Running Phthalates to Ground
Pinpointing Exposure Sources in a Virtual Home

Methods to measure concentrations of chemicals in adults and children, a science known as biomonitoring, can be costly and burdensome. And, although biomonitoring data provide useful aggregate information on exposure to all sources, it is almost impossible to tell how much comes from a specific source. A new mechanistic model may offer a way to identify the strongest sources of exposure to semivolatile organic compounds by showing how chemicals move from a single product through a home and which model parameters have the greatest influence on exposure [EHP 118:253–258; Xu et al.].

Researchers created a model of a hypothetical three-room house equipped with adjustable airflow systems to illustrate how human exposure to phthalates released by a specific source—in this case, vinyl flooring—might be predicted. Phthalates are plasticizers that are used in products as diverse as nail polish, plastic wiring, and children’s toys. Data from the Centers for Disease Control and Prevention suggest that more than three-quarters of the U.S. population may be exposed to these suspected endocrine disruptors.

The research team built on an earlier model that described how diethylhexyl phthalate (DEHP)—one of the most prevalent phthalates—is released from vinyl flooring into air and sorbs strongly to interior surfaces (walls, ceilings, floors, furniture, etc.) and suspended particles. Here the researchers used

Traffic Marker?
Early Exposure to Air Pollution Associated with Childhood Asthma

Asthma is now the most common chronic disease for children and a major cause of emergency room visits, hospitalizations, and school absences, according to the World Health Organization. Now a large population-based study has shown an association between elevated exposure to air pollution in utero and during the first year of life and a higher risk of asthma in preschool-aged children [EHP 118:284–290; Clark et al.].

There are multiple known risk factors for developing asthma, including genetic factors, diet, and exposure to secondhand tobacco smoke and allergens. The speed with which the disease has risen in most developed and developing countries suggests environmental exposures probably play a prominent role. Although air pollution is known to worsen existing asthma, a succession of recent studies is underscoring the wide range of possible exposures across the population—and the difficulty of relying on biomonitoring alone to identify the most harmful sources.

To estimate air pollutant exposures, the researchers mapped the residential history of each child against air pollution data obtained from regulatory monitoring, land use regression modeling, and proximity to stationary pollution sources and to roads. These metrics were used to calculate average exposures for the duration of the mother’s pregnancy and the child’s first year of life. Nine pollutant exposures were evaluated: carbon monoxide, nitric oxide, nitrogen dioxide, particulate matter (PM$_{10}$ and PM$_{2.5}$), ozone, sulfur dioxide, black carbon, and wood smoke.

The highest risk of asthma was associated with exposure to the traffic-related pollutants carbon monoxide, nitric oxide, nitrogen dioxide, and black carbon; lesser associations were seen with exposure to PM$_{10}$ and sulfur dioxide, as well as with proximity to industrial point sources. Proximity to roads was not associated with increased risk, but only a small number of children resided near major roads in the study population. Associations between air pollution and asthma were generally greater in girls than in boys, although asthma was significantly more common in boys, consistent with other populations. The authors observe that other researchers also have reported stronger associations in girls, although the finding is not entirely consistent.

This is one of the few studies to examine the effect of in utero exposure on pediatric asthma risk. However, because of relatively high correlation between in utero and first-year exposures, the relative importance of these periods could not be discerned.

Laura Alderson has written for EHP since the 1990s. She is a freelance writer based in Raleigh, North Carolina, specializing in medicine, science, and high technology.
To Each His Own
DEHP Yields Species-Specific Metabolic Phenotypes

Endocrine disruptors have been shown to disturb the balance between energy expenditure and storage in cellular models, a balance that is critical for proper metabolic functioning. Peroxisome proliferator–activated receptors (PPARs), potential molecular targets of endocrine disruptors in several tissues and organs, hold a key position as lipid sensors that direct metabolic gene expression. A new mouse study illustrates activation of a specific PPAR isotype with exposure to the endocrine disruptor diethylhexyl phthalate (DEHP) and provides evidence that the potential influence of DEHP exposure on diet-induced obesity may vary between species [EHP 118:234–241; Feige et al.].

DEHP is a widely used industrial plasticizer that can leach from diverse consumer products including food packaging and medical devices such as plastic tubing and bags. When ingested, DEHP is converted to monoethylhexyl phthalate (MEHP), which is readily absorbed. Previous in vitro research has demonstrated that MEHP can activate all three PPAR isotypes (PPARα, PPARβ, and PPARγ). The result in vivo can be opposing effects depending on which isotype is activated: induction of adipogenesis (PPARγ) or fatty acid oxidation (PPARα, PPARβ).

To determine the physical and biochemical effects of DEHP exposure, weanling mice were fed regular diets, with treatment groups receiving either 100 mg DEHP/kg/day (low dose) or 1,000 mg DEHP/kg/day (high dose) in the chow. Food intake and physical activity did not differ between groups, and lean body mass was not affected. However, in DEHP-treated mice fat reserves were reduced, and blood tests indicated increased hepatic fatty acid oxidation. As a result, mice in the high-dose group gained 15% less weight than low-dose and control mice over the 10-week treatment period.

In a separate experiment, adult mice were fed a high-fat diet for 13 weeks. Fat mass increased from a baseline 8–10% of body mass to 30% in untreated mice but remained unchanged in mice receiving 500 mg DEHP/kg/day. Further experiments investigating the pattern of PPAR target gene expression and using mice lacking either PPARα or PPARβ revealed that DEHP effects were mediated through PPARα in the liver.

Finally, to make the model more applicable to humans, mice genetically engineered to carry human PPARα were exposed to DEHP. Interestingly, MEHP did not protect these mice from diet-related obesity as it did in wild-type mice; in fact, MEHP led to these mice being even more obese than controls. If this relationship holds true in humans, exposure to certain endocrine disruptors could potentially contribute to obesity by promoting fat accumulation.

Conclusions drawn from this study include the identification of hepatic PPARα as a key site for DEHP-associated disruption. The doses applied in this study are 2–3 orders of magnitude higher than estimated typical human exposures when normalized to body mass. However, the observation of subtle, species-specific differences in metabolic response to DEHP point to an important factor that should be considered as the biological effects of DEHP on human health are further explored.

PFCs and Cholesterol
A Sticky Connection

Polyfluoroalkyl chemicals (PFCs), highly stable compounds used in consumer items such as food packaging, textiles, and paper products, are known to migrate throughout and persist in the environment. Animal studies have described the development of adverse health effects such as tumors and developmental delays with exposure to the PFCs perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS). A new study now suggests these and other PFCs may affect serum cholesterol levels in humans [EHP 118:197–202; Nelson et al.].

Elevated cholesterol levels are associated with an increased risk of cardiovascular disease, and are one of the conditions that define metabolic syndrome. Risk factors for high cholesterol include diet, low physical activity, and a family history of the condition, but increasing evidence indicates some environmental chemicals also may contribute. With estimated half-lives of up to 8.5 years, PFCs are classified as persistent organic pollutants (POPs). However, unlike most POPs, which are stored primarily in fat tissue, PFCs persist by forming chemical bonds to proteins in the liver and serum.

Previous studies in humans have reported positive associations between PFOS and PFOA exposures and higher cholesterol levels. The research team in the current study investigated the relationship between insulin resistance,

"Certain environmental chemicals may be a risk factor for high cholesterol."