Abstract:
While a convincing body of evidence has accumulated demonstrating the effects of chronic exposures. We are evaluating the association of long term exposure to air pollution with incident coronary and respiratory disease and with total mortality in the Nurses’ Health Study, an ongoing prospective cohort study of 121,700 women residing throughout the U.S. Between 1986 and 2000, 6,617 incident cases of cardiovascular disease, and 1,292 incident lung cancer cases have been reported. Confirmed prevalent cases of adult-onset respiratory disease include 2,092 cases of COPD and 5,823 cases of asthma. At enrollment in 1976, the participants resided in 11 large industrial states—California, Connecticut, Florida, Maryland, Massachusetts, Michigan, New York, New Jersey, Ohio, Pennsylvania, and Texas. By 2000, there were at least 10 residents in all 50 states and DC. Addresses from 1986 through 2002 are available, and will be used to track residence throughout the study period. This residential history will be linked to yearly ambient air pollution levels using geographic information system (GIS) software.

We will model air shed-specific, long-term exposure to air pollution for each participant for the relevant years using data from the Environmental Protection Agency’s Air Quality System (AQS), the national Emissions Trends database, the National Oceanic and Atmospheric Association, U.S. census data, and commercially available traffic data. In addition, area-specific information about home characteristics and ventilation patterns will be incorporated into the analysis, as will existing ambient monitoring data from specific sites, where available. Within each airshed, we will estimate annual average PM2.5 and sulfate concentrations at the latitude and longitude of each monitor using regression models based on measured particulate concentrations, site-specific traffic and population density, distance to roadway, land use, emission estimates, and visible range data from the nearest airport. To account for long-range transport, models will also include mean pollutant concentrations from neighboring air sheds. Kriging and other geographical smoothing techniques will be incorporated to account for any remaining spatial correlation. Since the coverage of the pollution databases is incomplete, it is likely that the study population will be restricted to areas in which sufficient pollution data are available. At a minimum, this will include participants living in the original eleven states, where the majority of the population still resides.

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ISEE-79
MODELING CHRONIC EXPOSURE TO PARTICULATE AIR POLLUTION FOR THE NATIONWIDE NURSES’ HEALTH STUDY
Francine Laden,* Helen Suh,† Jeffrey Yanosky,‡ Joel Schwartz,† Carlos Camargo,* Douglas W. Dockery,‡ Frank E. Speizer*. *Channing Laboratory; †Harvard School of Public Health

Abstract: While a convincing body of evidence has accumulated regarding the association of coronary and respiratory disease with acute exposures to particulate air pollution, few studies have examined the effects of chronic exposures. We are evaluating the association of long term exposure to air pollution with incident coronary and respiratory disease and with total mortality in the Nurses’ Health Study, an ongoing prospective cohort study of 121,700 women residing throughout the U.S. Between 1986 and 2000, 6,617 incident cases of cardiovascular disease, and 1,292 incident lung cancer cases have been reported. Confirmed prevalent cases of adult-onset respiratory disease include 2,092 cases of COPD and 5,823 cases of asthma. At enrollment in 1976, the participants resided in 11 large industrial states—California, Connecticut, Florida, Maryland, Massachusetts, Michigan, New York, New Jersey, Ohio, Pennsylvania, and Texas. By 2000, there were at least 10 residents in all 50 states and DC. Addresses from 1986 through 2002 are available, and will be used to track residence throughout the study period. This residential history will be linked to yearly ambient air pollution levels using geographic information system (GIS) software.

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Funded by EPA R83-0545-010.
valuation of the difference in health endpoints is used to determine the health-related cost benefit of the lower emissions.

**Results:** This research reveals that additional controls on fossil fuel would have enormous health benefits for Mexico City, São Paulo, and Santiago, averting about 32,000 deaths, 5 million asthma attacks, 200,000 child medical visits, and 50,000 cases of chronic bronchitis in the three cities over the 20 year period. Preliminary results indicate that in the year 2020 alone, the lowered pollution levels would prevent approximately 8,700 children’s medical visits in São Paulo, 80,000 asthma attacks in Mexico City, and 700 chronic bronchitis cases in Santiago. These and related health effects will be monetized to put the health-related economic benefits of lower emissions in perspective.

**Discussion:** This work emphasizes the need for diligence regarding air pollution’s health effects and for attention to the local, short-term benefits of climate change mitigation strategies. This research demonstrates the magnitude of health advantages of modest control policies.

**TABLE 1**

| PM2.5 w/ozone | Females | Males |
|---------------|---------|-------|
| Increment = 10 ug/m3 | RR = 1.28 | RR = 1.29 |
| Cardiopulmonary | 1.34 | 1.08–1.65 | 1.01 | 0.79–1.28 |
| All natural cause | 1.24 | 1.06–1.46 | 1.07 | 0.90–1.29 |

**Conclusion:** It is unclear why females show a higher sensitivity to the effects of ambient levels of PM2.5. The observed relationships could have implications for public health policy. However, further studies are needed to confirm our findings in other studies. This research was supported by EPA STAR grant #GR82-7998-01-0.
The authors are grateful to Drs. Achille Marconi, Giovanni Ziemacki, Giorgio Cattani and Giordano Stacchini, for the analyses of PM samples, and to Drs. Raffaele Antonelli Incalzi, Salvatore Basso, Raffaella Tiziana Benedetto, Anna Maria Della Corte, Leonello Fusco, Carmela. Maiolo, Sandra Sammarro, Maria Serra, Salvatore Spadaro, Lorenzo Maria Tramaglino for the spirometries and 24-h ECG recording. The study has been funded by the Italian Ministry for the Environment (PR22-IS, 1998-2002).

ISEE-83
ASSOCIATIONS OF LONG-TERM EXPOSURE TO AMBIENT PARTICULATES AND OZONE WITH LUNG FUNCTION IN AMERICAN ADULTS - A POPULATION BASED STUDY
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Abstract: We examined the association of long-term exposure to ambient particulate matter < 10 µm in diameter (PM10) and ozone (O3) with lung function using cross-sectional data from 10,240 adults, ages 46 to 70 years, participating in the first follow-up examination of the population-based Atherosclerosis Risk in Communities (ARIC) study. Using data from the Environmental Protection Agency’s (EPA) Aerometric Information Retrieval System (AIRS), we calculated long-term PM10 and O3 exposures as 1-year mean concentrations prior to standardized spirometric measurement (in 1990-1992) of forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1). After adjusting for age, sex, race, education, height, body mass index, education level, recent use of respiratory medications (antihistamines; oral steroids; nebulizers), self-reported history of asthma, and current respiratory symptoms (dyspnea; cough; phlegm; wheeze), significant inverse associations were found between PM10, O3, and FVC. Among never smokers, one standard deviation (SD) increases in PM10 (2.8 µg/m3) and O3 (8.6 ppb) were associated with 31 ml (95% CI: 16-44 ml) and 43 ml (95% CI: 30-58 ml) lower in FVC, respectively. Similar patterns of association between PM10, O3, and FEV1 were observed. These adjusted associations were stronger among former and current smokers and among users of respiratory medications. However, additional adjustment for study center-ethnicity effectively eliminated the associations (including the never smokers). Moreover, center-specific associations between PM10 and lung function were not statistically significant, possibly due to homogeneity of within-center exposures and/or insensitivity of FVC and FEV1. Larger, geographically heterogeneous studies of the association between long-term, low-level exposures to PM2.5 and forced expiratory flow during the middle half of the forced vital capacity maneuver (FEF25-75) may be helpful in examining these possibilities.

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ISEE-85
ENVIRONMENT, PARENTAL ATOPIA, AND ATOPIC DERMATITIS IN TAIWANESE SCHOOLCHILDREN
Yueliang Guo,* Chia-Wen Li,* Ying-Ling Lee,* Hsing-Sih Yur.† *National Cheng Kung University; †National Taiwan University
Purpose: Atopic dermatitis is among the most important childhood skin diseases. The aim of this study was to investigate the relationship between physician-diagnosed atopic dermatitis and risk factors in a population-based sample of six-to-fifteen year-old elementary- and middle-school children in Taiwan.
Methods: During February-June 2001, a cross-sectional national survey was conducted in Taiwan. The International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire was used to assess the prevalence and severity of atopic dermatitis and other allergic diseases. Hereditary, indoor, and outdoor environmental factors were also assessed as risk factors for atopic dermatitis. The population-attributable risks (PAR) were calculated to estimate the contribution of various risk factors for atopic dermatitis.
Results: A total of 35,447 children from 22 elementary and 22 middle schools satisfactorily completed the questionnaire, with response rate of 95.5%. All subjects were between 6 to 15 years old. 54.8% boys and 4.91% girls had physician-diagnosed atopic dermatitis. Adjustment for age, parental education level, maternal smoking during pregnancy, we found the hereditary factors such as atopic dermatitis in parents (OR: 3.81, CI: 3.32-4.37 in boys and 3.84, 3.29-4.49 in girls), indoor environmental factors, such as the existence of cockroach and visible molds on walls at home were associated with atopic dermatitis (OR: 1.19, CI: 1.1-1.44 in boys and 1.12, 0.91-1.40 in girls). Occurrence of atopic dermatitis was also related to the parents’ perceived air pollution (OR: 1.32, CI: 1.13-1.53 in boys and 1.42, 1.19-1.70 in girls), which was highly related to measured criteria pollutants by air monitoring stations. After adjusted with age, parental education level, and maternal smoking during pregnancy, the population attributable risks (PAR) of any parental atopy were calculated to be 42.2% in boys and 41.7% in girls. The PARs...
of any indoor factors were 12.9% in boys and 9.7% in girls, and those of perceived air pollution were 17.6% in boys and 22.2% in girls.

Discussion: Parental atopy, indoor environmental factors (cockroaches and visible molds on walls), and air pollution might have contributed to occurrence of atopic dermatitis in schoolchildren.

Ms. Chia-Wen Li was a medical student who received funding from the summer research program of National Cheng Kung University College of Medicine.

ISEE–86

ARE FINER AIR PARTICLES RISKIER TO LOWERING RESPIRATORY FUNCTION?: A PANEL STUDY

Jong-Tae Lee,* Hee-Kyung Seo,† Ho Kim,‡ Yoonshin Kim,‡ *Ewha Womans University; †Seoul National University; ‡Hanyang University

Introduction: Epidemiologic findings suggest that exposure to short-term ambient levels of particulate matters is associated with adverse health effects and that health effects are more strongly associated with fine particle mass than with coarse particle mass. Little data exists in which PM$_{2.5}$ is used as the exposure measure. The objective of this panel study is to investigate an association between particulate matter and peak expiratory flow rate (PEFR) in the elderly and to compare the estimated risks using PM$_{10}$ or PM$_{2.5}$ as the exposure measure.

Methods: We contacted the subjects living in an asylum for the aged in Seoul. They were informed that they were part of an environmental study and asked to participate in a 2-year longitudinal study (from November 11, 2000 to December 2, 2001). During this 2-year study period, each subject participated at three separate panel surveys. For every panel survey, each subject was provided with a peak flow meter (Vitalograph Inc., Lenexa, Kansas) and a preformatted health symptom diary for 5 weeks. Participants were instructed to perform the peak flow test three times in the standing position, three times daily (in the morning, in the afternoon, and in the evening), and record all the readings along with the symptoms experienced that day, and simple time-activity patterns of the day. Daily levels of particulate matter were measured from two separate MiniVol™ Portable Air Samplers (Airmetrics, Eugene, Oregon) (one for PM$_{10}$ and the other for PM$_{2.5}$) placed on the rooftop of the two-story residence building for the elderly. Using the MIXED procedure in SAS Software version 8.1, analyses were conducted with the assumption that the expected response varied linearly, for each participant, with an intercept and slopes that may depend on the really role of harmful factors such as gender and weather variables.

Results: The number of participants in each survey was 42–61 and the mean age was about 78 year-old. The daily mean concentrations of PM$_{10}$ and PM$_{2.5}$ during the study periods were 79.6 µg/m$^3$ and 56.4 µg/m$^3$, respectively. The daily mean PEFR was 245.3 l/min. An interquartile range (IQR) increment in daily mean levels for PM$_{10}$ (IQR=44.1 µg/m$^3$) and for PM$_{2.5}$ (IQR=34.4 µg/m$^3$) was significantly associated with a decreased PEFR level (–2.39/l/min for PM$_{10}$, 95% CI=–3.35, –1.43; –2.94/l/min for PM$_{2.5}$, 95% CI=–4.07, –1.87). These associations were independent to other covariates such as gender and weather variables.

Conclusion: We observed that particulate matter air pollution at substandard air quality levels is harmful to sensitive persons such as the elderly. This study also reveals that acute lower peaks in the elderly were more strongly associated with fine particulate mass than with PM$_{10}$.

ISEE–87

RISK ASSESSMENT OF AIR POLLUTION TO HUMAN HEALTH IN ARMENIA

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Abstract: The transition to the new social-economic condition created deep changes in the living standards in Armenia. Due to decreased industrial production, the industrial pollution was decreased, but the worsening in economic and social spheres resulted in the growth of poverty. The changes in living conditions influenced public health data.

This focuses on the important indicators of public health conditioned by air pollution concentrations. As a source of the information we have used the reports of Ministry of Health for 1988–1999, Department of Statistics, data of Environmental Pollution Monitoring Center. Materials were analysed by dispersion, correlation methods.

The results of our research show that in terms of anthropogenic chemical burden diminution on the human organism between of 1987–1993, the indexes of still-births and first year infant mortality have decreased. The sickness rate and the death-rate of breathing pathologies have also diminished. When the rate of pollution cut in almost half the still-births rate decreased from 19.2% to 10.09%. The decrease of the summary pollution index “P” (M. Pinigin 1978) from 10.7 to 4.8 is correlated with the stillbirth-rate decrease (r=0.85); correspondingly the breathing pathologies death-rate decrease can be described as the average correlation (r=0.44).

Starting in 1993, mainly due to the wide use of bad quality petrol, an unallowable concentration of formaldehyde and benzene were found in the air. At the same time breathing pathologies, contributing to a rise in death rate, lung cancer, still births, infant mortality and bronchial asthma, have increased. The population suffered from respiratory pathology in case of presence of dust accompanied of SO$_2$, NO$_2$, ozone with increased standard levels.

Because of changes in the type of heating system in Armenia, the level of indoor air pollution has also increased. During the energy crisis years (1993-1996) indoor air pollution was very harmful, because people used to burn wood, coal, oil for heating purposes. From 1992 to 1995, the number of poisonings from CO increased by 6.5 times.

From these results we can conclude that:

1) While estimating harmful impacts of air pollution as an indicator of pathology respirator diseases, lung cancer, some reproductive health indicators can be taken into account.

2) Meanwhile more accurate methods for estimation of the really role of each harmful factors must be established in the process of pathology forming especially for air pollution.

ISEE–88

RESPIRATORY FUNCTION AND PM$_{2.5}$ EXPOSURE IN A COHORT OF FOREST FIREFIGHTERS DOING PRESCRIBED FOREST BURNS IN THE SOUTHEASTERN UNITED STATES

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Abstract: In this study of occupational exposure to smoke from forest fires and respiratory health, we followed a cohort of 12 forest fighters over a 5-week study during the prescribed burn season in winter 2003 in a southeastern US forest. Daily pre- and post-shift spirometry (FEV$_1$, FVC, PEF) was done on each subject and a daily post-shift exposure and respiratory symptoms questionnaire (e.g., cough, phlegm, itchy eyes) and time activity diary was collected for each subject for the duration of the study. 54 individual personal work-shift PM$_{2.5}$ samples were collected during burn activities and 9 during non-burn activities (controls). Over the 5-wk study, there were 9 days of prescribed burn activity when fire fighters were sampled, with an average of 5.4 fire fighters monitored per burn (for an average duration of 7.9 hrs/sample). Burn sizes ranged from...
A COMPARISON OF HEALTH EFFECTS FROM EXPOSURE TO AMBIENT AND NON-AMBIENT PARTICLES

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Introduction: The plausibility of epidemiological associations between adverse health effects and outdoor concentrations of airborne particulate matter (PM) has been questioned by studies demonstrating low correlations between individual exposures to ambient PM and ambient PM concentrations. Since personal exposure to PM is frequently dominated by exposure to non-ambient particles, it is important to evaluate the potential health impacts of both ambient and non-ambient exposures.

Methods: In summer 1998, personal exposures to PM2.5 and sulfate, and ambient concentrations of PM10, PM2.5 and sulfate were measured for a repeated measures (7 repeats) panel study of respiratory and cardiovascular effects in chronic obstructive pulmonary disease (COPD) patients (n=16). In a further analysis of this dataset, we used an estimation method, based on time-activity data and the personal/ambient ratio of sulfate as a marker for the infiltration of ambient particles with the same size distribution, to develop separate estimates of exposures to ambient PM2.5, PM10 and PM10-2.5 and to non-ambient PM2.5. Health outcome measures included lung function, blood pressure, heart rate variability, and arrhythmia. The concentrations and association with health effects of these estimated exposures were compared to the originally measured total personal exposures and to measured ambient concentrations. Use of mixed models and elimination of one day of exposure associated with transported Asian dust led to larger and more significant associations than found in an earlier analysis.

Results: Personal exposures to PM2.5 were dominated by exposures to non-ambient PM2.5 (56% on average), which were uncorrelated with exposures to ambient PM2.5 and to measured ambient PM2.5. For most outcomes, ambient exposure provided greater and more significant effect estimates in the expected direction than non-ambient or total exposure. For most outcomes, the effect estimates between PM indicators and health outcomes were similar in direction and magnitude for ambient concentrations and their respective ambient exposures. However, for most outcomes, effect estimates for ambient exposures were larger and more significant than those for non-ambient concentrations.

Discussion: This study demonstrates a methodology that permits epidemiological analyses using separate indicators for ambient and non-ambient exposure. The results support the hypotheses that ambient exposures provide more precise and stronger estimates of effect in epidemiological analyses than ambient concentrations and that ambient exposures and non-ambient exposures will demonstrate different associations with health outcomes. These results also support the plausibility of associations between ambient concentrations and adverse health outcomes.
curves, using truncated linear splines with varying numbers and locations of knots. By varying the number and location of knots, almost all possible curves can be approximated. For each model, the estimated coefficients of the linear term (in all models), the knot-related terms of PM10, and the model Bayesian Information Criterion (BIC) were obtained. All possible models in this pre-specified family of models were then averaged (weighted by posterior probabilities computed based on the model’s BIC) to estimate a final dose-response curve. Use of the BIC to construct coefficient weights in this project was a modified version of an empirical approximation to a fully Bayesian form of model averaging described by Clyde. These weights depend on the degree to which data support each model. In addition to heavily weighting the best fitting models, the penalty extracted for dimensionality of the model ensures that parsimonious models are favored as well. The final result is a concentration-response relationship that incorporates model uncertainty with respect to both location and number of knots for PM10. The easily adaptable techniques used for this project allow for the development of a concentration-response relationship that incorporates model uncertainty with respect to both location and number of knots for PM10. The easily adaptable techniques used for this project allow for the development of a

ISEE-92

CAUSE SPECIFIC MORTALITY AND PARTICULATE MATTER: A CASE - CROSSOVER STUDY OF 19 US CITIES

Ariana Zeka, Antonella Zanobetti, Joel Schwartz. Harvard School of Public Health

Introduction: Growing evidence has consistently shown increased all-cause mortality from changes in airborne particles. Less is known about associations with specific causes of death, and modifiers of those associations. The present study aimed to examine the cause specific-mortality-daily PM10 association in 19 US cities. The study included a 12-year period between 1989 and 2000.

Methods: We obtained detailed daily mortality files from the National Center for Health Statistics (NCHS) for all US for the period between 1989 and 2000. Air pollution data were obtained from the EPA-provided web site (AIRS) for the same period of years for various air pollutants. The present study examined several associations between daily average of particulate matter of aero-diameter smaller than 10 micrometer (PM10) and daily mortality from all cause, and selected causes: cardiovascular disease, myocardial infarction, congestive heart failure, stroke, respiratory disease, chronic obstructive pulmonary disease, and pneumonia in the 19 US cities. A case-crossover design was used to examine these associations. Controls in this design were selected using the time-stratified approach and two days were left between each control day to eliminate any serial correlation in the controls. Risk of mortality for the list of causes was evaluated in association with PM10 exposures at the same day of the event, and with one, two, and three days prior to the event. All four lags were included in the model. In this study we report percent increase in mortality per any 10 microgram increment of PM10.

Results: All-cause mortality was found increased for PM10 exposures occurring both on the same day (0.27%; SE = 0.07%), and one day prior of the event (0.24%; SE = 0.06%). Cardiovascular disease mortality was also increased in association with the same-day PM10 (0.42%; SE = 0.09%). Similarly other associations were observed only with exposures occurring on the same day. Deaths from myocardial infarction showed a 0.66% (SE = 0.19%) increase. No effect of PM10 was shown in the risk of death from congestive heart failure. Risk for deaths from stroke showed a 0.69% increase (SE = 0.17%). All respiratory mortality had a 0.44% increase (SE = 0.12%) per any increment of PM10. Mortality from pneumonia increased 0.50% (SE = 0.20%). Interestingly chronic obstructive pulmonary disease mortality increased about 0.34% (SE = 0.21%) for exposures occurring one day prior.

Discussion: The present study found an overall evidence of increased all cause and specific cause daily mortality from exposures to PM10 on the same day of the event and the day before. In particular we confirm recent reports from Asia of an association with stroke mortality, which has been little examined to date. Further analyses will examine potential effect modifiers.

ISEE-93

DIABETES ENHANCES VULNERABILITY TO PARTICULATE AIR POLLUTION-ASSOCIATED IMPAIRMENT IN VASCULAR REACTIVITY AND ENDOTHELIAL FUNCTION

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Introduction: Epidemiological studies suggest that people with diabetes are vulnerable to cardiovascular health effects associated with exposure to particle air pollution. Endothelial and vascular function is impaired in diabetics and may be related to increased cardiovascular risk. We examined whether endothelium-dependent and independent vascular reactivity were associated with particle exposure in individuals with and without diabetes.

Methods: Study subjects were 270 participants in clinical trials, examined before randomization to therapy. Twenty-four hour average ambient levels of air pollution (fine particles (PM2.5), particle number concentration, black carbon (BC), and sulfates (SO4 2-)) were measured approximately 1 km from the patient exam site. Pollutant concentrations were evaluated for associations with vascular reactivity. Linear regressions were fit to the percent change in brachial artery diameter (flow-mediated and nitroglycerin-mediated), with the particulate pollutant index, apparent temperature, season, age, race, sex, smoking history, and body mass index as predictors. Models were fit to all subjects, controlling for disease status, then stratified by diagnosed diabetes vs. at risk for diabetes.

Results: Six-day moving averages of all four particle metrics were associated with decreased vascular reactivity among patients with diabetes, but not those at-risk. Interquartile range (IQR) increases in SO42- were associated with decreased endothelium-dependent (−10.7%, 95% confidence interval (CI): −17.3%, −3.5%) and endothelium-independent vascular reactivity (−5.4% (95% CI: −10.5%, −0.3%) among diabetics. BC increases were associated with decreased endothelium dependent vascular reactivity (−12.6%, 95% CI: −21.7%, −2.4%), and PM2.5 with endothelium-independent reactivity (−7.6%, 95% CI: −12.8%, −2.1%).

Discussion: These results are further evidence that diabetics are vulnerable to particles from coal-burning power plants and traffic.

ISEE-94

IMPACT OF EMISSIONS FROM REGIONAL INDUSTRIAL COMPLEX ON HEALTH OF RURAL POPULATION

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Introduction. The regional industrial complex (RIC) we report consists of 17 chemical plants and the all-country industrial toxic waste site. Environmental monitoring did not indicate exceeding of pollutants
concentrations over permissible levels at the RIC. Considering possible synergistic effect of low level emissions and also complaints of odor annoyance, we conducted epidemiological study. The purpose of this work was to evaluate possible effects of RIC emissions on health indicators of the rural population exposed to the RIC for approximately 25 years.

Methods: Two study methods were used: ecological and historical prospective. The ecological research (for 1995-2000) included the entire regional rural population stratified by gender and age. The historical prospective study was based on a sample of 7 agricultural communities (ACs). As a surrogate measurement of exposure we used distance (< 20 km or > 20 km) and wind direction from RIC. Data on health indicators were collected from: emergency room and hospitalization files of the regional medical center; medical records of local clinics and individual questionnaires. Also questionnaires included information on demography, occupational and local environmental hazards and family health history. Indirect age adjustment for emergency room visits (SER) and hospitalizations (SHR), Pearson correlation, chi-square or Fisher exact test, multivariate linear and logistic regression were applied for statistical analysis.

Results: SER for complaints of respiratory tract disorders and SHR for respiratory and cardiovascular diseases were not different statistically from expected levels in both populations of comparison by distance. Age and gender adjusted odds ratio for hospitalization probability per person due to chronic obstructive pulmonary diseases (COPD) did not exceed 1, by distance. The distance from RIC was not a predictor of the hospitalization duration caused by COPD. The number of hospitalization events for COPD did not correlate with monthly frequency of wind from RIC. In the historical prospective study differences between health indicators in adults from ACs were not associated with proximity to RIC. Among children (0-14) living within 20 km distance from RIC, the rate of chronic diseases of upper respiratory tract (tonsillitis, pharyngitis, laryngitis, rhinitis) obtained from medical record of local clinic was significantly higher (p=0.041) than in comparison group.

Discussion: The study performed at the first time in the region on possible health impairment of population living in the vicinity of RIC shows increased morbidity for upper respiratory tract among children as sensitive health indicator of exposure.

This study was partially supported by the Ministry of Health of State of Israel. Part of the study is included in the MSc thesis of student Tali Lahav.

ISEE-95
IMPLICATIONS OF THE REVIEW FOR ENVIRONMENTAL EPIDEMIOLOGY
Bert Brunekreef. Utrecht University, The Netherlands

Abstract: The WHO systematic review was based on questions developed by the Clean Air for Europe (CAFE) initiative. These questions were largely policy oriented and in some ways, drove environmental epidemiology to the limits of its capabilities.

Some examples include:
- are there population thresholds for air pollution effects? Major contributions from environmental epidemiology studies have been the basis for the answers to this question, but it became also clear that absolute certainty about the existence of population thresholds cannot be provided.
- are effects dependent on subjects’ characteristics such as age, gender and underlying disease? Clearly, such questions can only be answered by epidemiology, but as the population subdivisions become finer and finer, it also becomes harder to produce the science base for a definite answer.
- to what extent is mortality accelerated by long and short term exposure to air pollution (‘harvesting’)? This again is a question only recently addressed by environmental epidemiology, and the methodology to address such questions is still emerging.

ISEE-96
AIR POLLUTION AND PREMATURITY: CONSIDERING THE TIMING OF EXPOSURE
Nelson Gouveia. Department of Preventive Medicine - School of Medicine-University of Sao Paulo

Introduction/Rationale: Evidence is growing that pregnant women exposed to air pollution have higher risk of adverse reproductive outcomes such as low birth weight, birth defects and prematurity. However, one important concern in such studies is the time-dependent structure of the exposure and, in the case of prematurity, of the outcome as well. For example, it is not correct to compare last month exposure of premature babies with last month exposure of term babies as the latter can not develop the outcome (prematurity) after a certain point in time (37 weeks). Therefore, we examined the association between air pollution and prematurity, taking into careful consideration the timing of exposure.

Methods: Data on all singleton live births between 1998-2000 were obtained from the births registry. For each individual birth, information on maternal, pregnancy and children characteristics were available. Daily mean levels of PM10, SO2, NO2, CO and O3 were also gathered.

Maternal exposure was assessed during the first trimester for all pregnancies, during the last 4 weeks for preterm babies and last 4 weeks before the 37th week for term babies and during weeks 28th to 31st for all mothers. Logistic regression models were used.

Results: There were around 600,000 live births during this 3-year period. Mothers resident in peripheral districts of the city (not in the catchment areas of the 13 air quality monitoring stations) were excluded from the analysis as well as those with multiple gestations, those that delivered very premature babies (less than 28 weeks of gestational age) and those that delivered by caesarean section. This resulted in approximately 110,000 births for evaluation of which 5.5% were premature (less than 37 weeks). Prematurity was shown to be associated with infant gender, maternal education, maternal age, parity, and previous abortions. These covariates were included in final models as well as year of birth to allow for seasonal patterns. Exposure during the 1st trimester was not associated with prematurity. Exposures during the other periods specified were associated with a greater risk of prematurity. In multipollutant models, for a 1 ppm increase in the mean exposure to CO during weeks 28th to 31st the risk of prematurity rose 25%.

Conclusions: These results suggest that increased air pollution concentrations may contribute to the occurrence of prematurity. The time-dependent nature of the outcome requires cautious assessment of mother’s exposure. The use of proportional hazards regression might be an alternative to address this problem.

ISEE-97
AIR POLLUTION AND BIRTH DEFECTS IN SUMGAYIT
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Abstract: Since the main industrial enterprises do not operate, the environmental situation in Sumgayit does not improved and decrease of industrial pollution is accompanied by simultaneous increase of traffic intensity.

The aim of the study was to estimate the association between air pollution and reproductive health and birth defects.

The data was collected from the Statistical Department, Sumgayit Health Department, Transport Department and Sumgayit Ecological Committee. Air monitoring was conducted three times and 6 air pollutants were measured: nitric oxides, carbon oxides, sulfur dioxide, dust, phenol, formaldehyde.
Birth defects resulting from urban environmental factors are clearly evident when evaluating children's health in Sumgayit. Environmental pollution constitutes an increased danger for an increase in birth defects. Mutagenic environmental pollution leads to the birth of children with congenital defects of their organs and systems. The determinant role (to 70 per cent) in the genesis of congenital defects is the connection between genetic factors and the negative impact of the urban environmental pollution. In 1998 the proportion of abnormal development cases among causes of prenatal death was 51 per cent, of which 28 per cent constituted anencephaly, 56 per cent involved central nervous system defects, while other development defects amounted to 16 per cent. In the child death rate profile, the high index of prenatal causes shows direct connection with the environment. Three per cent of newborn infants were delivered with conditions of abnormal development, 6 per cent had anencephaly, 22 per cent had nervous system faults, 14.6 per cent had congenital heart disease, 10 per cent mongolism, 16.7 per cent had other developmental conditions. Over 1998-2000 years 170 children were born with different anomalies, for every 4-5 births one is complicated.

Conclusion: 1. At present traffic and heating are the main sources of air pollution in Sumgayit. 2. Poor quality of fuels and gasoline impact air quality. 3. Harmful industrial factors and environmental pollution in Sumgayit have been affecting reproductive and child health for years.

ISEE-98

INFLUENCE OF AIR POLLUTION FROM A REGIONAL INDUSTRIAL PARK ON MAJOR CONGENITAL MALFORMATIONS AND PERINATAL MORTALITY

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Introduction: The regional industrial park (IP) we report includes 17 chemical plants and the national industrial toxic waste site. The study objective was to evaluate possible influence of chemical pollutants from the IP on major congenital malformations (MCM) and perinatal mortality (PM) of the region.

Methods: Ecological study was conducted for period 1995-2000 years. Data on deliveries, MCM (which were detected at the birth) and PM were obtained from the regional medical center files, and stratified by ethnicity, dwelling type and socio-economic level. As a surrogate measurement of exposure we used distance (<20 km and >20 km) and prevailing wind direction from the IP. Incidence rates of MCM and PM (with 95% confidence interval) were calculated. Chi-square and Fisher exact tests were applied for statistical analysis.

Results: During the observation period, among 9567 newborns of Arab-Bedouin origin, residing within 20 km distance from the IP, the MCM rate was significantly increased compared to 17152 newborns living in the area remote from the IP (5.6% vs. 4.8%, p<0.01). The same trend was observed among two Bedouin population subgroups: those residing in permanent townships (4.1% vs. 2.9%, p<0.009) and those living in traditional nomadic territories (8.6% vs. 5.2%, p<0.001). The MCM incidence rate of 20625 newborns of urban and rural localities within 20 km distance from the IP were similar to the observed rate of 14701 newborns dwelling type and socio-economic level. As a surrogate measurement of exposure we used distance (<20 km and >20 km) and prevailing wind direction from the IP. Incidence rates of MCM and PM (with 95% confidence interval) were calculated. Chi-square and Fisher exact tests were applied for statistical analysis.

PM rates by distance from the IP did not differ (1.06% and 1.04%). We found no differences in the MCM and PM rates among all groups of comparison by the wind direction from the IP.

Discussion: Since the same effect was not observed in other population groups of the region, the conclusion of increasing in MCM and PM rates for the Bedouin newborns from the vicinity of the IP due to air pollution from the IP is doubtful.

ISEE-99

THE DISTRIBUTED LAG BETWEEN AIR POLLUTION AND INTRAUTERINE MORTALITY

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Abstract: Generalized additive distributed lag models are employed with the objective to investigate the distribution of the air pollution effect over time in the daily fetal death. Daily measures of intrauterine mortality (for fetuses over 28 weeks of pregnancy age), temperature, humidity and NO2 during a period of two years were considered. Primarily short-term displacement effect (5 days) of NO2 was detected and quantified. The fit of a restricted model showed that NO2 concentrations of the day preceding the death explain most of the effect. The relative risk due to an increase of 93 μg/m³ (interquartile range) in NO2 concentration is equal to 1.06 (90% CI: 1.009; 1.115). This effect is moderately larger than the estimated from the fit of a similar generalized additive model, in which the NO2 concentrations are represented by their five days moving averages. Long-term effect of NO2 was also investigated considering concentrations up to 30 days preceding the death. The fitted model suggested a harvesting effect of this pollutant. Estimation of both models was performed by maximum penalized likelihood, assuming a Poisson distribution for the responses and adopting the P-spline smoothing in the estimation of nonparametric terms in the model. Our results indicate that the association between air pollution and fetal mortality is robust to different estimating techniques and suggest that harvesting may occur in this situation.

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ISEE-100

THE INTERACTIVE EFFECT OF AIR POLLUTION AND GST POLYMORPHISMS ON BIRTH OUTCOMES

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Abstract: Prenatal air pollution exposure has been associated with adverse pregnancy outcome such as low birth weight and preterm birth. Glutathione-S-transferase (GST) is one of the multigene family of phase II metabolic enzyme that detoxify the exogenous chemicals. This study was designed to evaluate the association between prenatal exposure to air pollutants and adverse birth outcome, and the interaction with the GST polymorphisms.

We investigated 237 pregnant women who visited a university hospital in Seoul, South Korea. We obtained their address and personal data by questionnaire. The last menstrual period and ultrasound assessment were used to estimate gestational age. Each woman was estimated for air pollution exposure considering the individual address and the monitoring station. We estimated the means of concentration of air pollutants such as aerodynamic diameter less than 10 mm (PM10), nitrogen dioxide (NO2) and carbon monoxide (CO). GSTT1 and GSTM1 genotypes were determined for each pregnant woman. Classified by the GSTT1 and GSTM1 polymorphisms, we analyzed the relationship
between birth outcomes and air pollutants (lower than median concentration vs. above), controlling for maternal age and gestational age. We found that neonatal birth weight decreased as air pollutant levels increased in the women with GSTT1 null type. We observed similar results for birth length and gestational age. For the women with GSTM1 null type, higher CO exposure was associated with reduced gestational age (p = 0.022).

This study indicated that prenatal exposure to air pollutants such as PM10, NO2 and CO were associated with neonatal birth weight, birth length and gestational age, particularly in the null genotypes of GSTT1 or GSTM1.

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Abstract:

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Introduction: The literature on air pollution health effects has not provided firm data on mechanisms for associations with a variety of causes of death. We undertook a study to evaluate the relationship between daily ambient air pollution and immunity in an eastern European setting. Participants were pregnant women delivering between 1994 and 1998 in hospitals located in two districts. One district is characterized by high emissions from power plants and coal fired heating; the other has consistently lower outdoor air pollution.

Methods: Pregnant women were recruited when they appeared at a hospital in labor. Blood samples were obtained by venipuncture from the mother and the umbilical cord and were transported on dry ice to a hospital in labor. Blood samples were obtained by venipuncture from the mother and the umbilical cord and were transported on dry ice to a

RESULTS: Neither PM2.5 nor PAHs had any noticeable effect on maternal lymphocytes. Both exposures, however, showed significant associations with cord blood percentages of CD3+, CD4+, and CD19+. A 100 ng/m3 increase in 14-day average PAH exposure resulted in a 2.7% decrease in the percentage of CD3+ lymphocytes, a similar effect for CD4+ lymphocytes, and a 2.0% increase in CD19+ lymphocytes. For CD3+ and CD4+, these associations tended to be strongest when temperature was averaged over 3-days.

Discussion: In earlier work on a smaller sample, we reported alterations in both maternal and cord lymphocytes in association with 30-day PM10. The current results for 14-day average PM2.5 and PAHs differ in observing no association with lymphocyte percentages in maternal blood. However, cord blood findings are confirmed in this larger sample, and after adjustment for temperature. Thus, this analysis demonstrates robustness of cord blood lymphocyte associations to confounding by meteorologic conditions and suggests that the fetal immune system is affected by ambient air pollutants in the absence of altered immunity in mothers. The clinical significance of these associations is unclear.

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ISEE-102

MOTOR-VEHICLE RELATED AIR POLLUTION AND ADVERSE BIRTH OUTCOMES IN LOS ANGELES COUNTY, CALIFORNIA, 1994-2000

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Abstract: In a previous study we evaluated the relationship between distance-weighted traffic density (DWTD) – a surrogate measure of residential exposure to elevated air pollution in the immediate vicinity of roadways – and low weight and preterm birth. We observed an approximately 10-20% increase in risk of term LBW and preterm birth in infants born to women living close to heavy traffic roadways. In this study we expanded our analysis to the time period 1994-2000 and incorporated available information on the number of trucks frequenting freeways in our study area. We mapped subject home locations at birth and estimated DWTD and the number of trucks on freeways within 750 feet of each residence. Odds ratios (ORs) for term LBW and preterm and LBW (preterm-LBW) birth, and risk ratios (RRs) for preterm birth were estimated based on quintiles of the DWTD distribution and the 90th and 95th percentiles of the freeway truck distributions using logistic regression. We also evaluated associations between background air pollution concentrations (as measured at monitoring stations) and the risk of these three outcomes. Although our results for births during 1994-1996 were similar to those reported previously, we did not observe associations between DWTD and term LBW and preterm-LBW birth for 1997-2000. Associations between DWTD and preterm birth for this time period were observed for certain subgroups: women whose third trimesters fell primarily during fall/winter months (November-April) (RR = 1.07; 95% confidence interval (CI) = 0.99-1.12, comparing the highest to lowest DWTD quintile) and women living in census block groups with a fraction of children in poverty at or above the median value (RR = 1.08; 95% CI = 1.00-1.18). We observed an 11% increase in the risk of term LBW, a 10% increase in the risk of preterm-LBW birth, and a 4% increase in the risk of preterm birth per one ppm increase in annual average background CO (OR = 1.11, 95% CI = 0.97-1.28; OR = 1.10, 95% CI = 0.95-1.27; and RR = 1.04, 95% CI = 0.97-1.12, respectively) for births during 1997-2000. We also observed a 23% greater risk of preterm-LBW birth for women with 13,290 or more freeway trucks passing within 750 feet of their residence per day (95th percentile) (OR = 1.23, 95% CI = 1.06-1.43) for 1997-2000 births. Although these latest results suggest living near roads with a high total amount of traffic may no longer be associated with these outcomes (at least not LBW), living near to freeways frequented by a high number of trucks in neighborhoods with higher background air pollution may still be important.

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