



# **Changing Environment and Healthy Generations**

How to secure human health in the dramatic changing environments

# Abstract Book (1/2): Symposium and Oral Presentations



Application of IoT on indoor air quality monitoring

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## Introduction

Environmental health scientist often requires data collection of environmental conditions and human activity. Semi-automatic data collection system based on IoT can improve environmental health through exchange of information between population and government(or researcher).

## Methods

Data collection system with multiple sensors (AirGuard K) were deployed in various indoor locations. The sensors included temperature, relative humidity, carbon dioxide, PM, and noise. The data were transmitted via wi-fi and LTE. PM sensor of AirGuard K was evaluated by collocation of microPEM (TSI). Airguard K was placed in day care center, kindergarten and elementary school for one year.

# Results

The two measurements showed linear relationship. Measurement less than 50  $\mu$ g/m<sup>3</sup> were less accurate. PM measurement by AirGuard K underestimated in the range of 50 – 500  $\mu$ g/m<sup>3</sup>. The indoor air quality data for day care center, kindergarten and elementary school were continuously collected by the monitor. Data collection percentage was over 95%. Although active intervention could improve indoor air quality, better interactive intervention strategy should be developed.

# Conclusions

Prediction model for indoor air quality could be applied for short term prediction. Using new technologies, better data utilization system can be applied to environmental health service.

## Smart air quality monitoring in subway system

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PM is a major pollutant in subway stations that is known to be generated from various factors such as subway train operation, passenger movement, and the inflow of outside air through the ventilation system. Epidemiological studies show that exposure to PM is highly hazardous to the body, since it raises the sensible pollution level and along with it is the possible occurrence of disease and death rates. As PM concentrations measured in subways are generally higher and more toxic than those in the air, they play a major role in deteriorating subway air quality and as such require proper control. We set up air quality monitoring system for  $PM_{10}$ ,  $PM_{2.5}$ ,  $CO_2$ , temperature and humidity in subway systems using IoT technology. Then, to investigate correlation and dependence between the Subway system properties and the PM size and concentration, principal component analysis (PCA) that extracts essential information from multivariate data by reducing data dimension is used. PCA result shows that the tunnel PM concentrations have a strong correlation with those at the platform connecting to tunnel entrance (namely, preplatform). It infers a piston effect which pushes the PM-containing air from the platform to tunnel would be a major variable affecting the tunnel PM concentrations.

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# 0622\_S1-3

## Integrated Method of Combining Fixed and Mobile Stations for Air Pollution Tracking and Reduction Assessment

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## Background/Aim

VOCs from petrochemical facilities contribute to the formation of photochemical oxidants, which are typically monitored at photochemical assessment monitoring stations (PAMS). Some VOCs are classified as Air Toxics (also known as Hazardous Air Pollutants [HAPs]), but are not included in PAMS target VOCs. Toxic VOCs are typically measured by offline canister sampling in accordance with laboratory toxic organic (TO) methods. However, the deficient temporal resolution of the offline method makes it difficult to capture a full picture of the emission status. The shortfall is especially obvious when assessing impacts from random, intermittent emission sources, such as fugitive emissions, equipment leaks, and emissions from malfunctioning processes by petrochemical facilities.

## Methods

An integrated method that combines continuous air pollution monitoring at fixed and mobile stations is proposed for tracking the toxic VOC sources and reduction assessment after the emission correction. Figure 1 shows the procedure of this field study with four workflow stages. In Stage I, two sensitive receptors (schools) near the petrochemical industrial park were selected as locations for the fixed monitoring stations throughout the study. A continuous onsite speciated VOC monitoring system was installed at each fixed station for long-term air toxic exposure assessment. After acquiring the monitoring results, the concentrations of each speciated VOC was analyzed to determine the likely sources of emissions with the aid of meteorological data and the material inventory of each plant. With the likely sources identified, the mobile monitoring technique was utilized to track and verify the emission source during Stage II. The mobile station was equipped with the same speciated VOC analyzer as the fixed stations. With the assistance of the onsite real-time meteorological data, the mobile monitoringstation was moved to the downwind sites of the likely sources for continuous monitoring. The emission source could then be readily verified based on the mobile monitoring results of specific VOC concentrations and meteorological data near the likely source. With the assistance of the business, the mobile station could be placed inside the facility to further narrow down the source equipment or process. In Stage III, both the fixed station and mobile monitoring results were provided to the business operator of the source to develop a reduction plan. The proposed improvement or correction plan from operator was then reviewed, approved and implemented for toxic VOC reductions. At the final Stage IV, the implementation and effectiveness of the corrective process on VOC reduction was evaluated and maintained by continuous long-term monitoring at the same fixed stations where high air toxic concentrations were previously observed from the facility before corrective measures were implemented.

Fixed Station Monitoring	Mobile Station Monitoring		Fixed Station Monitoring
Stage I.	Stage II.	Stage III.	Stage IV.
Identify major pollutants and	Confirm the emission	Propose improvement plan	Assess the emission
emission sources	sources	for emission reduction	reduction results

Figure 1. Integrated method of combining fixed and mobile stations for air pollution tracking and reduction assessment

### Results

After the implementation of improvements, the average monthly concentrations of benzene dropped by one half while that of butadiene and vinyl chloride exhibited 1.5-fold decrease in concentrations. Overall, the results reveal that the emissions of major HAPs from the industrial park have substantially reduced and, as a result, the impact toward the sensitive receptors is decreased significantly.

#### Conclusions

The systematic approach has demonstrated that one can precisely track the emission source with greater temporal and spatial resolutions using the portable analyzers in comparison with commonly adopted offline methods.

## Field Study on Online Monitoring Network of Air Toxics and Tracking near a Petrochemical Industrial Park

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### Background/Aim

Air quality issues to public health have been attracting concerns globally. Air Toxics with various compounds are still measured by offline canister sampling in accordance with laboratory toxic organic (TO) methods, since diversified local specific sources make online monitoring challenging. Recently, an on-site continuous VOC monitoring network along fencelines of a mega steel manufacturing plant was successfully demonstrated to be a feasible solution enabling effective pollution source identification, earlier leakage detection, evaluation of VOC reduction control, and precise exposure assessment.

## Methods

## Site Selection and System Setup for Monitoring Network

The Renda Petrochemical Industrial Park (RPIP) in southern Taiwan consists of over thirty industrial plants and four waste water treatment facilities. Four sampling sites were selected to monitor ambient VOCs using a continuous online air toxics monitoring network. Each site represents its unique geographic location in corresponding to the Industrial Park. Each monitoring site was equipped with an anemometer on the roof of the building and a stand-alone chassis with the online toxic VOCs monitoring system on the ground. The online toxic VOCs chassis system consists of an automatic gas chromatography (Auto-GC) analyzer MiTAP P310 (Tricorntech Corp., Taipei, Taiwan) capable of continuously measuring fourteen specific VOCs related to industrial and traffic emissions.

## Results

In this study, a total of 14,765 data sets were collected from the monitoring network (Dec. 1, 2016 ~ Feb. 28, 2017). Figure shows the three-month average concentrations of targeted VOCs measured from four sites respectively. The average concentrations for most VOCs are below 2 ppbv, which is comparable to weekly off-line GC-MS measurements with canister samplings. Slightly higher concentrations of industrial specific VOCs were observed at Sites A and B near the industrial park compared to Site C (reference area). However, since random or unexpected VOC emissions may occur only within a day or several hours from a nearby industrial sources, the average concentration measure tends to mask the importance of actual VOC excursion events.



## Conclusions

An online continuous toxic VOC monitoring network over a large region of mixed industrial and residential areas is demonstrated to be effective in providing comprehensive status for emission patterns, source tracking, excursion types, general background concentration, and transportation. With objective selections of site locations and VOC species, the monitoring network provides solutions, enabling effective assessments of human exposure to air toxic pollution as well as air toxic impacts on the environment.

# CLIMATE CHANGE AND AIR POLLUTION: HEALTH IMPACTS AND CHALLENGES IN INDONESIA

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# ABSTRACT

Climate change in Indonesia greatly affects economy, poor population, human health, and the environment. It influences air pollutant emissions as higher emissions of carbon dioxide (CO<sub>2</sub>) have caused rapidly worsening air pollution. Urban areas being most affected by air pollution. The transportation sector contributes the most (80%) to the air pollution followed by emissions from industry, forest fires and domestic activities. The large number of vehicles together with lack of infrastructure results in major traffic congestions resulting in high levels of air polluting substances, which have a significant negative effect on public health. Current air pollution problems are greatest in Indonesia as it caused 50 % of morbidity across the country. Diseases stemming from vehicular emissions and air pollution include acute respiratory infection, bronchial asthma, bronchitis, and eye, skin irritations, lung cancer and cardiovascular diseases. The prevalence and incidence rate of diseases related to air pollution is predicted become worse in the near future since the range growth of energy consumption is about 6-8 percent per year. It is impacted to the increasing of NOx up to 51% (from 814 kilotons per year in 2015 to 1225 kt/yr in 2030), PM<sub>2.5</sub> up to 26% (from 87.7 kilotons per year in 2015 to 110.5 kt/yr in 2030) as well as other pollutants such as SO<sub>2</sub>, PM<sub>10</sub>, VOC, and O<sub>3</sub>. Most recently, some studies on developing scenarios for reducing emission have been conducting. These include analysis of fuel economy and the time effective for Euro IV standard implementation as compliment to transportation improvement policy in Indonesia, in which it suggested Government of Indonesia must enhance energy security and mitigate  $CO_2$  emissions, improve efficiency in energy production and use, increase reliance on non-fossil fuels, and sustain the domestic supply of oil and gas through decreased fossil fuel consumption, support the use of proposed breakthrough technologies, and protect human health from air pollution by conducting more research on health vulnerability and implementing more effective adaptation of human health.

Keywords: climate change, air pollution, health impacts, reduction emission scenarios

# Air pollution, haze and health risk: Current and future research agenda for Malaysia

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Air pollution in Malaysia is becoming important issues and unique in nature where seasonal, episodic and transboundary has been observed in many years. Recurring episodes of forest fires haze is an issue of great concern afflicting Southeast Asia, including Malaysia. Systematic reviews of forest fires have consistently demonstrated adverse respiratory effects. Our research groups are exploring the associations of air pollution and smoke haze on respiratory and cardiovascular diseases in Malaysia for past 20 years. We applied time series, case cross-over studies to estimates these risks during haze and non-haze episodes and evaluate the physicochemical and toxicological characteristics of particulates. Our time series study in Klang Valley reported significant forward displacement of all-cause mortality from exposure to PM10 and ozone. In the case crossover study, we found, haze events at lagged 2 showed significant association with children less than 14 years old (OR=1.41; 95% CI=1.01-1.99). Respiratory mortality was significantly associated with haze events for all ages at lagged 0 (OR=1.19; 95% CI=1.02- 1.40). Our study in 2013-2014 for Klang Valley, using PMF 5.0 identified motor vehicle emissions and biomass burning were the dominant sources of air pollution. The BaP equivalency results showed haze smoke particles have four times higher health risks than street level particles and namely to the infant group. Haze also affected the Malaysian economy due to the costs associated with illness, productivity loss, declines in tourist arrivals, flight cancellations, decline in fish landings, cost of fire-fighting, cloud seeding, and expenditure on masks. The average annual economic loss due to the inpatient impact from haze was estimated at MYR273,000 (\$91,000 USD). Our future studies include burden of disease and evaluation of the indoor school environment during haze episodes. Prevention and measures should be the priority in future research endeavours to minimize the air pollution especially in urban areas and to reduce smoke fires and open burning.

# Public Utility Vehicle Modernization program in the Philippines: a health impact assessment study

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## Background/Aim

In the Philippines, a roadmap of public utility vehicle modernization (PUVM) program took into effect in 2017, which intends to upgrade cars which are more than 15 years old into fuel efficient versions; i.e. electric vehicles and Euro IV-compliant vehicles. The intended plan has various implications which may even manifest towards impacts related to health. This study intends to determine the associated economic valuation of the implementation of PUVM on air pollution-related health impacts.

## Methods

In this study, we utilized published literature and assumed two scenarios: 1) status quo (current scenario) and 2) Euro 4 scenario. Pilot scenario was assumed to take place in the national capital region, specific assumptions for discount rate at 3%, average life expectancy at 34 years were utilized to calculate for monetized health impact metrics in the form of value of statistical life (VSL) and value of statistical life year loss (VSLY). Sensitivity analyses were carried out with varying income elasticity.

## Results

Results showed that by enforcing the Euro IV scenario would mean lower number of attributable mortality (AN= 3854) compared to status quo (AN = 17146). Similarly, economic gain due to the averted mortality monetized through VSL was estimated to be at 2.92 billion USD, which is approximately 1.46% of the country's GDP (in 2010). Further results indicate that the value to avert air pollution-related risk in status quo is five times higher than in Euro IV.

#### Conclusions

Overall, we found that the implementation of the PUVM, particularly for the enforcement of the Euro IV, indicated both the non-monetary and monetary air pollution-related co-benefits in health. Though the results provide an overall gain, with a multitude of socio-political and demographic dimensions which can affect the implementation process and the eventual valuation of the risks not taken into account in the study, a further investigation is warranted.

## Air pollution and Health in Vietnam: research updates and challenges

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## **Background/Aim**

Vietnam is in top 10 for worst air pollution all over the world (the Environmental Performance Index 2016), particularly in major cities like Ha Noi and Ho Chi Minh. This study aims to advance understanding of challenges, research updates in this field in Vietnam.

## Methods

We performed a mini review updating research so far on the health impact of air pollution in Vietnam. The challenges then were discussed. We also introduced three on-going works of our group that aim to address the challenges in this field.

## Results

The evidence on the impact of air pollution on health is relatively sparse in Viet Nam. Most studies have been conducted in megacities, i.e. Ha Noi and Ho Chi Minh; they are designed as ecological time series to investigate the short-term effect of air pollution on hospitalization. Two studies investigated the effect of air pollution on human health in Ho Chi Minh are out-of-date with data collection from 2003 to 2007. Other major challenges including the lack of automatic air monitoring stations across Vietnam, and the paucity of intervention studies. We are conducting researches aim to fill these gaps. In the first study, we examined the effects of short-term exposure to PM2.5 on hospital admissions of young children for acute lower respiratory infections in Ho Chi Minh City with the updated data from 2016-2017. The second study, we used aerosol reanalysis product to investigate the effects of air pollution on mortality and hospitalization. Finally, we demonstrated an on-going intervention study that evaluates the effectiveness of a clean cooking intervention on health outcomes in household used to traditional cooking methods.

## Conclusions

The evidence of air pollution impact on health in Vietnam is limited. Future researches that strengthen the evidence, overcome the challenges, and promote policy development are warranted.

# 0622\_S2-5

# Health effect of air pollution in Thailand: Recent research development and challenges

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## Background/Aim

Exposure to high levels of air pollutants is corresponding to various adverse health effects. Although many epidemiological studies have found the consistently positive association between air pollution and its health effects in many parts of the world, the scientific evidence about this association is still limited in Thailand. The purpose of this review is to illustrate the effect of air pollution that has been done in Thailand, and to find the challenges based on such literatures in order to identify the opportunity to conduct research about air pollution epidemiology in the future.

## Methods

Studies on health effects of air pollution in Thailand using epidemiological method were searched by PubMed using the keyword of air pollution, health effect, and Thailand in order to advance understanding of the gap based on such studies and to find the possible study that can be done to fulfill these gaps in the future.

## Results

Based on epidemiological evidence, there were a few studies that examined short-term effects of air pollutants on mortality and morbidity and no study, to our knowledge, that investigated long-termeffect of air pollutants because some essential data used for the analysis were somewhat not available.

## Conclusions

This review provided the research gaps on air pollution epidemiology that might be useful for figuring out the possible research topic on health effects of air pollutants in the future. Strengthening epidemiological study is important for considering policy development in Thailand, as well as provide the essential knowledge on environmental health.

## Traffic related air pollution and autism in Denmark

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## Background/Aim

Previous autism spectrum disorder (ASD) and air pollution studies focused on pregnancy exposures, but another vulnerable period is immediate postnatally. Here, we examined early life exposures to air pollution from the pre- to the postnatal period and ASD/ASD subtypes in the Danish population.

## Methods

With Danish registers, we conducted a nationwide case-control study of 15,387 children with ASD born 1989-2013 and 68,139 population controls matched by birth year and sex identified from the birth registry. We generated air dispersion model (AirGIS) estimates for NO2, SO2, PM2.5 and PM10 at mothers' home from 9 months before to 9 months after pregnancy and calculated odds ratios (OR) and 95% confidence intervals (CI), adjusting for parental age, neighborhood socio-economic indicators, and maternal smoking using conditional logistic regression.

#### Results

In models that included all exposure periods, we estimated adjusted ORs for ASD per interquartile range (IQR) increase for 9 month after pregnancy with NO2 of 1.08 (95% CI: 1.01, 1.15) and with PM2.5 of 1.06 (95% CI: 1.01,

1.11); associations were smaller for PM10 (1.04; 95% CI: 1.00, 1.09) and strongest for SO2 (1.21; 95% CI: 1.13, 1.29). Also, associations for pollutants were stronger in more recent years (2000-2013) and in larger cities compared with provincial towns/rural counties. For particles and NO2, associations were only specific to autism and Asperger diagnoses.

### Conclusions

Our data suggest that air pollutant exposure in early infancy but not during pregnancy increases the risk of being diagnosed with autism and Asperger among children born in Denmark.

## Environmental Tobacco Smoke Exposure and Infant Neurodevelopment Parameters at Eighteen Months: Results from Taiwan Birth Cohort Study

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## Background/Aim

Environmental tobacco smoke (ETS) exposure were prevalent in Taiwan. Previous studies also showed found to be associated with altered birth weight, increased risk of premature death and respiratory system diseases. Previous reports showed inverse association between ETS exposure and childhood neurodevelopmental outcomes, but less studies focused on the adverse effects affect infant neurodevelopment. We aimed to find the association between infantile environmental tobacco smoke exposure and neurodevelopment parameters.

## Methods

Taiwan Birth Cohort Study (TBCS) was the first nationwide birth cohort study in Taiwan that follows representatively sampled mother-infant pairs in 2005. We included the term singleton infants without major clinical illness in this study. The development and exposure condition of the participants were assessed by home interview with structured questionnaires upon six and eighteen months old.

Multivariate logistic and Cox proportional hazard model were applied to examine the odds ratio (OR) and hazard ratio (HR) between environmental tobacco smoke exposure status and caregiver-reported neurodevelopment milestones.

## Results

In this study, 17,530 term singletons were included from the TBCS cohort. Environmental tobacco smoke exposure was associated with delay in care-giver reported neurodevelopment milestone in language, such as able to wave goodbye (For persistent frequent exposure: Adjusted OR = 1.29,95% confidence interval (CI): 1.02 to 1.62; adjusted HR= 1.10, 95% CI: 1.03 to 1.17), and the effect was still seen in separated periods. Environmental tobacco smoke exposure was also associated with delay in other language development domain of calling a parent meaningfully in separated periods, but the effect was less pronounced upon combined.

## Conclusions

This study indicated possible associations between infant environmental tobacco smoke exposure and delay in neurodevelopment milestone achievement upon the first eighteen months. Further studies is indicated to further ascertain the cross-talk between environmental tobacco smoking and other indoor air pollutants.

## Keywords

Environmental tobacco smoke, neurodevelopment, birth cohort

# Prenatal exposure to PM10 and NO2 and children's neurodevelopment from birth to 24 months of age: Mothers and Children's Environmental Health (MOCEH) study

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# Background/Aim

Tentative conclusions of three recent systematic reviews show that the influence of air pollution has over neurodevelopment cannot be ignored and also classify the evidence for air pollutants as "moderate. We reviewed studies of ambient air pollution and neurodevelopment and particularly the association between prenatal exposure to particulates of less than 10  $\mu$ m in diameter (PM10) and nitrogen dioxide (NO2) and Bayley test in children during the 24 months of Korean study.

# Methods

In this review, we included studies only on ambient air pollution, and also included studies on several cognitive functioning results in adverse global intelligence quotient (IQ). In Korean birth cohort study, average exposure levels to PM10 and NO2 during the entire pregnancy were estimated using the inverse distance weighting (IDW) method. A total of 520 mother-child pairs who completed neurodevelopmental assessments using the Korean Bayley Scale of Infant Development II (K-BSID-II) more than once at ages of 6, 12 and 24 months were included

# Results

Exposure to pollutants can negatively influence neurodevelopment of children, can be associated with the decrease in cognitive test outcomes such as global intelligence quotient (IQ). In a Korean birth cohort study, prenatal air pollution exposure had significant effects on MDI(Mental Development Index) and PDI(Psychomotor Development Index) at 6 months, but no significant association was found at 12 and 24 months of age.

# Conclusions

The findings suggest that exposure to air pollution may result in delayed neurodevelopment in early childhood. The potential cellular mechanisms known to be responsible for CNS damage are neuroinflammation, oxidative stress, glial activation, and white matter injury.

# Prenatal exposure to outdoor air pollution and child behavioral problems at school age in Japan

# Takashi Yorifuji

# Background/Aim

Recent studies suggest positive associations between prenatal exposure to ambient air pollution and neurodevelopment of children, but evidence on the adverse effects of exposure to air pollution on child neurobehavioral development remains limited. We thus examined associations between prenatal exposure to outdoor air pollution and child behavioral developments, using data from a nationwide population-based longitudinal survey in Japan, where participants were recruited in 2001 and are continuously followed.

# Methods

Suspended particulate matter (SPM), nitrogen dioxide, and sulfur dioxide concentrations during the 9 months before birth were obtained at municipality level and assigned to those participants born in the corresponding municipality. We analyzed data from singleton births with linked pollution data available (e.g., N=33,911 for SPM). We used responses to survey questions about behavioral problems at ages 2.5, 5.5, and 8 years. We conducted multilevel logistic regression analysis, adjusting for individual and municipality-level variables.

# Results

Air pollution exposure during gestation was positively associated with risk for behavioral development problems. Specifically, air pollution was associated with verbal and fine motor development at age 2.5 years, with behaviors related to inhibition and impulsivity at 5.5 years, and with behaviors related to attention and delinquent or aggressive behavior at 8 years. In the fully-adjusted models, for example, odds ratios following

one-interquartile-range increase in nitrogen dioxide were 1.24 (95% confidence interval: 1.07, 1.43) for inability to compose a two-phrase sentence at age 2.5, 1.10 (1.01, 1.21) for inability to focus on one task at age 5.5, and 1.09 (1.03, 1.15) for failure to pay attention when crossing a street at age 8.

# Conclusions

Prenatal exposure to outdoor air pollution was associated with behavioral problems at age 2.5, 5.5, and 8 years in a nationally representative sample in Japan.

# Effects of Prenatal and Childhood Ambient Air Pollution Exposure on Childhood Mental and Behavioral Development in Taiwan

# Pei-Chen Lee

# Background/Aim

The average air quality in some cities or counties in Taiwan has worsened in recent years, with air pollution levels exceeding the national air quality standard in several days in a year. Air pollution has been recently hypothesized to contribute to childhood mental and behavioral development etiology. However, the results of epidemiologic studies that tested this hypothesis are limited and not consistent. Here, we investigated the associations between ambient air pollution and childhood cognitive and neurobehavioral outcomes in central Taiwan.

# Methods

We initially recruited 430 pregnant women in their third trimester and followed around 110~120 mother-child pairs at the children's age of 2-3, 5-6, 8-9, 11-12, and 14-15 years from 2003 to 2012 in central Taiwan. At baseline, we collected maternal lifestyle during pregnancy, and at each follow-up, we collected neurobehavioral test of children including the Chinese version of the Strengths and Difficulties Questionnaire (SDQ). The intellectual evaluations at each visit were administered to the children using a standardized protocol by qualified psychologists. The assessment was based on Chinese version of the Bayley Scales of Infant Development-II (BSID-II), the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R), the Wechsler Intelligence Scale for Children-Version III (WISC-III), and

the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV) at ages of 2, 5, 8, and 11 years, respectively. We used quantile-based Bayesian maximum entropy model, to estimate criteria ambient air pollution exposure concentrations at each follow-upperiod. Linear mixed-model was used to assess the association between air pollution and childhood cognitive and neurobehavioral outcomes.

# Results

The average IQ scores at the children's age of 8-9, 11-12, and 14-15 years were 108 (sd=12.6), 110 (sd=15.6), and 112.5 (sd=16.1), respectively. Using a linear mixed model adjusted for age at baseline, gender, and years at each visit since baseline, we found that with an interquartile range increased in PM2.5, the average IQ decreased (beta=-0.06), however, this result was not statistically significant.

# Conclusions

Ambient air pollution exposure during pregnancy and early childhood was not significantly

associated with decrements in IQ scores. Future validation studies that include large cohort sizes are needed to further explore these findings.

# 0623\_S4-1

# Make Taitung A Healthy & Livable City

# Background

In 2009 when I took office as Taitung County Governor, Taitung's health, proportion of low-income population and household income fell behind the indexes, and the core to the issues was economy.

# Objectives

To improve the determinant influencing Taitung's society, we focused on improving the economy first.

# Approaches

First, we broke through the obstacles with tourism advantages: use characteristic events including hot air balloons, surfing, and international ironman triathlons to bring in business opportunities and increase employment rate. Second, we created healthy and friendly environment via fundamental constructions, public safety, medical hygiene, environmental sustainability, social welfare, as well as smart living. Both economy and health-related policies need to be improved and implemented so that people can live a satisfying life and thus be aware of self-health management issues.

# Result

We have made a tremendous change of Taitung. In comparison to 2009, unemployment rate in 2017 was 3.5%, which was lowest of the entire nation; visitors, overall business revenue, and hotel rooms increased by 27%, 38% and 105% respectively. Business investment increased 26.6 billion. Bank savings increased 37.1 billion, which was NT\$16,863 per person. In 2015, we achieved Taiwan Healthy City Excellence award. Ratio of smoking decreased by 18.1%; ratio of exercising increased by 18.1%; average life span increased by 1.32 years. Over the years, we continued adding in more medical resources and therefore first aid success rate increased by 22.54%. All of the above is we make Taitung a healthy and livable city.

# The development and achievement of a healthy cities network in Taiwan: sharing leadership and partnership building

# Dr. Hsien-Wen Kuo

Abstract: The World Health Organization (WHO) Healthy Cities(HC) projects are the best known of the settings-based approaches to health promotion. Thev governments in healthdevelopment through a process of engage local capacity-building, partnership-based political commitment, institutional change, planning and innovative projects. Many cities have promoted HC projects in Taiwan since 2002. In 2008, the Taiwan Alliance for Healthy Cities (TAHC) was launched to assist local governments in effectively establishing, operating and promoting HC projects. In this article, we share our experiences of establishing a platform and network to promote the HC program in Taiwan. Based on individual city profiles and governance in Taiwan, the TAHC developed well-organizedframework and model to а encourage strong leadership in local governments and to promote participation and engagement in their communities. In the last 6 years, leaders from Taiwan's local governments in HC networks have integrated the HC concepts into their governance models, actively engaging and combining various resources with practical expertise and private sectors. The network of health in Taiwan allows each city to develop its unique perspective on the HC projects. Using this method, not only local government meets its needs, but also increases governance efficiency and effectiveness, resulting in the promotion of its citizens' overall sustainable urban

health development. This HC network in Taiwan has partnershipswith government and non-governmental organizations (NGOs), with academic support and citizen involvement, a dynamic data collection system and demonstrated leadership in the sharing of information in the Asian region.

# 0623\_S4-3

# Accessible Tourism as Leisure and Wheezing Service for Health Promotion for the Disabled, the Elderly and the Care Givers.

Prof. Dr. Chong-Wey Lin, Founder & CEO, OurCityLove Social Enterprise Taiwan / President, Association for Smart-Living and Service-Design Taiwan, ASTS Taiwan

## Summary

"Everyone has the right to access leisure and tourism services on an equal basis," said UN Secretary-General Ban Ki-moon in his message on World Tourism Day 2016. But the question is "how can we leverage the public and private powers to improve accessible tourism?" OurCityLove Social Enterprise Taiwan has 3 innovative approaches: (1) we trained and paid our disabled fellows to collect accessibility information in ever cities and created the online accessible tourism platform that ultimately benefits the physically challenged citizens and their care givers. (2) we organized car rental and taxi drivers with accessible vehicles in different cities so that we could offer family travel service everywhere and, hence, empower the market growth of accessible transportation and tourism. (3) we brought more tourists to accessible restaurants, hotels and touristic places and, therefore, significantly enhance private business owners' willingness and incentives to improve their accessible facilities and services.

2017/12, we launched the website of 9453 Family Accessible Tourism Taiwan with 8,000 accessible restaurants, hotels and touristic places, which are surveyed by OurCityLove's 463 disabled fellows. With 3M page-views, 9453 is now ranked top 1 if you googlefriendly travel (友善小旅行) in Taiwan. 127 accessible taxi drivers, 15 car rentalcompanies with accessible vehicles and 287 hotels with accessible guest rooms have

signed business contracts with us. Taiwan's leading car manufacturer YuLung Motor (裕隆) becomes our business partners and we co-designed their accessible vehicle the "Luxgen Model V7".

The United Nations World Tourism Organization (UNWTO) predicted accessible tourism will increase and experience sustained development, reaching 1 billion international tourists by 2030. Accessible cities and tourism provisions therefore ensure the full social and economic inclusion of all persons with direct benefits of promoting more sustainable travel habits among users. We witness and see the continuous market growth of accessible tourism as leisure and wheezing service for health promotion for the disabled, the elderly and the care givers.

# The Trajectory of Taipei Healthy City

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# Introduction

According to the World Health Organization (WHO), nearly 60% of the world's population will reside in urban areas by 2025. Taipei City, an international metropolitan city as well as a Capital, is no exception. Facing urbanization, aging, low birthrate, climate change, and multi-culturalism, All stakeholders reside in Taipei City have endeavored to construct a sustainable healthy city.

# Features (Methodology)

Echoing the World Health Organization's guideline and actively creating the "Health for All" trend for the 21st century, Taipei City continues to promote healthy city policies with features of healthy, safe, friendly, sustainable, prosperous and convenient smart city of technology. Taipei City Government investigates the needs of the public and adopts "Health in All Policies" in most Government-driven project with key performance indicators evaluation in City's strategic map. With the help and partnership of experts in every field, Healthy City Steering Committee constructs an integrated platform with five groups, safety & security, sustainable ecology, friendly culture, healthy vitality, and prosperity & convenience. All action plans coming out the committee have been crosssectional and community involvement to pursuit a healthier and sustainable Taipei City.

# Memorabilia (Outcome)

2002 is the "First Year of the Healthy City in Taipei". Taipei City Government began to cooperate with communities to launch the program. By 2011, all 12 districts have been recognized either safe communities, healthy communities, or age-friendly communities. In 2015, we further take the mission of "serving the people and innovating for the city", integrate healthy city, age-friendly city, and safe community program into one platform to campaign all health issues. On August of 2016. We successfully join the Western Pacific Health City Alliance (AFHC) and keep sharing our experience. The 2016 poll of citizen's satisfaction on health city action plans showed positive feedback.

# Conclusion

Through community empowerment, citizens' involvement, and international marketing strategies, with the help of strategic map and continuously indicator monitoring, Taipei City will continue to pursue the touched services, and towards the "people-oriented" livable and sustainable city, creating the first healthy city in Asia.

# Projecting future temperature-related mortality due to climate change

# Jae Young Lee

Projecting future human health risks due to temperature elevation is a key issue in understanding the effects of climate change. Particularly, the future mortality due to climate change have been well studied for the recent decade in multiple locations worldwide. However, research synthesis of previous results cannot be achieved due to their heterogeneity in baseline period, projection period, and scenarios of future climate, population and adaptation. As a result, it is not possible to compare the previous projection results from multiple locations and to understand which part of the world is relatively more in danger.

In this study, we introduced a method for normalizing the heterogeneous projection results with respect to changes in global  $CO_2$  concentrations. Using this method, we first normalized the previously reported relative risks in mortality due to climate change. In addition, we also calculated the normalized risks for additional locations based on data obtained from Multi-Country Multi-City Collaborative Research Network. In doing so, we used distributed lag nonlinear model (DLNM) for extracting the relationship between temperature and mortality. Lastly, we compared the normalized risks of climate change in multiple locations, and analyzed the association of the risks with environmental and socioeconomic factors to understand the regional variations of the risks.

## **Developing Weather-based Predicting Model for Dengue Fever Outbreaks**

## in Solomon Islands

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**Background:** During last decades, dengue viruses have spread around the world, including Solomon Islands. An unusual outbreak occurred since August 2016, resulted in more than 5000 cases occurred throughout the island within a year. The purpose of this study was to improve the surveillance system by assessing a modelling tool to predict the occurrence of dengue fever few weeks ahead.

**Methods:** This study used weekly dengue fever data from 2014 to 2017 and predicted the dengue fever incidence for eight weeks ahead. A time series analysis was conducted using Autoregressive Integrated Moving Average (ARIMA) modelling to forecast the dengue fever occurrence. This study further assessed the associations and impact of weather variables (maximum temperature and cumulative rainfall) on the

prediction of dengue fever incidence and incorporating them in the best fitting model.

**Results:** The results revealed that ARIMA (0,1,4) closely described the trends of dengue fever incidence and confirmed the existence of dengue fever cases in Solomon Islands for eight weeks ahead. We also use climate variables as external regressors and correlation analysis' result showed that maximum temperature and cumulative rainfall have correlation with dengue fever cases in Solomon Islands. But only maximum temperature improves dengue fever forecast better than the dengue fever itself.

**Conclusions:** ARIMA model with weekly variations involving weather variable as independent variables is a comprehensive model for disease control and prevention program as it is able to effectively predict (8 weeks-ahead) the number of dengue fever cases in Solomon Islands.

Keywords: dengue; prediction; ARIMA; weather

"

# Long-term exposure to temperature associated with the incidence of major depressive disorder

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## Background/Aim

Temperature was reported to be related with the acute effect of mental illness. However, the effect of long-term temperature exposure is unclear. This study aimed to evaluate the association between long- term exposure to temperature and the incidence of major depressive disorder (MD).

## Methods

We conducted a retrospective population-based study using Taiwan nationwide Longitudinal Health Insurance Database (LHID 2005). A total of 94,6345 subjects without MD diagnosis were followed from 2003 to 2013 for the occurrence of MD. Climate-related predictors including temperature (°C), sunshine duration (hrs/day), and rainfall (mm/day) were 11-year average of daily data collected from weather monitoring

duration (hrs/day), and rainfall (mm/day) were 11-year average of daily data collected from weather monitoring stations of Taiwan Central Weather Bureau. Cox proportional hazard model with year as underlying time-scale was performed to examine the association between MD occurrence and climate factors. Covariates including age, gender, insurance amount were adjusted.

## Results

A total of 9,550,372 person-years were followed. Female gender, higher age, and higher insurance amount were associated with greater risk of developing MD. People residing in long-term temperature of 20-23°C had the lowest risk of developing MD. Risk for MD incidence was increased among those people residing in regions of average temperature of >23°C, at 7% increase per 1°C increment. For regions with average temperature at <20°C, the effect of temperature was not significant although the

lower temperature seems to increase the risk of developing MD (HR=0.92, 95%CI=0.82-1.04).

## Conclusions

Long-term residing in the region with hot temperature may increase the risk of MD incidence. Under global warming, these findings have great health implications and warrants further confirmation.

## 0623\_S5-4

## Association between extreme ambient temperature and occupational injury

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### Abstract

## Background/Aim

Exposure to high temperature has been linked to adverse effects including cardiovascular and renal functions. It was also proposed to diminish human performance capacity and increase accidentrisk. However, the effects of extreme temperature on occupational injury have not been extensively studied.

The aim of this study was to determine the association between extreme ambient temperature and occupational injury (OI) occurrence.

## Methods

OI information was extracted from the National Health Insurance Research Database (NHIRD).

Daily ambient temperature and relative humidity (RH) were obtained from the Taiwan EPA air monitoring station. The day of first time OI outpatient/emergency visits during 2006-2011 was used as the event day. The same weekdays of the month were used as the referent day. We categorized ambient temperature into greater than 90percentile and less than 10-percentile as the indicators for extreme temperature.

Time-stratified case-crossover design and conditional logistic regression was used to investigate the relationship between extreme ambient temperature and OI outpatient/emergency visits, adjusting for RH. Results

There were 18,951 first time OI outpatient/emergency visits during 2006-2011. The odds ratio (OR) of OI outpatient/emergency visits associated with temperature less than 17  $^{\circ}$ C was 0.91 (95%

confidence interval, CI: 0.86-0.96). The ORs associated with extremely lower temperature at lag1 (the day before visit day) to lag3 day was 0.91 (95% CI: 0.87-0.96), 0.91 (95% CI: 0.87-0.96), and 0.93 (95%

CI: 0.88-0.98), respectively. Conclusions

Exposure to extremely lower ambient temperature was associated with decreased risk of OI outpatient/emergency visits.

# Landscape fire-related air pollution and mortality in a Southeast Asian city: health risk assessment using fire data from remote sensing

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## Background/Aim

Landscape fires occur frequently in Southeast Asia, and they often lead to large-scale haze pollution in the region. These fires are largely because of the slash-and-burn agricultural practices and peatland burning. Previous studies investigating health impact of haze have relied on ground monitors. We explored the use of fire data from remote sensing to disentangle the health effects of fire and non-fire-related air particulate matter.

## Methods

We collected daily averages of air particulate matter with aerodynamic diameter  $10\mu m$  or less (PM<sub>10</sub>), temperature, and relative humidity from ground monitors, and wind information from GDAS dataset, matching the mortality data in Klang Valley, Malaysia (MY), 2000-2006. We extracted the daily number of fire pixel count and total fire radiative power (FRP) at specific buffer distance (i.e. 0-500km, 500-1000km, and 1000-2000km) from MODIS with boundary overlay. We derived a step-wise algorithm to detect possible FRP cut-off points that produced higher PM<sub>10</sub> levels and used this information to predict daily fire-related PM<sub>10</sub>. Fire indicators were constructed using the 90th percentile of fire pixel count or median FRP by buffer distance and boundary. We used these indicators to stratify the estimates of risk associated with fire-related PM10, using a time-stratified casecrossover study design.

## Results

PM<sub>10</sub> attributable to high count of landscape fires detected in and out of MY were associated with higher risks of mortality. PM<sub>10</sub> for fire counts detected outside MY had larger risk estimates. There was evidence of risk increase when high fire counts were observed in the buffer distance 1000-2000km. This risk increase was similarly observed for high FRP (>median).

#### Conclusions

We demonstrated an objective approach to untangle fire-related health risk using remote sensing data. Fire and boundary-specific risk summaries might provide new information to inform current policies.

# Efficiency of local decision making units in addressing temperature-related risks in the Philippines

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## Background/Aim

Climate change impacts a variety of dimensions of society, with particularly notifiable effects on health. Recent progress in the field noted the projected magnification of temperature effects, with a large pool of projected temperature-related mortality in the future. There are a variety of ways to address these risks, some would take into account heat wave warning systems, or increase access to health services for the risk population, while there are aspects of behavioral and technological adaptations taken into consideration. However, there is a gap of understanding whether changes in socio-demographic variables would affect the temperature-related risks. This study intends to determine the efficiency of local decision making units (DMUs) in addressing temperature-related risks taking into account socio-demographic factors.

## Methods

Daily all-cause mortality data and daily average temperature from 33 locations in the Philippines, both spanning 2006-2011, were utilized to determine the location-specific risk estimates. Risk estimates were then utilized for 1) meta-regression, and 2) as a DMU-output for efficiency determination. Candidate meta- regressors/DMU-inputs included human development index (HDI), income gap, and social insurance coverage.

### Results

Cold-related deaths (75,922) were observed to be greater than heat-related deaths (10,152) among the 33 locations. Prolonged effects were apparent through the lower, but longer slope observed in the cold component of the exposure-response relationship, while immediate effects were observed in the steep and shorter slope of the heat component. Negative association was observed with social insurance coverage HDI, while income gap exhibited a positive association with the risks. Three DMUs were observed to be performing efficiently (efficiency score = 1), while other locations have the potential to be efficient if certain socio-demographic variables, such as income gap, were to be reduced towards the efficiency frontier.

## Conclusions

Results of this study can be utilized for a local policymaking in addressing temperature-related risks taking into consideration local socio-demographic factors.

# Birth cohorts in Asia: The importance, advantages, and disadvantages of different-sized cohorts

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Our aim is to discuss the importance, the advantages and disadvantages of different-sized cohorts in Asia, while showing representative findings on dioxins and perfluoroalkyl substances (PFASs). Although maternal exposure levels of dioxin (DLCs) in Japan were relatively lower than that in Europe and the US, adverse effects of prenatal exposure to DLCs on offspring health were observed even smaller cohort (N=514). These effects include reduced birth weight, reduced IgE at birth, increased free thyroxine (T4), delay of neurodevelopment, increased risk of infections and increased risk of wheeze at 7 years old. Their effects on steroid and reproductive hormones at birth and follow-up at onset of puberty are now being examined. Regarding PFASs, not only birth weight, but also metabolic biomarkers such as adipokine levels in cord blood samples have been investigated in association with PFAS exposure. It was found that lower prenatal exposure to PFTrDA may decrease the risk of eczema in infants in the first 2 years of life. At age 4, in utero exposure to long-chain PFASs, such as PFDoDA and PFTrDA, was inversely associated with eczema and total allergic diseases. On the other hand, PFHxS and PFOS were associated with increased risk of infections up to 7 years of age. These findings from a large-sized cohort (N=20,926) but sample size was under 2000 for the follow-up observation period suggest that prenatal PFASs may have immunotoxic and immunosuppressive effects in the next generation. In conclusion, even in a small cohort, a good design and original hypothesis brought novel findings. In a larger cohort, even more diverse findings will be expected by overcoming the limitation of small sample size. International collaboration, such as the BiCCA, can overcome the inherent limitation of sample size.

## The ShangHai Birth Cohort

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With rapid economic development in China, environmental pollution has become a major concern in many parts of the country. Government statistics indicates that the incidence of birth defects has been increasing in recent years. Meanwhile, thanks to "one child family policy", child health is often the central attention of the whole family. These joint concerns have driven children's environmental health to the forefront among various social issues. The Shanghai Birth Cohort (SBC) recruited more than 5,000 couples who came to maternity hospitals in Shanghai for preconceptional care or first prenatal care in the first trimester of gestation. Women were followed up to 12 months before pregnancy with bimonthly telephone interview. During pregnancy at each trimester, a follow-up visit was scheduled. A wide range of information from socioeconomic status to psychological, nutritional factors was collected. Blood and urine samples were collected at each visit. Approximately 4,000 babies were born. At birth, cord blood and placental tissue samples were collected. Children have been followed at 42 days postpartum, 6, 12 and 24 months. Diet, habit and disease information were recorded; growth measured. Child neurobehavioral assessments are made. The 4-year follow-up has just started. Future visits at 7 and 10 years of age are planned. The purpose of this study is to examine the effects of genetic, environmental and behavioral factors on female reproductive health, pregnancy outcomes, child growth and development, and risks of childhood diseases. Findings from this study will provide essential support for evidence-based public health policy making to improve environment, maternal and child health.

## Mothers and children's environmental health (MOCEH) study in Korea

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The Mothers' and Children's Health and Environment (MOCEH) study is a multi-center birth cohort study, which was initiated in 2006 to assess exposures and effects of the environmental factors (chemical, biological, physical, and psychosocial) in susceptible populations, including mothers and infants.

The participants were recruited from 2006 to 2016 and followed-up through 2017. Pregnant women in their first trimester of pregnancy and their spouses were recruited from three collaborating centers in Seoul (metropolitan area), Ulsan (industrial area), and Cheonan (medium-sized urban area), Korea.

A total of 489 Children has been followed-up between June 2017 and January 2018, 100 children in Seoul, 134 in Cheonan, and 255 in Ulsan. The health outcomes investigated in the follow-up included a neurodevelopmental test, growth measures, and health conditions.

From the results, 11 papers were published in 2017. One of the results showed that prenatal lead exposure increased children's behavioral problems at 5 years, particularly in males than in females. The gender difference in association with lead exposure and the types of behavioral problems was also found: for 1  $\mu$ g/dL increase in the blood lead concentration in the late pregnancy, the score of total behavioral problems increased by 3.00 (95% CI: 0.56, 5.45) in male, whereas 1  $\mu$ g/dL increase of lead in child blood at 2 years and 5 years was followed by 3.82 (95% CI: 1.25, 6.39) and 5.72 (95% CI: 0.44, 10.99) of total behavioral problem score in females, respectively.

By continuous follow-up into adulthood, we will examine the effects in adulthood of childhood exposures to environmental factors. We will evaluate age-specific susceptibility to exposure to hazardous environmental pollutants and growth-retardation accounting for the effects of environmental and genetic risk factors.

## The Taiwan Birth Panel Study

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The Taiwan Birth Panel Study (TBPS) is an ongoing cohort study that was conducted since 2004 in northern Taiwan. The primary goals are to exam the low-level, prenatal or postnatal exposure and genetic modification effect on the initiation and progress of "environmentally-related childhood diseases". At birth, 486 mother-infant pairs were enrolled and children were followed subsequently at age of 4,6 months and 1, 2, 3, 5, 7 and 9 years.

Our recent discovery focused on temporal change of environmental pollutants exposure and child health before puberty. For phthalate metabolites, the concentration of urinary mono-(2-ethylhexyl) phthalate (MEHP), monobenzyl phthalate (MBzP) and monobutyl phthalate (MBP) levels were the highest at the age of 2 years and decreased in the following age. However, the urinary mono-ethyl phthalate (MEP) concentration remain stable at different ages. We found that concurrent exposure to MEP was negatively associated with lung function in children at age 9. In addition, concurrent MEP exposure was associated with increment of body mass index (BMI) z-score and pediatric overweight or obesity during pre-puberty stage, particularly in boys. For common perfluoroalkyl substances (PFAS), the concentration in 9-year-old serum were lower compared with those in cord blood. We observed a diminished negative impact of prenatal prefluorooctyl sulfonate (PFOS) on fetal growth as children grow up to 8 years of age, with gender difference. There were trends noted between prenatal PFOS exposure and decreasing lung function at age 9 of children with lower birth weight or allergy.

Therefore, prenatal environmental pollutants exposure could have long term impact on children before puberty while the impact of concurrent exposure could not be ignored. Further follow-up to explore the change of puberty development is warranted.

# Hamamatsu Birth Cohort for Mothers and Children (HBC Study): Our mission and current status

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The Hamamatsu Birth Cohort for Mothers and Children (HBC Study) was established in 2007, having enrolled 1258 children and 1138 mothers from general population in Japan. The strengths of HBC Study are frequent and direct neurodevelopmental examinations of the participating children (9 times by 4 years and 3 more times by 9 years of age), including clinical assessments of autism spectrum disorder (ASD), and the low drop-out rate (8% by 2 years).

The primary aim of the HBC Study is to elucidate aetiology of ASD, including exploration of early risk factors for ASD and establishing a reliable diagnostic system of ASD, since aetiology of ASD, including when and how it develops, has been hardly understood.

We have thus far published a couple of papers along with the aim: the protocol papers (Tsuchiya et al., 2010; Takagai et al., 2016), proposition of five latent classes of the neurodevelopmental trajectories during the first two years (Nishimura et al., 2016), three of which are associated with the increased risk for developing autism spectrum disorder (Nishimura et al., in press). Currently, we are working on investigating the early, developmental risk sets for the trajectory leading to the emergence of ASD, although there remain plenty of hurdles to overcome.

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Cohort overview: Project Jeebon Authors: David C. Christiani, MD, MPH, MS Maitreyi Mazumdar, MD, MPH Molly Kile, ScD Ema Rodrigues, DsC, MPH Mohammad Rahman, MD, ScD Jane Lee, PhD Pi-I Debby Lin, MS, ScD Shangzi Gao, ScD Linda Valeri, PhD Kelsey Gleason, ScD Li Su, Md. Golam Mostofa, MBA Quazi Quamruzzaman, MD

We established Project Jeebon (meaning "life" in Bengali) in arsenic endemic regions of Bangladesh to assess health outcomes associated with prenatal exposure to environmental arsenic from drinking water. We used active surveillance to recruit newly pregnant women

≤16 weeks' gestation in Sirajdikhan and Pabna Sadar Upazilas of Bangladesh between 2008 and 2011. Exclusion criteria included <18 years of age at recruitment, multiple gestation, history of diabetes mellitus or use of oral hyperglycemic, did not use tube well as the primary source of drinking water or had change of drinking water source in the past 6 months, and intended to move during pregnancy or did not plan to continue receiving prenatal care through Dhaka Community Hospital. We scheduled four pregnancy visits and two childhood visits at enrollment (visit 1), 3<sup>rd</sup> trimester (visit 2), at delivery (visit 3), one month-postpartum neonatal (visit 4), early childhood at 12 months (visit 5), and at 20-40 months of child's age (visit 6). We collected information via interview and questionnaires, performed anthropometric assessments, perinatal health examination, dietary surveys, and neurodevelopmental assessments. We collected household drinking water sample and biosamples. From 1613 women recruited, we had 1,184 eligible singleton livebirths and 1,156 mother-child pair remained at onemonth postpartum visit. 817 children completed in neurodevelopmental assessments at 20-40 months and a subset children aged 4-5 years were followed up for immunotoxcitiy studies. Primary study outcomes include health condition throughout pregnancy, birth outcomes, and child neurodevelopment testing scores.

# Taiwan Maternal and Infant Cohort Study (TMICS)

Shu-Li Wang, Ming-Tseng Wu, Mei-Lien Chen, Chia-Jong Hsieh

In May 2011, a food scandal in Taiwan revealed that phthalates, especially di-(2-ethylhexyl) phthalate (DEHP), were deliberately added to a variety of foods commonly consumed by children there. The birth cohort study established in 2000 provided data on focused population of children for the special protection. Afterwards epidemiologists from northern, central, southern and eastern Taiwan established a birth cohort consortium and conducted a nationwide prospective birth cohort study known as the Taiwan Maternal & Infant Cohort Study (TMICS) to investigate environmental important environmental factors and its effects on maternal and child health in Taiwan.

Between October 2012 and May 2015, 1631 pregnant women in their first to third trimester were recruited, administered questionnaires, and asked to provide blood samples and urine samples from nine hospitals located in northern (n = 3), central (n = 3), southern (n = 2), and eastern Taiwan (n = 1). Subjects had a mean age (±SD) of 31.38 (±4.56) years with the quantification of eleven urine phthalate metabolites completed. Later the male/female ratio of their newborns was found to be about 1: 1. The TMICS have been following up the children at age of three years. Researchers kept the urine and blood samples from these mothers and children. Subsequent measurements of other important contaminants may include organophosphate pesticides, nonylphenol, bisphenol A, heavy metals, melamine and acrylamide. This maternal and children cohort may serve as certain susceptible populations for environmental health monitoring. Part of the details were also shown in the article from *International Journal Epidemiology* online in April 2018.

# **Overview of Taiwan Early-life Cohort Study (TEC)**

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## Background

Allergic diseases (AD) are most common chronic inflammatory disease in childhood. As symptoms of AD start early in human life, we therefore conducted a birth cohort study, Taiwan Early-life Cohort Study (TEC), to investigate the effect of early-life environmental exposure on childhood AD.

# Materials and methods

From 2001 to 2005, 1,587 mother–infant pairs were recruited from eight Taiwanese maternity hospitals. Children have been followed via phone interviews at the age of 3 months, 6 months, 12 months, 18 months, 2 years, and 5 years. Biological samples, including peripheral venous blood and urine from pregnant women and umbilical cord blood from neonates, were obtained. Thus far the concentrations of nine perfluoroalkyl substances and 21 metal species were measured in cord blood. The levels of maternal total IgE and specific IgE against five common allergens in Taiwan and neonatal cord IgE were also determined. Neonatal genotypes of candidate genes were also evaluated.

## Results

We aimed to explore the association among environmental exposure, genotypes, and AD in children. In overall, maternal stress during pregnancy and infants with interleukin-4 - 590CC/CT genotype were associated with elevated cord plasma IgE levels, a marker of predicting AD in childhood. For AD in 2-year-old children, elevated cbIgE levels ( $\Box \Box 0.5$  kU/l), lymphotoxin- $\alpha$  *NcoI* allele, the  $\Box \Box$  subunit of the high-affinity receptor for IgE E237G genotype, and maternal psychological stress during pregnancy were significantly associated with atopic dermatitis. Children with higher in-utero perfluorooctanoic acid (PFOA) exposure also had higher risk of developing atopic dermatitis.

# Conclusion

We found that early-life environmental exposure, genotype, and maternal mental stress were related to childhood AD development. Minimizing early-life PFOA exposure and improve maternal mental health during pregnancy may help against childhood AD development.

## Is the Fine Particulate Matter a risk factor of Metabolic Syndrome?

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## Background/Aim

Particulate matter (PM) has been reported to be associated with cardiovascular morbidity. Metabolic syndrome is also an important risk factor for cardiovascular diseases (CVD). However, few studies have investigated the epidemiological association between PM and metabolic syndrome. To investigate the association between 1-year exposure to PM with an aerodynamic diameter <  $2.5 \mu m$  (PM2.5) and the risk of metabolic syndrome in Korean adults without CVD.

## Methods

Time-dependent Cox model was used to investigate the association between 1-year average PM2.5 level and risk of incident metabolic syndrome in 153,417 adults from the national health screening cohort provided by Korea National Health Insurance from 2009 to 2013. Metabolic syndrome was defined by National Cholesterol Education Program the third Adult Treatment Panel (NCEP-ATPIII). Also, 1-year

average PM2.5 levels were measured for each subsequent follow-up visit.

## Results

Each  $1-\mu g/m3$  increase in 1-year average PM2.5 concentration was associated with a higher risk of metabolic syndrome (hazard ratio/HR: 1.020, 95% confidence interval/CI: 1.017-1.024), waist-based obesity (HR: 1.022, 95% CI: 1.015-1.029), hypertension (HR: 1. 019, 95% CI: 1.015-1.022),

hypertriglyceridemia (HR: 1.025, 95% CI: 1.015-1.028), low HDL-C (HR: 1.017, 95% CI: 1.014-1.020),

and hyperglycemia (HR: 1.016, 95% CI: 1.014-1.019). When PM2.5-Metabolic syndrome association was analyzed according to body mass index (BMI) group and sex, the association between PM2.5 and the risk of metabolic syndrome was significant in men regardless of BMI group. In women, this association was only significant in consistent obese group.

## Conclusions

Exposure to 1-year average PM2.5 is associated with an increased risk of metabolic syndrome and its components in adults without CVD. Such association is significant in men and consistent obese women. Our findings indicate that this association might contribute to increased risk of CVD due to PM2.5.

• Oral (Symposium) : Unexpected health risks associated with air pollution
### Fine particulate matter and hypothyroidism

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#### Background/Aim

Previous experimental and epidemiological researches have been reported to associate that the some chemicals (i.e. polycyclic aromatic hydrocarbons, perfluorinated compounds, persistenc organic pollutants, heavy metals, and so on) disturb thyroid function. However, there has been no epidemiological investigation, in which the particulate matter increase the risk of hypothyroidism. The purpose of this study is to identify the relation between long-term exposure to particulate matter and hypothyroidism in a nationwide cohort.

#### Methods

Through the retrospective cohort study with Korean National Health Information Database, a total number of 301,501 subjects (20 to 85 years old) were enrolled and the research have been performed from January 1, 2007 to December 31, 2013. The PM2.5 average in 2006 and one-year moving average of PM2.5 were estimated by Community Multiscale Air Quality (CMAQ) model. The exposure estimations of PM2.5 were assigned to residential address (district level) of each subject. Cox proportional hazard models were used to examine the association between PM2.5 exposures and hypothyroidism (ICD code: E03.x). For multivariate analyses, sex, age, income, exercise habit, alcohol drinking, and smoking status were adjusted.

#### Results

During 7 years of follow-up, 8974 patients with hypothyroidism occurred. The average of PM2.5 exposed in 2006 for people with hypothyroidism was  $33.2 \ \mu g/m^3$  and for people without hypothyroidism was  $33.0 \ \mu g/m^3$  (p=0.022). The one-year moving average of PM2.5 exposed for people with hypothyroidism was  $28.4 \ \mu g/m^3$  and for people without hypothyroidism was  $28.3 \ \mu g/m^3$  (p<0.001). The PM2.5 average in 2006 was significantly associated with hypothyroidism, where the aHR and 95% CI were 1.004 and 1.000-1.007, respectively. The one-year moving average was significantly associated with hypothyroidism, where the aHR and 95% CI were 1.077 and 1.072-1.082, respectively.

#### Conclusions

To the best of our knowledge, our study is the first to show association between PM2.5 exposure and hypothyroidism. Our findings are of critical public health importance because of the ubiquity of particulate matter and the possibility of long-term health consequences of thyroid function disturbance.

#### Keywords

Particulate matter; hypothyroidism; thyroid function disturbance

#### Oral (Symposium): Unexpected health risks associated with air pollution

## The effect of air pollution on the incidence of tuberculosis among adult

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#### Background/Aim

Environmental factors may play a role in the development of tuberculosis and some studies have shown that ambient air pollution is associated with the development of tuberculosis. The study was designed to investigate the impact of outdoor air pollution on tuberculosis among adult, by using the Kriging data of air pollution.

#### Methods

A nested case-control study was performed using the cohort database during 2002-2013 provided by National Health Insurance Service-National Sample Cohort in Korea. Data of kriging model were collected from the national air pollution monitoring data including PM10, CO, NO2, O3 and SO2. We identified individuals aged 20 and over with tuberculosis during 2013. Individuals who had tuberculosis between 2002-2012 were excluded. A total number of 516 cases with tuberculosis and 2064 controls without tuberculosis were matched by sex and age group. Average concentrations of 1-4 years of air pollution were predicted at each patient's residence.

#### Results

In binary logistic regression analysis, which is adjusted for income level, BMI, smoke habit and drink habit, 2, 3 and 4 years of SO2 exposures were positively associated with the incidence of tuberculosis among adult (OR=1.15, 95% CI: 1.01-1.31 for 2 years average, OR=1.15, 95% CI: 1.01-1.31 for 3 years average, OR=1.16, 95% CI: 1.02-1.33 for 4 years average). Furthermore, we also observed an increased risk for tuberculosis in the second quartile level of NO2. However, concentration levels of PM10, O3 and CO were not associated with tuberculosis.

#### Conclusions

In conclusion, 2-4 years of long-term exposure to SO2 showed significantly increased the risk of tuberculosis in the adult.

# Effect of traffic related air pollution on childhood neurodevelopment at 5 years of age

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#### Objective

To investigate whether performance intelligence quotient (IQ) in children is associated with traffic-related air pollution (TRAP) and greenness during pregnancy.

#### Methods

We used prospective birth cohort data from 697 participants of the Mothers and Children's Environmental Health (MOCEH) study, a multi-center cohort project in Korea. The Wechsler Preschool and Primary Scale of Intelligence- revised edition (WPPSI-R) was used to examine intelligence and neurodevelopment at 60 months of age. Multivariate linear regression analysis was performed to analyze the association between IQ in children and TRAP (satellite AOD-based estimates of PM2.5, PM10 and NO2) and greenness during pregnancy, after adjustment for covariates.

#### Results

TRAP during pregnancy was inversely associated with performance and total IQ, after adjustment for covariates such as sex, educational levels of both parents, family income, and maternal BMI. Green space was associated with cognitive IQ with adjustment for covariates.

#### Conclusions

Childhood neurodevelopment is associated with TRAP and green space during pregnancy. A potential public health policy for expanding green space is needed to protect and improve children' health.

#### Keywords

PM2.5, greenness, neurodevelopment, satellite AOD, IQ, children

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#### Oral (Symposium) : Unexpected health risks associated with air pollution

## 0624\_S8-1

# Legislation on Maternity Protection at Work and Classification of Reproductive Hazards in Japan

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The proportion of female employee in Japan has been increasing constantly during three decades and they have more opportunities of working in manufacturing workplace than before. Hence, the importance of the maternity protection and the risk reduction of reproductive hazards at work has been emphasised. This keynote speech will overview Japanese occupational health polices on maternity protection with some background information regarding the classification of the reproductive toxicity.

There are two important legislations in Japan to provide safe and healthy workplace for female workers in relation to maternity protection. The Act on Securing, etc. of Equal Opportunity and Treatment between Men and Women in Employment explains the promotions of measures to ensure the health of female workers with regard to employment during pregnancy and after childbirth. Labour Standard Act stipulates limitations on dangerous and injurious work for expectant and nursing mothers. The Regulation on Labour Standard for Women stipulates the exact conditions for the protection of female employees based on Labour Standard Act.

Besides, Japan Society for Occupational Health (JSOH) annually announces the classification of chemical substances with adverse effects on the sexual function, the fertility, and the development of offspring based on the reproductive toxicity reported by epidemiological and toxicological studies. This list has significant impact on Japanese government and industrial organisation; however, JSOH sometimes receives criticism from industrial organisations. For example, the classification of di-2-ethylhexyl phthalate as the reproductive toxicant was recently criticised by a chemical company.

These legislations and classifications of reproductive toxicant may play more important roles for the promotion of maternity protection at work in Japan.

## 0624\_S8-2

Prevalence of Abortion and Adverse Pregnancy Outcomes among Working Women in Korea Prof. Chulyong Park (Republic of Korea) Email: ironyong@gmail.com Department of Occupational and Environmental Medicine, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine

Many female workers start their jobs at mid-twenties or early-thirties, which overlap in time with marriage, pregnancy and delivery. There is ongoing trend of low birth rate, increasing rate of hard-to-gestations and infertility problems among eight million female workers in Korea. Moreover, various repro-toxic agents, including suspicious or unknown agents, are affecting workers' reproductive health. Our study aims to investigate epidemiological traits of reproductive problems related with occupations, and accommodate preventive management plan for high risk industries.

We obtained claim data of National Health Insurance from 2011 to 2015 and analyzed to obtain the odd ratio (OR) for abortion and other obstetrical complications. We compared each industry group to non-working female and public administrative workers as a reference group.

We analyzed the data from 2011 to 2015, and found out the industries having steadily higher ORs. In 2013, the OR for miscarriage(spontaneous and missed abortion) of all working female is 1.26(95%CI : 1.23-1.28), which is statistically higher compared to non-working female, i.e., female dependents of the employment-based NHI program. Industry groups showed higher OR for abortion and have over 1,000 cases of abortion were business support services (1.45, 95%CI 1.35-1.56), manufacture of electronic components, computer, radio, television and communication equipment and apparatuses (1.40, 95%CI 1.33-1.48), human health (1.36, 95%CI 1.31-1.41), other manufacturing (1.33, 95%CI 1.24-1.42), and etc. The OR of all female workers compared to non-working female for habitual abortion, threatened abortion, small for gestational age(SGA) and placenta abruption were 1.28 (95%CI 1.21-1.36), 1.40 (95%CI 1.38-1.43), 1.19 (95%CI 1.13-1.26) and 1.28 (95%CI 1.15-1.42),

respectively. The trend that higher rate of abortion in working women than non-working women were continued from 2011 to 2015.

We investigated the epidemiological traits of Korean female workers' reproductive health problems and provided data indicating female workers in several industry groups have higher OR for several reproductive health problems. Finally, we suggested that working status itself might be considered as a risk factor for reproductive health problems, such as abortion, habitual abortion, threatened abortion, SGA and placenta abruption.

### **Risk Assessments for Pregnant Workers in a Workplace : A Taiwan Experience**

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#### Introduction

The **ILO** advocates maternity protections from the hazards within workplaces. In Taiwan, under *Labor Safety and Health Act* and *Regulations for Implementing Maternal Health Protection of Female Workers*, employers have to ensure that the pregnant and lactating women are not exposed to any work-related risks at work, and that the maternity employees' fitness-for-work must be evaluated on the basis of a health assessment.

According to the laws and regulations of Taiwan, the institution managers employing more than 300 workers must provide maternal health protections for all pregnant or breastfeeding mothers during the legislative period, at least one year. All the jobs that may affect the mother's and baby's health during pregnancy or breastfeeding ought to be carefully monitored. In terms of fitness-for-work for the pregnant and breastfeeding mothers, there are three (1<sup>st</sup> to 3<sup>rd</sup>; from lower to higher for safe to dangerous) levels of managements which determined by factory physicians, based on the official exposure standards of hazards and the personal health conditions.

#### **Materials and Methods**

The present data were collected from Occupational Health Service (OHS) records (2012.5.1~ 2018.2.8). Every pregnant-employees-related OHS consultation meeting was held to invite a pregnant mother, an occupational physician, an occupational nurse and a hygienist. The *Guidance for Implementing Maternal Health Protection of Female Workers* was utilized for determining the levels of protections for maternal health factors or work-related factors.

#### Results

Within 2925 OHS-visits, our team conducted a total of 502 person-times of pregnant employees consults. There was a 7% factor (5% 2<sup>nd</sup>-level, 2% 3<sup>rd</sup>-level) recognized as work-related.

#### Discussion

In accordance with the **precautionary principle**, both absolute risk and relative risk should be disclosed in detail to employees and managers; and we required higher levels of action and management for unknown risk factors and incompletely reported risk factors. We suggest that the responsibility of both managers and employees in work and health maintenance be fully discussed in the consultation of OHS.

## 0624\_S9-2

#### Protect the Future: Laws and Practices on Maternity Protection at Work in Taiwan

Female participation in the labor force has been increasing steadily worldwide over the last few decades; in 2015, more than half of working-age women in the USA, the UK, Germany, Singapore, and Taiwan were in the labor force. As more women of reproductive age enter labor forces, their safety and health have become a priority in many nations. Changes in body shape and physiological condition during pregnancy may increase susceptibility to occupational hazards such as radiation, repetitive work, heavy metal exposure, and long working hours. Therefore, pregnant women need additional care and protection in the workplace. In Taiwan, many laws and regulations have been established to ensure pregnancy/maternity protection at workplace. Occupational Safety and Health Act and Maternity Protection Regulations state that employers shall conduct hazard assessments and prevent pregnant workers from performing jobs that are potentially hazardous to maternal health, including exposures to chemical, physical, and biological agents, industrial processes, movements and postures, and physical and mental stress. Pregnant employees are entitled to maternity leave and non-night shift schedule under Labor Standards Act and Act of Gender Equality in Employment. In today's speech, we will go over these laws and regulations in more details.

## Overview of Study Design and Method on Taiwan Maternal and Infant Cohort Study (TMICS): Current Status and Future Perspectives

## <sup>1</sup>Ming-Tsang Wu,

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## **Background/Aim**

In 2011, news broke in Taiwan that phthalates, especially di-(2-ethylhexyl) phthalate (DEHP), were deliberately added to a variety of foods commonly consumed by children there. In response, epidemiologists from northern, central, southern and eastern Taiwan established a birth cohort consortium and conducted a nationwide prospective birth cohort study known as the Taiwan Maternal & Infant Cohort Study (TMICS) to investigate environmental phthalate exposure and its effects on maternal and child health.

## Methods

Between October 2012 and May 2015, 1631 pregnant women in their third trimester from nine hospitals located in northern (n = 3), central (n = 3), southern (n = 2), and eastern Taiwan (n = 1) were recruited. Phenotype and environmental data include: Self-completed mother and newborn questionnaires and clinical assessment; biological samples such as blood, urine, amniotic fluid, placenta, cord blood, and baby meconium at delivery; and breast milk samples at two to five weeks post-delivery etc. Form October, 2016, we started to collect different biological specimens from the mothers and their offspring when their children turned three years old.

## Results

Study pregnant women had a mean age ( $\pm$  SD) of 31.38 ( $\pm$  4.56) years. Later, the male/female ratio of their newborns was found to be about 1: 1. The concentrations of urinary phthalate metabolites in pregnant women were lower than those reported by previous studies from Taiwan, suggesting the phthalate exposures in general population significantly decreased after the 2011 phthalate food scandal.

## Conclusions

The TMICS cohort is the first to cover a large sample size of study sites in Taiwan's four major areas (north, central, south, and east). Besides the anticipated results of urinary phthalate metabolites, the future goal is to analyse other environmental hazards such as organophosphate pesticides, nonylphenol, bisphenol A, heavy metals, melamine and acrylamide etc. to increase the value of this cohort.

## Acknowledgement:

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## Exposure determinants of phthalates among pregnant women in Taiwan

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#### **Background/Aim**

Phthalates are a group of high-production-volume synthetic chemicals with widespread human exposure because of their common use in primary plasticizers for polyvinyl chloride and solvents in personal care products. The aim is to explore the exposure determinants of phthalates among pregnant women in Taiwan.

#### Methods

In years 2012-2015, we conducted a birth cohort study named the Taiwan Mother Infant Cohort Study in Taiwan. We had recruited study population in northern, central, southern, and eastern Taiwan in 9 collaborative medical centers and/or hospitals between. A total of 1676 pregnancy women were recruited in this study. We only included participants if they contributed more than two urine samples and completed the questionnaire. This study includes 281 participants whom contributed 635 urine samples. Maternal urine samples collected during pregnancy were analyzed for 11 phthalate metabolites. We collected their behavior information about personal care products and food containers use with urinary phthalate metabolite concentrations was assessed using linear mixed models.

#### Results

Levels of several phthalate metabolites were significantly associated with the use of PCPs, especially leave-on PCPs. The mono-ethyl phthalate (MEP) was significantly associations with increasing

frequencies of use of skin toners ( $\beta$ =0.46, 95% CI=0.08-0.84) and lipsticks ( $\beta$ =0.55, 95% CI=0.14-0.95). Additionally, a significant positive trend was found regarding the number of leave-on PCPs used and the measured change in MEP concentrations (p for trend=0.0402). The concentration of DEHP was positively associated with use of plastic food containers ( $\beta$ =0.22, 95% CI=0.02-0.41).

#### Conclusions

These results indicate the use of leave-on PCPs is the more probable source of phthalate exposure in contrast to use of rinse-off PCPs. These finding can be utilized to prevent pregnant women from excess exposures to phthalates in the future.

## Prenatal phthalate exposure and birth outcomes: a nationwide survey by Taiwan Maternal and Infant Cohort Study (TMICS).

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#### Background/Aim

Phthalates, also called phthalic acid esters (PAEs), are ubiquitous chemicals and known endocrine disruptors that are widely used in several products. In 2011, tainted food scandal was reported that the plasticizers (especially di(2-ethylhexyl)phthalate, DEHP) were adulterated as a clouding agent into beverages (juice, sport drinks and tea), fruit jams/jelly, and dietary supplements in Taiwan. The Taiwan Maternal and Infant Cohort Study (TMICS) was launched to assess the effects of prenatal exposure to PAEs on infant health.

#### Methods

A total of 1121 pregnant women were enrolled in this study from 2012 to 2016. All participants completed a structured questionnaire and their urine specimens were collected. The urinary concentrations of PAEs metabolites in the third-trimester were measured using ultra-performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS). The average daily intake (DI) of PAEs was also estimated.

Generalized additive model-penalized regression splines and a multivariable regression model were employed to determine the effects of PAEs exposure on birth outcomes.

#### Results

The mean DI of DEHP was  $3.43\pm5.26$  µg/kg body weight/day. The percentage of pregnant women who exceeded tolerable daily intake (TDI) and reference dose (Rfd) was 1.61% and 0.27% respectively. In the penalized regression splines, a downward curvature was observed between the Mono-n-butyl phthalate (MnBP) level and male neonatal body weight. A dose-response relationship also existed between MnBP and low birth weight (LBW) or small for gestational age (SGA). The odds ratio (OR) of low birth weight was 2.84 (0.43-18.74), 7.07 (1.13-44.11), and 8.90 (1.17-68.02) for pregnant women who had low (25th

%ile-50th %ile), median (50th %ile-75th %ile), and high (>75th %ile) MnBP levels.

#### Conclusions

This study indicated that maternal high PAEs exposure in the third trimester was associated with LBW or SGA in male neonates. Adverse effects on susceptible population who has been exposed to high levels of PAEs should be a concern.

# Associations of maternal urine levels of phthalate metabolites with newborns' sex hormones.

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### **Background/Aim:**

Environmental exposure to phthalate has been demonstrated to induce endocrine disruption, and Di-2-ethylhexyl phthalate (DEHP) is an established developmental and reproductive toxicant. However, the effect of maternal phthalate exposure on fetus sex hormones is still unclear. The purpose of this study is to explore the association between maternal phthalate exposure and newborns' sexual steroid hormones in general population.

## Methods:

Among 1,631 pregnant women enrolled in the Taiwan Maternal and Infant Cohort Study (TMICS) between October 2012 and May 2015, we included a total of 632 mother-infant pairs with relevant measurements in this study. Nine phthalate metabolites in maternal urine were measured by liquid chromatography/electrospray tandem mass spectrometry (LC–ESI-MS/MS), and 10 sex steroid hormones in cord blood were determined using Electrochemiluminescence immunoassay (ECLIA). The sum of DEHP was calculated based on nanomolar concentrations of each metabolite. Linear regression analysis was separately performed for male and female newborns, which were conducted to relate tertiles of phthalate metabolite levels and cord blood levels of sex hormones.

## **Results:**

After adjustment for parity and several maternal characteristics (including age, frequency of physical activity, education level, body mass index), no significant association was found between mother's phthalate metabolites and cord blood level of sex hormones in female newborns. However, analyses in male newborns showed that increased cord blood level of progesterone was associated with decreased maternal urine levels of mono(2-ethyl-5- hydroxyhexyl) phthalate (MEHHP), mono-(2-ethyl-5- oxohexyl) phthalate

(MEOHP), mono(2-ethyl-5-carboxypentyl) phthalate (MECPP), and  $\Sigma$ DEHP (*p* for trend was 0.012, 0.025, 0.012, and 0.046, respectively); increased level of follicle-stimulating hormone (FSH) in cord blood was associated with decreased levels of (MEP) and mono-n-butyl phthalate (MnBP) (*p* for trend was 0.004 and 0.025) in mothers; and core blood level of insulin-like growth factor (IGF) was positively associated with mono-ethyl phthalate (MEP) in mothers (*p* for trend = 0.010).

## **Conclusions:**

Our findings suggest that maternal exposure to DEHP may associate with decreased cord blood level of progesterone and FSH, and increased level of IGF in male newborns.

### Air Pollution during Pregnancy and Allergic Sensitization at Birth

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#### Background/Aim

The prevalence of childhood allergic diseases has been increased over the past two decades in Taiwan. It has been suggested that environmental contaminants or exposures may contribute to these disease etiology. Cumulative studies have shown that air pollution exposure during childhood is associated with the development of allergic diseases such as asthma. However, little is known about whether air pollution during pregnancy may influence fetal immune system. Here, by utilizing a prospective birth cohort study (the Taiwan Maternal and Infant Cohort Study (TMICS)), we aim to investigate whether ambient air pollution exposure during pregnancy is associated with cord blood immunoglobulin E (IgE) concentration.

#### Methods

The TMICS recruited approximately 2000 mother–infant pairs in Taiwan and collected extensive information on environmental exposure data, maternal lifestyle during pregnancy, and neurobehavioral test of newborn. Maternal specimens, including urine and blood during pregnancy, and cord blood were also collected. We used quantile-based Bayesian maximum entropy model, to estimate trimesters and entire pregnancy criteria ambient air pollution exposures. Based on logistic regression models we estimated odds ratios (ORs) and 95% confidence intervals (CIs) of air pollutant exposures during pregnancy and concentration of cord blood IgE.

#### Results

The median of cord blood IgE was 0.39 KU/L. In multi-pollutant model (i.e., model also adjusted for other pollutants), the first trimester PM2.5 exposure was positive associated with cord blood IgE concentration.

#### Conclusions

This birth cohort study suggests that traffic related pollutants such as PM2.5 exposure during pregnancy may influence fetal immune system development, which may contribute to increased risk of developing allergic diseases in childhood.

## Phthalate Exposure among Pregnant Women in Project Jeebon--A Prospective Birth Cohort in Bangladesh

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**Background/Aim**: Project Jeebon is a prospective birth cohort with 1614 pregnant women in Siradjdihand and Pabna Sadar Upzilas of Bangladesh. phthalate exposure among pregnant women had never been evaluated before in Bangladesh. This study aimed to assess urinary phthalate metabolites level and characterize the phthalate exposure profile.

**Methods**: Third trimester urine were obtained from pregnant women enrolled in Project Jeebon. The metabolites of di-ethyl-hexyl phthalate [DEPH], including monoester metabolites (mono-2-ethylhexyl phthalate [MEHP], mono(2-ethyl-5-oxohexyl) phthalate [MEOHP], mono(2-ethyl-5-carboxypentyl) phthalate [MECPP], mono(2-carboxymethylhexyl) phthalate [MCMHP] and mono(2-ethyl-5- hydroxyhexyl) phthalate [MEHP], as well as biomarkers representative of other commonly used phthalates, including mono-benzyl phthalate [MBzP], mono-butyl phthalate [MBP], mono-ethylphthalate [MEP], mono-isobutyl phthalate [MBP], and mono-methylphthalate [MBP], were measured using liquid chromatography-electrospray ionization-tandem mass spectrometry. Urinary phthalate biomarker level were assessed using descriptive analysis stratified by demographic characteristics, and geometric means and standard error of the metabolites level were presented.

**Results**: Among the 487 samples analyzed to this date, the detection rate ranged from 52.8% to99.8%, with MEHHP, MECPP, MEHP, and MCMHP being the highest and MBzP being the lowest. The phthalate metabolites level were the highest for MEP (GM=9.8 ppb, 95% CI=8.7-11. ppb) and lowest for MBzP (GM=0.8 ppb, 95% CI=0.8-0.9 ppb). Overall exposure levels among pregnant women in Bangladesh were lower compared to levels found in pregnant women enrolled in the Taiwan Maternal and Infant Cohort Study (TMICS).

**Conclusions**: This is the first study to examine the phthalate exposure levels among pregnant women in Bangladesh. The result can be used for future evaluation on the association between phthalate exposure and reproductive health outcome. We also plan to use the result to validate findings from other birth cohorts in Asia.

# Effect of ambient fine particles, extreme temperatures and the interactions on preterm birth

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#### Background/Aim

To quantitatively evaluate the effect of fine particles ( $PM_{2.5}$ ) in Beijing Tongzhou District on preterm birth and to explore the interactive effect between  $PM_{2.5}$  and extreme temperatures on preterm birth.

#### Methods

We collected birth records of 13 hospitals, air pollutant and meteorological data from January 1, 2013 to December 31, 2015 in Tongzhou District, Beijing. Extended Cox proportional hazard regression models with time-dependent covariates were performed to assess the effects of PM<sub>2.5</sub> and ambient extreme temperatures and their interactive effect on preterm birth.

#### Results

 $PM_{2.5}$  was significantly associated with preterm birth. For every  $10\mu g/m^3$  increase in  $PM_{2.5}$  mass concentration, the OR value was 1.0043 (95%CI: 1.0002,1.0084). Extreme low temperatures were significantly associated with preterm birth. With a 1.0°C decrease in extreme low temperature, OR value was 1.3163 (95%CI: 1.1713, 1.4792). The protective effect of extreme high temperatures on preterm birth was statistically significant. With a 1.0°C increase in extreme high temperature, OR value was 0.8710 (95%CI: 0.8182, 0.9271). There were significant interactive effects between ambient  $PM_{2.5}$  and extreme temperatures on preterm birth (p<0.05).

#### Conclusions

Ambient  $PM_{2.5}$  exposure during pregnancy was significantly associated with preterm birth in Tongzhou District, Beijing. Extreme low temperatures also had a significant positive correlation with preterm birth. There are significant interactive effects between ambient  $PM_{2.5}$  and extreme temperatures on preterm birth. This study will provide some methodological support, and may also shed a new light on preventing the birth-related hazards of  $PM_{2.5}$  and extreme temperatures exposure.

## **Risk for Recurrent Spontaneous Abortion in Relation to Phthalates Exposure in Taiwanese Reproductive-aged Women: A Case-Control Study.**

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#### Background

Recurrent spontaneous abortion (RSA) is the termination of pregnancies, usually before 20 weeks of gestation. Studies reported that phthalates might be involved in the pathogenesis of RSA, and that Taiwan's reproductive-aged women still expose to high levels of DEHP and DBP than other age groups after 2011 DEHP episode in Taiwan.

#### Aim

We assessed the exposure and risk of phthalates in Taiwanese women with RSA.

#### Methods

Between August 2013 and August 2017, we recruited 103 RSA patients and 76 controls from the obstetrics and gynecology department of a hospital in southern Taiwan. Urine samples were analyzed for

11 phthalate metabolites through liquid chromatography-tandem mass spectrometry; subsequently, principal component analysis (PCA) and agglomerative hierarchical clustering analysis were performed to determine the main sources of phthalate exposure. Finally, multivariate logistic regression was used to determine the RSA risk.

#### Results

The creatinine-unadjusted (ng/mL) median levels of mono-n-butyl phthalate (MnBP), mono-iso-butyl phthalate (MiBP), mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), and mono-(2-ethyl-5-carboxypentyl) phthalate (MECPP) were 27.2, 9.8, 11.4, and 12.9 ng/mL, respectively, in women with RSA and 13.1, 5.3, 8.1, and 9.5 ng/mL, respectively, in control women; furthermore,  $\Sigma DBP$  and  $\Sigma DEHP$  were 0.18 and 0.15 nmol/mL, respectively, in women with RSA and 0.10 and 0.12 nmol/mL, respectively, in control women. PCA revealed three primary components of phthalate exposure: diethyl phthalates (DEP), DBP, and DEHP. Plastic food container use and medication use were identified as the main phthalate exposure sources. After adjustment for potential confounding factors (creatinine, age, age at menarche, educational level, plastic food container use, and food preservation bag use), we observed significantly high adjusted odds ratios for RSA: 3.15 (p= 0.034), 3.31 (p= 0.035), and 2.57 (p= 0.074) in the third tertile for MiBP,  $\Sigma DEHP$ , and  $\Sigma DBP$ , respectively.

#### Conclusions

Our findings suggested that exposure to certain phthalates increases RSA risk in Taiwanese women possibly have an effect on the early development of implantation. Large and mechanistic studies are needed to elucidate the association.

## Association between organochlorine pesticide levels in Taiwanese breast milk and their reproductive effects

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#### Background/Aim

Human exposure to organochlorine pesticides (OCPs) has been studied in correlation to reproductive disruptions. However, few studies have focused on the associations between human exposure to OCPs and female reproduction in Taiwan. Our goal is to examine breast-milk OCPs and their associations with female infertility and gynecological diseases.

#### Methods

The breast milk samples were collected in southern Taiwan (n = 68) from 2013 to 2016. The OCP residues in the breast milk were analyzed using high resolution gas chromatography with low resolution mass spectrometry (HRGC/LRMS) after extraction, concentration, and cleanup.

#### Results

OCP The results show that the most abundant residue in the breast milk was 4,4'-dichlorodiphenyltrichloroethylene (4,4'-DDE), with a geometric mean $\pm$  standard deviation of 8.07  $\pm$ 6.53 ngg-1 lipid-1. Certain OCP residues were significantly associated with demographic parameters, including age, pre-pregnant body mass index (BMI), annual incomes, population, birth year, and parity (p

< 0.05). The logistic regression showed that the odds ratio (OR) of log  $\gamma$ -hexachlorocyclohexane ( $\gamma$ -HCH) was higher for mothers who received medical treatment for infertility than for the normal group (OR = 25.6, p = 0.035) after the adjustments of age, pre-pregnant BMI, annual income, population (i.e., native-born Taiwanese), birth year, and parity. In principal component analysis, cis-chlordane (cis-CHL) and  $\gamma$ -HCH were found to be related to participants who received medical treatment for infertility and 4,4'-DDT was associated with those who received gynecological surgery.

#### Conclusions

Among the investigated OCPs, HCH exhibited a probable association with infertility diseases for Taiwanese women.

Keywords: organochlorine pesticides; breast milk; breast-feeding; infertility; female reproduction

## 0624\_S11-4

# Organohosphate flame retardants in house dust and their association with school children's asthma and allergies

## Atsuko Araki

Background/Aim: Organophosphate flame retardants (PFRs) are used as additives as flame retardants and plasticizers, and are present in residential dust. We have reported the association between TCIPP and TDCIPP levels and prevalence of atopic dermatitis among inhabitants. There was no study examined the associations among children, who are more vulnerable to chemical exposure. In this study, we aimed to find association between PFRs and asthma and allergic symptoms among children,

Methods: Hundred and twenty-eight elementally school children in Sapporo participated this study. We visited children's home and dust samples were collected from multi-surface objects > 35 cm above the floor in 2009 and 2010. Eleven PFRs in dust were measured by GCMS. Wheeze, rhino-conjunctivitis and eczema were evaluated using ISAAC. The odds ratio (OR) of loge transformed dust concentration was calculated by logistic regression model, and adjusted for sex, grade, dampness index, annual house income, and parent history of allergy. Categorical model was also examined by quartile (detection frequency > 75%), tertile (detection frequency <50%).

Results: Prevalence of wheeze, rhino-conjunctivitis, and eczema were 22.7%, 36.7%, and 28.1%, respectively. Among 11 PFR, TBOEP was the highest median concentration (detection

% >LOD), 26.55  $\mu$ g/g (95.3%), followed by TPhP 3.13  $\mu$ g/g (94.4%). Detection percentage of TMP, TEP, TEHP and TCP were lower than 10% so that no further analysis was conducted. A significant associations between TDCIPP and eczema were found: OR (95% conficence interval) per loge unit was 1.44(1.13-1.82), and for > LOD (vs <LOD) was 3.92(1.37-11.21).

Conclusions: Similar to this study, TDCIPP showed significant association with increasing atopic dermatitis in our previous study conducted at 6 regions in Japan. The results of two different populations are in line, so that these association are likely to be true. On the other hands, cross-sectional study do not suggest the causal relationship, and relatively low detection percentage of TDCIPP in this study should be cautioned.

## 0624\_S12-1

## Children's specific exposure factor: how are they derived, what are the data gap?

## Xiaoli Duan

Health risks from exposure to environmental pollutants are not only determined by the pollution level and toxicity, but also strictly related to human exposure related activity The purpose of this research is to study the Chinese children's environmental patterns. exposure related activity patterns, so as to provide necessary information for the first Children's Exposure factors handbook and epidemiology studies. The multi-stage cluster random sampling method was used in this survey, with consideration of economic situation, rural/urban status, gender and age as stratified factors. A total of 75519 subjects aged from 0 to 17 years old from 316 schools in 165 villages, 55 counties, 30 provinces in China were recruited. Face to face questionnaires by trained surveyors were used to obtain their indoor/outdoor retention time, bathing/showering time, soil contact time, etc. The quality assurance and quality control measures are conducted through all the process. Unified QA/QC protocol was obeyed through all the process in every field sites. Responding rate is 97.2%. Questionnaire recovery rate is 100%. Chinese children's environmental exposure related activity patterns are different within different age, gender, rural/urban and regional groups. Inhalation exposure composite coefficient is 1.1~2.5 time of the adults. Water exposure composite coefficient is 1.2~2.7 time of the adults. Chinese children are facing both traditional and modern environmental health problems. There are 26.8% children still live in households using solid fuel for cooking and heating. There're 13.6% children live in residential area where high risk manufactures like petrol, coke are within 1km. There're 14.6% children whose playground is near highways within 50km. There activities are significant related to educational background of parents, economic status etc. This is the first national wide study for Chinese children's environmental exposure related activity patterns. Uncertainty in environmental health risk assessment may be decreased by accurate exposure factors. Both modern and traditional problems should be focused.

#### Children's exposure measurements for birth cohort studies

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Since May 2015, we have launched the Korean CHildren's ENvironmental health Study (Ko-CHENS), the national birth cohort study. Ko-CHENS's object is to find scientific evidences between exposure of hazardous chemicals and health outcomes and to establish an environmental health policy to protect children's health. We have recruited about 40,000 pregnant women and have been conducting follow-up studies with children aged 6, 12, 24 months. By 2019, a total of 70,000 pregnant women will be recruited.

In general, pregnant women and children are exposed to numerous hazardous chemicals in various ways during their daily lives. Therefore, in order to confirm exposure of environmentally harmful chemicals to them, various analysis attempts are needed.

First of all, it is possible to collect biological samples such as blood and urine by direct confirmation method from pregnant women and their child and analysis the harmful substances contained in these biological samples. In Ko-CHENS study, some blood heavy metals such as lead, mercury and cadmium, urine phthalate metabolites, bisphenols, and cotinine are analysed. Since the volume of biological samples that can be collected is limited, it is very important to develop a method for simultaneous analysis of various hazardous chemicals using a smaller amount of biological sample. So, we are currently developing methods for the simultaneous analysis of persistent organic compounds such as PBDEs, PCBs, OCPs, PFCs using blood or serum of several hundred microliters.

In addition, new biological samples should be tested in terms of the total exposure of hazardous chemicals, and in our study, we are investigation the possibility of milk teeth as a candidate new biomarker. However, there are some problems to be solved such as proper storage method, pre-treatment method, and structural separation of teeth according to exposure periods from prenatal period.

Since 2020, Ko-CHENS study is planning to analyse hazardous chemicals such as persistent organic compounds by using new simultaneous analysis method and cryogenic storage biological samples. And we will also collect milk teeth through a follow-up study of 5,000 children. The development of these new analytical methods and the search for new biomarkers are expected to help create scientific evidence in assessing the impact of exposure to environmentally hazardous chemicals on children'shealth.

## 0624\_S12-3

#### Pesticides exposure measurements using urine samples from infants and toddlers

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#### Background/Aim

Exposure measurement is necessary for risk assessment. Biological monitoring (BM) using urine reveals overall exposure of individual study participants to pesticides coming from all sources and via all pathways. However, urine sampling in infants and toddlers before toilet training in epidemiological studies is challenging. This is why reports regarding their exposure levels to insecticides were limited. This presentation introduces our BM methods using disposable diapers and the urinary concentrations of insecticide metabolites in Japanese infants and toddlers.

#### Methods

We established the urine extraction method from diapers using acetone and applied the method to a birth cohort study called Japan Environment and Children's Study (JECS). We recruited the diapered participants of Aichi Regional subcohort of JECS when they became 1.5 and 3 years old between June 2015 and September 2017. Six urinary dialkylphosphates (DAPs) and creatinine (Cr) were analyzed by ultra-performance liquid chromatography with tandem mass spectrometry.

#### Results

Six hundred ninety-one children were enrolled both at 1.5 and 3 years. The median concentrations (nmol/g Cr) of the urinary total dimethylalkylphosphates ( $\Sigma$ DMAP), total diethylalkylphosphates ( $\Sigma$ DEAP), and total DAPs ( $\Sigma$ DAP) were 157.6, 54.7, and 249.2 in 1.5-year-old children and 177.1, 67.5, and 258.1 in 3-year-old children, respectively. Reproducibility of exposure categories at both ages classified using quartile DAP concentrations was poor. The medians of  $\Sigma$ DAP concentrations in each season (nmol/g Cr) at 1.5 and 3 years old were 199.4 and 213.2 for spring, 235.5 and 270.6 for summer, 340.5 and 506.1 for fall, and 239.6 and 257.3 for winter, respectively. The concentrations in fall at both ages were higher than those in other seasons (p<0.05 except for a difference between fall and winter at 1.5 years old).

#### Conclusions

## 0624\_S12-3

The OP exposure levels in Japanese young children were revealed. Seasons contributed to the levels.

# The exposomics approach to explore children's health effects in the vicinity of a petrochemical complex

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#### Background/Aim

Petrochemical complex is usually a consortium of high-pollution facilities that emit multiple air toxics which can induce common complex diseases. However, it is not easy to evaluate the complex association between petrochemical related air toxics and potential health effects on nearby communities, especially for children who are more susceptible to the pollutants exposure because of their immature physical development and higher inhalation of air per unit time. Hence, we apply the concept of exposome to explore the children's health effects in the vicinity of a petrochemical complex.

#### Methods

First, we recruited a total of 587 children and observed the influence of incidence rates of allergic rhinitis, bronchitis and asthma by linking the Taiwan Health Insurance Database with the long-term SO<sub>2</sub> pollution. Second, we classified 40 high vs. 70 low exposure children subjects to estimate external exposure and measured internal exposure and early effect biomarker levels in urine. And, we explore the urine metabolomics to identify potential metabolites for linking plausible exposures-related pathways. Third, we recruited 168 children and conducted FFQ survey and analyze heavy metals and biomarkers for oxidative stress in urine to assess the protective effect of antioxidant dietary on environmental pollutions.

#### Results

First, children living in the vicinity of a petrochemical complex were exposed to significantly higher levels of SO<sub>2</sub> and had significantly higher incidences of allergic rhinitis, bronchitis and asthma more than 4 years after the petrochemical complex began operating. Second, urine metabolomics in children subjects identified biological pathways, including tryptophan metabolism and phenylalanine metabolism that could associate multiple exposures with oxidative stress. Third, the children dietary intake of antioxidants might be not enough to protect this population from urinary oxidative damage when exposure to the polluted environment.

#### Conclusions

We clarify the health effects of children in the vicinity of a petrochemical complex by applying different exposomics approach.

## 0622\_O1-1

## The effects of climate and air pollution on people with chronic lung disease in Australia

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## BACKGROUND

While the deleterious effects of excessively cold and hot temperatures are well-documented in the general population, there is little evidence specific to people with cystic fibrosis (CF). We assessed the role of climate and air pollution on respiratory exacerbations using the Australian CF data registry.

## METHODS

We obtained de-identified registry data on Australian children and adults with CF during 2006-11. We linked their residential postcode to long-term climatological data, a national satellite-based model for nitrogen dioxide (NO2) exposure, remoteness categories, and indices of socio-economic advantage and disadvantage. We used negative binomial regression with generalised estimating equations to account for repeated measures per person, and assessed the association between temperature and the relative risk (RR) of respiratory admission episodes (as a proxy for respiratory exacerbations).

## RESULTS

There were 3,553 individuals with 17,868 person-years of records over 2006–2011, and postcodes were available for 73.2% of records. We adjusted for age, sex, Pseudomonas infection, pancreatic insufficiency, macrolide use, remoteness, distance to clinic, and socio-economic status. We found a 28% increase in the relative risk of respiratory episodes in the highest compared with the lowest mean daily temperature quintile (95% CI: 1.16, 1.49). We observed a protective effect in the third quintile (RR = 0.83, 95% CI: 0.73, 0.94). We found no significant associations with NO2 exposure.

## CONCLUSIONS

We found evidence that the association between temperature and respiratory exacerbations in people with CF may be non-linear. Given Australia's diverse and changing climates, clinicians and patients should be aware of the risks associated with higher temperatures.

## Climate Change and Temperature Rise: Implications on Food Poisoning Cases in Malaysia

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Background/Aim : This study is an attempt to quantify climate-induced increases in morbidity rates of food poisoning cases.

Methods: Monthly food poisoning cases and average monthly meteorological data from 2004 to 2014 were obtained from the Malaysian Ministry of Health and Malaysian Meteorological Department, respectively. Population projections in Malaysia, up to the year 2040 were adopted from the Malaysian Department of Statistics and modified to the year 2100. The PRECIS model was used to project future climate up to the year 2100 under the A1B scenario. Poisson generalized linear models were developed to quantify the relationship between climatic parameters and the number of reported food poisoning cases in the future.

Results : The findings revealed that the total number of food poisoning cases in Malaysia during the 11 years study period was 134,820 cases with 46 deaths. The mean age of the patients was  $20\pm18$  years. Half of the cases were among the ages of 13-24 years old. Among the cases, 98.2% were Malaysians and 55.7% were females. The PRECIS model projection under the A1B scenario showed that the surface temperature in Malaysia has a monotonic increment for all states with slightly higher warming rates over the Southern and Northern regions, with an increase of more than 3.0 °C towards the end of the 21<sup>st</sup> century. Temperature gave a significant impact on the incidence of food poisoning cases in Selangor (p<0.001), Melaka (p<0.001), and Kelantan (p<0.001). For a 1.0°C increase in temperature, the excess risk of food poisoning in each state will increase up to 56.4%.

Conclusion: The study concludes that climate does affect the distribution of food poisoning cases in Selangor, Melaka, and Kelantan. Food poisoning cases in other states are not directly associated with temperature but related to long term trends and seasonality.

## Ambient Temperature and Cardiovascular Biomarkers in A Panel of Healthy Adults

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#### Background/Aim

Associations of ambient temperature with cardiovascular morbidity and mortality have been well documented in numerous epidemiological studies, but the underlying pathways remain unclear. We investigated whether systemic inflammation, coagulation, systemic oxidative stress, antioxidant activity and endothelial function may be the mechanistic pathways associated with ambient temperature.

#### Methods

Forty study participants underwent repeated blood collections for 12 times in Beijing, China in 2010-2011. Ambient temperature and air pollution data were measured in central monitors close to student residences. We created five indices as the sum of weighted biomarker percentiles to represent the overall levels of 15 cardiovascular biomarkers in five pathways (systemic inflammation: hs-CRP, TNF- $\alpha$  and fibrinogen; coagulation: fibrinogen, PAI-1, tPA, vWF and sP-selectin; systemic oxidative stress:

Ox-LDL and sCD36: antioxidant activity: EC-SOD and GPX1; and endothelial function: ET-1,E-selectin, ICAM-1 and VCAM-1). We used generalized mixed-effects models to estimate temperature effects controlling for air pollution and other covariates.

#### Results

There were significant decreasing trends in the adjusted means of biomarker indices over the lowest to the highest quartiles of daily temperatures before blood collection. A 10 °C decrease at 2-d average daily temperature were associated with increases of 2.5% [95% confidence interval (CI): 0.7, 4.2], 1.6% (95%

CI: 0.1, 3.1), 2.7% (95% CI: 0.5, 4.8), 5.5% (95% CI: 3.8, 7.3) and 2.0% (95% CI: 0.3, 3.8) in the indices for systemic inflammation, coagulation, systemic oxidative stress, antioxidant activity and endothelial function, respectively. In contrast, the associations between ambient temperature and individual biomarkers had substantial variation in magnitude and strength.

#### Conclusions

The altered cardiovascular biomarker profiles in healthy adults associated with ambient temperature changes may help explain the temperature-related cardiovascular morbidity and mortality. The biomarker index approach may serve as a novel tool to capture ambient temperatureeffects.

## Drought and distress by age, gender and farming: findings from southeastern Australia.

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Background: Droughts may increase the risk of mental health problems, but evidence suggests a complex story with some groups being vulnerable while others are not. Previous studies from Australia have found associations with suicide, depression and distress that vary by age, gender and remoteness. Understanding the effects of drought on mental health is important because drought is predicted to be more intense in some areas in the future. We investigated the associations between drought and distress in a survey of rural Australians by age, gender and farming status.

Methods: We collected distress data using a survey of 5,312 people from across the state of Victoria, Australia, in 2015. Respondents completed the Kessler 10 (K10) psychological distress index, and demographic and general health data were collected. We linked a climatic drought index to the locality of residence of respondents. Associations between distress and drought were analyzed using multi-variable regression models with interactions by age, gender and farming occupation.

Results: Parts of Victoria were in drought in 2015. Drought duration was associated with higher distress in younger rural women (aged 40–54: odds ratio 1.18 per Inter-Quartile Range (IQR) increase of drought duration) but not older rural women or men. This pattern did not vary between farmers and non-farmers.

Conclusions: Drought was associated with increased distress, but this differed between subgroups. Our results suggest that supporting younger women may be particularly important, and understanding ways older Australian rural women cope may enable us to build adaptive capacity and resilience.

## Arsenic Exposure from Rice Among a Cohort of Adolescents in Kunming, China

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#### **Background/Aim:**

It has been well documented that inorganic arsenic (As<sub>i</sub>) is associated with various cancers. Dietary exposure to As<sub>i</sub> is concerning among adolescents who are still developing and often eat more calories per unit body weight than adults. The aim of this study was to assess As<sub>i</sub> exposure from rice among adolescents living in Kunming, China and to evaluate their potential As<sub>i</sub>-related cancer risks.

#### Methods:

300 adolescents (15-18 years, 44.5% males and 55.5% females) were recruited from two Kunming high schools in 2015. Adolescents completed food frequency questionnaires which were used to estimate average daily consumption (ADC) of rice. Rice samples obtained from 6 Kunming markets that varied in price and location were sent to a commercial lab for analysis. Estimated daily intake (EDI) of As<sub>i</sub> from rice was calculated using ADC, average concentration (AC) of As<sub>i</sub> in sampled rice, and average body weight (BW). Lifetime Cancer Risk (LCR) was calculated using EDI and the U.S. EPA derived As<sub>i</sub> oral slope factor.

#### **Results:**

The average BW and ADC of rice were 60.8 kg (range 34.8-177.6 kg; SD 15.5 kg) and 124 g/day, respectively. The AC in the sampled rice was 0.058 mg/kg (range 0.045-0.076 mg/kg; SD 0.012 mg/kg). EDI was estimated to be  $1.2x10^{-4}$  mg/kg-BW/day (range  $5.3x10^{-5}$ - $1.6x10^{-4}$  mg/kg-BW/day). The calculated LCR for the cohort was  $1.8x10^{-4}$  (range  $8.0x10^{-5}$ - $2.4x10^{-4}$ ), and 80% of the participants were above the upper limit of the U.S. EPA LCR of  $1x10^{-6}$ - $1x10^{-4}$ .

#### **Conclusions:**

While the AC in the sampled rice was below the Chinese maximum contaminant level of 0.2 mg/kg, studyresults indicated that Kunming adolescents may be exposed to high levels of As<sub>i</sub>. These estimated risks suggest the need for monitoring of As<sub>i</sub> in rice, biomonitoring of high-risk populations and more precise risk assessment and public awareness of the health impact of As<sub>i</sub>.

## Assessment of Heavy Metal Concentrations in Road Dusts Around The City of Kuala Lumpur.

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This study aimed to assess the concentrations and health effect of heavy metals (Cd, Cu, Cr, Ni, Pb and Zn) in road dust of selected locations in the city of Kuala Lumpur. Sampling was conducted for three times at four locations namely Jalan Tun Razak, Jalan Raja Abdullah, Jalan TAR and Jalan Ayer Molek. The concentration of heavy metals in road dust was analyzed by using ICP-MS. The study found that Jalan TAR has the highest concentrations for the heavy metals Cd  $(0.23 \pm 0.04 \text{ mg/kg})$ , Cu  $(116.39 \pm 38.77 \text{ mg/kg})$ , Ni  $(83.29 \pm 23.66 \text{ mg/kg})$ , Pb  $(43.53 \pm 7.00 \text{ mg/kg})$  and second highest for Cr  $(34.69 \pm 3.57 \text{ mg/kg})$  and Zn  $(86.22 \pm 23.07)$ . The pollution level of heavy metals in road dust were assessed by Pollution Index and Pollution Load Index, showing that all locations are highly contaminated except Jalan Ayer Molek. Health risk assessment was determined to access the health effect of carcinogenic and non-carcinogenic to adults and children caused by exposure of heavy metals in road dust. Based on the integrated HI for children at all locations are more than 1. Indicating great chance of non-carcinogenic effects. All incremental lifetime cancer risk (ILTCR) values for adult and children at all locations are within acceptable limit. Traffic and activities that take place in these four locations are the sources of heavy metals. Jalan TAR which is loaded with commercial activities is the most polluted location followed by Jalan Raja Abdullah (commercial area), Jalan Tun Razak (highway area) and Jalan Ayer Molek (residential area).

Keywords: Health risk assessment; Heavy metal; Road dust; Pollution index

## ENVIRONMENTAL HEALTH RISK ASSESSMENT OF HEAVY METAL IN SOIL IN A PRIMARY SCHOOL EXPOSED TO MINING ACTIVITIES.

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Bauxite mining activities in Pahang has been operated since early 2013. The hazardous heavy metals from mining gave health impact to school children. Therefore, the objectives of this study were: (1) to determine of the selected heavy metal level (As, Cd, Cr, Ni, Pb and Al) of the soil sedimentation within the school area near to mines and (2) to assess the environmental health risk of exposure to bauxite mining activities. Cross-sectional study was conducted on 121 students randomly selected. Respondents were distributed using selfconstructed questionnaire to collect information on their background and the health symptoms. Environmental sampling for 14 school soil surface samples were collected from the school area by using shovel and were analyzed using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). For the respiratory problem the highest health reported was nasal congestion (45.5%) and itchiness (29.8%) for dermal problem. The mean concentrations of the heavy metals in soil from the school area varied significantly and decreased in the order of Al> Cr > Ni > Pb > As > Cd. The health risk assessment for the population exposed to bauxite mining activities also indicated for ingestion of As in soil (1.799) and Cr in soil (9.477). The lifetime cancer risk also showed significant hazard as the lifetime excess cancer risk that was ingestion of As(6.9378 x10<sup>-5</sup>), Cr(1.218 x10<sup>-3</sup>) and Pb(1.557 x 10<sup>-6</sup>). In addition, for dermal was As in soil (8.887 x  $10^{-6}$ ) and for inhalation was Cr in soil (3.843 x  $10^{-6}$ ). The ingestion route seems to be major contributor to excess health hazard and lifetime cancer risk.

Keywords: Bauxite mining, Heavy Metal, School Children, Health Risk Assessment

## Relationship of Co-exposure to Urinary Chromium, Cobalt, Cadmium, Lead and Microalbumin in Young Taiwanese: Taiwan Environmental Survey for Toxicants (TESTs) 2013-2016

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#### **Background/Aim**

Epidemiology and experimental studies reported that exposure to nephrotoxicity metals, such as chromium (Cr), cobalt (Co), cadmium (Cd), and lead (Pb), may alter the renal functions in adults. However, there is limited information regarding the potential effects of mixture low-dose exposure to nephrotoxicity metal on renal function, particularly for the children and adolescents. We aim to evaluate the co-exposure levels of four nephrotoxicity metals in relation to renal function index in the general young Taiwanese.

#### Methods

We enrolled 633 subjects [≧7yrs - <13 years old (yrs), N=403; ≧13yrs - <18yrs, N=230] participants

who provided questionnaire information, blood and first-morning urine samples from twenty countries in Taiwan during 2013 to 2016. We measured the levels of Cr, Cd, Co, and Pb in each participants' urine sample using inductively coupled plasma mass spectrometry. Indicators of renal function such as microalbumin and creatinine were measured, and albumin-to-creatinine (ACR) were assessed to renal function. Multiple linear regression modelling was used to assess the association between urinary metal levels and renal function index. Potential confounders significantly difference or correlation between metals and renal function index were adjusted for in our model.

#### Results

The geometric mean (GM) levels of urinary Cr, Cd, Co, Pb, in children/ adolescents were 0.23/0.21 µg/L, 0.45/0.55 µg/L, 0.51/0.60 µg/L, 1.04/0.83 µg/L, respectively. We found that urinary Cd/Co/Pb levels of all our subjects were 12.5/1.1/8.6 and 4.7/1.1/4.1 fold higher, respectively, than those reported from NHANES 2013-2014 (6-19 yrs), whereas, no information of urinary Cr level in US minor was available for comparison. The GM (abnormal percentage, %) of microalbumin, creatinine, and ACR in children/ adolescents were 0.35(4.5%) / 0.47(9.1%) mg/dL, 97.2(2.0%) / 147.3(7.8%) mg/dL, and 6.13(2.7%) / 5.72(3.5%) mg/g, respectively. We found that urinary Cr level was significantly and positively associated with levels of microalbumin and ACR in children (microalbumin:  $\beta$ = 0.123, p= 0.005; ACR:  $\beta$ = 0.108, p= 0.014) and adolescents (microalbumin:  $\beta$ = 0.191, p= 0.001; ACR:  $\beta$ = 0.186, p= 0.001), respectively, after adjusting for significant covariant such as BMI, gender, urinary Cd/Pb/Co, or creatinine. Besides, Co exposure was positively association for microalbumin ( $\beta$ = 0.179, p= 0.027) in adolescents.

#### Conclusions

Our findings suggest that low-doses co-exposure to nephrotoxicity metals, especially urinary Cr, in young Taiwanese may have potential effects on the feedback of renal tubuloglomerular. Further mechanistic studies are needed to elucidate the association.

## 0622\_02-5

## DNA methylation as a link between environmental exposures and diseases

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Environmental pollutants constitute risks for various diseases; however, the strength of associations varies widely, and we have limited understanding what moderates these relations. In addition, studies have shown that environmental conditions have an effect across generations. One mechanism linking exposure and diseases within one or across two generations is a change in DNA-methylation (DNAm). The addition of methyl groups to cytosine-phosphate-guanine (CpG) dinucleotides can alter the activity of the specific genes resulting in diseases. In humans, differential DNAm of various genes has been demonstrated for smoking, pesticides, PCBs, DDE, phthalates, arsenic, air pollution, ambient light, heat stress, and food allergens. Further, DNAm has been linked to changes in gene expression and a number of diseases later in life. Taking a time-order into account, the analyses of DNAm describes intervening variables between exposures and diseases. Hence, the addition of epigenetics to our environmental research agenda is justified, first, if we can alter DNAm preventing exposure effects, or second, if DNAm provides information on how to modify the disease mechanisms after exposure. In addition, information on changes of methylation of specific genes can improve our mechanistic understanding. However, (1) there is a lack of science focusing on how to develop protective DNAm profiles or how to intervene in the epigenetic disease process (e.g. pharmacological epigenetics). (2) The majority of findings focus on collectable cells, not organs or tissue affect by disease, emphasizing the need for tissue biobanks. (3) The process to establish links between exposures, DNAm, and diseases is laborious and time-consuming. To improve the promptness of our research, we need to mutually support one another, for instance, by establishing an exchange office on environmental epigenetics. This needs to be a bottom-up and researcher-driven consortium that allows different investigators to participate in various projects depending on their data, time, priorities, and interest.

## Arsenic, DNA Damage, and Cancer of Kidney and Bladder: Long-Term Follow-Up of Residents in Arseniasis Endemic Area of North-Eastern Taiwan

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#### Background/Aim

Arsenic is considered to be a global health risk factor especially in the area where ground water is consumed as source of drinking water. In the last decade, the mortality of kidney and bladder cancer has increase 27.4% and 23.4% respectively. The purpose of this study is to investigate the association between arsenic exposure, DNA damage, and the risk of kidney and bladder cancer.

#### Methods

A total of 887 subjects aged  $\geq$ 40 and with complete personal identification information were enrolled in 1991–1994, and followed in 2011–2014. All study participants were interviewed to obtain detailed histories of residency and duration of artesian water consumption at baseline. A total of 3901 well-water samples and first-morning spot urine samples were collected in 1991–1994 to estimate the arsenic exposure. Urinary 8-Oxo-2'-deoxyguanosine (8-OHdG) and N7-methylguanine (N7-MeG) were quantified to assess the DNA lesions, using liquid chromatography/tandem mass spectrometry

(LC-MS/MS). The National Cancer Registry Data using the pathology finding defined kidney and bladder cancer.

#### Results

The urinary arsenic species (iAs, MMA, DMA) were significantly associated with increased 8-OHdG and N7-MeG after adjustment for age, sex and cigarette smoking. There were 34 subjects to be diagnosed with kidney and bladder cancer during the follow-up period from 887 subjects, and these cancercases had higher percentage than controls (55.88% vs. 33.06%) to consume well water with As concentration over 37.62 µg/L. In further analysis, subjects with consumed well As and urinary 8-OHdG higher than median had higher risk to occur kidney and bladder cancer (OR=3.04; 95%CI 1.51, 6.12), and urinary total As and 8-OHdG higher than median also increase the risk of kidney and bladder cancer (OR=2.54; 95%CI 1.24, 5.23).

#### Conclusions

It is suggested that subjects with high arsenic exposure and high level of DNA damage experienced further risk of kidney and bladder cancer.

# Prenatal exposure to antibiotics and risk of childhood obesity in a multi-center cohort study

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Background/Aim: Mounting evidence has linked postnatal antibiotic use with body mass index (BMI) in children, but the influence of prenatal antibiotic use on offspring obesity risk remains unclear.

Methods: We aimed to assess the association between fetal exposure to antibiotics and obesity among 43,332 children using a multicenter prospective cohort of the U.S. Collaborative Perinatal Project (1959-1976). Antibiotic use was ascertained for mothers during pregnancy. Height and weight were measured at the age of 4 and 7 years. Modified Poisson regression models were used to estimate risk ratios (RRs) of obesity (BMI > 95th percentile) and linear mixed models were applied to assess the association with BMI Z-score.

Results: Prenatal exposure to antibiotics repeatedly was associated with childhood obesity at age 7 years, and odds of obesity increased with an increasing number of antibiotic exposures (2-3 times: RR = 1.20, 95% confidence interval (CI): 1.02, 1.41;  $\geq$  4 times: RR = 1.32, 95% CI: 1.02, 1.71, P-trend =0.02). The magnitude of association was strongest for repeated exposure in second trimester (RR = 1.36, 95% CI = 1.12, 1.65). Prenatal antibiotic use was not associated with obesity or BMI z-score at age 4 years.

Conclusions: These findings support an increased risk of childhood obesity with increasing use of antibiotics during pregnancy.

## Cord serum concentrations of perfluoroalkyl substances and BMI changes from 1 to 50 months of age: HBC Study

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#### Background/Aim

Prenatal exposure to the perfluoroalkyl substances has been reported to affect body weight from birth to childhood, but the results are not consistent. We investigated if cord blood levels of perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) are associated with children's longitudinal change in BMI (body mass index).

#### Methods

Cord blood serum from 599 children enrolled in The Hamamatsu Birth Cohort for Mothers and Children (HBC study) were analyzed for PFOS and PFOA levels. Children's weight and height were measured at 11 occasions from birth to 50 months of age. We assessed the associations between log10 transformed PFOS and PFOA levels and standardized BMI using the growth curve modeling adjusted for potential confounders.

#### Results

PFOS (median, 1.20 ng/mL; range, 0.21-7.10 ng/mL) and PFOA (median, 1.10 ng/mL; range, 0.22-10.00 ng/mL) were detected in 99.5% and 99.7% of samples, respectively. Using a growth curve modeling analysis adjusted for potential confounders, the PFOS level was negatively associated with standardized BMI (Coef.=-0.40, p=0.005), while this effect showed a significant interaction with child's months of age (Coef.=0.008, p=0.02). A similar association was found in the PFOA level (Coef.=-0.29, p=0.03) with the significant interaction with child's months of age (Coef.=0.008, p=0.02).

#### Conclusions

Prenatal exposure to PFOS and PFOA lowered children's BMI during infancy, but this effect gradually diminished along months of age and appeared to be reversed in childhood.

# Relationship between residue levels of PCBs, p, p'-DDE, PBDEs and trace elements in maternal and umbilical cord serum from Chiba, Japan

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#### Background/Aim

The problems of persistent organic pollutants (POPs) and trace elements are substances of major concern for human health, especially in development in gestation period. In this study, we determined the contamination status of polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), 2,2-Bis(4-chlorophenyl)-1,1-dichloroethylene (p, p'-DDE), and trace elements (Mn, Se, Cd, Hg, Pb)in serum from Chiba prefecture, Japan.

#### Methods

The Chiba study of Mother and Child Health (C-MACH) consisted of three hospital-based cohorts. A total of 433 women consented to participate in C-MACH, of whom 25 subsequently withdrew, resulting in a final cohort of 408 women. In this study, we investigated contaminant levels in maternal serum and umbilical cord serum in cohort of women from Onodera Ladies Clinic (Chiba, Japan). Human serum samples and paired umbilical cord serum (93 cord sera) were collected from the participants. Serum concentrations of the organic compounds and trace elements were analyzed by GC-NICI-qMS and

ICP-MS, respectively.

#### Results

In this study, PCBs, p, p'-DDE, Mn, Se and Hg were detected from almost all sample; however, detection rate of Cd were around 50% of maternal serum and Cd in fetal serum, Pb and PBDE levels in most of sample were below detection limit.

Residue levels of POPs, Se, Cd and Hg in maternal serum were significantly higher than those in umbilical cord serum. On the other hands, residue levels of Mn in umbilical cord serum were significantly higher than those in maternal serum.

#### Conclusions

These results show that exposure of POPs and trace elements for human were still continuing in Japan.
# Cytotoxicity of TSP and PM<sub>2.5</sub> in ambient air near elementary schools in Southern Taiwan

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### Background/Aim

Recently, total suspended particulate (TSP) and particulate matter 2.5 (PM<sub>2.5</sub>) have been included as air quality indicators in the global Pollutant Standards Index (PSI). There is a growing public concern because human exposure to high concentrations of TSP and PM<sub>2.5</sub> may increase the chances of getting respiratory disorders, such as nasal inflammation and asthma. There are fifteen continuous outdoor dust and particle monitors stationed in Southern Taiwan. However, those data only express the air quality within a wide range. Therefore, the aim of this study was to investigate TSP and PM<sub>2.5</sub> levels in elementary schools from Southern Taiwan and evaluate its health risk to school-age children

### Methods

TSP and PM<sub>2.5</sub> sampling were accomplished using High Volume Air Sampler "HV-RW" and BGI PQ 200 Particulate Sampler, respectively. After sampling, TSP and PM<sub>2.5</sub> were extracted using the Soxhlet extraction method. Following extraction, ATP bioassay was used to test TSP and PM<sub>2.5</sub>'s cytotoxicity in three different types of cells (T47D-kbLuc, A549, and H4IIE).

### Results

TSP and PM<sub>2.5</sub> exhibited low toxicity effects in T47D-kbLuc, A549, and H4IIE cells. Notably, very low AhR activity was also determined in the paired PM2.5 and TSP samples (0907PM<sub>2.5</sub>, 0908PM<sub>2.5</sub>, 0907TSP, and 0908TSP) at concentrations of 0.482, 0.756, 0.016, and 0.008 pg BEQ m<sup>-3</sup>, respectively. The PM<sub>2.5</sub> had a higher AhR response as compared to TSP.

### Conclusions

Although  $PM_{2.5}$  and TSP both activated the AhR pathway, their levels in the environment are still considerably low. Our results indicated the low toxicity effect of TSP and  $PM_{2.5}$  samples, which may be due to no significant source of contamination.

Keyword: total suspended particulate (TSP), particulate matter 2.5 (PM2.5), ATP bioassay

# Using artificial neural network in predicting *Plasmodium knowlesi* susceptibility area in Sabah, Malaysia.

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### Background/Aim

*Plasmodium knowlesi* is an emerging species for malaria and a significant cause of zoonotic disease in Southeast Asia. Due to its short intra-erythrocyte lifecycle, *P. knowlesi* infection causes rapid parasetemia, which can lead to a life-threating condition. In Malaysia, this infection contributes to almost half of all malaria cases and deaths, and poses a challenge in eliminating malaria. The aim of this study was to explore a predictive model for *P. knowlesi* susceptibility area in Sabah, Malaysia using artificial neural network (ANN).

### Methods

It was conducted from 1<sup>st</sup> January 2013 to 31<sup>st</sup> December 2014. There were 1892 *P. knowlesi* cases reported in Sabah for 2013 and 2014 which were mostly located in the Kudat, West Coast, and Interior Divisions. Weekly malaria cases were obtained and plotted based on their coordinates, and subsequently Kernel density was used to identify the hotspot areas. Satellite images of vegetation, rainfall and temperature were downloaded and pre-processed using ERDAS software. A topographical map of rivers, water bodies, and population density map were obtained from various agencies. Using ANN analysis, best network architecture design and correlation were selected. Malaria susceptibility index was derived from the predicted parameters, which was then used to map the malaria susceptibility zones.

### Results

From the ANN model, a 6-15-1 architecture design with 0.7 correction was selected as the best fitted model. Only 6 parameters fitted the model, namely rainfall, temperature (LST), vegetation (NDVI), elevation, river density and population size. Almost all areas in Sabah were susceptible to *P. knowlesi* infection, however areas located along the Croaker Range, and eastern part of Tawau and Sandakan division were highly susceptible.

### Conclusions

Further entomological mapping for the reservoir and vector could be initiated from this study, especially in areas highly susceptible to malaria. Hence, a strategic malaria control programme could be targeted specifically in these areas.

# Integrating 3-km resolution AOD with meteorological parameters and land use data to refine satellite-based PM<sub>2.5</sub> estimation model across Taiwan

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Background: Satellite aerosol optical depth (AOD) combined with meteorological parameters and land use data is now widely used for estimating ground fine particulate matter (PM<sub>2.5</sub>). Comparing with land use regression, these satellite-based PM<sub>2.5</sub> estimation model can improve the temporal resolution of estimates. To our knowledge, there are currently no study have established satellite-based estimation model in Taiwan using 3-km resolution AOD product. We therefore aimed to develop a model integrated 3-km AOD with meteorological parameters and land use data in Taiwan during 2005-2015.

Methods: The 3-km resolution AOD was retrieved from the MODerate resolution Imaging Spectroradiometer (MODIS) on board Terra and Aqua satellites. We used multiple imputation (MI) with additive regression to fill missing AOD values on a weekly basis. A linear mixed effect model with slopes for AOD, meteorological parameters, and land use data was then used to construct the PM<sub>2.5</sub>estimation model. Further, we conducted tenfold cross validation (CV) to assess the model performance.

Results: The average weekly  $R^2$  for the MI models is 0.62 ranged from 0.19-0.98. The overall model CV  $R^2$  is 0.79 with a root mean square error of 8.6 µg/m<sup>3</sup>. According to the estimates from the model, the highest PM<sub>2.5</sub> concentrations appear in the winter and the lowest concentrations appear in the summer. The spatial distribution of PM<sub>2.5</sub> measurements is generally higher in the western Taiwan than in the eastern region. Comparing with the 10 km estimation model, the 3-km resolution model indeed improves the ability for addressing the spatial distribution of PM<sub>2.5</sub> on the intra-urban scale.

Conclusions: Our study suggests the 3-km resolution estimation model is a reliable approach for estimating PM<sub>2.5</sub> concentrations in the area without monitoring stations in Taiwan. This validated model can be further implanted for epidemiological studies.

# Exploring spatial and temporal variation of barcode and knockdown resistance genes in *Anopheles coluzzii* in Democratic Republic of Sao Tome and Principe

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**Background/Aim.** Vectorial capacity of malaria transmission and insecticide resistance status are varied between *Anopheles* mosquito species. It is important to define which malaria vector is dominant in an area, and its genetic background which may influence the efficacy of malaria control. Democratic Republic of Sao Tome and Principe (STP) is an island nation located in the central west Africa. This study was aim to explore the genetic background and insecticide resistance of malaria vector collected in 16 sites from 2010-2016 in STP.

**Methods.** The barcode gene, mitochondrial cytochrome oxidase subunit I (*COI*) was PCR amplified and sequenced. A total of 140 *COI* sequences were analyzed by phylogenetic and population genetic methods. Knockdown resistance (*kdr*) and acetylcholinesterase (*ace-1*) genes were screened through allele-specific PCR to understand the target site resistance toward pyrethroid and carbamate, respectively.

**Results.** *COI* sequences of malaria vector in STP was most similar to *Anopheles coluzzii* with an identity of 99.4  $\sim$  99.7%. Moreover, Sao Tome Island owned higher genetic diversity compared to the outer island- Principe which is the malaria pre-elimination area. On the other hand, *kdr* L1014F mutation was detected in 2010 (6.39%), and dramatically increased to 73.5% in 2013. Followed by the change of insecticide use in indoor residual spraying (IRS), *kdr* L1014F frequency decreased to 40.7% in 2016. *Ace-1* G119S mutation associated with carbamate resistance had not yet been detected until2016.

**Conclusion.** This study explored the recent genetic diversity and insecticide resistance trend of malaria vector among different locations and time slots in STP. High haplotype diversity relative to low nucleotide diversity suggested the vector population experienced bottleneck followed by a rapid expansion. The intensive vector control campaigns of IRS and long-lasting insecticidal nets were effective, but raised up the insecticide resistance concern which should be addressed to the future control strategies.

Keywords. Malaria, Anopheles coluzzii, phylogeny, population genetics, knockdown resistance

### Low Lead Exposure and Health Effects among Communication Radio-Repair Workers, Thailand

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### Background/Aim

Prolonged occupational low-lead exposure can cause adverse health. Communication radio-repair workers routinely use lead for soldering. This study aims to investigate the occupational health effects of lead exposure among workers in Thailand.

#### Methods

A cross-sectional study design was used in this study. There were 67 repairmen in exposed group and low exposed group were 53 clerks working in the same plant building. The structured-questionnaire including general characteristics and 14 signs and symptoms of lead exposure were used for face to face interview. Blood samples were collected for measuring lead concentrations and assessing anemia, hepatic function, and kidney function. Descriptive statistics, independent t-test, chi-squared test, and logistic regression were used in this study.

#### Results

Average age ( $\pm$ SD) of the exposed group was 36.81 $\pm$ 10.04 years and another group was 41.49 $\pm$ 10.63 years (P-value = 0.013). For working hour, the exposed group was 6 hrs/day (38.8%) and another group was 8 hrs/day (60.4%) (P-value = 0.032). Mean blood lead levels (BLLs) of the exposed group and low exposed group were 2.5 $\pm$ 1.5 µg/dl and 1.3 $\pm$ 1.1 µg/dl, respectively (P-value = 0.000). Five signs and symptoms including loss of appetite, nausea and vomit, excessive tiredness and weakness, nervous irritability, and muscle and joint pain were significant difference between two groups (P-value = 0.041, 0.042, 0.004, 0.004, and 0.000, respectively). And, there was the significant association between BLLs and those 5 signs and symptoms of lead exposure between two groups (P-value = 0.003, no.047, and 0.035, respectively).

#### Conclusions

The mean of age and working hour of low exposed group were higher than exposed group but the mean BLL of exposed group was higher. The findings revealed that there were existing adverse effects of low lead levels on the workers working in the same plant building.

## Estimating Work-related Cerebro- and Cardiovascular Disease Burden Attributed to Long Working Hours: A Population-Based Study of Taiwan

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Background/Aim: In many East Asian countries, cerebro- and cardiovascular disease (CCVD) due to heavy workloads have been a central occupational health issue. In Taiwan, there were 68 compensated cases of work-related CCVD, accounting for a substantial share of compensated occupational diseases (9.6%). Almost all these cases had long working hours prior to the disease occurrence. This study aimed to estimate the disease burden and health care costs of CCVD attributed to long working hours.

Methods: The population attributable risk percentage (PAR%) was used to estimate disease burden. The prevalence of long working hours, defined as >=55 working hours/week, was derived from a nationally representative survey of working population in Taiwan. Odds ratio (OR) of self-reported CCVD was calculated based on data of the same survey and by adjusted logistic regression models. Relative risks (RRs) of CCVD from existing meta-analysis studies were also applied for the calculation of PAR%.

Beneficiaries of the National Health Insurance (NHI) in 2015 who were aged 20-64 with a diagnosis of CCVD were identified and the burden of CCVD attributed to long working hours was estimated based on PAR%.

Results: Based on the national survey data, PAR% of CCVD was estimated to be 4.66% in men and 5.48% in women; and based on a selected meta-analysis study, PAR% of heart disease and stroke were estimated to be 1.44% and 5.75%, respectively. Annually, the cases of work-related CCVD were estimated to be in the range of 2,651 to 2,916, with healthcare costs in the range of 4.1-4.7 millionUS dollars.

Conclusion: A sizable number of CCVD cases were attributed to long working hours. While working hours should be shortened to reduce workers' CCVD risk, policy makers and concerned stakeholders should be aware that substantial health care costs for work-related CCVD have been inadequately laid upon the NHI. (300)

Keywords: overwork, heart disease, stroke, population attributable risk percentage, occupational disease

# Occupational noise, salivary cortisol and the incidence of cardiovascular disease: A prospective cohort study

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### Background/Aim

The relationship between occupational noise exposure and cardiovascular disease (CVD) is not consistent because of the difference in the precision of noise exposure assessment and exposure bias from the use of hearing protective devices. This study used a stress biomarker, salivary cortisol, to investigate the association between noise exposure and incidence of CVD.

### Methods

A cohort of 774 volunteers in an aircraft manufacturing company in Taichung, Taiwan was established in 2008 and followed to 2016. Personal noise measurements of 143 workers during 2008-2009 were used to establish a predictive model that was validated by individual noise measurements of 123 subjects in 2014. Salivary cortisol levels were analysed using the enzyme-link immunosorbent assay method.

Personal noise and salivary cortisol levels were measured simultaneously among 120 subjects on working and non-working days to develop the dose-response relationship between occupational noise exposure and salivary cortisol concentration in 2016. Cox regression models were used to estimate the relative risk of CVD after adjustment for potential confounders.

### Results

Subjects exposed to noise levels  $\geq$ 75 A-weighted decibel (dBA) at work had a higher but not significant risk of CVD (adjusted relative risk [ARR] = 1.30, 95%CI=0.94-1.80) compared with those exposed to noise levels <75 dBA. Workers with salivary cortisol levels  $\geq$ 0.4 µg/dL between before sleep and 30-min after wake-up next working day had a significantly higher risk of CVD (ARR = 1.39, 95%CI=1.01-1.91) than those with salivary cortisol levels <0.4 µg/dL. However, neither workers exposed to cumulative noise levels  $\geq$ 90 dBA-year nor subjects with salivary cortisol levels  $\geq$ 0.5 µg/dL at 30-min after wake-up next non-working day revealed a significantly higher risk of CVD compared with reference groups, respectively.

### Conclusions

Occupational noise exposure induced the higher cortisol level between before sleep and 30-minafter wake-up next day may be associated with the higher risk of CVD.

Keywords: Cardiovascular disease, occupational noise, prospective cohort study, salivary cortisol.

## Estimating Disease Burdens and Healthcare Costs of COPD Attributable to Occupational Exposure to Vapors, Gas, Dusts and Fumes in Taiwan

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**Background/Aim:** Chronic obstructive pulmonary disease (COPD) has imposed heavy burdens of occupational diseases worldwide, and its risk factors include workplace exposures to vapors, gases, dusts or fumes (VGDF). Work-related COPD should be covered by workers' compensation insurance (WCI). However, under-recognition of work-related COPD is common, resulting in cost shift to the general healthcare system. We aimed to estimate the disease burden of COPD due to occupational VGDF and its healthcare cost.

Methods: WCI claim data was obtained from the Bureau of Labor Insurance, and healthcare utilization data was obtained from the National Health Insurance (NHI). Beneficiaries aged 20-64 with adiagnosis of COPD (ICD-9-CM codes: 490-492, 494-496) were identified and the numbers of visits to medical facilities and related healthcare costs were analyzed. Prevalence rates of self-reported occupational exposure to VGDF were derived from a national representative survey of working population in Taiwan. In combination of relative risk data reported in existing meta-analysis studies, we calculated the smoking-adjusted population attributable risk percentage (PAR%) for work-related COPD.

Results: The smoking-adjusted PAR% estimate for work-related COPD was 6.09% (95%CI: 2.79%-9.92%). In 2015, 9,000 patients were estimated to suffer from work-related COPD, costing 0.69 million USD in healthcare. However, less than 150 cases were recognized by the WCI under the category of occupational respiratory diseases in the same year. Based on our estimation, an upward trend of work- related COPD cases was found during the period from 2005 to 2015.

Conclusions: Healthcare spending on COPD was substantial and a significant proportion could be attributed to occupational exposure of VGDF. The under-compensation of work-related COPD suggested an unfair cost shift from WCI to NHI. Healthcare financing for COPD should take work-related factors and employers' responsibility into account.

Keywords: chronic obstructive pulmonary disease; workers' compensation insurance; population attributable risk percentage, burden of disease estimation.

## 0623\_05-5

# Estimating Disease Burdens and Healthcare Costs of Work-related Asthma in Taiwan: Application of a Job Exposure Matrix

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Background/Aim: Asthma is among the most prevalent chronic diseases in working population, and work-related exposures have been considered as crucial asthma inducers. Work-related asthmashould be covered by workers' compensation insurance (WCI). However, work-relatedness of asthma is often neglected, resulting in cost shift to the National Health Insurance (NHI). We aimed to estimate the fraction of disease burden and related healthcare costs of asthma attributable to work.

Methods: Healthcare utilization data was obtained from the NHI database. Beneficiaries aged 20-64 with a diagnosis of asthma (ICD-9-CM codes: 493) were identified and the numbers of visits to medical facilities and related healthcare costs were analyzed. Employment estimates by ISCO-classified occupation were inferred from Taiwan Social Change Survey. Merging with EGEA JEM, an

asthma-specific job exposure matrix, prevalence rates of occupational exposures to asthmagens and the smokingadjusted population attributable risk percentage (PAR%) for work-related asthma were derived.

Results: The combined PAR% estimate of high molecular weight agents, low molecular weight agents and mixed environments was 2.16% (95%CI: 0.17%-6.86%). In 2015, less than 50 cases were recognized and compensated as occupational diseases in the WCI, with a healthcare cost of 36,561 USD paid by the WCI. In contrast, according to our estimation, there should be 3,268 asthma cases caused by work-related asthmagens, costing 0.39 million USD. An upward trend of work-related asthma cases and healthcare costs was found during the period from 2005 to 2015.

Conclusions: Significant under-compensation of work-related asthma indicated an unfair cost shift from WCI to NHI. Healthcare financing for asthma should take work-related agents and employers' responsibility into consideration. Occupational history should not be ignored when pulmonologists assessing asthma patients in working age.

Keywords: asthma; workers' compensation insurance; population attributable risk percentage, burden of disease estimation; job exposure matrix

### Analysis of volatile organic compounds to detect cytotoxicity of quartz on human alveolar cells: a cell breath study

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### Background/Aim

Quartz can increase oxidative stress, lipid peroxidation, and cause pulmonary fibrosis. Analysis of volatile organic compounds (VOCs) in breath had been used to detect the metabolomics changes in pneumoconiosis patients. The breathomics approach may be used to detect the cytotoxic effects at cellular level. The objective of this study was to detect the cytotoxic effects of quartz by analysing VOCs.

### Methods

We conducted an *in vitro* study in quartz-treated human alveolar epithelial cells. Quartz used in this study was first examined by scanning electron microscopy with energy dispersive spectroscopy to confirm the physical and chemical properties. We exposed human alveolar A549 cell lines to 50, 100, 200, 500 and 1000 µg/ml of quartz for 24 hours, and measured the cell membrane damage by LDH assay, generation of reactive oxidative stress by 8-isoprostane assay, and inflammatory reaction by interleukin-6 assay. We determined the existence of cytotoxicity when a dose-response relationship existed. When the cytotoxic effects were confirmed by ELISA analyses, we then analysed the VOCs in the headspace of cell lines, and used canonical discrimination analysis to assess the discrimination ability using gas analysis techniques.

### Results

The mean diameter of quartz was 2.3  $\mu$ m. The toxicity effects were significant increased when the exposure dose was greater or equal to 200 $\mu$ g/ml. Based on the results of cytotoxicity study, we analysed the VOCs when cell lines were exposed to quartz at the concentration of 200  $\mu$ g/ml for 24 hours. The discrimination accuracy was 100% and the leave-one out cross-validation accuracy was 70%.

### Conclusions

By gas analysis technique, quartz exposed cell lines can be accurately discriminated fromnon-exposed cell lines by VOCs. This preliminary result suggested that cellular volatile metabolites may be associated with the cytotoxicity effects. We suggested further studies may develop volatile biomarkers based on pathophysiological mechanisms.

### Association of Tea Drinking and Dysmenorrhea in China

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### Background/Aim

Dysmenorrhea, a common gynecological disorder, not only results in poor quality of life but also increases financial burden of the patients. Tea has a prominent role in Chinese culture. In the preconception cohort of the Shanghai Birth Cohort study, we aimed to examine how tea drinking was associated with dysmenorrhea among women who were planning to be pregnant.

### Methods

At the enrollment, 1152 participants were asked to provide information on demographic, menstrual characteristics and lifestyle factors. A multinomial logistic regression was performed to assess the relationship of tea drinking with dysmenorrhea.

### Results

The prevalence of dysmenorrhea was 57.8%, among whom 10.4% and 3.5% had moderate and severe dysmenorrhea, respectively. Tea drinkers were less likely to suffer from mild dysmenorrhea than non- drinkers (aOR=0.68, 95%CI: 0.50-0.93). Green tea offered most reduction in the risk of dysmenorrhea (mild dysmenorrhea: aOR=0.63, 95%CI: 0.44-0.90; moderate-to-severe dysmenorrhea: aOR=0.42, 95%CI: 0.20-0.85). Consumption of oolong tea was non-significantly associated with risk of dysmenorrhea (mild: aOR=0.60, 95%CI: 0.35-1.03, P=0.063; moderate-to-severe: aOR=0.34, 95%CI: 0.11-1.09, P=0.070).

#### Conclusions

Our findings suggested that consumption of green tea and possibly oolong tea was beneficial for relief of dysmenorrhea.

# Children's Preservatives Exposure Estimates of Modelling Clays and Slimes Use in Korea

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### **Background/Aim**

Modelling clays or slime have been used for art activities or playing thus popular to children. They may include preservatives to avoid the bacterial growth. Some preservatives can pose harmful effects. The purpose of this study was to investigate the contents of preservatives and to estimate dermal exposures of preservatives in modelling clays and slimes use by children.

### Methods

Sixty five modelling clays and fifteen slimes were selected and were analysed for preservatives. The nationwide survey was performed to get use patterns of modelling clays and slimes by home visit survey of 10,000 children divided into three age groups: 0-2, 3-6, and 7-12 years old. Based on chemical analysis results and exposure factors from nationwide survey, dermal exposure estimates were calculated using deterministic method and were determined by each age group.

### Results

Five preservatives were detected: triclosan (range:7-261 µg/kg in clays, 132-153 µg/kg in slimes, detection rate

24/80), methyl paraben (7.1-3220 in clays, not detected in slimes, 6/80), methylisothiazolinone(MIT, 1.6-12 in clays, 1-5.7 in slimes, 22/80), chloromethylisothiazolinone(CMIT, 4-96 in clays, 2.2-43 in slimes, 21/80), octylisothiazolinone(OIT, 10-130 in clays, 85-93 in slimes, 23/80). Proportions of clays and slimes user population were 69.2% and 45.8%, and mean use frequencies were 5.4 and 9.8 per month, respectively. Mean times spent to play with products each use were 23 min (range:  $5\sim200$ ) and 17 min (range:  $5\sim100$ ). Exposure estimates of modelling clays were higher than those of slimes. For modelling clays, exposure estimate was the highest in 3-6 years old age group and for slimes, 7-12 years old group was the highest.

### Conclusions

Exposure levels were estimated based on the use pattern information representing children in Korea. Harmful preservatives were found in modelling clays and slimes. Depending on exposure pattern, these products use could cause unacceptable risk in worst cases.

# 0623\_06-3

# Long-term nitrogen dioxide exposure, asthma, and lung function in Australian children

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# BACKGROUND

The majority of studies on long-term exposure to air pollution and respiratory health in children have been performed in countries with moderate concentrations of pollutants. We aimed to determine the effect of outdoor nitrogen dioxide (NO2), as a surrogate for urban air pollution, on current asthma and lung function in Australia, a low-pollution setting.

# METHODS

We undertook a national cross-sectional study of children aged 7–11 years during 2007–2008 in 12 Australian cities. We used a questionnaire to collect information on asthma and socio-demographic and environmental covariates. We measured lung function (forced expiratory volume in one second [FEV1], forced vital capacity [FVC]) and fractional exhaled nitric oxide [FeNO]) using standard methods. We estimated lifetime and recent (last 12 months) exposure to NO2 based on regulatory monitors near each child's school, and also estimated recent exposure at each child's school and home address using a satellite-based land use regression (LUR) model.

## RESULTS

Our analysis comprised 2,630 children. We observed a significant association between an IQR (4.1 ppb) increase in recent NO2 exposure and current asthma using monitor and LUR-estimated exposures: odds ratios (ORs) = 1.23 (95% CI: 1.04, 1.45) and = 1.55 (95% CI: 1.24, 1.94), respectively. Each IQR increase in monitored recent NO2 exposure was associated with a significant decrease in predicted FEV1 (-1.37 percentage points [95% CI: -2.35, -0.39]) and FVC (-1.21 percentage points [95% CI: -2.26, -0.16]. An IQR increase in NO2

was associated with a 73% increase in FeNO (95% CI: 40%, 114%).

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# CONCLUSIONS

We found evidence of associations between exposure to outdoor NO2 and multiple adverse respiratory effects in a population-based sample of Australian children performed in a country with low NO2 concentrations.

### Risk assessment of methylmercury based on internal exposure and fish and seafood consumption estimates in Taiwanese children

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### Background/Aim

Fish and seafood consumption is a major source of human exposure to methylmercury (MeHg). This study evaluated the potential health risk of MeHg in Taiwanese children from fish and seafood consumption using a toxicokinetic model, hazard quotients and hazard indices (HIs).

### Methods

Two biomonitoring programs provided an important resource for blood specimens for assessing MeHg exposure for blood specimens for assessing MeHg exposure in human populations. For internal exposures, total mercury (THg) was measured as a biomarker of MeHg in whole blood (WB) and red blood cells using inductively coupled plasma mass spectrometry and cold-vapor atomic absorption spectroscopy, respectively. The THg concentrations were used to estimate MeHgconcentrations.

Consumption of fish and seafood was assessed using the National Food consumption database in Taiwan, while mercury concentrations in edible fish and seafood were collected from published studies in Taiwan.

### Results

Our results indicated that 1) the highest median THg (representing estimated MeHg) daily intakes were found to decrease with increasing age in children consuming saltwater fish for age groups 0-3, 4-6, 7-12, and 13-8 years: 0.03 > 0.02 > 0.017 > 0.007 ( $\Box$ g kg-BW<sup>-1</sup> day<sup>-1</sup>); 2) HI greater than one, based on WB-THg, was found in 28% of 4–6-year-old children and 3) internal exposure estimates based on WB- THg, though slightly higher, were comparable to those based on fish and seafood consumption.

#### Conclusions

The results support the use of dietary intake estimates as surrogates for internal blood MeHg levels in Taiwanese children to assess their exposure.

#### Keywords

Risk assessment; Methylmercury; Internal exposure; Fish; Seafood; Children

### Urinary Melamine levels and Microalbuminuria in Taiwanese Children and Adolescents: Taiwan Environmental Survey for Toxicants (TESTs) 2013-2016

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### **Background/Aim**

Melamine is wide-used in tableware products in Asian countries, especially in Taiwan. Whether environmental low-dose melamine exposure levels can cause adverse renal health effects in the susceptible population such as children and adolescents is large unknown. Therefore, we conducted a population-based cross-sectional study to explore this enquiry.

### Methods

A total of 297 Taiwanese children and adolescents ( $\geq$ 7- <18 years) were recruited from 20 different Taiwan's counties during 2013 to 2016. Exposure assessment was based on urinary melamine measured by liquid chromatography/ tandem mass spectrometry, and the outcome indicator of renal function was urinary microalbumin. We further used participant's urinary melamine level to estimate the daily intake of melamine by a creatinine-excretion based model.

### Results

The median (IQR) levels of urinary melamine and estimated daily intake (DI<sub>est</sub>) of melamine in all the children and adolescents were 4.17 (1.46-10.35) ng/ml [creatinine-adjusted: 0.40 (0.18-0.78)  $\mu$ g/mmol cr] and 0.10 (0.05-0.21)  $\mu$ g/kg/day, respectively. The median (IQR) of albumin-to-creatinine ratio (ACR)was

0.41 (0.27-0.60) mg/mmol cr and 9 (3%) children and adolescents had microalbuminuria (urine ACR > 3.5 mg/mmol cr). We found that higher urinary melamine levels in children ( $\geq$ 7-<12 years) than in adolescents ( $\geq$ 12-<18 years), in male than in female, in over weight than in normal BMI. We also found that subjects

had the highest urinary melamine levels from southern Taiwan and the lowest from remote island of Taiwan. Compared to the lowest quartile of melamine exposure, the odds ratio of highest quartile was

3.63 fold (95%CI: 0.35-37.8) for microalbuminuria using the univariate logistic regression models.

### Conclusions

Our findings indicated that melamine exposure in a sample of the general Taiwanese population of children and adolescents varied by age, gender, and area, probably affected by different lifestyles. Although melamine exposure in children and adolescents now is far below the recommended tolerable daily intake (TDI) of 0.063 mg by US FDA, we still found that melamine exposure may be a potential risk factor for microalbuminuria, a marker of glomerular injury in children and adolescents in Taiwan. Continuing bio-monitoring surveillance and follow-up studies are warranted.

### The associations between diabetic severity and risk of cancer

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### Background/Aim

Diabetes is a serious disease and causes microvascular and microvascular complications. It also increases risk of nonvascular complications, mainly cancer events. The 1.25-fold increased risk of cancer related death in patients with diabetes, as compared to those without diabetes, arouse the concern of the possible prevention. However, among patients with diabetes, the associations between the degree of diabetic severity and risk of cancer are not well known. We conducted a retrospective diabetic cohort study of Taiwan National Insurance Health, among near 2.3 million Taiwanese diabetes population to assess the associations of diabetic complications as proxy of diabetic severity with cancer risk.

### Methods

We used data from the database of Taiwanese NHI and identified patients with newly diagnosed diabetes between 1998 and 2013. The primary clinical outcomes considered were the first cancer events. All potentially confounders related cancer were identified, including comorbid illness and medication. The Diabetes Complications Severity Index (aDCSI) was developed to model the severity of diabetes complications and annual time-varying aDSCI was created by summing all categories of complications each year. We calculated the hazard ratio by using the Cox proportional regression models in the time-dependent variables with consideration of death as competingrisk.

### Results

As compared with reference group (with a DSCI of zero), hazard ratios for those with higher DSCI or more were 1.06 (95% CI, 1.03 to 1.08) for incident all-site cancer in male diabetic patients, but not in female population (HR 1.039 (95% CI, 1.00 to 1.08). Increase risk of colon, stomach, HCC, respiratory, kidney, urinary tract cancers and melanoma were observed in both gender and elevated risk of pancreas cancers only in men and breast cancer in postmenopausal women. The dose response relationship between the severity of diabetes and cancer were observed in both gender, but more strong relationship was observed in men population than in women. We do subgroup analysis of diabetes longer or less then 9 years, and the results were not altered.

### Conclusions

Because the increased risk of cancer among patients with advanced diabetic severity, enhanced cancer screening beyond that offer to the those with less diabetic severity might recommended.

# 0623\_07-3

# **Correlations between Phthalates Exposure and Kidney Function in the General Taiwanese: Results from Taiwan Environmental Survey for Toxicants (TESTs) 2013**

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# Background/Aim

Phthalates (PAEs) are endocrine disruptors and national scale survey indicated that ubiquitous PAEs exposure in the general Taiwanese. Some studies suggested that children exposed to phthalate-tainted products were positively associated with increased urinary microalbumin. We aim to assess the correlation between PAEs exposure and renal function index in the general Taiwanese.

# Methods

We enrolled 311 subjects [ $\geq$  40 years old (yrs), N=183; < 40 yrs, N=128] participants who provided questionnaire information, blood and urine samples from the Taiwan Environmental Survey for Toxicants (TESTs) 2013. Urinary PAEs metabolites were analysed by an online modified analytical method coupled to a liquid chromatograph/electrospray tandem mass spectrometer method with quantification by isotope dilution. renal function index, We measured serum level of blood urea nitrogen (BUN), and urinary levels of creatinine, microalbumin, albumin and protein. We used multiple and logistic regression or cumulative risk assessment (estimated HI values, HIhep) to evaluate the relationships between PAEs exposure and renal function in the generalTaiwanese.

# Results

Median levels of urinary sum DEHPm and sum DBPm in subjects <40 yrs were 0.29 (interquartile range [IQR] = 0.17-0.44) and 0.14 (IQR = 0.10-0.30) nmole/mL, respectively, which were higher than those [sum DEHPm: 0.19 (IQR= 0.12-0.32) nmole/mL; sum DBPm: 0.11 (IQR = 0.05-0.19) nmole/mL] in subjects  $\geq$ 40 yrs. The frequency of abnormality of microalbumin (>1.9 mg/dL), ACR (albumin/creatinine ratio> 30 mg/g creatinine), BUN (>20 mg/dL), eGFR (<60 mL/min/1.73 m2) were higher in subjects  $\geq$ 40 yrs than those <40 yrs. The adjusted odds ratio (AOR) of the highest quartile of estimated DEHP daily intake in

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subjects  $\geq$  40 yrs for abnormal microalbumin was 14.2 (95% confidence interval (CI)= 1.52-133.3) fold higher than that of the lowest quartile group. However, we didn't find similar phenomena in subjects <40 yrs. Using multiple regression model, we found that cumulative HIhep were significantly increased with microalbumin ( $\beta$  : 5.12, 95% CI: 2.52, 7.72; p<0.001), ACR ( $\beta$  : 1.12, 95% CI:0.005, 2.23; p=0.049), protein ( $\beta$  : 3.05, 95% CI: 0.94, 5.12; p=0.005) in subjects  $\geq$  40 yrs without type 2 diabetes mellitus after adjustment of age, sex, BMI, smoking and drinking.

Conclusions.

Our findings suggested that higher daily exposure of PAEs were significant positively associated with an increased risk of microalbumin. Large or mechanistic studies are worthy to elucidate the association.

# Benchmark dose for prenatal exposure to di(2-ethylhexyl) phthalate and behavioral problems in children: Recommendation for a lowered level for pregnant women

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Prenatal exposure to di(2-ethylhexyl) phthalate (DEHP) has been reported to be associated with adverse effects on neurodevelopment that yield behavior syndromes in young children with an estimated median exposure lower than the recommended tolerable daily intake (TDI). The current recommended level might not be able to protect the neurobehavioral development of offspring during pregnancy. Our aim was to derive the benchmark dose for prenatal exposure to DEHP to safeguard neurodevelopmental health in children. A total of 122 motherchild pairs from the Taiwan Maternal and Infant Cohort Study were analyzed for the doseresponse relationship between maternal exposure to DEHP and children's behavioral syndromes evaluated at 8 years (n = 122, 2009), 11 years (n = 94, 2012), and 14 years (n = 76, 2015) of age. We employed structural equation models (SEMs) by integrating the individual behavioral problem scores of children evaluated by age and the specific scores to obtain an overall measure related to maternal exposure of DEHP concentration. Based on the established dose-response relationship, we derived the benchmark dose (BMD) and the lower limit (BMDL). Except for somatic complaints, all the associations with the Child Behavior Checklist scores were significant, adjusting for age, gender, and other covariates. The BMDL, given a benchmark response of 0.10 and a background response of 0.05, was for an integrated overall behavioral problem score. The current TDI of 50 3.91 for DEHP might need to be lowered substantially to prevent future behavioral problems in the developing fetus.

# 0623\_07-5

# Persistent organic pollutants exposure and its association with bone density and bone metabolism markers in Japanese farmwomen

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Background: Dioxins and organochlorines pesticides (OCP) are widely spread persistent organic pollutants (POPs) with multitude of health effects, including on bone metabolism. Previous epidemiological studies showed no or negative association between POPs and bone mineral density (BMD). Our objectives were to explore the association between serum level of dioxins and OCP with BMD and bone turnover markers in women from agricultural areas in Japan.

Methods: Participants were from Japanese Multi-centered Environmental Toxicant Study (JMETS) conducted in five agricultural areas across Japan on 2001-2006. Serum dioxins level was measured by cell-based assay; hexachlorobenzene (HCB),  $\beta$ -hexachlorocyclohexane

 $(\beta$ -HCH) and p,p'-dichlorodiphenyldichloroethylene (DDE) levels were measured by gas chromatography-mass spectrometry. Forearm BMD was measured by dual energy X-ray absorptiometry (DXA). Bone specific-alkaline phosphatase (BALP) and osteocalcin in serum and N-telopeptide cross-linked collagen type I (NTX) and deoxypyridinoline (DPD) in urine were also measured. General linear model (GLM) was used to examine the association between POPs and bone-related variables.

Results: Women age 35-75 (n=1,140) years from five agricultural areas were included in the analysis. Most of the participants were post-menopausal, non-smoker, non-drinkers, and did not take calcium supplement. Only those with dioxins (n=386), HCB (n=894),  $\beta$ -HCH (n=570) and DDE (n=785) levels above limit of detection (LOD) were included in GLM analyses.

Bone-related variables were entered as dependent variables, each POPs was entered as fixed factor in quartiles, and we included age, body mass index (BMI), smoking, drinking, parity, lactation, age at menarche, maximum grip strength, and blood Cd as covariates. The result showed that serum dioxins and DDE were not associated with any of bone-related variables. Increasing quartiles of serum HCB and  $\beta$ -HCH were associated with higher BMD (p for trend 0.03 and 0.01, respectively). Increasing quartile of  $\beta$ -HCH was associated with lower level of bone resorption markers (BALP, p<0.001; NTX, p=0.02; DPD, p<0.001). Higher quartile of HCB was also associated with lower level of NTX (p=0.01).

Conclusions: For the first time, we reported positive association between OCP body burden with BMD and bone turnover markers in Japanese women. Mechanism underlying the association remains to be elucidated.

## 0623\_08-1

# Investigation of PBDEs and PBDD/Fs levels in air-conditioning filter dust from nursing homes in southern Taiwan

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### Background/Aim

Nowadays, more facilities like nursing homes are established to provide assistance to the elderly. The average time a person spends in indoor environments, such as nursing homes, is about 80-90% each day. Therefore, the impact of indoor pollutants on human health is of important concern. Polybrominated diphenyl ethers (PBDEs) are released from the surface of electronic products after long usage and consequent thermal increase. Polybrominated dibenzo-p-dioxins/furans (PBDD/Fs), another indoor pollutant, are released from fixed or mobile sources into indoor spaces. PBDD/Fs may also be released as a result of PBDE combustion during production or recycling processes. These pollutants can combine with aerosol particles, settle as dust, and make their way into the body through ingestion. The objectives of this study were to determine PBDE and PBDD/F concentrations in indoor dust and evaluate their daily intake levels and health risks.

### Methods

Dust samples from air-conditioner filters were collected in 10 nursing homes in Pingtung, Taiwan. Surveys were conducted to find the associations between nursing home parameters and indoor pollutants. PBDEs and PBDD/Fs were analyzed using high-resolution gas chromatography/high-resolution mass spectrometer (HRGC/HRMS).

### Results

Levels of  $\Sigma_{14}$ PBDEs and  $\Sigma$ PBDD/Fs in dust ranged from 275-17637 and 1.364-66.0 ng/g, respectively. No significant correlations were found between nursing home parameters and pollutant levels. However, a significant positive correlation (*p*=0.002) was observed between PBDE and PBDD/F levels in dust, indicating PBDEs as precursors to PBDD/Fs. After assessing the risks (daily intake; cancer and non-cancer risks) of PBDEs and PBDD/Fs, it was found that the calculated risks did not exceed the threshold values.

### Conclusions

Although our pollutant levels are higher compared to other studies, our findings suggest that PBDEs and PBDD/Fs do not pose a potential risk to the elderly population in nursing homes.

Keywords: PolybrominatedDiphenyl Ethers (PBDEs), Polybrominateddibenzo-p-dioxins/furans (PBDD/Fs),

dust, nursing homes.

0623\_08-2

### DNA metabarcoding to assess airborne fungal communities in school classrooms in Taiwan

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### Background/Aim

Fungi are diverse and ubiquitous in the environment, including ambient and indoor air, and are important aeroallergens. To date, studies examining airborne fungi in Taiwan have relied on microscopy and culture identification, which is laborious and lacks specificity compared to DNA-based identification. To overcome these limitations, DNA metabarcoding based on next-generation sequencing platforms has recently been applied to examine fungal communities targeting the ribosomal DNA internal transcribed spacer (ITS) region. The aim of this study was to use DNA metabarcoding to assess airborne fungal communities in school classrooms in Taiwan.

### Methods

Electrostatic dust collectors (EDCs) were placed in elementary and junior high school classrooms in 22 districts throughout Taiwan for 2 week periods to collect airborne dust containing fungal spores and other debris. Fungi were eluted from EDCs, genomic DNA was extracted, and ITS2 was PCR-amplified using the ITS86F/ITS4 primer pair with Illumina adapter overhangs and confirmed by gel electrophoresis. Illumina MiSeq 2 x 250 bp paired-end sequencing was conducted following standard Illumina library preparation for amplicon sequencing. DADA2 was implemented in R to resolve amplicon sequence variants (ASVs) and assign taxonomy against the UNITE database, then phyloseq and ampvis2 packages were used for data analysis.

### Results

EDCs were successfully deployed in 32 schools between April 2016 and June 2017, and fungal sequences from 133 of 140 classrooms were retained for analysis. 2706 non-singleton ASVs were analyzed, with genus and species identified for 82% and 51% of ASVs, respectively. Airborne fungal communities displayed heterogeneity by region and season. Nearly half of the 15 most abundant genera across region and season are known allergens, several of which were undetectable using previous methodologies.

### Conclusions

This study provides new qualitative insights into airborne fungal communities in school classrooms in Taiwan, with important implications for the future study of allergic respiratory diseases in schoolchildren.

### 0623\_08-4

# Application of time activity pattern and microenvironmental PM concentrations to determine population exposure in Korea

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### Background

Korea Simulation Exposure Model for PM (KoSEM-PM) is a simulation model to estimate population exposure to PM. KoSEM is based on actual PM measurement in many microenvironments and time activity patterns of Korean population. The purpose of this study was to estimate personal exposures to PM<sub>10</sub> and PM<sub>2.5</sub> using time-activity pattern and microenvironmental concentration in summer and winter. Methods

The time location data were collected by the Statistics Korea (KOSTAT). Technicians carried a nephelometer for  $PM_{10}$  and  $PM_{2.5}$  while engaging in scripted time location activities. The scripted activities of 9 different population groups were based on time activity patterns of the Seoul population in Korea. The monitoring was repeated in summer and winter for seasonal variation.

Results

Mean daily PM<sub>10</sub> personal exposures in summer and winter were 37.8±25.6 µg/m<sup>3</sup> and 48.5±32.9 µg/m<sup>3</sup>, respectively. Mean daily PM<sub>2.5</sub> personal exposures in summer and winter were 27.8±21.4 µg/m<sup>3</sup> and 36.9±28.7 µg/m<sup>3</sup>, respectively. Personal exposures to PM<sub>10</sub> and PM<sub>2.5</sub> in winter was slightly higher than in summer. Personal exposures to PM were up to 3 times different by time activity groups. PM concentration in restaurants was the highest. PM<sub>2.5</sub>/PM<sub>10</sub> ratio of personal exposure was similar in two seasons, but the ratios were varied by microenvironments. Residential indoor was the largest contributor to personal exposure in two seasons. PM<sub>2.5</sub>/PM<sub>10</sub> ratio in each group ranged 0.50 - 0.79 in summer and

0.61 - 0.78 in winter. Average PM<sub>2.5</sub>/PM<sub>10</sub> ratio were similar between summer and winter ( $0.72\pm0.16$  and  $0.73\pm0.14$ , respectively).

Conclusions

The different contributions of microenvironments among population groups suggest that the impact of activity pattern on personal exposure is significant

# 0623\_09-1

# Does green space quantity or quality matter more for mental wellbeing trajectories in childhood? Findings from a multilevel longitudinal study

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## Introduction:

Investigations of green space quantity and health still dominate the literature. But in the few adult-based studies where green space quality has been assessed, it has turned out to be an important predictor of health outcomes. Our aim was to conduct one of the first longitudinal studies of green space quality and quantity in a child cohort.

# Methods:

Multilevel linear regression adjusted for demographic and socioeconomic confounders was used to track change in mental wellbeing (Strengths and Difficulties Questionnaire Total Difficulties Score and "internalizing" and "externalizing" subscales) across five separate occasions among a cohort of 4,968 Australian children aged 4–5 years beginning in 2004. Mental wellbeing was assessed with respect to objectively measured green space quantity and parent-reported green space quality, with interaction terms fitted with age to assess for potential effect modification.

## **Results:**

Mental wellbeing was found to be more favourable among children living in areas with more green space and with better quality green space. Parental reports of green space quality were positively associated with green space quantity. Mental wellbeing in relation to green space quantity appeared to be most favourable in areas where 21%-40% of local land-use was green space, with higher amounts not appearing to confer any further benefit. At younger ages, the importance of having quality green space was small, but these benefits increased as children got older, resulting in an inequality in mental wellbeing over time between those with and without quality green space nearby.

## Conclusions:

Urban planners and policy makers may take note that at least 21%–40% of residential land-use might ideally be set aside for green space in order to provide children with a healthy start in life. Secondly, as the quality of that green space becomes increasingly important as children age, investments must involve community preferences and needs.

# 0623\_09-2

Is the risk of developing Alzheimer's disease higher in rural areas? Multilevel discretetime event history analysis of a cohort of 261,669 Australians aged 45 years and older tracked over 11 years

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## Introduction

Some research suggests the risk of developing Alzheimer's disease is higher in rural areas. This longitudinal study contrasted the risk of developing Alzheimer's disease in urban and rural areas in Australia.

## Methods

Data for this study comprised 261,669 participants in The Sax Institute's 45 and Up Study baseline (2006 to 2009). Diagnoses of Alzheimer's disease were identified using the first recorded prescription of a cholinesterase inhibitor from recruitment to December 31st 2016, linked from the Pharmaceutical Benefits Scheme (provided by the Department of Human Services and part of Australia's universal health insurance). Participants with a cholinesterase inhibitor record prior to baseline were excluded. Multilevel discrete-time event history Poisson regressions were used to measure geographic variation in Alzheimer's disease incidence and to assess the contribution made by rurality. Models were adjusted for age, gender, educational attainment and area-level disadvantage.

## Results

A total of 3,046 from 261,669 participants (1.16%) were diagnosed with Alzheimer's disease during the study. A median rate ratio of 1.48 indicated meaningful geographic variation between areas of 48%. A random slope with negative covariance indicated this geographical variation converged over the 11 year period. Compared to people living in major cities and adjusted for confounding, the risk of Alzheimer's disease was lower in outer regional or remote areas (risk ratio: 0.81, 95% CI 0.67 to 0.97). Rurality explained only 3% of the geographic variation denoted by the median rate ratio. Effect modification by age, gender, educational attainment or area-level disadvantage was not observed.

## Discussion

We found non-trivial geographic variation in Alzheimer's disease risk. Unlike other studies, living in rural areas was associated with a lower risk, but rurality explained little of the overall variation between areas. More longitudinal studies are needed to examine environmental factors associated with the risk of developing Alzheimer's disease.

### Health effects of unawareness to green scenes in urban environments

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In the modern society, human are always busy and hurry, hardly notice the green landscapes in their living environment. Whereas, vegetation is proved to be beneficial to human in psychological and physiological ways, for example, green environments in urban areas help people reducing mental fatigue, restoring attention, and reducing heart rate. Research indicates that even with the 0.03 second sight of seeing the street trees, it might recover our attention ability. In other words, people can get benefits from the experience of exposing in the urban green environments without awareness of vegetation. On the other hand, with the assistance of the technique of functional magnetic resonance imaging (fMRI), we are able to discover brain activities while people are watching landscape images. Which is available for researchers to compare the brain activation of the stimulation of different landscape types and characteristics, and clarify the relationship among environments, emotions and brain activation. In this research we address the question, what is the activated brain areas of the experience of unaware green environments? We are using fMRI machine to examine the activated brain areas while viewing landscape scenes and doing the attention tasks, and examine the attention restoration ability. We anticipate that the results could contribute to the urban green infrastructure design on streets for people to communicate daily and make cities healthier.

Key words: awareness, functional magnetic resonance imaging, brain activation, attention restoration, green infrastructure

## Validity of Using Stoffenmanager® Exposure Modeling Tool in Taiwanese Companies

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### Background/Aim

Quantitative exposure modeling tools for estimating chemical exposure in occupational settings have greatly expanded since regulatory risk assessment under REACH came into force. Calibration data used to derive the quantitative estimations in these tools, namely, Stoffenmanager® and Advanced REACH Tool, are mostly obtained from European countries. For similar exposure scenarios, differences in exposure levels across countries presumably due to technical and cultural differences have been reported. While this variability is partially accounted for by the uncertainty factor, the applicability of these tools in Asian countries have yet been explored. In this study, the level of protection of one of these tools, Stoffenmanager®, in Taiwanese exposure setting for airborne chemical exposures was investigated and compared with exposure models more commonly used in Taiwan for control banding, namely, the zero ventilation model and saturation vapor pressure model.

#### Methods

Input parameters describing the exposure scenarios were collected from walkthrough surveys and past exposure assessment reports. The exposure levels estimated by the modeling tools were then compared with measured data by calculating the bias and precision between observed and estimated exposures. The estimated exposures were also compared with occupational exposure limits to evaluate the level of protection.

### Results

Preliminary results include estimation of exposures situations collected from manufacturers of copper clad laminates and quartz crystal blanks. Assessed chemicals include acetone and methanol used in treating and cleaning processes. Both the zero ventilation model and saturation vapor pressure model tend to underestimate the exposure level for scenarios with high variability, which may result in false security in risk assessment.

#### Conclusions

The higher uncertainty factor considered in Stoffenmanager® provides a more conservative estimate when using the 90<sup>th</sup> percentile estimation, but may lead to unnecessary controls for lower exposure level scenarios.

# How is environmental greenness related to students' academic performance in English and Mathematics?

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### Background/Aim

Studies have proved that greenness has beneficial effects to environment, human health and children development. Previous studies point out that there were association between academic performance and school surrounding greenness, but only specified grade were studied. To design a more all-rounded investigation of the association between school surrounding greenness and students' academic performance in general in Massachusetts, USA.

### Methods

We examined the association between academic performance based on English and Mathematics achievement level data (n=27,494) of 3<sup>rd</sup> to 8<sup>th</sup> and 10<sup>th</sup> grade students from public schools over 9 years (2006-2014) and school surrounding greenness, including Normalized Difference Vegetation Index (NDVI), and green land use area within 250-meter, 500-meter, 1,000-meter, and 2,000-meter circular buffer around each school. Generalized Linear Mixed Models (GLMMs) was utilized to investigate the relationship between surrounding greenness and academic performance with adjustment on socio- economic and socio-demographic factors. To confirm the robustness of the model, sensitivity analysis and stratify analysis were applied.

### Results

All results showed a statistically significant positive association (p<0.05) between environmental greenness and both English and Mathematics academic performance of students from all grades in general, implying that the variation of method in calculating academic achievement level, the effect of financial status and sex has insignificant effect on the relationship between surrounding greenness and academic performance.

### Conclusions

A higher surrounding greenness contributes to better academic performance in students from all grades. This finding could serve as a reference for making changes in the school environment and designing green landscape especially near school areas.

## Antenatal Exposure of Heavy Metals and Birth Sizes, Neurobehavioral Examination of Newborns lived in the residents of Petrochemical Complex in Taiwan

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### Background/Aim

The mothers were recruited since the second trimester of pregnancy and lived in the vicinity of the Petrochemical complex (PC) of Taiwan. We evaluated the effect of antenatally heavy metals exposure in the pregnant mothers and birth size, neurobehavior scales in their newborns.

### Methods

Spot urine samples were collected in 370 pregnant women between 2010 and 2015. The urinary concentrations of 11 heavy metals were measured by ICP-MS. The gestational age (GA), birthweight (BW), length (BL), head circumference(HC) and neonatal neurobehavioral examination (NNE) of the newborns delivered to the subjects were measured. The relationship between birth outcome and urinary metal concentration was examined by linear and non-linear analysis of generalized additive models (GAM) using R statistical computing.

### Results

The geometric mean concentration of urinary As, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Sr, Tl, and V were 12.6, 0.413, 5.58, 46.7, 1.66, 5.34, 21.3, 58.0, 0.299, 1.35, 1.02  $\mu$ g g-creatinine–1, respectively. The mean birth size of the newborns was close to the national average value in Taiwan. The lasso regression analysis using birth sizes or neurobehavioral scales as a dependent variable and 11 urinary metal concentrations and 10 maternal covariates as independent variables extracted antenatal arsenic (As) with significantly negative coefficient for GA, mercury (Hg) negatively for BW, birth year and vanadium (V) for BL, manganese (Mn) negatively for HC and CG. When preterm delivery, low birth weight, short body length, small head circumference, these antenatal heavy metals had increased odds ratio, corrected by infant birth year, maternal education levels by GAM analysis. Ni was correlated to the neonatal posture, Pb to tremor, and Cd to scarf sign.

### Conclusions

Antenatal heavy metals exposures in the residents around petrochemical complex in Taiwan had negative effect on birth outcomes and increased risk of preterm delivery, small birth sizes, and neurobehavioral scales of newborns.

# 0624\_010-2

## Prenatal exposure to perfluorinated alkyl substances and behavioural and coordination development of children at preschool age: the Hokkaido Study on Environment and Children's Health

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Background/Aim: Animal studies have shown that perfluorinated alkyl substances (PFASs) affect offspring neurobehavioural development. However, effects on human is not known. Therefore, we investigated whether maternal PFAS levels were associated with child behavioral and coordination development at preschool age. Methods: We used the data of the follow-up study from prospective birth cohort: the Hokkaido Study on Environment and Children's health. We measured the 3rd trimester maternal blood levels of 11 kinds of PFASs. Parents completed Strengths and Difficulties Questionnaire (SDQ) and Developmental Coordination Disorder Questionnaire (DCDQ) when their child reached 5 years of age to assesschild behavioral and coordination development. The response rate was 55.8%. We applied cut-off scores of Japanese version of SDQ to define behavioral problems and DCDQ scores below 5th percentile was defined as a suspected DCD. Associations were examined for 1001 children with both PFASs measurement and SDQ/DCDQ scores by logistic regression models adjusted for maternal age, parity, pre-pregnancy BMI, maternal education, maternal smoking and alcohol consumption during pregnancy, and child sex.

Results: Eight kinds of PFASs showed detection rate over 75%. We found that 10-fold increased maternal PFDA was associated with reduced risk of child conduct problems (Odds (OR)=0.41, 95% Confidential Interval (CI); 0.17, 0.99). Reduced risk of conduct problems in association with maternal PFOS and reduced risk of prosocial behaviour problems in association with maternal PFDoDA were observed overall without significance (OR=0.44, 95% CI; 0.17, 1.11, OR=0.29, 95% CI; 0.09, 1.00, respectively), however, with significance only in boys. None of the maternal PFAS levels were associated with child DCD risk.

Conclusions: The findings suggested that prenatal PFASs exposure was not adversely associated with behavioural or coordination development at preschool age and may possibly be sex-specific. The interpretation of findings should be carried out with caution since postnatal factors were not adjusted in this study.

# 0624\_010-3

# Prenatal and Childhood Exposure to Phthalate Diesters and Neurobehavioral Development in a 15-Year Follow-up Birth Cohort Study: Taiwan Maternal and Infant Cohort Study

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## Abstract

Objective: Longitudinal studies concerning neurobehavioral development in relation to prenatal and postnatal exposure to phthalates and in school-age children and adolescents are limited. We investigated the associations between prenatal and children's phthalate exposure and children's behavioral syndromes at 8–14 years of age.

Method: We recruited 430 pregnant women from 2000 to 2001 and followed up their children at 2, 5, 8, 11, and 14 years of age, yielding 153 mother-child pairs in total. Urine samples from pregnant women in the third trimester and children at 2–8 years of age were analyzed for the concentrations of seven urinary phthalate metabolites: monomethyl phthalate, monoethyl phthalate, mono-butyl phthalate, monobenzyl phthalate and three di(2-ethylhexyl) phthalate (DEHP) metabolites, namely mono-2-ethylhexyl phthalate, mono(2-ethyl-5-hydroxyhexyl) phthalate, and mono(2-ethyl-5-oxohexyl) phthalate. Behavioral syndromes in children aged 8-14 years were assessed using the Child Behavior Checklist. We constructed mixed models to examine these associations after adjustments for potential covariates. Results: Maternal urinary MEHP levels were associated with higher scores for internalizing problems ( $\beta = 0.028, 95\%$  confidence interval [CI]: 0.0004, 0.055) and externalizing problems ( $\beta = 0.040, 95\%$  CI: 0.013, 0.066). We observed positive associations between the maternal urinary sum of DEHP metabolite levels and delinquent behavior scores and externalizing problems scores ( $\beta = 0.035$ , 95% CI: 0.013, 0.057 for delinquent behavior;  $\beta = 0.026, 95\%$  CI: 0.001, 0.050 for externalizing problems). Furthermore, Children's urinary MBzP levels were associated with higher scores for social problems ( $\beta = 0.018, 95\%$  CI: 0.001, 0.035).

# 0624\_010-3

Similar patterns were found for borderline and/or clinical ranges.

Conclusion: Early life exposure to phthalates could influence behavioral syndrome development in children.

# Chronic prenatal exposure to endocrine disrupter DEHP causes neuron dislocation and learning deficiency in newborn rats

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Neurodevelopmental disabilities, including autism, attention-deficit hyperactivity disorder, dyslexia, and other cognitive impairments, affect millions of children worldwide. Industrial chemicals that injure the developing brain are among the known causes for this rise in prevalence. Studies have identified industrial chemicals di-(2ethylhexyl) phthalate (DEHP) and methylmercury (MeHg) act as potent neuroendocrine disruptors. Animal data suggested that exposure to DEHP alters the lipid metabolism and reduces cell population and spine density in the fetal brain. Some in vivo studies showed that MeHg can disrupt neuronal migration in the developing cerebral cortex as well. Here we hypothesize that exposure to the DEHP and/or MeHg leads to aberrant neurodevelopment during fetal stage. Maternal exposure was induced by a daily oral gavage of DEHP plus MeHg from gestational day 2 to postnatal day 0 in SD rats. The effects of DEHP on neurogenesis were determined by three continuative days of bromodeoxuridine (BrdU) injection from GD 16, and measure the layer-specific markers, Tbr1 (layer VI), Ctip2 (layer V) and Satb2 (layer II/III) to determine the neuronal migration. The behavioral tests in the adulthood were identified with behavioral deviant and learning deficiency in response to the DEHP+MeHg exposure. Our findings elucidate the biological machinery resulting in these morphological failures in response to DEHP plus MeHg, and its associated neuronal functional and morphological alteration. These results provide evidence for the neurodevelopment issue in response to prenatal exposure to DEHP and/or MeHg.

Keywords: DEHP, neurodevelopment, behavioral test battery

### Prenatal trace elements in cord blood, DNA methylation of imprinted genes and child birth outcomes

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### Background/Aim

Trace elements are essential nutritional components in humans. Either insufficient or excessive amount of trace elements have long been suspected to affect birth weight and size. Therefore, the aim of this study is to evaluate the prenatal exposure effects of trace elements during pregnancy in relation to DNA methylation changes at imprinted genes involved in prenatal and postnatal growth.

### Methods

A total of 328 mother-infant pairs from Taiwan Birth Panel Study (TBPS) collecting from 2004 to 2005 had sufficient cord blood samples available and were included in the analyses. Prenatal trace element exposures and DNA methylation levels were measured by using cord blood samples. Birth outcomes were observed from medical record. Linear mixed effects regression models were used to estimate the associations of interest.

#### Results

The detection rates of seven trace elements (Cu, Zn, Ga, Mo, Cd, Ba, Co) were above 80%. We found that prenatal exposure to Zn and Mo were significantly associated with smaller gestational age and head circumference. Increased Co level was significantly related to reduced neonatal neurobehavioral examination (NNE) scores, mainly the problem of primitive reflexes. As for the associations between trace elements and DNA methylation, increased Cu and Mo significant correlated with reduce in MEST methylation, however, negative association was observed between Cd, Mo and PEG3 methylation.

#### Conclusions

This study indicated that increase in prenatal exposure to trace element was associated with adverse child birth outcomes, and this effect might partly be explained by changes in DNA methylation of imprinted genes.

# Identification of novel miRNA biomarkers for exposure to BPS in male zebrafish (*Danio rerio*)

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### Abstract

In response to the restriction on the use of bisphenol A, bisphenol S (BPS) has been broadly used worldwide. Although endocrine disruption effects of BPS have been observed in previous studies, the complex molecular mechanisms of BPS remain poorly understood. In the present study, microRNA (miRNA) profiles of the BPS-exposed male zebrafish were investigated to understand how miRNAs mediate adverse effects by BPS. Adult male zebrafish were exposed to control, 5 µg/L, and 50 µg/L BPS for 21 days. After the exposure, miRNA was isolated from the gonad and the expression profiles of 255 known zebrafish miRNAs were analysed using Affymetrix miRNA microarrays. Using bioinformatics data analysis, we identified enriched GO terms and the interactions among protein-coding genes of the selected miRNAs. Quantitative real-time polymerase chain reaction (qRT-PCR) was used to validate the expression of several miRNAs in the microarray data. The putative targets of four miRNAs (dre-miR-193b,

-223, -363, and -499), which are significantly regulated by BPS exposure were identified. The GO term analysis revealed that miRNAs that were significantly affected by BPS exposure were involved in hematopoiesis, lymphoid organ development, immune system development, and aromatization, indicating the role of BPS-induced toxicity via the interference with these process. In all cases, the qRT-PCR and microarray data showed high correlation. The present study showed that BPS alters the expression of various miRNAs involved in development and reproduction defects, providing clues to the molecular mechanisms of BPS toxicity. Commonly regulated miRNAs such as dre-miR-499 can be used as novel miRNA biomarkers for exposure to BPS.

Acknowledgement: This study was supported by National Research Foundation of Korea (NRF; Project no. 2015R1D1A1A01056628).

Key words Bisphenol S; microRNA; microarray; zebrafish

Topic: Chemical toxicant transport and effect
## 0624\_011-3

### Interactive Effect of Bisphenol A (BPA) Exposure with Genetic variants in ESR1,

#### and ESR2 genes on the Risk of Endometriosis

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#### Background

It has been hypothesized that the increased prevalence of Endometriosis (EM) may be attributable to endocrine disrupting chemicals, such as Bisphenol-A (BPA), which is widely used and ubiquitous in the environment and by disrupting the secretion or regulation of hormones. However, little research has explored the role of BPA-gene interactions.

#### Methods

In this study, we examined urine BPA\_Cre (ng/g) and 48 polymorphisms in 10 hormone-metabolizing genes (CYP11A1, CYP19A1, ESR1, ESR2, PGR, PPARG, LAMC1, HMGA2, MTHFR and SUMO1P1) among 230 EM patients and 263 control subjects in a Chinese Han population, Interaction and stratified analyses were conducted between BPA exposure and EM risk by genotype.

#### Results

BPA\_Cre concentration in the case group  $(15.5 \pm 27.0)$  was significantly higher than the control group  $(9.1 \pm 29.8)$ . After adjusting for confounding factors such as age, BMI, education and family income, the risk of infertility was significantly higher in high-concentration group than in low-concentration group (OR =2.59, 95% confidence interval = 1.77-3.79). Accordingly, the following genotypes at various loci were associated with increased EM risk: AA genotype at rs3778082 and GG genotype at rs3798573 in ESR1, GG genotype at rs484389, AA genotype at rs547378, TT genotype at rs566351, CC genotype at rs500760 and TT genotype at rs608995 in PGR. Moreover, rs3778082 (P=0.0122) and rs3798573 (P=0.0195) in ESR1, rs944459

(P=0.0215) in ESR2 modified the association between BPA exposure and EM risk.

#### Conclusions

Therefore, our results suggest that certain ESR1 and ESR2 polymorphisms may modify the associations between BPA exposure and EM risk. Further functional studies are warranted to elucidate the underlying biological mechanisms.

## 0624\_011-4

## Associations of certain genetic polymorphisms and arsenic exposure with bladder cancer

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Background/Aim: Arsenic is well established as a human carcinogen, and previous studies have demonstrated that it may act through the inhibition of DNA repair mechanisms and the disruption of mitosis to induce apoptosis and centrosome aneuploidy. DNA adducts caused by chemical carcinogens are repaired primarily through the nucleotide excision repair (NER) pathway. Aneuploidy is a common phenomenon regulated by Aurora A (STK15) in cancer cells. The tumor suppressor p53 is an important regulator of the cell cycle and apoptosis, and is frequently inactivated in human cancers. We conducted a study in southwestern Taiwan to evaluate whether genetic polymorphisms in the NER (*ERCC1 Asn<sup>118</sup>Asn, XPD Lys<sup>751</sup>Gln*, and *XPC Ala<sup>499</sup>Val*) and cell cycle pathways (functional *STK15 Phe<sup>31</sup>Ile* and *p53 Pro<sup>72</sup>Arg*) have associations with bladder cancers related to arsenic exposure.

Methods: We recruited 104 bladder cancers patients and 265 cancer-free controls and collected data on demographics, life style, and environmental factors with a questionnaire. Genotypes were determined using PCR-RFLP. The address of each participant was coded according to the arsenic level in drinking water. The core zone (CZ) included the four townships of the black-foot disease (BFD) endemic area, where the drinking water had arsenic levels above 0.35 ppm. Zone 1 (Z1) included the areas outside the BFD endemic where the drinking water also had arsenic levels above 0.35 ppm, Zone 2 (Z2) included the areas where the drinking water had arsenic levels between 0.1 and 0.35 ppm, Zone 3 (Z3) included the areas where the arsenic levels in drinking water were below 0.1 ppm.

Results: We found that older age, male sex, lower education level, smoking, and arsenic exposure (with doseresponse relationship, p<0.05 for test for trend) were risk factors of bladder cancer. Among the NER pathway polymorphisms, we found *ERCC1 Asn<sup>118</sup>Asn* was associated with bladder cancer (odds ratio [OR]=5.4; 95% confidence interval [CI]: 2.7-11.0) after adjusting for the arsenic level in drinking water and other risk factors. Among the cell cycle pathway polymorphisms, we found *STK15 Phe<sup>31</sup>Ile* (T>A) mutant type (AA) (OR=2.7; 95% CI: 1.1-7.1) was associated with a higher risk of bladder cancer.

Conclusions: *ERCC1 Asn<sup>118</sup>Asn* and *STK15 Phe<sup>31</sup>Ile* are associated with bladder cancer in Taiwan, independent of the major environmental risk factor—arsenic exposure from drinking water.

Key Word: arsenic, polymorphism, DNA repair, NER pathway, bladder cancer

### 0624\_O11-5

## Epigenetic indicators of effect of fetal PCB exposure on DNA methylation status in human umbilical cord

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#### Background/Aim

Polychlorinated biphenyls (PCBs) have been associated with abnormal fetal development as a result of their endocrine-disrupting effects. PCB exposure may cause epigenetic alterations during development, but studies analyzing the association between PCB levels and fetal DNA methylation status are limited. In this study, we aimed to identify alterations in DNA methylation status in umbilical cord tissue with residue levels of PCB in cord serum using an Infinium EPIC Methylation array.

#### Methods

The Chiba study of Mother and Child Health (C-MACH) consisted of three hospital-based cohorts. A total of 433 women consented to participate in C-MACH, of whom 25 subsequently withdrew, resulting in a final cohort of 408 women. In this study, we investigated PCB levels in maternal serum and DNA methylation status in cord tissue in the cohort of women from Onodera Ladies Clinic (Chiba, Japan), with the aim of identifying potential biomarkers of PCB exposure. Cord serum samples and paired cord tissue (n = 93) were collected from participants. The participants of the mothers who had smoking habit, no questionnaire data, not enough sample for analyze were available were excluded. data from paired participants (gender, PCBs, EPIC array data, birth weight) were available Finally, data from 75 participants (male = 32, Female = 43) were used for data analysis.

#### Results

In this study, PCB levels in cord serum were related in identified five and one sites that tended to change in methylation status of cord tissue from female and male, respectively (FDR < 0.1). Some kinds of methylated locations were related to neurodevelopmental effect and regulation of mitogen-activated protein kinase (MAPKs)-signaling pathways.

#### Conclusions

These results indicated that the exposure of PCBs is possibly had an adverse effect through epigenetic alternation.

## 0624\_012-1

# Characterization and health risk assessment of exposure to volatile organic compounds in the region of an integrated circuit assembly and testing company

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#### Background/Aim

There has been an increase in number of integrated circuit industries worldwide, and VOCs are a major concern of air pollutant due to their acute or chronic health effects. The aims of this study were to investigate volatile organic compounds relevant for the air quality in industrial inside and outside environments and to evaluate the potential health risk of exposure.

#### Methods

Air Samples were collected in winter and summer at 1 location within the premises and 6 locations outside. Samples were collected using stainless steel canisters and glass cartridges, and analyzed the VOCs and formaldehyde using gas chromatography/ mass spectrometer and HPLC, respectively. The health risk assessment was conducted using carcinogenic risk formula for cancer risk and calculating the hazard index for non-cancer risk.

#### Results

Out of the 88 measured VOCs, 12 compounds were identified with the acute adverse effects and 21 compounds have the chronic adverse effects. Five compounds were classified as group 1 and 2A carcinogens. VOCs concentration levels inside the premises were higher than those outside. The annual average concentrations of known carcinogens of formaldehyde, benzene, methylene chloride, 1,3 butadiene and trichloroethylene were 78.63  $\mu$ g/m3, 21.72  $\mu$ g/m3, 2.58  $\mu$ g/m3, 1.82  $\mu$ g/m3, 1.22 $\mu$ g/m3 respectively. Workers had potential acute non cancer risks of exposure to acrolein and formaldehyde and chronic non cancer risk of exposure to acrolein, benzene, formaldehyde and 1,2 dibromoethane.

The HIa for surrounding residents was significant for the eyes while HIc was significant for the respiratory system seconded by alimentary canal. The risk of leukemia and respiratory cancer was high for both workers and surrounding residents.

#### Conclusions

The study demonstrated non cancer and cancer risks of exposure to VOCs for both surrounding residents and workers, therefore measures have to be put in place to control emission of VOCs.

Keywords: volatile organic compounds, health risk assessment, inhalation exposure, Taiwan

## Mortality burden attributable to PM<sub>2.5</sub> emitted from coal-fired power supplies in Taiwan

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#### Background/Aim

Taiwan government had announced that the coal-fired power supplies should be reduced to 30% of total power supply in 2025. Based on this future scenario, there is a need to understand the air quality and associated mortality impacts under the current coal-fired supplies.

#### Methods

We collected the emission inventories from 5 coal-fired power plants and 33 coal-fired co-generations of electricity from Taiwan Emission Database System (TEDS) in Taiwan. Based on year 2013 current setting, 117 meteorological stations and 71 air monitoring sites observations were also collected. The Gaussian Transfer Coefficient Modelling Systems (GTx) was applied to assess the county-based PM<sub>2.5</sub> concentrations and those impacted from coal-fired power supplies. We applied the comparative risk assessment framework and the relative risk estimates of the Global Burden of Disease (GBD) study to estimate the mortality burden attributable to PM<sub>2.5</sub>, and specifically the burden attributable to PM<sub>2.5</sub> emissions of coal-fired power supplies in Taiwan.

#### Results

There were 28.5 $\pm$ 7.5 (range:13.1-40.5), 1.33 $\pm$ 0.89 (0.19-4.22), 0.70 $\pm$ 0.45 (0.03-1.59), and 2.03 $\pm$ 1.29 (0.32-5.64)  $\mu$ g/m<sup>3</sup> for whole PM<sub>2.5</sub> mass concentrations, and those from power plants, co-generations, and the summary of coal-fired power supplies, respectively. There were 7037 people deaths attributable to PM<sub>2.5</sub>, which represented 4.5% of total deaths and included 2095, 2924, 1345, and 673 from ischemic heart disease, stroke, lung cancer, and chronic obstructive pulmonary disease, respectively, during 2013 in Taiwan. According to the model results, overall 295 people died due to current coal-fired power supplies.

#### Conclusions

This study showed that GTx and GBD approaches could be combined well to estimate the mortality impacts from coal-fired power supplies in Taiwan. At the same time, the mortality impacts from co-generations should be concerned simultaneously. In addition, we might underestimate the contributions to PM<sub>2.5</sub> mass as their acid emission data were not available.

## 0624\_012-3

National Geographic Ecological Association between Particulate Matter 2.5 Air Pollution and Risk of Cardiovascular Disease and Cancer Mortality in the United States: Findings from the Location and Outcomes Study

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**Background/Aims:** To examine the burden of leading courses of death attributable to environmental factors and to estimate the associations of preventable and health policy relevant factors with health outcomes across the counties and states in the Unites States (U.S.).

**Methods:** Data from 1714 counties across the U.S. from 50 states on particulate matter 2.5 (PM2.5) measured in 2005-2010, and annual county-level mortality from coronary heart disease (CHD), stroke, heart failure (HF), lung cancer and all-cancer from 2007 to 2015 in residents aged 35 and older were analyzed using an ecological study design. Annual average county-level PM2.5 concentrations were adjusted for the total population of individual counties (ratios of PM2.5 to the total number of population). Average annual mortality rates for every 3-year period (2007-2009, 2010-2012, and 2013-2015) were calculated using direct age-adjusted method (adjusted for the U.S. 2000 standard population). Multilevel spatial regression analysis technology was applied to estimate the associations between PM2.5 and the outcomes of the study interest, with controlling key covariates.

**Results:** Of the 1714 counties, the annual mean (SD) PM2.5 concentration was 11.75 (1.55), and ranged from 12.30 (2.45) in 2005 to 11.85 (1.38) in 2010. The average 3-year age-adjusted mortality rates (per

100,000 population) from CHD were 250.93 (71.92) in 2007-2009, 226.21 (68.28) in 2010-2013, and 209.86 (65.06) in 2013-2015, respectively. The corresponding values of mortality from stroke were 91.85 (23.83), 83.71 (21.45), and 80.41 (20.45), and from HF were 50.42 (31.94), 48.58 (31.67), and 51.64 (28.74), from lung cancer were 109.82 (25.82), 104.41 (26.05), and 96.57 (24.59), and from all-cancers were 361.08 (46.75), 349.94 (46.54), and 336.92 (46.61), respectively. Increased annual PM2.5 concentrations were significantly correlated with increased risks of mortality from CHD, stroke, HF, lung cancer and all-cancers (p < 0.001). The strongest correlation was observed between PM2.5 and HF (correlation coefficients,  $r_s$  were 0.57, 0.59, and 0.56 in 2007-2009, 2010-2012, and 2013-2015, respectively), followed by the correlation between PM2.5 and stroke (0.32, 0.35, and 0.32), all-cancers (0.29, 0.36, and 0.38, and separate for lung cancer were 0.32, 0.40, and 0.39), and CHD (0.21, 0.22, and 0.22), respectively. These associations remained significant after control for country-level poverty rates, proportions of people aged 65 and older and ratios of urban to rural population using multilevel regression models.

## 0624\_012-3

**In conclusion**, using national surveillance data, the present study further highlights that increased PM2.5 concentrations were significantly associated with the risk of death from HF, stroke, cancer and CHD. Findings from the study using multiple years and taking cause-effect time-consequences into consideration is the first to address the most serious effects of PM2.5 on the risk of mortality are HF, followed by stroke, cancer and CHD.

### Association between Exposure to PM2.5 and O3 and the risk of Uterine Fibroids

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**Background:** Uterine fibroids (UFs) are a kind of benign muscle neoplasms of uterus. It usually occurs in women of reproductive age and causes some reproductive problems. There is little epidemiologic study concerning the association between air pollution exposure and the development of UFs. We conducted a 10-year cohort based nested case-control study to evaluate the association between air pollution and the UFs development among Taiwanese women.

**Methods:** We carried out a cohort based nested case-control study in Taiwan from 2001 through 2010. The case group consisted of 24,979 newly diagnosis of UFs during the study period and the control group was density-sampling matched one to four based on the day, month or year of birth from source population of 449,565 women age 12-97 from National Health Institute Research Database (NHIRD). We used Geographic Information System (ArcGIS 10) and inverse distance weighting (IDW) to combine the postal code together with the data of the air pollution exposure to estimate the individual level of exposure to PM<sub>2.5</sub> and O<sub>3</sub>. Adjusted conditional logistic regression model was performed to estimate odds ratios per integuartile change for air pollutants during the study period.

**Results:** In the conditional logistic regression, adjusted for confounding factors, the risk of UFs was associated with  $PM_{2.5}$  (aOR: 1.08, 95% CI: 1.06-1.10 per 10.09 µg/m<sup>3</sup> change) and O<sub>3</sub> (aOR: 1.07, 95% CI: 1.04-1.09 per 12.06 ppb change) exposures. According to the stratified analysis of menopausal syndrome (MPS), the women without MPS led to higher aORs (PM<sub>2.5</sub>: 1.09; O<sub>3</sub>: 1.11) than the women with MPS when they exposure to the air pollution.

**Conclusions:** The finding suggests that exposure to  $PM_{2.5}$  and  $O_3$  may increase the risk of UFs. Compared to the women with MPS, we further provide new evidence that the women without MPS may more likely to develop of UFs.

### Volatile organic compounds (VOC), formaldehyde and nitrogen dioxide (NO<sub>2</sub>) in schools in Johor Bahru, Malaysia: Associations with rhinitis, ocular, throat and dermal symptoms, headache and fatigue.

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Background: This paper studied associations between volatile organic compounds (VOC), formaldehyde, nitrogen dioxide (NO<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) in schools in Malaysia and rhinitis, ocular, nasal and dermal symptoms, headache and fatigue among students. Methods: Pupils from eight randomly selected junior high schools in Johor Bahru, Malaysia (N = 462), participated (96%). VOC, formaldehyde and NO<sub>2</sub> were measured by diffusion sampling (one week) and VOC also by pumped air sampling during class. Associations were calculated by multi-level logistic regression adjusting for personal factors, the home environment and microbial compounds in the school dust. Results: The prevalence of weekly rhinitis, ocular, throat and dermal symptoms were 18.8%, 11.6%, 15.6%, and 11.1%, respectively. Totally, 20.6% had weekly headache and 22.1% fatigue. Indoor CO<sub>2</sub> was low (range 380-690 ppm). Indoor median NO<sub>2</sub> and formaldehyde concentrations over one week were 23 µg/m3 and 2.0 µg/m3, respectively. Median indoor concentration of toluene, ethylbenzene, xylene, and limonene over one week were 12.3, 1.6, 78.4 and 3.4 µg/m3, respectively. For benzaldehyde, the mean indoor concentration was 2.0  $\mu$ g/m<sup>3</sup> (median = 1  $\mu$ g/m<sup>3</sup>). Median indoor levels during class of benzene and cyclohexane were 4.6 and 3.7  $\mu$ g/m<sup>3</sup>, respectively. NO<sub>2</sub> was associated with ocular symptoms (p=0.001) and fatigue (p=0.01). Formaldehyde was associated with ocular (p=0.004), throat symptoms (p=0.006) and fatigue (p=0.001). Xylene was associated with fatigue (p=0.001) and benzaldehyde was associated with headache (p=0.03). Conclusion: Xylene, benzaldehyde, formaldehyde and NO2 in schools can be risk factors for ocular and throat symptoms and fatigue among students in Malaysia. The indoor and outdoor levels of benzene were often higher than the EU standard of  $5 \mu g/m^3$ .

Keywords: environmental air pollutants, respiratory symptoms, VOC, school children.

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## 0624\_013-2

# The risk-based air quality health index (AQHI) on morbidity and mortality for Taiwanese population: development and validation

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Background: The current used air quality index (AQI) in Taiwan follows an USbased system on calculating the index of the single air pollutant which does not consider co-pollutant exposures and resultant health implications but is needed to refine. Objectives: This study aims to develop an awareness system of air quality health index (AQHI) based on exposure to multiple air pollutants associated with morbidity and mortality. Methods: The developing process was referred to the methodology proposed by Canada and Hong Kong. We evaluated the concentration-response (C-R) relations between the all-cause deaths (ICD-9 codes 001 – 799) for elders ( $\geq$  65 ages) and the daily maximum exposure levels on 3-hr moving average of ambient PM2.5, PM10, temperature, relative humidity, SO2, NO2, CO and O3 for 2006–2014. The overall and seasonal (warm period > 23 oC vs. cold period  $\leq$ 23 oC) comprehensive excess risks were used to generate the AQHI. Both AQHI and AQI were validated with the morbidity (the outpatients of respiratory tract illness in children, adults and elders) using the Akaike information criterion (AIC) and the unbiased risk estimator (UBRE) criteria.

Results: The C-R relations indicated PM2.5-, PM10-, SO2-, NO2-, CO-, and O3-related mortality were varied by season. O3, PM2.5 and NO2 were predominant pollutants and significantly associated with mortality over the seasons and locations. A proportion of 20.3% (AQHI = 3) and 15.1% (AQHI = 5) in years was classified as unhealthy for sensitive groups in the overall and seasonal scenario, respectively, while 33.9% of years with AQI system was observed. The AQHI had a lower estimated AIC and UBRE for morbidity in all populations than the AQI.

Conclusions: The AQHI presenting a better fitness on the various health effects and performing a better awareness of daily air quality is suggested to use.

## Asbestos ban policy and a bibliometric analysis of asbestos-related diseases research gap: A global perspective

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#### Background/Aim

The global burden of asbestos-related diseases (ARD) is expected to peak in the coming decades, but this problem is still underreported in many developing countries. About 80% of the world's population live in countries where the use of asbestos has not been prohibited. We examined whether national policies were in line with the ILO Convention towards banning asbestos and the gaps of ARD-related research on prevention across countries.

#### Methods

First, we collected data on the year that each country prohibited the use of three types of asbestos, including chrysotile, crocidolite, and amosite, and obtained the list of countries and the date that each country ratified the ILO Convention C162 Asbestos Convention. Second, we conducted a bibliometric analysis of the scientific literature to analyze the trends of ARD-related research. We compared the research performance of selected countries and assess the extent of research gap over the years and across countries.

#### Results

The first policy of banning all types of asbestos was enforced by Iceland in 1983. As of 2018, there were 62 countries implemented the total asbestos ban policy. Among countries that ratified C162, only 63% of them introduced the total ban policy. However, some countries, such as Russia and Kazakhstan, are still among the biggest producers of asbestos, despite they have ratified C162. As of ARD-related articles, we found there was less emphasis on prevention, in particular, the public health area even shows a declining trend.

#### Conclusions

Historical asbestos consumption and loose regulations have introduced challenges to eliminating ARD. Although several countries have reoriented the national policy in line with the global trend of banning all types and forms of asbestos, the gap between developing asbestos policy and research on prevention ARD burdens is widened in developing countries, warranting efforts to rectify the current trendin ARD-related research.

## Portable Device Use by Three-Year-Old Children and the Mother-Child Relationship

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#### Background/Aim

With the spread of portable devices such as smartphones in recent years, there is concern about the adverse effects of excessive Internet use on the physical/neuropsychological development of children. In this study, we analyzed data from a birth cohort study to investigate the relationship between portable device use in 3-year-old children and maternal device use.

#### Methods

We collected questionnaire data about children aged 3 years (N = 4652) from the Japan Environment and Children's Study at Chiba Regional Center. The relationships between children's use of mobile devices and bedtime and mother-child communication were analyzed by cross-tabulation. Associations between children's excessive device use and maternal device use were analyzed by multivariate logistic regression adjusted for the child's sex, maternal age, and socioeconomic factors.

#### Results

Fifty-three percent of children used mobile phones, mobile information terminals, and electronic gaming consoles, with 11% using devices for more than 1 h per day. The longer children used mobile devices, the more often bedtime occurred after 10:00 pm and the less frequent the mother and child talked while looking at a picture book. The risk of children's excessive use of mobile devices (> 1 h) increased with increasing maternal device use. Among mothers who used devices for more than 2 h per day, the odds ratios of children's excessive use were 5.8, compared with mothers who did not use them.

#### Conclusions

Results showed that the longer mothers used Internet or game devices, the higher the risk of children's excessive use of mobile devices. Because bedtime tends to be delayed in children who excessively use devices, there is concern about adverse health effects in these children.