Suspect Inheritance

Potential Neurotoxicants Passed to Fetuses

In a new twist in an ongoing saga, recent findings show that mothers exposed to polybrominated diphenyl ethers (PBDEs) are passing the suspected neurotoxicants on to their unborn infants [***EHP* 111:1249–1252**]. Researchers led by Anita Mazdai of the Indiana University School of Medicine report in this issue that not only did infants have the same serum concentrations of these persistent organic pollutants as their mothers, but those concentrations were 20–106 times the levels found in mothers and infants in Sweden, where concern over the chemicals has led to their ban.

PBDEs came into use over the last two decades as flame retardants. They're used in many household items including carpets, furniture cushions, and construction materials. PBDEs are of concern to the public health community because of their structural similarity to polychlorinated biphenyls (PCBs). Once widely used as electrical insulators, PCBs were banned in the United States more than 25 years ago after they were associated with memory and learning impairment, immune disorders, and possibly cancer in humans. Studies show that mice and rats exposed to PBDEs before and shortly after birth suffer permanent learning, memory, and behavior disorders. PBDEs hamper the rats' mental development by reducing thyroid hormone. Researchers believe the chemicals may have a similar effect in humans.

No one is sure just how widespread exposure to PBDEs is in the United States. But several recent studies of scattered populations, including this one in Indiana, suggest that U.S. exposure is among the highest in world. PBDEs have been found in meat, poultry, fish, and dairy products, and people are exposed by eating these foods. Researchers in Northern California have also found evidence, described elsewhere in this issue, that people inhale PBDEs in household dust [see "Concentrating on PBDEs," this page; Petreas et al., pp. 1175–1179].

Mazdai and her colleagues theorized that further PBDE exposure may occur *in utero*. To test this theory, they measured concentrations of PBDEs in 12 paired samples of maternal and umbilical cord blood. They recruited their subjects at two hospitals in Indianapolis. Maternal blood was taken upon admission to the labor and delivery unit; cord blood was taken after delivery.

Unexpected delivery. New findings show that certain persistent organic pollutants pass through the placenta from mother to fetus.

Maternal blood PBDE concentrations ranged between 15 nanograms per gram (ng/g) lipid and 580 ng/g lipid, with a mean of 118 ng/g lipid. Concentrations in the cord blood ranged from 14 ng/g lipid to 460 ng/g lipid, with a mean of 105 ng/g lipid. The researchers found no statistical difference between the mothers' levels and those of their matching cord blood, indicating that the infants had essentially the same levels as their mothers. The correlation indicates that maternal PBDE levels can be used to predict exposure in neonates.

The researchers compare these concentrations to those found in similar European mother–infant populations. Compared to a Swedish population described elsewhere in this issue [see Guvenius et al., pp. 1235–1241], the Indiana mothers had up to 69-fold higher levels, and the Indiana infants had up to 109-fold higher levels. It's unclear whether these high concentrations represent a regional- or national-level trend.

The researchers also measured thyroid hormone levels in 9 of the 12 sample pairs, but found no relationship between the hormone and PBDE concentrations. However, they believe they might have found a relationship had the study been larger.

The researchers write that "it is likely that lipophilic compounds such as PBDEs move into fetal circulation along with maternal lipids. . . . Furthermore, there is dramatic mobilization of maternal fat stores during the third trimester of gestation, a period critical to brain development." What this means in terms of PBDEs' effect on the developing human brain has yet to be determined.

The researchers consider their study preliminary. They call for large-scale studies to assess exposure nationwide, identify exposure sources, and determine the effects of PBDEs on fetal development.
–Cynthia Washam

Concentrating on PBDEs

Chemical Levels Rise in Women

On the heels of a European Union announcement of a forthcoming ban on polybrominated diphenyl ethers (PBDEs) comes a report by researchers led by Myrto Petreas of the California Department of Toxic Substances Control that women in the San Francisco Bay Area have 3–10 times higher concentrations of the suspected neurotoxicants than women in other parts of the world [***EHP* 111:1175–1179**]. Although the study involved relatively few subjects, it's among several reports suggesting that exposure to these chemicals is high among Americans of all ages, including women of childbearing age.

Little is known about the human health effects of PBDEs—which are used as flame retardants in household goods—because they've been widely used for only a couple of decades. Concern over human exposure stems from PBDEs' structural similarity to polychlorinated biphenyls (PCBs), banned industrial compounds that disrupt memory and learning. PBDEs are known to disturb the balance of thyroid hormone in rodents exposed *in utero* or postnatally, leading to learning deficits. Scientists speculate that the impact of PBDEs on humans might be similar.

Scientists have known for some time that PBDEs, like PCBs and other persistent organic pollutants, accumulate in fat. People are exposed to such chemicals mainly through consumption of meat, poultry, fish, and dairy products.

As part of their study, Petreas and her colleagues analyzed stored tissue samples collected during three separate epidemiologic studies of women living in the San Francisco Bay Area. The first group consisted of 420 mothers sampled between 1959 and 1966 in a study of *in utero* exposure to organophosphate pesticides. The second group consisted of 32 women aged 25–54 who were participating in a breast

PhotoDisc

cancer study in the late 1990s. The third group consisted of 50 Laotian immigrants aged 19–40 who were participating in a study of organochlorine effects on menstrual function, also in the late 1990s.

The researchers measured BDE-47, a prevalent constituent of PBDEs, in samples from the three groups. They found no detectable PBDEs in serum samples from the early 1960s group. In samples of breast adipose tissue from the second group, they found BDE-47 concentrations ranging from 5.2 nanograms per gram (ng/g) lipid to 196 ng/g lipid, with a mean of 28.9 ng/g lipid. And in serum samples from the third group, they found concentrations ranging from less than 10 ng/g lipid to 511 ng/g lipid, with a mean of 50.6 ng/g lipid. The 10-ng/g level is the lowest concentration at which a laboratory can report results with confidence.

Concentrations in the 1990s groups were 3–10 times higher than those in similar populations in Japan, Sweden, Germany, and Norway. Petreas and her colleagues speculate that this may be due to California flammability regulations for polyurethane foam and textiles used in furnishings (although these regulations do not require the use of PBDEs in particular).

At first the researchers predicted that the Laotian women's exposure came through the fish that was a regular part of their diet. But these women's concentrations of PCBs—which should also have been high if fish consumption were the route of exposure—were low relative to those of the U.S.-born women sampled during the same time period. The researchers therefore suggest inhalation or ingestion of household and office dust from goods treated with PBDEs as an alternative route of exposure.

The researchers conclude by calling for more studies on the effects of PBDEs, writing that "increasing body burdens, particularly in young women of reproductive age, pose a potential public health threat to future generations." **–Cynthia Washam**

Heavy on the Metals

Parsing the Particulate Content of the London Smog

Half a century after the 1952 London Smog debacle, in which an estimated 12,000 people were killed in the months following a particularly intense early December bout of air pollution, a team of English and U.S. researchers has sliced through samples of old evidence to unveil a few hints about which fine particulates may have played a role in the disaster [***EHP* 111:1209–1214**]. Although the final evidence is scant, it may help today's researchers discover the exact mechanism by which fine particulates, found to be harmful in more than 100 studies, actually damage and kill.

The team from the Royal London Hospital and the State University of New York Upstate Medical University in Syracuse knew that the thick London Smog likely contained a variety of fine particulates from coal, diesel, and other sources. They also knew from a preliminary review that autopsy diagnoses of chronic obstructive pulmonary disease (COPD) following the London Smog episode were about double the rates in the winters before and after. Given these clues, they decided to investigate the presence of particulates in archived autopsy tissues for the period of December 1952 through March 1953.

The team began by picking only those people who had a COPD diagnosis at the time of death, and winnowed that group further by selecting only people generally considered more vulnerable to pollutants—those older than 45 or younger than 1. From these, they selected those subjects for whom pulmonary tissue had been preserved in blocks that could be sliced and analyzed. The tissue had to be from one of four pulmonary compartments so the team could gauge how long the particulates may have been in the body. Their premise was that the most recently inhaled particulates—those taken in within a few hours before death—would have lodged in the airway (bronchiole) compartment, whereas particles inhaled earlier would reside progressively deeper, in the airspace (alveolar) macrophages, interstitial macrophages, or lymph nodes.

The researchers ended up with tissue samples from 18 people who died at the time of or shortly after the London Smog. Examination of samples from 2 infants did not yield readily quantifiable amounts of particulate matter. But the tiny, embedded evidence in 16 adult tissue samples included more than a dozen substances, including carbon, lead, tin, zinc, manganese, antimony, and silicon.

However, the team found ultrafine and fine particulates in the airways of only 2 adult subjects. This paucity can be attributed in part to chance, says primary author Andrew Hunt, because the tissue available was limited and was not necessarily representative of each compartment. The same may hold true for the airspace macrophages, assumed to illustrate the next-most-recent exposures, for which 5 subjects yielded particulates. The deeper interstitial macrophages were more productive, yielding particulates in 15 subjects, while the lymph nodes yielded particulates in only 2 subjects.

Within the context of the limitations noted, the team concludes that the range of carbonaceous, heavy metal, and other fine particulates they found provides fodder for future investigations, even though the particulate sources of today may differ in quantity and content. Perhaps most intriguing is the finding that, in the 2 cases where fine particulates were found in the airway compartment—marking them as components breathed by the individuals shortly before death—the same substances (including lead and a zinc–tin mixture) were rarely found in other compartments. The researchers believe this is most likely explained by the solubility of these metals—that they can dissolve into the body as the particles they are attached to pass through the airway compartment. If soluble components of particulate matter affect physiologic processes, they write, it may be a factor in particulate matter–mediated mortality and morbidity. **–Bob Weinhold**

Hulton Archive

Thick as pea soup. New data on the fine particulate makeup of the 1952 London Smog may tell at least part of the story behind how these pollutants damage human health.