PBDEs: Information for Pediatric Health Professionals

The halogenated flame retardant chemicals, PBDEs (Polybrominated Diphenyl Ethers), are present in many consumer products. Several studies demonstrate widespread exposure that is higher in children than adults. Animal studies and emerging epidemiological data provide evidence of adverse effects on the developing nervous system from early life exposure. These data have led to increased public concern and ongoing policy efforts to decrease use.

PBDEs in Consumer Products and Environmental Contaminants

PBDEs increase the time it takes for a material to ignite. They are used in consumer products that contain foam such as carpet padding, furniture, airplane seats, and baby items, some textiles, and the plastic casings of computers, cell phones, televisions and remote controls.

PBDEs are chemically related to Polychlorinated Biphenyls (PCBs) which were banned in the 1970's. PBDEs and PCBs share the properties of a larger class of chemicals known as persistent organic pollutants (POPs). This class of chemicals as a whole is not biodegradable, and may persist in the environment for many decades. They accumulate in fatty tissues of animals. They are also partially vaporized into the air and may precipitate into remote areas, such as the Arctic.

Human Exposure

PBDEs are found in tissue samples from humans worldwide, with the highest levels in North America and a trend of increasing body burdens over the last three decades.

The main routes of human exposure are thought to be ingestion of contaminated house dust and foods, particularly fats from fish, meat, poultry and dairy. Small amounts of PBDEs have also been detected in a wide variety of plant-based foods.

Concentrations are consistently higher in children compared with adults likely reflecting increased hand to mouth behaviors and a higher ratio of food intake to body weight for children compared to adults. For infants, transplacental exposure and breast milk exposure are important sources. For toddlers, ingestion of house dust predominates. Investigations are ongoing to determine if inhalation is a significant exposure route.

While human data examining breast milk exposure to PBDEs and effects on infant or child neurodevelopmental health are not available, several studies have examined other POPs. These studies find an overriding beneficial effect of long term breastfeeding on neurodevelopment even in the presence of POPs such as DDT and PCBs. Thus, the overall recommendation is to promote breastfeeding. The detection of PBDEs in breast milk underscores the need to reduce environmental sources.

Information on human metabolism and elimination of PBDEs is very limited. PBDEs are believed to persist in human tissues from months to many years, depending on the specific commercial mixtures.

Medical Evaluation of PBDE exposure

PBDEs can be measured in human blood, body fat and breast milk for epidemiological studies. However, for the individual patient, obtaining PBDE levels are not accessible or useful clinical tests. They are prohibitively expensive and have no interpretable reference ranges for clinical outcomes. For more information, contact your local Pediatric Environmental Health Specialty Unit (PEHSU) by calling 888-347-2632 or going to www.pehsu.net.

This factsheet is up to date as of May 10, 2010.

Sources for content on this page: Overviews - Costa 2007, Talsness 2008; Breast milk POPS & neurodevelopment - Ribas-Fitó 2003, Pan 2009, Exposure sources & pathways – Frederickson 2009.

PBDEs and Child Health

The following is an abbreviated evidence review to summarize the current understanding of child health risks of exposure to PBDEs. The prominent concern is effects on the developing nervous system. This is based on multiple studies of laboratory animals. Limited epidemiologic data exist on child health effects**.**

Experimental animal studies of PBDE exposure during the prenatal and perinatal period identify:

Neurobehavioral effects

- Deficits in learning and memory.
- Changes in motor activity and reactivity to the environment.

Sources: Costa 2007, Suvorov 2009a

Thyroid disruption

- Decreased thyroid weight and T4 levels. (This may be one mechanism of the neurodevelopmental deficits observed, see above).
- Decrease in total T3, total T4, and free T4 in prenatally exposed lambs

Sources: Costa 2007, Talsness 2008, Adhelouhab 2009

Growth effects

- Increased plasma IGF-1 and glucose uptake in male pups and increased body weight and length in male and female pups from low dose pre and post natal PBDE-47 exposure

Sources: Suvorov 2009b

Reproductive effects

- In male animal studies, marked decreases in sex steroid hormones and decreased anogenital distance (a marker of estrogenization).Also, Increased sweet preference in males, a marker of feminization for this sexually dimorphic behavior. Decreased sperm production, sperm counts, and sperm head deformities. Dose related decreases in epididymis, seminal vesicle, and prostate weight.
- In female animal studies, delay in puberty, decreased ovarian follicles,.

Sources: Lilienthal 2006, Kuriyama 2005, Van der Ven, 2007

Combined exposure effects: PBDEs + PCBs

- Limited animal data suggests that combined exposure to low levels of PBDEs and PCBs may increase their adverse effect on neurobehavior and reproductive effects. This is important to keep in mind since children are frequently exposed to multiple toxicants at low levels

Source: Costa 2007

Epidemiological data regarding PBDE exposure and child health are limited. Preliminary and relatively small human studies of PBDE exposure in early life (assessed as breastmilk or cord blood concentrations) observe associations with:

Decreased birth weight and length, chest circumference and BMI in a study of 20 Taiwanese infants. (Chao 2007)

Better coordination, visual perception, and behavior but worse fine manipulative abilities and worse attention in an exploratory study of 62 Dutch school children. (Roze 2009)

Worse performance on neurodevelopmental test scores at ages 1-4 years and 6 years in a longitudinal cohort of approximately 100 children in NYC. (Herbstman 2010)

Increased risk of cryptorchidism in a nested case-control (62 cases) study of Danish-Finnish infants. (Main 2007)

In a study of 297 infants, prenatal PBDE exposure was weakly associated with decreased cord blood thyroid hormone measures. (Herbstman 2008)

Precautionary steps to lowering exposure to PBDEs for concerned patients and their families

Given their widespread use and persistence, some level of exposure is unavoidable. There are no known effective therapies to reduce the body burden or consequences of halogenated flame retardant exposures such as PBDE. However, practical steps may decrease the accumulation of exposure by reducing these chemicals in our surroundings, for example:

- Dust frequently with a moist cloth (not dry dusting) and vacuum with a HEPA filter vacuum to reduce dust loads in indoor environments, thereby reducing circulating PBDEs and other contaminants which may be present on dust particles and surfaces.
- Cook meats in a way that allows the fat to drain off to reduce ingestion of lipophilic chemicals such as PBDEs and other POPs. Also, minimize consumption of high fat meats, high fat dairy products and processed meats.
- Prevent small children from mouthing remote controls and other small electronic device casings that may contain PBDEs.
- Repair tears in upholstered furniture and cushions to ensure interior foam is enclosed. Replace old and crumbling foam regardless of the covering.
- If your occupation is in electronics recycling or in the manufacture of products containing flame retardants, take extra precautions to avoid "take home" PBDE or other contaminant dust by changing cloths and washing exposed skin and hair after work and before entering your home. Use proper protective equipment in the workplace.
- Choose consumer goods without halogenated flame retardants. For example, concentrations may be higher in polyurethane foam pillows compared to down or polyester fiber pillows. When an item contains foam and the label states that it complies with the California furniture flammability standard. California TB 117 (Technical Bulletin 117) it can be assumed that the product contains chemical flame retardants.
- For more information about avoiding PBDEs in consumer products see http://www.ewg.org/pbdefree.

Preventing exposure to PBDEs – Policy and regulatory issues

Three main mixtures of PBDEs have been used commercially: penta, octa, and deca, named for the average number of bromine atoms. U.S. manufacturers have voluntarily phased out Penta and Octa PBDEs. Deca PBDE is in the process of being phased out. The legacy of these chemicals, in production in the US or not, results in a mix of PBDEs that will be global pollutants for decades.

Alternative products include very similar chemical fire retardants with chlorine in place of bromine, or another minor change in their structure. Little or no evidence exists about the safety of these alternative products. There has also been no evidence review about whether the presence of chemical fire retardants in children's products has reduced fire related injuries.

Additional useful resource:

ATSDR Public Health Statement. Polybrominated diphenyl ethers. September 2004. Information in factsheet format written for general public by the Centers for Disease Control and Prevention's Agency for Toxic Substances and Disease Registry. http://www.atsdr.cdc.gov/toxprofiles/tp68-pbde-c1-b.pdf

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Disclaimer: Based upon interpretation of the current literature, the PEHSU program is providing this guidance for persons who wish to take a precautionary approach to personal decisions, and is not meant to substitute for personal medical consultation with your health care provider.

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