

Backpack on Board

Individual Air Monitoring Predicts Prenatal Exposure to PAHs

Scientists studying human exposure to air pollutants have traditionally had to rely on data from stations monitoring ambient pollution levels. These stations are unable to account for neighborhood variation of or indoor exposure to pollutants such as tobacco smoke, and thus do not capture personal exposures. An international group of researchers studying pregnant women in Krakow, Poland, found they could accurately predict individual exposures by using data from personal air monitors, allowing the development of a predictive model of exposure that may be generalizable to pregnant women in similar exposure settings [*EHP* 116:1509–1518; Choi et al.]. Moreover, they found most of the women's exposure was to outdoor pollutants that penetrated indoors.

The researchers assessed the exposure of 341 nonsmoking pregnant women to airborne polycyclic aromatic hydrocarbons (PAHs). PAHs are ubiquitous carcinogenic compounds formed by the incomplete burning of wood, coal, oil, and other organic substances. The eight PAHs selected for analysis are associated with a variety of health effects including cancer, developmental abnormalities, and asthma. PAHs are known to cross the



placenta and have been demonstrated to pose significant harm to developing fetuses.

Pregnant women were recruited from prenatal clinics in the center and outskirts of the city. Each was given a backpack equipped with an air monitor to wear for a 48-hour period during the second trimester. Before they went to sleep, the subjects placed the device alongside their beds. A subset of 78 women also used the device for 48-hour periods in their first and third trimesters. To

account for seasonal variations in pollution, an approximately equal number of women were enrolled each season. Subjects also completed questionnaires about their health and lifestyle, including exposure to secondhand tobacco smoke.

The results revealed that although most of the women spent less than 3 hours a day outdoors, their personal PAH exposure correlated closely with outdoor levels of the pollutants. The data also showed exposure increased significantly during the winter months with levels declining in the summer, appearing to confirm that coal-burning municipal furnaces and industries were the source of most ambient PAHs in the city.

Using data from the monitors and questionnaires, the researchers reported they could accurately predict personal PAH exposure throughout pregnancy based on the outdoor mean PAH concentration at any given month of the year. They note, however, that indoor data are more accurate for assessing short-term (48 hours or less) individual exposure. —Cynthia Washam

The Irritation of House Dust

DEHP Heightens Inflammatory Response in Allergy Sufferers

Past research has suggested that di(2-ethylhexyl) phthalate (DEHP), a commonly used plasticizer, contributes to asthma symptoms in children [*EHP* 116:98–103 (2008)] and to dermatitis caused by dust mite allergens in mice [*EHP* 114:1266–1268 (2006)]. Both the prevalence of allergic diseases and environmental exposure to phthalates have increased dramatically in the past several decades, but few studies have examined how people's mucosal airways respond to inhaled DEHP. A new study reveals that exposure to DEHP in house dust altered the response of nasal mucosa in allergic people but not in nonallergic people [*EHP* 116:1487–1493; Deutsche et al.].

DEHP is found in polyvinyl chloride pipes, flooring, food containers, and other household products. Oral intake is the main route of exposure, but inhalation offers an alternative route. DEHP vaporizes from consumer products directly into the home and attaches to inhalable airborne dust particles.

The subjects included 16 controls and 16 people who were allergic to house dust mites. The researchers exposed the subjects to one of two house dust samples—vacuumed samples containing 0.41 mg/g (DEHP_{low}) or augmented samples containing 2.09 mg/g (DEHP_{high})—for 3 hours. Nasal fluid was collected after exposure to

measure biomarkers of allergic inflammation, including interleukin (IL)-2, -4, -5, -6, and -8, granulocyte colony-stimulating factor (G-CSF), and eosinophilic cationic protein (ECP). The expression of 1,232 genes was analyzed by microarrays in biopsies obtained from one nostril.

Following either DEHP dose, the nonallergic group experienced no changes in nasal mucosa, and biomarker levels did not change significantly. However, DEHP exposure was associated with biomarker changes in the allergic group: half the allergic subjects challenged with DEHP_{low} showed significantly elevated levels of G-CSF, ECP, IL-5, and IL-6, whereas other allergic subjects exposed to DEHP_{high} showed significantly diminished levels of G-CSF and IL-6, suggesting a reduced immune response.

DEHP is a known modulator of gene expression, as illustrated by the current study results. Among healthy subjects, between the two exposure groups, 6 genes were upregulated and 4 were downregulated. Among allergic subjects, between the two exposure groups, 8 genes were upregulated and 8 were downregulated. One of the genes elevated by DEHP was anti-Müllerian hormone, which is associated with proper gonad development in males. DEHP dampened the expression of lactate dehydrogenase A and fibroblast growth factor 9, regulators of testis formation. Although the gene expression data shed little light on allergic reactions, they support earlier evidence for phthalates' action as endocrine disruptors that can impair reproductive tract development. —Carol Potera

Growing Weight of OP Evidence Parathion Linked to Metabolic Effects in Rats

Parathion and other organophosphate pesticides, the most widely used class of insecticides, have long been known as neurotoxicants but were only recently linked to metabolic disorders. A new study adds to the growing evidence that parathion may be contributing to epidemics of obesity and diabetes [EHP 116:1456–1462; Lassiter et al.].

Obesity and type 2 diabetes have surged in recent decades to the point where two-thirds of U.S. adults are now overweight and approximately 26% have diabetes or prediabetes (elevated fasting blood glucose level below the level considered diabetic). These conditions also are increasing in children, and a growing body of evidence suggests that perinatal exposures to a variety of compounds may have a significant impact on metabolic programming. The authors were prompted to focus on the role of pesticides in these conditions after noting that subpopulations with the highest rates of diabetes and obesity—impoverished residents of inner cities and residents of farming communities—also tended to have the highest pesticide exposures.

The researchers chose parathion as a representative organophosphate. Rats received daily injections of the compound during

their first 4 days of life, a developmental period that corresponds to the second to early third trimester in human gestation. Half the treated rats were given a dose (0.1 mg/kg/day) just below the threshold for symptoms of exposure. The other half were given a dose (0.2 mg/kg/day) just above the threshold.

Both doses altered the rats' metabolism into adulthood, but the effects differed in males and females. Male rats given the lower dose ate about as much as control rats, but outweighed them throughout the 22-week study. Equally important, they showed signs of prediabetes, with elevated fasting serum glucose levels and impaired fat metabolism. High-dose males weighed about as much as controls while consuming less food.

In contrast, both high- and low-dose females weighed less than controls although they consumed at least as much food, indicating a “wasting” condition. This was confirmed by a demonstrated disruption of both glucose and lipid metabolism at both doses.

After reaching adulthood, half the rats were switched to a high-fat diet. Increased fat intake exaggerated parathion's metabolic effects, particularly in females. The researchers believe early-life exposure to parathion and other chemicals might similarly disrupt human metabolism, thereby contributing to obesity and diabetes. They recommend further studies on the metabolic influence of environmental chemical exposures. —Cynthia Washam

Dioxin Exposure and Cardiovascular Disease An Analysis of Association

Dioxins have long been known as highly toxic compounds, having been implicated in cancer, immune system disorders, endocrine disruption, and birth defects. Animal and *in vitro* studies have also suggested a role for dioxins in heart disease. Now a systematic review of epidemiologic studies has found an association between dioxin exposure and death from cardiovascular diseases, particularly ischemic heart disease (reduced blood supply to the heart) [EHP 116:1443–1448; Humblet et al.].

The authors reviewed all English-language studies on dioxin exposure and death from cardiovascular disease reported in PubMed as of December 2007. They used a broad definition of “dioxins” that included polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs) with dioxin-like effects, and polychlorinated dibenzo-*p*-dioxins (PCDDs). However, they excluded studies that focused primarily on PCBs because results pertaining to the non-dioxin-like members of this family would muddy the interpretation of dioxins' cardiovascular effects. Likewise, studies of occupational exposure in the leather processing and flavor/fragrance industries were excluded because workers in these industries are exposed to cardiotoxic methylmercury, arsenic, and xylene along with dioxin.

The remaining studies included 12 dioxin-exposed cohorts, one of which was a large multicenter cohort study; 10 of these cohorts involved military or occupational dioxin exposure, and 2 involved environmental exposure of the general public. The cohorts included Vietnam veterans exposed to herbicides; the population of Seveso, Italy, exposed in 1976 by an industrial accident to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), the most toxic dioxin; and a Taiwanese population exposed in 1979 to polychlorinated dibenzofurans in rice oil.

The researchers identified numerous potential limitations in the reviewed studies. For example, none of the studies adjusted for all



After the 1976 Seveso accident involving TCDD, an official posts a sign warning residents not to touch or eat garden produce and to avoid contact with vegetation, soil, and grass.

the known cardiovascular risk factors of diet, smoking, physical activity, family history, and body mass index, so residual confounding was a concern. Furthermore, not all studies made internal comparisons between lowest-exposed and highest-exposed members of a cohort. Some compared the exposed cohorts with the general population, which may confound results because of the “healthy worker effect” (that is, workers as a group are typically healthier than the general population, which includes those who are too ill to work). There was also wide variation in the precision of exposure estimates.

Despite these potential limitations, the authors concluded that the literature as a whole presented reasonable evidence that dioxin exposure at high doses raises the risk of death from heart disease. They suggest the need for further studies that account for the limitations in the existing studies, particularly with respect to confounders, choice of comparison populations, and environmentally relevant exposure concentrations. —Valerie J. Brown