Division of Environmental Epidemiology, Utrecht University, ⁴School of Public Health, Medical College of Qingdao University

OPS 44: Occupational health studies with environmental implications, Room 411, Floor 4, August 27, 2019, 16:30 - 17:30

Background/Aim: Millions of transportation and industrial workers worldwide are exposed to diesel engine exhaust (DEE), an established lung carcinogen that contains DNA-damaging constituents. Alu retroelements are repetitive DNA sequences that can multiply, insert throughout the genome, and disrupt gene expression and genomic architecture. Site-specific DNA strand breaks activate Alu retrotransposition and altered Alu repeats have been linked to cancer and mortality risk. However, whether Alu retroelements are influenced by environmental pollutants is largely unexplored. In an occupational setting with high levels of DEE, we investigated associations between personal exposure and Alu copy-number.

Methods: A cross-sectional study was conducted in China with 54 DEE-exposed male workers from an engine testing facility and 55 unexposed male controls. Personal air samples were measured for elemental carbon (EC), a DEE surrogate, using NIOSH Method 5040. Leukocyte DNA was extracted from blood samples and quantitative polymerase chain reaction was used to measure Alu copy-number relative to albumin (Alb) single gene copy-number. The unitless Alu/Alb ratio reflects the average Alu copy-number. Linear regression models were used to test for differences in Alu/Alb ratio between controls and DEE-exposed workers, and to evaluate exposure–response relationships across DEE-exposure groups (i.e., controls and EC-tertiles: 6.1–39.0, 39.1–54.5, and 54.6–107.7 µg/m³) adjusted for age and smoking status.

Results: DEE-exposed workers had a higher Alu/Alb ratio than unexposed controls (p=0.03). Further, we found a positive exposure-response relationship with EC (p-trend=0.02). The Alu/Alb ratio was largest among DEE-exposed workers in the highest EC-tertile versus controls (1.12+/−0.08 SD versus 1.06+/−0.07 SD, p=0.01). Age, body mass index, smoking, and work years were not associated with Alu/Alb ratio.

Conclusions: Our findings suggest that increased levels of DEE exposure may contribute to genomic instability, possibly reflected by Alu copy-number. Further studies are needed to evaluate the influence of environmental pollutants on Alu copy-number in relation to carcinogenesis.
Ambient air pollution is a notable environmental health threat in cities and rural areas worldwide. Annually estimated 3 million deaths occur as a result of exposure to ambient air pollutants especially PM2.5 ranked as 6th highest risk factor for morbidity and premature deaths globally. About 90% of the population living in cities exposed to particulate matter in concentrations exceeding the WHO air quality guidelines. In Uganda, ambient air pollution is on the rise due to rapidly increasing use of second hand vehicles and industrialization.

We measured Ambient PM2.5 Concentration using the Beta Attenuation monitor 1022, Centrally installed the Central Sub City of Kampala City and the E-samplers installed in public primary schools in 4 Sub Cities - Kawempe, Central, Makindye and Lubaga, Kampala. The BAM 1022 and E-Samplers generated real time data for PM2.5, Relative Humidity and Ambient Temperature. Data analysis was done using MS Excel 2016 to generate daily and monthly averages of PM2.5 concentrations.

Our results showed the January 2018 had highest average monthly mean PM2.5 concentrations of 69.1µg/m³ (min 13µg/m³–max 251µg/m³), December 2017- 50µg/m³ (min 6µg/m³–max 238µg/m³), February 2018- 45.4µg/m³ (min 1µg/m³–max224 µg/m³), September 44.8µg/m³ (min 2µg/m³–max149µg/m³), August 2018-44.0µg/m³ (min 1µg/m –max184µg/m³), July 2018- 41.7µg/m³ (min 7µg/m³–max147µg/m³).

There is notable rise in monthly mean PM2.5 concentrations from Dec 2017 (50.0 µg/m³), Jan 2018 (69.2 µg/m³) through Feb 2018 (54.3 µg/m³)

The evidence from our findings reveal that PM2.5 concentrations were exceeding the WHO air quality guidelines, Unhealthy for sensitive groups (35.5-55.4µg/m³) and Unhealthy (55.5-150.4µg/m³) for the months Oct-Dec 2017, Jan-March 2018 and June-September 2018. These results show that people living Uganda are experiencing increased exposure to outdoor air pollution. These results will provide a genesis of scientific evidence on air pollution exposure, public health impacts, and influence policy in Uganda.
Background/Aim: This study was to assess personal exposure to PM2.5 for an elderly population using a measurement-based microenvironmental model.

Methods: we recruited thirty-three subjects (age > 65) in Taipei, Taiwan from a cohort study of PM2.5 exposure and health effects. We conducted a 24-h personal monitoring of PM2.5 exposure using a real-time monitor (TSI SidePak AM510) for each participant with repeated measurements across four seasons. PM2.5 concentrations in subjects’ indoor and outdoor households and in the ambient were also measured simultaneously. Participants filled out the time-activity diary recording the location, activity and awareness of air quality and ventilation in time during their sampling day. The microenvironmental model in cooperation with a generalized estimating equation (GEE) model were used to estimate personal exposure of daily PM2.5.

Results: Personal exposure to PM2.5 is mainly associated with ambient air quality, season, individual activity and habits, involved location, ventilation, and nearby source. We found home indoor was mainly attributable to daily personal PM2.5 exposure, while the elders spent much time (88%) at home indoor. Using ambient PM2.5 as an exposure surrogate underestimated personal exposure. Home outdoor PM2.5 concentration could explain 64% of personal exposure, while ambient PM2.5 was only attributable to 50%. Awareness of air quality and smelling in individuals is an important indicator to positively affect PM2.5 exposure. Personal exposure to PM2.5 was significantly increased by 90-110% with a report of smelling cigarette and incense smokes. Through a developed model, the estimation of daily personal PM2.5 exposure could be up to 67%.

Conclusions: Our developed model could be used to evaluate personal exposure to PM2.5 in the elderly health cohort study, where we took PM2.5 concentrations in indoor and outdoor home and various microenvironments for individuals into account.
Background: The Mother and Child in the Environment (MACE) birth cohort aims to determine the effects of ambient air pollution on pregnancy outcomes and childhood respiratory disorders in Durban, South Africa. A land use regression model (LUR) was developed to characterise exposure.

Methods: Based on the European Study of Cohorts for Air Pollution Effects (ESCAPE) methodology, particulate matter (PM10 and PM2.5), sulphur dioxide (SO2), and nitrogen dioxide (NO2) were measured over a period of one year, at 41 sites, with Ogawa Badges and 21 sites with PM Monitors.

Results: Air pollution concentrations showed a clear seasonal trend with higher concentrations being measured during winter (25.75 µg/m3, 4.18 µg/m3, 50.44 µg/m3, and 20.90 µg/m3 for NO2, SO2, PM10 and PM2.5 respectively) as compared to summer (10.51 µg/m3, 2.8 µg/m3, 20.49 µg/m3, and 8.49 µg/m3 for NO2, SO2, PM10 and PM2.5 respectively). The LUR NO2 models for annual, summer and winter explained 73%, 60% and 59% of the variance with elevation, traffic, population, open space and a regional variable being identified as important predictors. The SO2 models were less robust with lower R2 annual (37%), summer (49%) and winter (33%) with industrial and traffic variables being important predictors. The R2 for PM10 models ranged from 59-66% while for PM2.5 models this range was 62%-73% with only total length of major roads emerging as a predictor. Variables such as urban area and length of minor roads remained statistically insignificant in each model.

Conclusion: These results highlight the influence of industrial and traffic emissions from major roads on air pollution concentrations. Furthermore, this is the first study in South Africa highlighting the importance of a regional variable serving as a proxy marker for industry, as areas of higher industrial activity are geographically grouped within the city.
Mobile-monitoring of Black Carbon and PM2.5 Air Pollution - Data only approach from Bangalore, India

Kushwaha M\textsuperscript{1}, Upadhya A\textsuperscript{1}, Savio E\textsuperscript{1}, Sreekanth V\textsuperscript{2}, Asundi J\textsuperscript{2}, Apte J\textsuperscript{3}, Marshall J\textsuperscript{4}

\textsuperscript{1}Ilk Consultancy Llp, \textsuperscript{2}Center for Study of Science, Technology and Policy (CSTEP), \textsuperscript{3}Civil, Architectural and Environmental Engineering, University of Texas at Austin, \textsuperscript{4}Civil & Environmental Engineering, University of Washington

OPS 46: Exposure assessment to air pollution in Asia and Africa, Room 315, Floor 3, August 27, 2019, 16:30 - 17:30

INTRODUCTION
Mobile monitoring campaigns that repeatedly cover all roads in an area (“wall-to-wall driving”) have shown they can robustly capture spatial patterns in on-roadway pollution. Yet, this technique has not been tried in a low-income country. India is home to several of the world’s most polluted cities. We explore the potential for mobile monitoring to provide high-resolution exposure data in Indian cities.

METHODS
Our aim was to over-sample each location, thereby shedding light on how many measurements are needed to obtain robust estimates of concentrations at each location. Our mobile platform was equipped with an aethalometer for black carbon (BC) and an atmos for PM2.5. We sampled each location 45 times during September - December 2018. Monitoring consisted of 2025 vehicle-km (135 h) of measurement, across two neighborhoods: a mixed-use neighborhood (“MUN”; 15.4 km of road) and a residential neighborhood (“RN”; 18.8 km of road). Raw BC and PM2.5 measurements were corrected for common measurement artifacts. We then computed average concentration for each 30m road segment and used Monte Carlo sampling to develop synthetic datasets representing N driving sessions, where N = 1, 2, 4, 6 ... 45 driving sessions. We compared average concentrations of the subsampled data-set against the entire 45-day dataset.

RESULTS
Mean (median) values (135 h of data) were 33 (18) µg/m\textsuperscript{3} in MUN, 29 (15) µg/m\textsuperscript{3} in RN for BC, and 43 (39) µg/m\textsuperscript{3} [MUN], 31 (39) µg/m\textsuperscript{3} [RN] for PM2.5. Monte-carlo subsampling for BC revealed R\textsuperscript{2} = 0.9 for ten rides, and diminishing returns for >10 rides; in contrast, for PM2.5, R\textsuperscript{2} ~ 0.6 for ten rides, with continued R\textsuperscript{2} improvement with more data (R\textsuperscript{2} >0.9 for >30 rides).

CONCLUSION
Data-only approach may be more suitable for BC measurements in the Indian context.
OPS 47: Increasing spatiotemporal resolution in assessment of exposure to outdoor air pollutants

Daily NO2 modelling using OMI satellite data over Switzerland for 2005 – 2016

de Hoogh K1,2, Saucy A1,2, Shtein A3, Schwartz J4, West E5, Strassmann M5, Röösli M1,2, Stafoggia M6, Kloog I3
1Swiss Tropical and Public Health Institute, 2University of Basel, 3Department of Geography and Environmental Development, Ben-Gurion University of the Negev, 4Department of Environmental Health, Harvard T. H. Chan School of Public Health, 5Epidemiology, Biostatistics and Prevention Institute, University of Zurich, 6Department of Epidemiology, Lazio Regional Health Service

Background/Aim
Nitrogen dioxide (NO2) remains an important traffic-related pollutant associated with health effects. Here we aim to model daily average NO2 concentrations combining spatial and temporal predictor variables including data from the Ozone Monitoring Instrument (OMI) and Copernicus Atmosphere Monitoring Service (CAMS).

Methods
In stage 1 we imputed missing OMI data, due mainly to cloud cover, by developing mixed effect models between OMI and CAMS estimates of Total Column Nitrogen Dioxide/nitrogen oxides also including additional large scale spatiotemporal predictors. In stage 2 the large OMI grid cells (13x24km) were downscaled to 1x1km using bilinear interpolation and linked to the NO2 monitoring network (appr. 100 sites). We then developed mixed effect models to explain the measured NO2 concentration using the imputed, downscaled OMI data and spatiotemporal predictors. In stage 3, the last downscale step to 100x100 meter grid cells, we calculated the residuals between the daily measured NO2 at monitoring locations and the daily predicted NO2 at 1x1km and explained the spatiotemporal variation using Random Forest including fine scale spatiotemporal predictors at the 100m scale.

Results
The stage 1 models explained on average 68 percent of variability in the OMI data (range R2 = 0.62 – 0.72) for the years 2005-2016. The stage 2 linear mixed effect models were able to explain on average 58% (range 56-64%) of the variation in measured NO2 concentrations. The Random Forest models in stage 3 explained on average 73% (range R2 = 0.70 – 0.75) of the overall variation in the residuals.

Conclusions
This is the first study showing the potential of using earth observation data to develop robust models explaining fine scale spatial (100 x 100 m) temporal (daily) variation of NO2 across Switzerland from 2005 to 2016. The predicted NO2 concentrations will be made available to facilitate heath research in Switzerland.
Estimating daily PM2.5 and PM10 over Italy using an ensemble modeling approach

1Department of Geography and Environmental Development, Ben-Gurion University of the Negev, 2Department of Environmental Health, Harvard T. H. Chan School of Public Health, 3ARIANET s.r.l., 4Department of Epidemiology, Lazio Regional Health Service / ASL Roma 1, 5INAIL, Department of Occupational & Environmental Medicine, 6Institute of Biomedicine and Molecular Immunology “Alberto Monroy”, National Research Council, 7Karolinska Institute, Institute of Environmental Medicine

OPS 47: Increasing spatiotemporal resolution in assessment of exposure to outdoor air pollutants, Room 412, Floor 4, August 27, 2019, 16:30 - 17:30

Background: Exposure to particulate matter (PM) pollution has been associated with various adverse health effects. PM concentrations are measured worldwide sparsely by monitors; therefore, models that allow continuous spatiotemporal estimations are needed for better exposure assessment. The primary aim of this research is to estimate PM2.5 and PM10 concentrations over Italy for 2013-2015 years using an ensemble model.

Methods: In the first stage multi-angle implementation of atmospheric correction (MAIAC) aerosol optical depth (AOD) product is imputed for all locations using a novel spatiotemporal land-use random-forest (RF) model. In the second stage PM estimations are produced using four different modeling approaches: linear mixed effects (LME), RF, extreme gradient boosting (XgBoost) and an Italian chemical transport model, the flexible air quality regional model (FARM). The imputed MAIAC AOD alongside additional spatial and temporal predictors are used as inputs in the three first models. In the third stage a general additive model (GAM) ensemble model is used to fuse the estimations from the four models by providing different weights for each model and allowing them to vary over space and time.

Results: Cross-validated performance was robustly evaluated separately for each individual model showing variability in the root mean squared error (RMSE) and R2 of the five different models that were used. For example, in 2015, the GAM ensemble model showed the lowest RMSE (6.3) and highest R2 (0.81) for PM2.5 in comparison to those of the four separate models (7.8, 0.71 for LME; 6.9, 0.77 for RF; 6.58, 0.79 for XgBoost; and 10.42, 0.48 for FARM).

Conclusions: This study shows that the ensemble model is a strong method for estimating PM concentrations, combining PM estimations from different models and taking the advantages of each individual model. The continuous PM estimations produced by this model can be applied in further epidemiological studies in Italy.
High resolution spatiotemporal assessment of ambient air pollution using ensemble modeling and links with hypertension in a Delhi based cohort

Mandal S\textsuperscript{1,2}, Madhipatla K\textsuperscript{1}, Prabhakaran D\textsuperscript{1,2}, Schwartz J\textsuperscript{3}

\textsuperscript{1}Center For Chronic Disease Control, \textsuperscript{2}Public Health Foundation of India, \textsuperscript{3}Harvard School of Public Health

OPS 47: Increasing spatiotemporal resolution in assessment of exposure to outdoor air pollutants, Room 412, Floor 4, August 27, 2019, 16:30 - 17:30

Aim: High levels of ambient air pollution has been implicated as a major risk factor for morbidities and premature mortality in India. In this work, we retrospectively assessed daily average PM2.5 exposure at 1 km × 1 km grids in Delhi, India from 2010-2016, using multiple data sources and ensemble averaging approaches that combine machine learning algorithms. In addition, we linked the assessed exposures with blood pressure and hypertension in a cohort study.

Methods: We implemented a multi-stage modeling exercise involving satellite data, land use variables, reanalysis based meteorological variables and population density. The relationship between PM2.5 and spatiotemporal predictors was modeled using five learners; generalized additive model, elastic net, support vector regressions, 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. For studying the effects of ambient air pollution on blood pressure and hypertension, we used longitudinal mixed effects modeling with different exposure metrics while adjusting for confounders.

Results: Average cross-validated (CV) R\textsuperscript{2} 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\textsuperscript{3}. 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\textsuperscript{2} (yearly average) varied between 0.91-0.99, while temporal CV-R\textsuperscript{2} (daily variability) ranged from 0.65-0.90, showing adequate model performances. We demonstrated important seasonal and geographical differences in PM2.5 particulate matter concentrations using the model outputs.

Conclusion: We have developed a detailed exposure assessment for ambient air pollution in a highly polluted region of India and provided insights to the effects of such exposures on longitudinally measured blood pressure measurements in a representative cohort.
Source-specific Fine Particulate Using Spatiotemporal Concentration Fields Developed using Chemical Transport Modelling and Data Assimilation: Application to North Carolina for Health Associations with Coronary Heart Disease

Russell A¹, Huang R¹, Zhai X¹, Ivey C², Shi G³, Devlin R⁴
¹Georgia Institute of Technology, ²University of California Riverside, ³Nankai university, ⁴US Environmental Protection Agency

OPS 47: Increasing spatiotemporal resolution in assessment of exposure to outdoor air pollutants, Room 412, Floor 4, August 27, 2019, 16:30 - 17:30

A number of studies have found differing associations of disease outcomes with PM2.5 components (or species), and sources (e.g., biomass burning, diesel vehicle and gasoline vehicle). Here, a unique data fusion method has been utilized to generate spatiotemporal fields of major gaseous pollutants and PM2.5 components (e.g., ozone, NO2, SO2, total PM2.5 mass and speciated PM2.5 including crustal metals) over North Carolina for 2002-2010. In a prior study, the PM2.5 total mass field was used as part of the CATHGEN study of associations between PM2.5 and disease associated with cardiac heart disease patients. Here, we extend the exposure method for further health analyses. The method fuses daily CMAQ model observations with observations to develop accurate spatiotemporal maps of pollutant concentrations. Those results are then used in an advanced chemical mass balance source apportionment model, CMBGC-Iteration, that uses both gas and particulate matter concentrations to quantify source impacts. The method, as applied to North Carolina, quantifies the impacts of nine source categories and estimate source contributions of total PM2.5 mass. The nine source categories include sources of both primary (diesel vehicle, gasoline vehicle, suspended dust, biomass burning, and coal combustion sources) and secondary components (ammonium sulfate, ammonium bisulfate, ammonium nitrate and secondary organic carbon). The results show the dramatic decrease in source impacts, e.g., sulfate, primarily from coal-burning, and from mobile sources. Secondary organic aerosol, e.g., from biogenic emissions, is becoming more dominant over the state. This study highlights an advantage of using a chemical transport model to develop spatiotemporal fields of pollutants, i.e., the ability to assess PM components and their sources.
PDS 67: Outdoor air pollution cardiometabolic effects
Associations between short-term exposure to fine particles and systemic inflammation, coagulation, vasoconstriction and metabolism cytokines: A nested case-control panel study
Chen W1, Han Y1,3, Wang Y1,4, Chen X1,5, Li W6, Zhang H6, Zhu T1,2

1State Key Joint Laboratory of Environment Simulation and Pollution Control, College of Environmental Sciences and Engineering, Peking University, 2Beijing Innovation Center for Engineering Science and Advanced Technology, Peking University, 3Environmental Research Group, MRC PHE Centre for Environment and Health, King’s College London, 4National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, 5Center of Research and Innovation, Shenzhen Institution of Building Research Co., Ltd., 6Peking University Hospital, Peking University

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background/Aim: Epidemiological studies have shown that exposure to ambient fine particles (PM2.5) is associated with increasing morbidity and mortality of cardiovascular diseases, both in healthy individuals and those with glucose metabolism disorders. Systemic inflammation, coagulation, vasoconstriction, and metabolism are potential mechanisms underlying the PM2.5 induced health effects, but direct evidence is limited. This study aims to provide further understanding of the detailed effects of PM2.5 and the underlying biological mechanisms based on multiple cytokines involved in systemic inflammation, coagulation, vasoconstriction, and metabolism mechanisms.

Methods: In a nested case-control panel study (SCOPE) conducted in Beijing, China, 54 prediabetes and 66 healthy controls were recruited to complete 4-7 repeated clinic visits. During the entire study period, mass concentration of PM2.5, temperature, and relative humidity were monitored hourly at a fixed monitoring station. 28 cytokines in serum were measured with Milliplex MAP kits. The associations between serum cytokines and the PM2.5 moving average concentrations during the 1-14 days prior to the clinic visits were estimated with a linear mixed effects model.

Results: Interthelin-8 (IL-8) and monocyte chemotactic protein-1 (MCP-1), biomarkers of systemic inflammation, were positively associated with daily ambient PM2.5 exposures in both groups, and prediabetes showed quicker and stronger responses. The positive association between PM2.5 and soluble CD40 ligand (sCD40L) was only observed in healthy controls, while those between PM2.5 and soluble intercellular adhesion molecule-1 (sICAM-1) and D-dimer only showed in prediabetes. Exposure to PM2.5 was associated with the decreases in certain cytokines including E-selectin, resistin and plasminogen activator inhibitor-1 (PAI-1) in both groups, and P-selectin and soluble vascular adhesion molecule-1 (sVCAM-1) in healthy controls. Besides, PM2.5 induced impacts showed a time-cumulative effect.

Conclusion: Disorders of glucose metabolism may aggravate systemic inflammation and coagulation induced by PM2.5 exposures. The biological mechanisms of PM2.5 associated effects may differ between prediabetic and healthy individuals.
Exposure to Particulate Matter of Different Fraction Sizes and Blood Glucose in Children and Adolescents

Zhang Z\textsuperscript{1,2}, Dong B\textsuperscript{1}, Li S\textsuperscript{3}, Chen G\textsuperscript{3}, Guo Y\textsuperscript{3}, Ma J\textsuperscript{1}
\textsuperscript{1}Peking University, \textsuperscript{2}Institute for Clinical Evaluative Sciences, \textsuperscript{3}Monash University

Background: The health effects of particulate matter (PM) air pollution on glucose metabolism have been rarely examined in children and adolescents. We investigated the associations between long-term PM exposure and blood glucose and prevalence of impaired fasting glucose in a large population of Chinese children and adolescents.

Methods: In 2013, a total of 11,814 children and adolescents aged 7 to 18 years were recruited from seven provinces in China. Fasting blood sample was taken for the measurement of blood glucose. Satellite-based spatial-temporal models were used to estimate exposure to ambient submicrometer particles (PM1), fine particles (PM2.5) and thoracic particles (PM10). Cross-sectional analyses were performed using multivariable linear and logistic regression models.

Results: After adjustment for a range of covariates, every 10 µg/m\textsuperscript{3} increment in PM1 and PM2.5 concentrations was associated with 0.109 [95% confidence interval (CI): 0.092,0.126] and 0.078 (95% CI: 0.063,0.093) mmol/L higher blood glucose levels, respectively. Consistently, PM1 and PM2.5 were associated with higher prevalence of impaired fasting glucose [odds ratio per 10 µg/m\textsuperscript{3} increment in PM1 and PM2.5: 1.38 (1.14,1.65) and 1.17 (1.02,1.36), respectively]. No significant associations were found for PM10.

Conclusions: We found that long-term exposure to PM1 and PM2.5 air pollution was associated with increased levels of blood glucose and higher prevalence of impaired fasting glucose in children and adolescents. The smaller fraction size of PM, the stronger impacts.
Long-term exposure to NO2 and PM2.5 on renal function in type 2 diabetes

Chin W1, Chang Y2, Huang L3, Hsu C3,4,5, Guo Y6,7

1Taipei Medical University, 2Department of Medical Research, Tung’s Taichung Metro Harbor Hospital, 3Institute of Population Health Sciences, National Health Research Institutes, 4Department of Health Services Administration, China Medical University, 5Department of Family Medicine, Min-Sheng General Hospital, 6Department of Environmental and Occupational Medicine, National Taiwan University (NTU) College of medicine and NTU Hospital, 7National Institute of Environmental Health Science, National Health Research Institutes,

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background:
Chronic kidney disease is a common comorbidity in patients with type 2 diabetes. Previous studies found that exposures to air pollutants are relevant factors for chronic kidney disease. However, few studies examined the impact of long-term exposures to air pollutants on renal function in type 2 diabetes. Therefore, in this study we followed patients with type 2 diabetes and assessed the effect of long-term exposure to air pollutants on their renal function.

Method:
Between 2003 and 2005, we recruited 1,316 participants with type 2 diabetes and followed through to the end of 2012. Demographics data, medical history, and baseline biomarkers were inquired and corrected at the beginning of recruitment. The Taiwanese Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation was used to derive the estimated glomerular filtration rate (eGFR) which was obtained from blood test between 2006 and 2012. Monthly averages of five criteria air pollutants – CO, NO2, O3, SO2 and PM2.5 – were retrieved from 72 air-quality-monitoring stations, and interpolated to all participants’ home addresses using the kriging method. The association between air pollutants and eGFR decrease was assessed using mixed-effect model with random intercepts for 36 clinics.

Results:
Among the participants, 985 subjects were qualified for and included in the analysis. The mean ages of subjects was 57.5 years old and mean follow-up years were 5.3. The prevalence rates of eGFR lower than 60 mL/min/1.73 m2 at baseline and last surveys were 5.8 % and 11.5%. The decreased eGFR was significantly associated with NO2 and PM2.5 exposure within follow-up period.

Conclusion:
Our study suggested that long-term exposure to air pollutants (NO2 and particulate matter 2.5) was associated with reduced renal function among Type 2 diabetes patients in Taiwan.
Urban environment and body mass index trajectories during first 5 years of life


1Barcelona Institute For Global Health (ISGlobal), 2Fundació Institut Universitari per a la recerca a l’Atenció Primària de Salut Jordi Gol i Gurina (IDIAPJGol), 3University of Bristol

Background/Aim: Air pollution, noise, green spaces and built environment could lead to distinctive body mass index (BMI) growth which is associated with several health outcomes. However, there is limited evidence due to a lack of longitudinal data. Our aim is to evaluate the association between the urban environment and BMI trajectories during the first 5 years of life.

Methods: A longitudinal study included children (n=77,329) born between 01/01/2011-31/12/2013 identified from primary care records (SIDIAP) in Spain and were followed up until 31/12/2016, date of death or transferred-out. Height and weight were measured several times during childhood and BMI was calculated (kg/m2). The urban indicators were calculated at census tract level. The estimated urban indicators were air pollution (nitrogen dioxides (NO₂), particulate matter <10μm (PM₁₀) and < 2.5μm (PM₂.₅)), noise, green spaces (Normalized Difference Vegetation Index (NDVI) and % green space) and built environment (population density, intersection density, mixed land use and walkability index). BMI individual trajectories from 0 to 5 years were estimated using a linear spline multilevel model and were adjusted by sex and socioeconomic status.

Results: An interquartile (IQR) increase in NO₂ (21.2 μg/m3), PM₁₀ (6.3 μg/m3), PM₂.₅ (1.5 μg/m3) and population density (34237 people/km2) increased BMI growth per year from birth to age 5 years [β(NO₂)=0.01 (0.00;0.02); β(PM₁₀)=0.02 (0.01;0.03); β(PM₂.₅)=0.01 (0.00;0.01); β(population density)=0.02 (0.01;0.03)]. We observed a reduced BMI growth per year in an IQR increase in NDVI (0.2 units), % green spaces (40.8% units) and mixed land use (0.4 units) [β(NDVI)=−0.01 kg/m2 (-0.01;-0.00); β(% green spaces)=−0.02 (-0.01;-0.00); β(mixed land use)=−0.02 (-0.03;-0.01)]. We did not find any association for noise, intersection density and walkability index.

Conclusions: Preliminary results suggest that air pollution and population density are associated with an increased BMI per year, whereas green spaces and mixed land use is associated with a decreased BMI.
Ambient air pollution association with anaemia prevalence and hemoglobin levels in Chinese older adult; cross-sectional study from who wave 1 study on global aging and adult health (sage)

Elbarbary M¹, Morgan G¹, Guo Y², Negin J¹

¹School of public health, Faculty of medicine and Health, The University of Sydney, ²Department of Epidemiology and Preventive Medicine, School of Public Health and Preventive Medicine, Monash University,

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background:
Health effects of air pollution on anemia have been scarcely studied worldwide. We aimed to explore the associations of long-term exposure to ambient particulate matter (PM) and gaseous pollutants (NO2) with anemia prevalence and hemoglobin levels in China.

Methodology:
We used two-level linear regression models and modified Poisson regression with robust error variance to examine the associations of particulate matter (PM), and nitrogen dioxide (NO2) on haemoglobin levels and prevalence of anaemia, respectively, among 10611 older Chinese adults enrolled in WHO Study on global AGEing and adult health (SAGE) China Wave1 in 2007-2010 from 64 townships. The average community exposure to ambient air pollutants (PM with an aerodynamic diameter of 10 μm or less [PM10], 2·5 μm or less [PM2·5], 1 μm or less [PM1] and nitrogen dioxide [NO2]) for each participant was estimated using a satellite-based spatial statistical model. Haemoglobin levels were measured for participants from dried blood spots. Anaemia was defined using WHO haemoglobin-based criteria of b13 and b12 g/dL for men and women, respectively. Models were controlled for confounders. Mediation by C-reactive protein (CRP), a marker of systemic inflammation, was also investigated.

Results:
All the studied pollutants were significantly associated with increased anaemia prevalence (eg, the adjusted prevalence ratios associated with an increase in IQR in five year moving average for NO2, PM1, PM2·5, and PM10 were 1.42, 95% CI 1.35-1.50; 1.15, 1.09-1.23; 1.12, 1.06-1.18; 1.05, 1.02-1.08, respectively). These air pollutants were also associated with lower concentrations of haemoglobin (-1.76 95% CI -1.90- -1.62; -0.67, -0.78--0.55; -0.98, -1.00--0.68; -0.52, -0.65--0.39, respectively). Stratified analyses indicated greater effects on the individuals who were smokers or alcohol drinkers.

Conclusions:
Air pollution exposures were significantly associated with increased prevalence of anaemia and decreased haemoglobin levels in a cohort of older Chinese adults.
How Protective is China’s National Ambient Air Quality Standard on Short-term PM2.5? Findings from Blood Pressure Measurements of 1 Million Adults

Guan T, Xue T, Wang Z
1School of Public Health, Chinese Academy Of Medical Sciences, 2Peking University, 3Fuwai Hospital, Chinese Academy Of Medical Sciences

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background
To protect the public from adverse health effects of ambient fine particulate matter (PM2.5), China developed an action plan of air pollution control and prevention in 2013, which has considerably improved the air quality. Therefore, it may be time to evaluate the health effects of below-criteria concentration of PM2.5 with a nation-scale study.

Using blood pressure (BP) elevation as a biomarker for acute exposure to PM2.5, this study explored the protective effects of China’s current air quality standard on short-term PM2.5 concentration.

Methods
We explored the association between BP change and short-term exposure to PM2.5 in nationwide China, based on a representative population of over 1 million individuals, 2013-2016. Based on the spatiotemporal epidemiological study, we linked BP measurements to daily estimates of PM2.5 from multiple sources (i.e., in situ observations, satellite measurements of aerosol and numeric simulations of air quality model) after adjusting for several individual-level covariates and further conducted the below-criteria models by restricting the analyses within subsets of individuals with short-term PM2.5 exposure below 75 μg/m3 (i.e., current standard of 24-hour PM2.5 in China). We further explored variations in BP-PM2.5 associations by pollution level and for different demographic groups.

Results
A 10-μg/m3 increase in short-term exposure to PM2.5 was associated with a 0.049 (95% confidence intervals: 0.041, 0.057) mmHg increase in systolic BP, a 0.022 (0.017, 0.027) mmHg increase in diastolic BP or a 0.77% (0.62%, 0.92%) increased risk of hypertension. The association between BP elevation and low-concentration PM2.5 (< 75 μg/m3) remained statistically significant and were even stronger than the estimates from the above full-population analyses.

Conclusions
We estimated significant acute effects of PM2.5 exposure on BP elevations below the current China standards. These findings can help support decisions by policymakers to revise related environmental regulations to protect public health.
Dynamic changes in long-term exposure to ambient PM2.5 and incidence of diabetes in adults: A natural experiment

Lao X¹, Bo Y¹, Guo C¹
¹The Chinese University Of Hong Kong

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background/Aim: Many countries dedicated in mitigation of air pollution in the past several decades. Thus, many cities and regions, especially those with advanced economies, have experienced dynamic increases and decreases in air pollution. However, little is known about how air quality improvement affects the development of diabetes. It is crucial to demonstrate if reduced air pollution can prevent diabetes development. We thus conducted a longitudinal cohort study to investigate the associations of dynamic changes in long-term exposure to ambient PM2.5 with fasting plasma glucose (FPG) level and incidence of diabetes.

Methods: A total of 151,398 adults aged 18 years or older were recruited between 2001 and 2014. All participants underwent at least two standard medical examinations including FPG measurements. We estimated PM2.5 concentrations by using a satellite-based spatio-temporal model at a high resolution (1 km²). The change in PM2.5 (ΔPM2.5) was defined as the difference between the values measured during follow-up and during the immediately preceding visit. We investigated the effects of ΔPM2.5 on FPG and incidence of diabetes using the multivariable linear mixed model and time-varying Cox model, respectively.

Results: Every 5-µg/m³ change in PM2.5 (i.e., a ΔPM2.5 of 5-µg/m³) was associated with a change of 0.26-mg/dl/year in FPG [95% Confidence Interval (CI): 0.21, 0.31] and a 20% change in incidence of diabetes (95% CI: 16%, 0.23%). Both stratified and sensitivity analyses generally yielded similar results.

Conclusion: Improvement of PM2.5 air quality is associated with a decreased level of fasting plasma glucose and a decreased risk of developing diabetes. The research findings suggest that reducing air pollution is an efficient strategy to combat the pandemic of type 2 diabetes.
The relationship between air pollution exposure and the risk of diabetic retinopathy

Pan S1, Huang C2, Chin W3, Chen B4, Chan C1, Guo Y1,2,5

1Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University, 2Department of Environmental and Occupational Medicine, College of Medicine, National Taiwan University (NTU) and NTU Hospital, 3School of Nursing, College of nursing, Taipei Medical University, 4Department of Medical Research and Development, Chang Gung Memorial Hospital, 5National Institute of Environmental Health Sciences, National Health Research Institutes

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background/Aim
Exposure to air pollution has been linked to adverse effects on vascular diseases. However, the effects of air pollution exposure on diabetic retinopathy (DR), a form of vascular disease, have not been studied. The aim of this study was to determine the association between ambient air pollution exposure and diabetic retinopathy occurrence.

Material and Methods
Retrospective cohort study design was applied for investigating the long-term effect of ambient air pollution on DR occurrence among diabetics. Newly diagnosed diabetes mellitus (DM) cases during 2003-2012 from the National Health Insurance Research Database (NHIRD) – Longitudinal Health Insurance Database 2005 (LHID2005) were included in the study cohort. Yearly air exposure levels were obtained from the Taiwan EPA air monitoring station. Kriging method was used to interpolate concentrations of air pollutants in township levels. We linked yearly townships exposure levels with townships of residence in each year, and calculated the average concentrations of follow-up period as personal exposure. The Cox proportional hazard models were performed adjusting for sex, age of DM onset and comorbidities.

Results
A total of 17,403 subjects with newly diagnosed DM were included in the study. Among them, 585 newly diagnosed DR cases were found during the follow-up periods (mean: 5.6 years). The hazard ratio (HR) of DR occurrence associated with per 10 μg/m³ increase in PM2.5, PM2.5-10, 1 ppb in nitrogen dioxide (NO2) and sulfur dioxide (SO2), were 2.06 (95% confidence interval, CI: 1.60-2.66), 1.71 (95%CI: 1.39-2.10), 1.05 (95%CI: 1.03-1.08), and 1.23 (95%CI: 1.13-1.34), respectively. In two-pollutant models, the effects of PM2.5, PM2.5-10, NO2 and SO2 remained robust after adjusting for other air pollutants.

Conclusion
Exposure to higher levels of air pollution was associated with increased risk of DR occurrence in diabetic patients.
Association between air pollution and venous thromboembolism: a 16 years time-series study in Rome

Solimini A, Renzi M, Stafoggia M, Michelozzi P, Forastiere F, Davoli M

1Department of Epidemiology of Health Authority Service of Lazio Region, ASL Rome 1, 2Karolinska Institutet, Institute of Environmental Medicine, 3Institute of Biomedicine and Molecular Immunology "Alberto Monroy", National Research Council, 4University of Rome La Sapienza

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background: Air pollution is responsible for a large burden of diseases worldwide. Contrary to other cardiovascular diseases, little and contrasting evidence has been provided on the association of air pollution with venous thromboembolism. We investigated the association between short-term exposure to air pollution and hospital admissions for deep vein thrombosis (DVT) and pulmonary embolism (PE) in the city of Rome.

Methods: We conducted a time-series analysis from 2001 to 2016 of daily levels of air pollution (PM₁₀ and PM₂.₅ and nitrogen dioxide, NO₂) and daily counts of urgent hospital admissions for DVT and PE. An over-dispersed Poisson model was applied to study the associations at different time lags after controlling for several time varying covariates. Additionally, we evaluated two-pollutant models and the influence of selected pre-existing medical conditions in subgroup analyses.

Results: In total, 37,998 urgent hospital admissions for DVT and 19,667 for PE were recorded during the study period. The larger associations were observed at same day (lag 0) with increased risks of 1.60% (95% CI=0.53; 2.69), 0.29% (-1.22; 1.83) and 3.98% (2.97; 5.00) for DVT and of 1.42% (-0.02; 2.88), 0.66% (-1.35; 2.71) and 4.64% (3.24; 6.05) for PE hospital admissions, corresponding to 10μg/m³ increments of PM₁₀, PM₂.₅ and NO₂, respectively. The association with NO₂ decreased substantially at lag 2-5 days before exposure. Associations with PE were stronger than those with DVT. Subgroup analyses evidenced larger effects in elderly for DVT while no differences resulted for other conditions. Estimates for NO₂ were robust after adjustment for PM₁₀ and PM₂.₅.

Conclusions: Short-term NO₂ exposure was associated with increased hospital admissions for deep vein thrombosis and pulmonary embolism in this long time series.
Effects of different size fractions of ultrafine particles from short-term exposure to indoor sources on arterial stiffness using single and multipollutant modeling

Soppa V1, Shinnawi S1, Hellack B2,3, Quass U4, Kaminski H2, Schins R5, Kuhlbusch T6,7, Hoffmann B1

1University of Düsseldorf, 2IUTA – Institute of Energy and Environmental Technology, 3UBA - Federal Environmental Agency of Germany, 4LANUV - Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen Fachbereich 44, 5IUF – Leibniz Research Institute for Environmental Medicine, 6BauA - Federal Office for Occupational Safety and Occupational Medicine, 7CENIDE - Center for Nanointegration

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background/ Aim: In our previous analysis on rapid effects of fine and ultrafine particles from indoor sources on arterial stiffness we showed that UFPs led to significant increases in augmentation index (AIx). Here we aim to investigate which size fraction of UFPs from indoor sources is mainly responsible, and if there is an independent effect of UFP.

Methods: We measured UFP number concentration during a 2 h exposure to candle burning (CB), toasting bread (TB), and frying sausages (FS) with a Fast Scanning Mobility Particle Sizer (©TSI) and calculated the effects of different size fractions of UFPs (5.6-10 nm, 10-30 nm, 30-50 nm, 50-100 nm) on AIx in 55 healthy volunteers, using multiple mixed linear regression. In order to examine whether effects of UFPs on AIx were independent from particle mass, we additionally adjusted for particle mass concentration (PM10) in a multipollutant analysis.

Results: Within the fraction of UFP, the smallest particles (<10 nm) were responsible for the effect of CB and the fraction of particles between 30-100 nm dominated the effect of FS. The effects from CB for UFPs <10 nm were immediate, reaching a maximum increase in AIx of 9.5% (95%-CI: 3.1; 15.9) directly after the exposure and returning to pre-exposure values within 24 hours. The effects of UFPs between 30 and 100 nm from FS on AIx were also immediate but persisted up to 24 hours. The increase was about 5%. In multi-pollutant models, the effects of UFPs on AIx measured during CB and FS increased upon adjustment with PM10 for nearly all size fractions and time points.

Conclusion: There was an overall clear and independent effect of short-term exposures to UFPs from typical indoor sources on arterial stiffness. We observed distinct patterns of association of various particle size fractions, according to the exposure scenario.
Long term exposure to air pollution and coronary artery calcification in the SCAPIS cohort


1Department of Occupational and Environmental Medicine, Institute of Medicine, Sahlgrenska University Hospital & University Of Gothenburg, 2Swedish Meteorological and Hydrological Institute, 3Department of Clinical Neuroscience and Rehabilitation/Ophthalmology, Institute of Neuroscience and Physiology, Sahlgrenska Academy at the University of Gothenburg, 4Molecular and Clinical Medicine, Wallenberg Laboratory for Cardiovascular and Metabolic Research, Sahlgrenska University Hospital, University of Gothenburg, 5The Wallenberg Laboratory, Department of Molecular and Clinical Medicine, Institute of Medicine, Sahlgrenska Academy at the University of Gothenburg, 6Department of Radiology, Institute of Clinical Sciences, The Sahlgrenska Academy at University of Gothenburg; Department of Radiology, Sahlgrenska University Hospital

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background:
Air pollution is associated with incidence of cardiovascular morbidity and mortality. A main suggested mechanism is that air pollution accelerates the progression of atherosclerosis, and some studies have found associations with measures of atherosclerosis. For coronary artery atherosclerosis, relevant for myocardial infarctions, the few existing studies have found weak or null results though. We use the Swedish CArdioPulmonary bioImage Study (SCAPIS)-Gothenburg cohort to study associations between long-term air pollution and coronary artery calcium (CAC) score, a measure of calcified plaques.

Methods:
A cohort was recruited from the general population of Gothenburg during 2013-18 (n=6265, age 50-64) and thoroughly examined for cardiovascular risk factors, including computed tomography of the heart providing a CAC score. Participants were assigned yearly residential exposures to air pollution (source-specific PM10, PM2.5, NOx, BC, 1990-2015) from dispersion models. We used logistic regression to examine associations between long-term (15+ years) exposure to air pollutants and CAC (Agatston) score, adjusting for confounders and road traffic noise.

Results:
Median exposure to PM2.5 was low by international standards (mean 15-year exposure 8 µg/m3) and decreased during the study period. About 40% of participants had a positive CAC score, and there was a dose-dependent but non-significant increase in CAC at higher air pollution exposure, with 8% higher risk of high (>100) CAC score in the highest PM2.5 exposure quartile compared to the lowest. A positive CAC score was more common, and the association with PM2.5 stronger, in men. Road traffic noise did not affect the association.

Conclusions:
In this well-examined cohort we found a tendency of an association between long-term exposure to air pollution and coronary artery calcification, but not statistically significant. We aim to use the entire SCAPIS cohort (N=30000), recruited from 6 Swedish cities, to confirm or reject the hypothesis with greater power.
Long-term ambient air pollution exposure and measures of brachial arterial stiffness: results from COMPASS study.

Tasmin S, Ahsan H, Aschebrook-Kilfoy B

1The University Of Chicago

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

In this study, we aim to investigate the associations of long-term exposure to ambient air pollution with brachial artery markers of arterial stiffness using pulse waveform analysis in a recently established community-based U.S. cohort.

We assessed brachial artery measures [included brachial artery distensibility (BAD), brachial artery compliance (BAC), and brachial artery resistance (BAR)] using waveform analysis of the arterial pressure signals obtained from a standard cuff sphygmomanometer (DynaPulse2000A, San Diego, CA). The long-term exposures to particles with an aerodynamic diameter < 2.5µm (PM2.5) and nitrogen dioxides (NO2) for the 3-year periods prior to enrollment were estimated at residential addresses from validated spatio-temporal models. To adjust for potential clustering of the outcomes on a small-scale spatial level, linear mixed models adjusted for potential confounders were used to examine associations between air pollution exposures and brachial artery markers.

The current study included 2387 participants (mean age 55 ± 11, 52% women) enrolled between 2013-2016 with valid address information, PM2.5 or NO2 estimates, key covariates, and hemodynamics measurement. We observed long-term exposure to PM2.5 and NO2 were associated with decreased arterial stiffness measured as BAD and BAC. A 1-µg/m3 increment in preceding 3-year exposures to PM2.5 was associated with a 0.55 %mmHg lower BAD (95% CI: -0.804, -0.301; p < 0.001), and a 0.009 mL/mmHg lower BAC (95% CI: -0.013, -0.005, p < 0.001). A 1-ppb increase in preceding 3-year exposures to NO2 was associated with a 0.088 %mmHg lower BAD (95% CI: -0.144, -0.033; p = 0.002), and a 0.001 mL/mmHg lower BAC (95% CI: -0.002, -0.001, p = 0.001).

In conclusion, evidence from this study provides strong support that long-term exposure to ambient air pollution, specifically PM2·5 and NO2, are related to adverse arterial stiffness parameters.
Long-term Exposure to Air Pollution and Incidence of Stroke: A Danish Nurse Cohort Study

Andersen Z1,2, T. Jørgensen J1, Dehlendorff C3, Ketzel M4, Brandt J4, Hertel O4, Backalarz C5, Amini H1, V. Braüner E6, Loft S1

1University Of Copenhagen, 2Centre for Epidemiological Research, Nykøbing F Hospital, 3Danish Cancer Society Research Center, 4Department of Environmental Science, Aarhus University, 5DELTA Acoustics, 6Department of Growth and Reproduction, Rigshospitalet, University of Copenhagen

PDS 67: Outdoor air pollution cardiometabolic effects, Exhibition Hall (PDS), Ground floor, August 27, 2019, 4:30 PM - 5:30 PM

Background: Exposure to air pollution has been linked to stroke, yet few studies had data allowing examination of different exposure windows and disentangle effects via road traffic noise. We studied the association between long-term exposure to air pollution and road traffic noise and incidence of stroke, separately for ischemic and hemorrhagic stroke.

Methods: We used the Danish Nurse Cohort of 28,562 female nurses who at recruitment in 1993 or 1999 reported information on stroke risk factors. We obtained data on incident stroke from the Danish National Patient Register until the end of 2014. Annual mean concentrations of PM₂.₅ and NO₂ at the nurses’ residence since 1970 (1990 for PM₂.₅) were estimated using Danish THOR/AirGIS dispersion model, while road traffic noise levels since 1970 were estimated using Nord2000 model, as the annual mean of Lden. We used time-varying Cox regression models to examine the association between 1- and 3-year moving averages of PM₂.₅ and 1-, 3-, 10-, and 23-year moving averages of NO₂ and Lden with stroke incidence.

Results: Of the 28,562 women, 1,557 developed stroke during a mean follow-up of 18.3 year, of which 1,365 were ischemic and 192 hemorrhagic. We found statistically significant positive association between 1-year mean of PM₂.₅ preceding stroke diagnosis in a fully adjusted model (hazard ratio; 95% confidence interval: 1.14;1.08-1.22) per IQR of 3.9 µg/m³ and NO₂ (1.09;1.02-1.15) per 8.0 µg/m³ after adjusting for Lden. The associations were weaker with longer exposure windows and strongest for ischemic stroke (PM₂.₅: 1.17;1.09-1.25 & NO₂: 1.10;1.03-1.17), whereas the associations were neutral for hemorrhagic. We found no association between Lden and any stroke.

Conclusion: Long-term exposure to PM₂.₅ and NO₂ was associated with ischemic stroke, with more recent exposure, within a year before stroke onset being most relevant. Exposure to road traffic noise was not associated with stroke.
Background Newborn telomere length (TL) may be a biomarker of prenatal environmental exposures during fetal development. Shorter TL may predict future cardiorespiratory disease risk and longevity. We prospectively examined the effect of a prenatally-delivered cookstove intervention, and resulting maternal prenatal household air pollution (HAP) exposures, on cord blood mononuclear cell (CBMC) TL.

Methods The Ghana Randomized Air Pollution and Heath Study (GRAPHS) randomized non-smoking pregnant women to Liquefied Petroleum Gas (LPG), improved combustion-efficiency biomass stove (BioLite), or control (3-stone fire). 72-hour personal carbon monoxide (CO) were measured four times and particulate matter less than 2.5 microns in diameter (PM2.5) measured once over pregnancy. In N=144 mother-infant dyads, venous umbilical cord blood was collected at birth, mononuclear cells isolated, and DNA extracted. Duplex quantitative real-time polymerase chain reaction was used to measure the relative amplification of telomere repeat copy number to single gene copy number; samples were run in triplicate. We employed linear regression to determine associations between GRAPHS cookstove arm and exposures on plate pool-normalized CBMC TL, in the entire subset, while exploring interaction by child sex.

Results Median prenatal CO and PM2.5 exposures were 0.85ppm (IQR 0.52-1.43) and 56.70µg/m3 (IQR 38.35-83.35) respectively. Exposure-response analyses suggest increasing prenatal PM2.5 was associated with reductions in CBMC TL ($\beta$=-0.01, SE=0.01, p=0.04, per 1 µg/m3 increase in PM2.5); no association with prenatal CO was seen ($\beta$=-0.05, SE=0.08, p=0.51). Infants of mothers randomized to the LPG cookstove had increased CBMC TL, compared to 3-stone fire ($\beta$=0.83 SE=0.33, p=0.01). Girls were most affected (Girls $\beta$=1.65 SE=0.54, p=0.003; Boys $\beta$=-0.09 SE=0.36, p=0.81).

Conclusion These findings suggest that increased prenatal HAP exposure decreased TL at birth. Conversely, a clean-fuel cookstove intervention reversed this effect; girls were particularly affected. Our findings support the hypothesis that prenatal environmental exposures alter TL setpoint at birth, with potential implications for lifelong health.
Placental methylation signatures from maternal smoking during pregnancy and potential impacts on fetal growth: meta-analyses from 7 cohorts

Everson T1, Vives-Usano M2,3,4, Craig J5,6,7, Hivert M8,9, Karagas M10, Lacasaña M4,11,12, Lepeule J13, Marsit C1,14, Bustamante M2,3,4,15

1Department of Environmental Health at Rollins School of Public Health at Emory University, 2Center for Genomic Regulation at Barcelona Institute of Science and Technology, 3Universitat Pompeu Fabra, 4CIBER Epidemiologia y Salud Pública, 5Molecular Epidemiology at Murdoch Children’s Research Institute, 6Department of Paediatrics at University of Melbourne, 7Centre for Molecular and Medical Research at Deakin University, 8Department of Population Medicine at Harvard Medical School, 9Diabetes Unit at Massachusetts General Hospital, 10Department of Epidemiology at Geisel School of Medicine at Dartmouth College, 11Andalusian School of Public Health, 12Instituto de Investigacion Biosanitaria, 13University Grenoble Alpes, 14Department of Epidemiology at Rollins School of Public Health at Emory University, 15Barcelona Institute for Global Health

Background/Aim: Maternal smoking during pregnancy (MSDP) causes adverse birth outcomes, is a major public health issue, and prior studies have observed a strong signature of prenatal tobacco exposure on the newborn methylome in cord blood. However, the placental methylome has not been as thoroughly studied, despite the placenta serving numerous critical functions related to fetal growth and development. We aimed to study the relationships between maternal smoking during pregnancy, placental DNA methylation, and birth outcomes within the Pregnancy and Childhood Epigenetics (PACE) Consortium.

Methods: DNA methylation was measured at ~450,000 cytosine-phosphate-guanine (CpG) sites in placental tissues via the Illumina 450K array. We performed meta-analyses, first to estimate the associations between MSDP and placental DNA methylation (7 studies, N=1700, 344 exposed to any MSDP and 163 exposed to MSDP throughout the pregnancy), then to estimate the relationships between DNAm with birth weight and gestational age. We performed pathway enrichment analyses via ConsensusPathDB to gain insights into the placental processes that may be perturbed by tobacco smoke exposure.

Results: We identified 1224 CpGs that were associated with MSDP (Bonferroni-adjusted), of which 298 were associated with gestational age and 43 associated birth weight (Bonferroni-adjusted); 141 were associated with gene expression in placental tissue (5%FDR). The most notable association was observed at cg27402634 which produced the strongest magnitude of association and smallest p-value (methylation difference = -22.95%, p-value = 5.35E-119, any versus no MSDP). Overall, the genes annotated to the MSDP-associated CpGs were enriched for processes and pathways that could plausibly be involved in the mechanisms of toxicity from prenatal tobacco smoke exposure, including growth-factor signaling, hormone activity, inflammatory cytokines and vascularization.

Conclusions: We observed numerous relationships between the placental methylome, MSDP and birth outcomes. These may better inform the mechanisms through which MSDP impacts placental function and fetal growth.
Background: Latent class analysis (LCA), although minimally applied to the statistical analysis of mixtures, may serve as a useful tool for identifying individuals with shared real-life profiles of chemical exposures.

Methods: We applied LCA to identify classes of pregnant women within the LIFECODES birth cohort (N=460) with shared exposure patterns across a panel of urinary phthalate metabolites and phenols, and evaluated the association between class membership and urinary oxidative stress biomarkers. We examined the reproducibility of these classes using data from the National Health and Nutrition Survey (NHANES). Finally, we compared this classification approach to the more commonly implemented k-means clustering. Results: LCA identified four classes of individuals with: “low exposure,” “low phthalates, high parabens,” “high phthalates, low parabens,” and “high exposure.” Class membership was associated with several demographic characteristics. Women classified as having “high exposure” had elevated urinary concentrations of the oxidative stress biomarkers 8-hydroxydeoxyguanosine (19% higher, 95% confidence interval [CI]=7%, 32%) and 8-isoprostane (25% higher, 95% CI=0%, 57%) relative to women who were in the “low exposure” class. However, associations between oxidative stress biomarkers and “high exposure” were not statistically different from those with “high phthalates, low parabens,” suggesting a minimal effect of higher paraben exposure. We demonstrated reproducibility of the latent classes within the NHANES population. Compared to LCA, k-means clustering identified fewer, less meaningful clusters. When the number of clusters was forced to four as identified by LCA, the results were similar but somewhat less interpretable. Conclusion: LCA is an easily implemented and interpretable approach to examining the joint effect of exposure to multiple chemicals, and may provide a more informative and interpretable output compared to k-means clustering. Furthermore, more meaningful public health interventions for preventing exposure may be facilitated by identifying demographic and behavioral characteristics of individuals in high risk groups.
The domains, methods, and tools used in human exposome studies: a systematic review

Haddad N1, Andrianou X1, Makris K1

1 Water And Health Laboratory, Cyprus International Institute For Environmental And Public Health, CUT-Limassol, Cyprus

PDS 71: Exposome, Johan Friso Foyer, Floor 1, August 27, 2019, 4:30 PM - 5:30 PM

Background: The “human exposome” emerges as a new concept in health sciences, comprising the totality of environmental exposures from conception and throughout lifespan. Dynamic by nature, the exposome has been divided into three domains: general external, specific external and internal. Numerous assessment methods, tools and study designs have been used to date, to explore specific exposome domain(s), in various populations at critical life stages. However, a commonly understood exposome language, methods and tools need to be set that will pave the way for the future of exposome research and its utility.

Objective: A systematic review was conducted to answer the question: “Which domains of the human exposome have been included in the literature and what tools of exposure/disease metrics and data discovery/validation techniques have been used?”

Methods: A comprehensive search of articles published up to February 2019 was conducted. Original, peer-reviewed articles focused on human studies that contained the word exposom* in text were included. A protocol was developed based on Cochrane guidelines and registered in PROSPERO, evaluating the potential risk of bias, rating the quality and strength of the body of evidence for each included study, using the Effective Public Health Practice Project Tool.

Results: A total of 1033 references were screened and 84 human exposome studies were identified that met our inclusion criteria. Initial screening showcased the non-consistent use of the human exposome definition and its tools. Various study designs were presented, ranging from case-studies to prospective cohorts, from secondary data analysis to primary data collection using targeted and/or untargeted biomarker measurements with -omics platforms, occasionally relying upon environment-wide association study (EWAS) tools. The final results of rating the quality of the evidence, including the most/least frequently encountered exposome study characteristics will be laid out.
Recent and chronic residential air pollution exposure and buccal telomere length in children

Hautekiet P1,2, Saenen N2, Bijnens E2, Nawrot T1,3

1Sciensano, 2Centre for Environmental Sciences, Hasselt University, 3Centre for Environment and Health, Leuven University

PDS 71: Exposome, Johan Friso Foyer, Floor 1, August 27, 2019, 4:30 PM - 5:30 PM

Background/Aim: Telomere length is known as a biomarker of aging and might entail a possible molecular pathway by which air pollution may affect human health. In this study we evaluated the association between residential air pollution exposure, greenness and distance to the nearest major road and telomere length.

Methods: Of the 199 children (9-12 years), 91 (46%) had buccal swaps collected at one time point while 72 (36%) and 35 (18%) had respectively two and three buccal swaps collected on different time points within three months. At the child’s residence, recent (week before each examination) and chronic (month and year before each examination) exposure to nitrogen dioxide (NO2), particles ≤ 2.5 µm (PM2.5) and ≤ 10 µm (PM10) and black carbon (BC) was modeled using high resolution spatial interpolation models. The distance to major road and greenness for a 1000m buffer was calculated using ArcGIS software. Mixed effect models were used for statistical analyses while adjusting for gender, age, BMI, passive smoking, season at examination and parental socio-economic status.

Results: Both recent and chronic residential PM2.5 exposure were associated with shorter buccal telomere length. An interquartile range increment in residential PM2.5 was associated with a 6.0% (95% CI: -9.7;-2.2%) and 15.4% (95% CI: -22.9;-7.0%) shorter buccal telomere length for respectively the exposure on the week and year before examination. Comparable results were found for PM10, BC and NO2. In contrast, no significant results were found for residential greenness or distance to the nearest major road.

Conclusion: In a study with repeated measures, we found an inverse association between child buccal telomere length and both recent and chronic air pollution exposure, independent of exposure to residential greenness or distance to the nearest major road. These data add to the literature on air pollution-induced effects of biological ageing from early life onwards.
The association of urinary phosphorous-containing flame retardant metabolites and oxidative stress among pregnant women in Puerto Rico

Ingle M1, Watkins D1, Rosario Z2, Vélez-Vega C3, Huerta-Montanez G3, Calafat A4, Ospina M4, Cordero J5, Alshawabkeh A3, Meeker J1

1University of Michigan, 2University of Puerto Rico, 3Northeastern University, 4Centers for Disease Control and Prevention, 5University of Georgia

Background: Phosphorous-containing flame retardants (PFRs) are frequently used as flame retardants and plasticizers. Previous research has suggested oxidative stress, the imbalance of reactive oxygen species and antioxidants, is a possible mechanism for pollutant-induced health effects. Oxidative stress measured prenatally has been associated with adverse birth outcomes including preeclampsia and preterm birth. To our knowledge, only one human study has explored associations between PFRs and oxidative stress.

Methods: Pregnant women 18-40 yrs. were recruited from two hospitals and five prenatal clinics in Northern Puerto Rico (n=47) between 2011 and 2015. Concentrations of: bis(2-chloroethyl) phosphate (BCEtP), bis(1-chloro-2-propyl) phosphate (BCPP), bis(1,3-dichloro-2-propyl) phosphate (BDCPP), and diphenyl phosphate (DPHP) were measured in urine up to two times during pregnancy. Biomarkers for oxidative stress, 8-hydroxydeoxyguanosine (8-OHdG) and 8-isoprostane, were also measured in urine up to two times during pregnancy. Associations between oxidative stress biomarkers and PFRs were assessed using linear mixed models adjusted for specific gravity, age, BMI, income, and season.

Results: PFR metabolites were frequently detected (≥77%). All metabolites were associated with a statistically significant increase in 8-OHdG and 8-isoprostane levels (p<0.05). BDCPP was associated with the highest increase of 8-OHdG (β=0.29; p<0.0001) while BCEtP and BCPP had the lowest increase (β=0.15; p<0.01). Similarly, BCEtP was associated with the lowest increase of 8-isoprostane levels (β=0.13; p=0.04), while BCPP was associated with the largest increase (β=0.30; p<0.0001).

Conclusion: PFR metabolites were frequently detected and although our sample size was modest, our results suggest that exposure to PFRs is associated with higher levels of oxidative stress. Further investigation into these relationships and birth outcomes is warranted.
Linking mitochondrial and telomere damage in foetal tissue: TP53 and PPARGC1α as a central hub?

Janssen B1, Martens D1, Penders J2, Lefebvre W3, Vanpoucke C4, Vrijens K1, Nawrot T1

1Hasselt University, 2Hospital East-Limburg, 3Flemish Institute for Technological Research (VITO), 4Belgian Interregional Environment Agency (IRCELNIE)

PDS 71: Exposome, Johan Friso Foyer, Floor 1, August 27, 2019, 4:30 PM - 5:30 PM

Background

Observations from experimental studies have put forth a “core axis of ageing” involving telomeres, mitochondria, TP53, and peroxisome proliferator-activated receptor gamma coactivator 1 alpha (PPARGC1A). In this study, we hypothesized that these hallmarks of ageing in placental tissue are interconnected and influenced by early-life ambient air pollution exposure during pregnancy.

Methods

In 680 newborns of the ongoing ENVIRONAGE birth cohort, we measured protein levels of TP53 and PPARGC1A in cord plasma and telomere length and mitochondrial DNA (mtDNA) content in placental tissue. Daily ambient particulate matter with a diameter less than 2.5 μm (PM2.5) was calculated for each participant’s home address using a spatial-temporal interpolation model in combination with a dispersion model. The associations between prenatal PM2.5 exposure and specific hallmarks of ageing were analysed with linear regression models, while accounting for covariates and potential confounders.

Results

PM2.5 exposure averaged (SD) 13.5 μg/m3 (2.5) over the entire pregnancy period. A 5-μg/m3 increment in PM2.5 exposure during the 3rd trimester was associated with 13.2% (95%CI, −19.3% to −6.7%) shorter placental telomere length, 11.2% (95% CI: -4.1 to -17.7) lower placental mtDNA content, and 7.4% (95% CI: 2.1 to 13.0%) higher TP53 protein levels. Telomere length and mtDNA content were linked [a 10% shorter telomere length was associated with a 4.8% (95% CI: 3.6 to 6.1%) lower mtDNA content], and we observed a negative trend between TP53 protein levels and telomere length (p=0.08). PPARGC1A protein levels were not associated with mtDNA content.

Conclusions

Prenatal air pollution is associated between candidate hallmarks of ageing (telomeres, mitochondria, TP53) in placental tissue. This is the first observational study demonstrating some degree of interconnectedness between master regulators of the molecular circuit linking PM-induced telomere damage and compromised mitochondrial biogenesis.
The urban exposome framework and a proof-of-concept study

Andrianou X1, Charisiadis P1, Makris K1

1Water and Health Lab, Cyprus International Institute for Environmental and Public Health, Cyprus University of Technology

PDS 71: Exposome, Johan Friso Foyer, Floor 1, August 27, 2019, 4:30 PM - 5:30 PM

Cities face rapid changes including increasing inequalities and public health issues. Therefore, urban centers should become more resilient, monitor and address all emerging issues with cost-effectively. Using the city and inter-city areas as measurement units, the urban exposome can be defined as the continuous spatiotemporal monitoring of environmental and health indicators with an interdisciplinary approach that combines qualitative and quantitative methods. The urban exposome framework was applied in a proof-of-concept study in Limassol, Cyprus combining: a mixed-methods study on stakeholders’ perceptions, a systematic assessment of secondary data from the cancer, birth and death registries, and a population health and biomonitoring survey. Data collection was conducted in summer 2017. The first results on drinking water and quality of life were described and combined with an agnostic environment-wide association analysis (EWAS). Water quality parameters and participants’ opinions on city life (i.e. neighborhood life, health care and green space access) were mapped using small administrative areas as the reference unit. In the exploratory EWAS analysis, all variables were used (questionnaire responses and water quality metrics) to describe correlations. Overall, urban drinking-water quality using chemical (disinfection byproducts-trihalomethanes) and microbial (coliforms, E. coli, and Enterococci) quality indicators did not raise concerns. General health and having a chronic disease were significantly (FDR-corrected p-value<0.1) associated with different health conditions e.g. hypertension and asthma, as well as having financial issues in access to dental care. Additionally, correlations between water trihalomethanes and participant behaviors (e.g. household cleaning, drinking water habits) were documented. This proof-of-concept study showed the potential of using integrative approaches to develop urban exposome profiles to prospectively identifying within-city differences in environmental and health indicators. The continuous monitoring of the urban exposome will allow stakeholders to timely identify and develop targeted to the city interventions to tackle urban health challenges.
Identifying novel metal biomarkers and biochemical networks in the Strong Heart Family Study: An integrative metallome-metabolomic analysis

Sanchez T1, Hu X1, Tran V2, Zhao J3, Go Y2, Cole S4, Umans J5, Jones D2, Navas-Acien A1, Uppal K2

1Columbia University, 2Emory University, 3University of Florida, 4Texas Biomedical Research Institute, 5MedStar Health Research Institute

PDS 71: Exposome, Johan Friso Foyer, Floor 1, August 27, 2019, 4:30 PM - 5:30 PM

Background: Chronic exposure to certain toxic metals plays a role in disease development. Integrating untargeted metabolomics with urinary metallome data may contribute to better understanding the pathophysiology of diseases and complex molecular interactions related to environmental metal exposures. Using a previously measured panel of urinary metals and untargeted metabolomics data available in the Strong Heart Family Study (SHFS), we conducted an integrative metallome-metabolome analysis to discover novel associations between urinary metal biomarkers and metabolism networks.

Methods: The SHFS is a prospective family-based cohort study comprised of American Indian men and women recruited in 2001-2003. In this cross-sectional analysis, we included participants without baseline diabetes and with available metabolomic and urinary metal data (n=145). Concentrations of creatinine-adjusted urine metals/metalloids (antimony [Sb], cadmium [Cd], lead [Pb], molybdenum [Mo], selenium [Se], tungsten [W], uranium [U] and zinc [Zn]), and arsenic species (iAs, MMA, DMA, AsB) were measured. Global metabolomics was performed on plasma samples using high-resolution Orbitrap mass spectrometry. We performed an integrative network analysis using the R package xMWAS and used the R package Mummichog for the metabolic pathway analysis.

Results: In our integrative network analysis, most metal species were associated with distinct subsets of metabolites, forming single-metal-multiple-metabolite clusters (correlation efficiency: |p|>0.3). DMA (clustering with W), iAs (clustering with U), together with Mo and Se showed modest interactions through associations with common metabolites. Pathway enrichment analysis of associated metabolites (|p|>0.17, P< 0.05) showed effects in amino acid metabolism (AsB, Sb, Se and U), fatty acid and lipid metabolism (iAs, Mo, W, Sb, Pb, Cd and Zn) and redox metabolism (Cd and Se).

Conclusion: This first proof-of-concept study shows the importance of metal-metabolite interactions. Understanding the biochemical networks underlying metabolic homeostasis and their association with exposure to metals may help identify novel biomarkers and pathways of disease and potential signatures of metal exposure.
Background/Aim: Type 1 Diabetes (T1D) is an autoimmune disease affecting ~400,000 people across the UK. Environmental factors likely trigger the disease process in genetically susceptible individuals. We assessed the associations between a wide range of environmental factors and childhood T1D incidence in England, using an agnostic, ecological Environment Wide Association Study (EWAS) approach, to generate hypotheses about environmental triggers.

Methods: We undertook analyses at the Local Authority District (LAD) level using a national Hospital Episode Statistics (HES) based incident T1D dataset, comprising 13,948 cases aged 0-9 years over the period April 2000- March 2011. We compiled LAD-level estimates for a range of potential demographic and environmental risk factors including meteorological, land use and environmental pollution variables. The associations between T1D incidence and risk factors were assessed via Poisson regression, disease mapping and ecological regression.

Results: Case counts by LAD varied from 1 to 236 (median 33; inter quartile range: 24-46). Overall T1D incidence was 21.2 (95% CI 20.9-21.6) per 100,000 individuals. The EWAS and disease mapping indicated that 15 out of 53 demographic and environmental risk factors were significantly associated with diabetes incidence after adjusting for multiple testing. These included air pollutants (particulate matter, nitrogen dioxide, nitrogen oxides, carbon monoxide), as well as lead in soil, radon, outdoor light at night, overcrowding, population density and ethnicity. Disease mapping revealed spatial heterogeneity in T1D risk. The ecological regression found a significant association between T1D and the living environment domain of the Index of Multiple Deprivation (RR 0.995 (95%CI 0.991-0.998)) and radon potential class (RR 1.044 95%CI 1.015-1.074).

Conclusions: Our analysis identifies a range of demographic and environmental factors associated with T1D in children in England.
Prenatal exposures to mixtures of endocrine disrupting chemicals and children’s growth up to six years of age in the SELMA study

Svensson K
Karlstad University

Background: Great variations in growth rate occur during pregnancy and childhood and each child follows an individual growth trajectory. However, it is not well-known how prenatal exposures to endocrine disrupting chemicals (EDCs), and especially their concurrent and combined mixture effect may impact children’s pre- and postnatal growth. Therefore, the aim of this study was to evaluate the effect of EDCs mixtures on birth weight and growth trajectories.

Methods: We used data from 429 mother-child pairs participating in the Swedish Environmental Longitudinal Mother and child Asthma and allergy (SELMA) study with data on 41 EDCs, measured in urine/serum in median week 10 of pregnancy, and growth measures. Children’s weight trajectories from birth to 5.5 years of age were individually modeled using double logistic regression to estimate growth indicators; infant peak weight velocity (PWV) and age at infant PWV. The EDCs mixtures effect was modeled with birthweight and each growth indicator using a weighted quantile sum (WQS) regression model.

Results: We found that increase of one decile in the WQS index of the EDC mixture was significantly associated with 91.07 (SD: 20.94) grams decrease in birth weight, and 0.27 (SD: 0.10) months later PWV. This adjusted for maternal smoke exposure, weight, age, education, parity, fish consumption and urinary creatinine as well as child’s sex and gestational age at birth. PCB-74, PBA, and MBzP, 2OH-PH, MEP, PFOA and MEHP were identified as bad actors for decrease in birth weight accounting for 70% of the WQS index. BPA, Triclosan, MCiNP, MEP, MEHP, MBP, PCB180 and BPS were identified as bad actors for postnatal growth accounting for 70% of the WQS index.

Conclusion: Prenatal exposure to mixtures of chemicals may affect children’s pre- and postnatal growth.
Maternal Serum Metabolome and Ambient Air Pollution Exposure in Pregnancy
Yan Q¹
¹UCLA Fielding School of Public Health

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Background: Maternal exposure to ambient air pollution during pregnancy has been shown to increase the risk of adverse birth outcomes and neurodevelopmental disorders. By utilizing high-resolution metabolomics (HRM), we investigated perturbations of the maternal serum metabolome in response to ambient air pollution to identify biological mechanisms.

Methods: We retrieved stored mid-pregnancy serum samples from 160 mothers who lived in the Central Valley of California known for high air particulate levels. We estimated prenatal ambient air pollution exposure using the California Line Source Dispersion Model, version 4 (CALINE4) based on residential addresses recorded at birth. We used liquid chromatography-high resolution mass spectrometry to obtain untargeted metabolic profiles and partial least squares discriminant analysis (PLS-DA) to select metabolic features associated with air pollution exposure. Pathway analyses were employed to identify biologic pathways related to air pollution exposure.

Results: In total we extracted 4,038 and 4,957 metabolic features from maternal serum samples in hydrophilic interaction (HILIC) chromatography (positive ion mode) and C18 (negative ion mode) columns, respectively. Controlling for confounding factors, 181 and 251 discriminatory metabolic features (HILIC and C18, respectively) were selected (Variable Importance in Projection (VIP) >= 2). Pathway enrichment analysis for discriminatory features associated with air pollution indicated that in maternal serum oxidative stress and inflammation related pathways were altered, including linoleate, leukotriene, and prostaglandin pathways.

Conclusion: The metabolomic features and pathways we found to be associated with air pollution exposure suggest that maternal exposure during pregnancy induces oxidative stress and inflammation pathways previously implicated in pregnancy complications and adverse outcomes.