



“Polycyclic Aromatic Hydrocarbons (PAHs) are a group of environmental toxics that might impact children’s health, resulting in neurological and

developmental difficulties and cognitive developmental delays. Several PAHs are known to cause cancer in animals; some are classified as probably causing cancer in humans.

Most of the environmental toxics discussed in this series of fact sheets are found in specific products. However, PAHs are everywhere – in the air that we breathe, the soil, the surfaces of plants, and our groundwater. They can accumulate in foods and in animals, including seafood. Exposure to this environmental toxic can come from the air we breathe, the food we eat and the dust that builds up on furniture, drapes and carpets in our homes.

Because of the pervasiveness of PAHs, the probability of exposure is high. PAHs cross the placenta; thus, the fetus can be exposed in utero. Infants can be exposed through breast milk. Children of all ages are at risk of exposure to PAHs through the air they breathe, the food they eat and the dust that is a normal part of any home.

This column will focus on what you can do to minimize the possible exposure to PAHs. Read the information carefully. Don’t be overwhelmed with what you have little control over. Start with what you can do to minimize your child’s exposure to PAHs in the ways you can have an impact. More information is available through the list of resources at the end.”

- Larry B. Silver, MD

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What are polycyclic aromatic hydrocarbons?

Polycyclic aromatic hydrocarbons, or PAHs, are a type of chemical that can be formed when certain materials are burned. They can be formed and released into the air during natural burning processes such as forest fires and volcanoes¹. However, most of the PAHs in our air result from human activity, including the burning of coal, oil, gas, garbage, wood and tobacco. PAHs can be found in charbroiled or smoked meat, coal tar, crude oil, roofing tar and creosote (commonly used as a wood preservative and for paving roads).^{2,3}

When released into the air, some PAHs attach to small particles and eventually settle into the soil and onto the surfaces of plants. PAHs in the air can also get into the soil through rainfall². As a result, PAHs can travel both short and long distances¹. At hazardous waste sites, PAHs can enter into the soil if they leak from storage containers. PAHs can then move through the soil and into the groundwater. Water can also be contaminated by discharges from industrial and wastewater treatment plants and by oil spills at sea^{2,3}.

Plants that grow in contaminated soil can develop much higher levels of PAHs than the soil itself. Similarly, PAHs can accumulate in animals that live in contaminated bodies of water, especially those that live near the bottom (since PAHs tend to settle) or are filter-feeders like mussels and oysters^{2,3,4}.

How do PAHs affect children’s health?

More than 100 different chemicals are classified as PAHs; some are considered to be safe, but others are thought to be harmful. Several PAHs are known to cause cancer in animals, and some are classified as probable human carcinogens -- likely to cause cancer^{1,2,3}. In the workplace, exposure to PAHs has been associated with higher risk of lung, skin and bladder cancers³, as well as changes in cardiac function⁵. Lung cancer has also been associated with higher levels of PAHs in the general population⁶. An association has also been found between

relatively low prenatal environmental exposure to carcinogenic PAHs and changes to genetic material (DNA) in umbilical cord blood that can lead to cancer⁷. Furthermore, animal studies have shown that PAHs can affect the immune and reproductive systems^{1,3}.

PAH exposure is particularly concerning for pregnant women and children because it may impact healthy development. Animal studies have shown that certain PAHs can have neurological and developmental effects³. One study in New York City looked at mothers' exposure to PAHs during

pregnancy and the impact on their children's cognitive/thinking ability at three and five years of age. In three-year-olds, investigators found that high prenatal exposure was associated with lower mental development scores and higher odds of having a cognitive developmental delay⁸. At age five, they found that high prenatal exposure was associated with lower IQ scores⁹. Additionally, among African-American women in New York City, PAH exposure during pregnancy was associated with higher risk of preterm delivery and decreased fetal growth¹⁰, both of which can have serious lifelong implications for an infant.

How are children exposed to PAHs?

Children are primarily exposed to PAHs by breathing contaminated air, eating contaminated food, or accidentally swallowing contaminated dust.

Air: Sources of PAHs in outdoor air include cigarette smoke, car and truck exhaust, wood smoke, wildfires, and agricultural burn smoke². Indoors, sources of exposure include burning wood, incense or candles^{11,12}; cigarette smoke; and gas cooking and heating appliances¹. In contrast to the outdoors, indoor spaces are often poorly ventilated, which may lead to increased exposure with indoor burning. Workers may be exposed to contaminated air at smokehouses, trash incineration facilities, and oil refinery plants and coal tar- and asphalt-production plants².

Food: Other than in work settings, much of our exposure to PAHs comes from food³. Plants take up PAHs from contaminated soil and air, and PAH particles in the air can settle on the surfaces of plants¹. Foods including cereals, flour, bread, fruits and vegetables can contain PAHs, with foods growing in polluted environments having higher PAH levels^{1,4}. PAHs also build up in the fatty tissues of animals that eat contaminated food and breathe contaminated air. As a result, PAHs can be found in foods like milk and meats^{1,4}. PAHs can also be found in seafood, with higher

concentrations in fish and shellfish that are bottom-dwellers or filter-feeders. Fish advisories have been issued in parts of the U.S. based on concentrations of PAHs¹.

The method of preparation can also contribute to PAH levels in food¹: Foods that have been charred, grilled or barbecued over a charcoal, wood, or other type of fire have higher PAH levels, as do smoked meat or fish^{2,3}.

Dust: Just as PAHs in outside air can attach to small particles and eventually settle to the ground, PAHs can settle and accumulate in dust any time they are released into the air inside your house. As a result, PAHs can build up on furniture, drapes and carpets. Contaminated soil can be tracked indoors on shoes and mix with the dust on the ground and in carpets. Dust is a particular concern for young children, since they spend much of their time playing or crawling on the floor and tend to put their hands and other objects in their mouths. In fact, one study found that 42% of non-food exposure in young children was from ingesting dust¹¹.

Fetuses can also be exposed in utero since PAHs cross the placenta. Infants can be exposed through breast milk³. Despite this fact, breastfeeding is still best for your baby.

What can you do to reduce your child's risk?

PAHs are all around us in our environment, but don't feel discouraged! There are things that you can do to reduce your child's risk:

- **Leave your shoes at the door** in order to prevent PAHs from soil from being tracked into your home. Also, use a doormat to trap residues from pets.
- **Prevent dust from building up** in your home:
 - Dust frequently with a damp rag (don't use a feather duster as these disperse dust into the air).
 - Mop hard floors frequently with a damp rag.
 - Avoid carpeting when possible.
 - Vacuum frequently with a HEPA filter vacuum if possible.
- **Reduce exposure from food:**
 - Wash fruits and vegetables well, since PAH concentrations are generally higher on the surface of plants than on the inside. By carefully washing produce, you can remove up to 50% of the total PAH content⁴.
 - Check your local fish advisories to select seafood likely to have lower PAH and mercury levels¹ (see Resources below).
 - Since PAHs accumulate in fatty tissues of animals, select lean meats, dairy products and fishes. Trim visible fat from meats and fish⁴.
 - Avoid smoked meat and fish.
 - Avoid eating charbroiled, chargrilled or barbecued foods, and remove charred portions¹³.
- **Reduce exposure from cooking:**
 - Avoid cooking food at very high temperatures and avoid contact of foods with open flames^{1,4,13}.
 - If cooking with open flames, broil rather than grill so that the flame is above the food. When the flame is below the food, fat can drip on the fire and send up smoke that coats the food in PAH⁴.
 - In general, it is better to cook at lower temperatures for a longer time⁴.
- Make sure your cooking area is well-vented: Install exhaust fans over gas stoves and ranges and turn them on whenever you're cooking¹⁴. It's a good idea to turn exhaust fans on over electric stoves when cooking, too, in order to vent any smoke.
- Ask your gas company to check the pilot lights of gas stoves so that the flame tip is blue. If you're buying a new gas stove, look for one with pilotless ignition¹⁴.
- **Eliminate exposure to tobacco smoke:**
 - If you smoke, quitting is the best thing you can do for your own health and the health of those around you. Visit www.smokefree.gov/ for a step-by-step quitting guide and to find out about resources in your area.
 - Do not allow others to smoke inside or near your children since cigarette smoke has high levels of PAHs and other cancer-causing substances³. Not only is cigarette smoke toxic for your children to breathe, but it can also leave residues on your furniture, drapes, carpets and surfaces that will continue to pose a danger. The safest route is to make your home and car smoke-free¹⁵.
- **Minimize exposure through heating appliances:**
 - Avoid using gas heaters that are not vented to the outdoors¹⁶. See resources below for guidelines on safer use of unvented gas heaters.
 - Replace older, high-emitting woodstoves with EPA-certified woodstoves that have lower levels of emission^{17,18}. See resources below for tips.
 - Avoid using an open fireplace. If you do use a fireplace, make sure the flue and chimney are properly installed and maintained.
 - Never use a gas stove or oven to heat your house, since it will not be adequately vented¹⁴.
 - Make sure all gas-burning appliances (heaters/furnaces, stoves, dryers, water

heaters) are well-vented and in good working order. Have these appliances, as well as the ductwork and vents, inspected annually and repaired if needed. When using a gas fireplace, make sure the flue is open¹⁴.

- **Minimize exposure from car exhaust:** If you have an attached garage, make sure the door to the house is airtight, and don't idle your car while it's in the garage¹⁹.

Resources

Centers for Disease Control and Prevention, Agency for Toxic Substances & Disease Registry, Polycyclic Aromatic Hydrocarbons:

www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=25

EPA Fish Advisories:

http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/advisories_index.cfm

Bureau of Air Quality, State of Maine, Wood Stove Emissions:

www.maine.gov/dep/air/education/woodstv.htm

Maine Indoor Air Quality Council, Unvented Heating Appliances:

www.miaqc.org/fact-sheets/11-unvented-heating-appliances

Footnoted resources

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a concern? July 2009. www.mayoclinic.com/health/third-hand-smoke/AN01985, viewed March 22, 2011.

16. Maine Indoor Air Quality Council. Unvented heating appliances. <http://www.miaqc.org/fact-sheets/11-unvented-heating-appliances>, viewed March 22, 2011.

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For more information or for other Practice Prevention columns, visit the Learning and Developmental Disabilities Initiative online at www.disabilityandenvironment.org or call 360-331-7904.

