

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Arsenic



KEY POINTS

- Arsenic is a widespread metallic element naturally occurring in soil and groundwater. It is also released into the environment by industrial sources.
- Children can be exposed through ingestion, inhalation, and prenatally.
- Arsenic is a carcinogen. Chronic exposure raises the risk of bladder, lung, and skin cancers. Early-life exposures, including prenatal exposures, are especially dangerous.
- Public health policies include standards that focus primarily on exposure through drinking water. Exposures may also occur, however, through other items consumed by children, including rice cereals, fruit juices, apple products, and brown rice syrup.

CLINICAL GUIDANCE

Children are at increased risk of exposure to arsenic because they eat more food, breathe more air, and drink more water per pound of body weight than adults. Children are also more likely to put their hands in their mouths.

Children can be exposed through:

- Ingestion of arsenic-contaminated well water.
- Consumption of rice-based cereals, brown rice syrup, juices, and other foods contaminated with arsenic.
- Ingestion of contaminated soil or dust.

Prevention is key!

- For babies, varied diets are recommended. Iron-fortified rice cereal need not be the first grain introduced to infants. Other options include oat, barley, and multigrain cereals. For older kids, varied grains are also recommended in addition to rice.
- When preparing rice, rinse it before cooking. Cook the rice in plenty of water (as you would pasta).
- When possible, avoid buying food products made with “rice syrup.”
- Limit consumption of fruit juices.
- Ask whether wood in family’s decking or playgrounds has been treated with Chromated Copper Arsenate (CCA). If yes, refer to a hardware or paint store for safe alternatives or wood coatings.
- Families with well water should have their water tested for arsenic (as well as for microbials and other metal and contaminants according to screening [tests recommended by the EPA](#)).
- In areas with elevated levels of arsenic in drinking water, consider drinking bottled water. Boiling does not remove arsenic and most filtration systems do not remove arsenic.

Clinical effects are different for acute versus chronic exposures.

- Arsenic is an anti-metabolite and can impact every organ system. The primary targets are the gastrointestinal tract and skin due to the high metabolic rates in those organs.
- Chronic exposure to arsenic can increase risk of bladder, lung, and skin cancers.
- Early childhood exposure is linked to increased risk of infection, bronchiectasis, altered hepatic function, neurodevelopment and cognitive effects, skin changes (eczematoid eruptions, hyperkeratosis, and hyperpigmentation), and increased risk of skin cancer.
- Prenatal exposure can lead to spontaneous abortion, stillbirth, preterm birth, and, later on, a risk of neurodevelopmental disorders and cancer.
- Acute, high-dose exposure can cause severe symptoms including nausea, vomiting, hematemesis, diarrhea, anorexia, weight loss, bone marrow suppression, cardiac dysfunction, and sensorimotor peripheral neuropathy (stocking-glove distribution that may mimic Guillain-Barre).
- Arsenic toxicity may be worse in children who are chronically malnourished, especially those with deficiencies in methionine, zinc, folate, vitamin A, and/or selenium.

Diagnose and treat arsenic exposure.

- Timed urine collection for 8 to 24 hours is the best diagnostic test. “Speciation” of the arsenic is mandatory to determine if the patient has been exposed to the toxic “inorganic” form of arsenic or the relatively non-toxic “organic” form of arsenic.
- The patient should avoid consuming seafood for at least 5 days prior to collecting the urine sample to rule out the contribution of the organic arsenic commonly found in many types of seafood.
- Hair and fingernail analysis have not been validated and are not recommended.
- Children suspected to have had significant arsenic exposure should be referred immediately to a medical toxicologist, Poison Control Center, or Pediatric Environmental Health Specialty Unit for possible chelation therapy.

FOR MORE INFORMATION

The following resources offer additional information regarding arsenic:

- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Tips to Reduce Arsenic in Your Baby's Diet](#) – HealthyChildren.org
- [Parents Plus: Limit infants' exposure to arsenic by feeding a variety of grains](#) – AAP News
- [PEHSU Fact Sheet: Arsenic in Food](#) – PEHSU Resource
- [What You Can Do to Limit Exposure to Arsenic: Tips to Limit Exposure to Arsenic](#) – FDA Resource
- [Heavy metals in baby food and juice: Advice from Environmental Pediatricians](#)

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Children Are Not Little Adults: Why Children's Environmental Health Matters



KEY POINTS

Children differ from adults physically, mentally, biologically, and socially, and are growing and developing. “Children” refers to infants, children, and adolescents.

- Environments free from hazards are best for children. Children may, however, encounter hazards such as chemicals in the environment (toxicants) as they move through their day.
- Children often are more vulnerable than adults to any hazards in the environment because they breathe more air, consume more food, and drink more water than adults do, in proportion to their weight.
- Children's body systems – including the central nervous, immune, reproductive, and digestive systems – are still developing. During certain critical windows of time, exposure to environmental toxicants can lead to irreversible damage.
- Depending on their developmental stage, children behave differently from adults and have different patterns of exposure.
- Unlike adults, children have less control over their environments and may be unaware or unable to make choices that protect their health.

CLINICAL GUIDANCE

Pediatricians can help address environmental health concerns by:

- Educating families, children, and others about exposures, and how different developmental stages impact a child's vulnerability.
- Asking about common potential exposures at home such as secondhand tobacco smoke, lead, and mold. If these are present, pediatricians can provide advice or resources for abatement.
- Giving other anticipatory guidance about preventable exposures. This includes assuring that the home has working smoke detectors and carbon monoxide detectors.
- Staying alert to unusual, persistent symptoms or situations where multiple people in the household are experiencing similar symptoms, and by identifying, diagnosing, and treating those individuals promptly.

A child's exposure occurs within several environments during the course of the day. Vulnerability changes as children grow and experience new skills, abilities, and environments. Factors include:

- Children's **physical location** throughout each day changes as they begin to walk, explore the neighborhood, and become more independent, leading to various exposures in different settings.

- **Breathing zones** are the physical areas where we typically breathe. The breathing zone for a toddler is closer to the ground where they may be more likely to encounter hazards.
- **Oxygen consumption** is higher for children. Therefore, they may be exposed to any toxicants in the air such as secondhand tobacco smoke and secondhand emissions from electronic cigarettes.
- **Quantity and quality of food consumed** may mean greater exposure to chemicals present in what they eat or drink.
- **Water intake** is also higher for children who have smaller bodies than adults and developing biological systems that process contaminants.
- Children are more vulnerable to topical contaminants because the ratio of surface area to body mass is larger than an adult's (depending on the age of the child).
- **Normal behavioral development**, including oral exploration and hand-to-mouth behaviors, increase exposure for infants and young children. These behaviors usually end in later developmental stages.

The manner in which a child absorbs, distributes, and metabolizes environmental toxicants is determined by that child's developmental stage and genetics.

- **Absorption** occurs through the placenta, through skin contact, inhalation, or the gastrointestinal tract.
- **Distribution** varies with body composition such as fat and water content, which vary by developmental stage.
- **Metabolism** may activate or deactivate toxicants, and varies based on the activity of enzymes at different developmental stages.

ADDITIONAL INFORMATION

Regulatory policies often do not take into account the unique combinations of developmental characteristics, physical environment, and biological environment that place children at risk. Additionally, not all industrial chemicals used in the United States are thoroughly tested for safety prior to application. Pediatricians can help address environmental health concerns of the patients and families they serve by advocating for environmental health laws that specifically address childhood needs and differences.

FOR MORE INFORMATION

The following resources offer additional information regarding children's development and environmental health:

- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Pediatric Environmental Health Specialty Units](#)
- [Bright Futures Guidelines and Pocket Guide](#)

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Food Safety



KEY POINTS

- Although the US food supply is among the safest in the world, foodborne illness is a common occurrence and many chemicals can be found in foods sold in the US.
- Pediatricians can help monitor the safety of the food supply by reporting incidents of foodborne illness to public health agencies.
- Organic foods are not shown to be more nutritious than conventionally grown foods but may have lower pesticide residue levels.
- A diet rich in a variety of fresh fruits, vegetables, whole grains, and lean protein is encouraged. Avoiding heavily processed foods and sugar sweetened beverages has multiple health benefits.
- All fruits and vegetables should be washed prior to consumption.

CLINICAL GUIDANCE

Infectious/Pathogenic Food-related Illness

- Pathogenic hazards are ubiquitous in the environment and can enter the food supply in many ways. Common examples include viruses (hepatitis A, norovirus), bacteria (Salmonella, Shigella, Campylobacter, Listeria, E. Coli) and parasites (Cyclospora, Toxoplasma).
- To reduce the risk of pathogen-related illness, remind families to:
 - Clean hands, surfaces, and utensils frequently and thoroughly.
 - Keep food groups separated during the cooking process.
 - Refrigerate perishable foods promptly after cooking.
 - Cook food to the appropriate temperature.
 - Dish towels and cutting boards have been shown to harbor bacteria. Clean cutting boards and dish towels frequently.
 - Wash produce before consuming.
 - Suggest families avoid processed meats, especially during pregnancy.

Pesticide Residues in Produce

- Pesticide residue can be widely found on fruits and vegetables because pesticides are applied extensively to food crops around the world.
- All produce should be thoroughly washed by scrubbing under running cold water to remove superficial residues.

- When possible, consider buying organic produce, especially for those items known to be highest in pesticide residues.
- The Environmental Working Group's "[Dirty Dozen](#)" and "[Clean 15](#)" lists provide a resource for information on pesticides in produce.
- Consuming fresh or frozen produce is of paramount importance. Families should not avoid consuming produce just because organics are not available or possible for the family to purchase.

Chemical Contaminants

- To reduce exposure to plastic-based chemicals (eg, bisphenol-A (BPA), phthalates):
 - Encourage families to reduce plastic containers for water, food (choosing glass or stainless steel when possible).
 - Look at the recycling code on plastic: Codes 1, 2, 4, and 5 tend to be safer alternatives; avoid codes 3 (phthalates), 6 (styrene), and 7 (bisphenols) when possible.
 - Advise families to avoid microwaving food in plastic containers (use glass instead) and avoid placing plastic food containers in the dishwasher.
 - Prioritize fresh or frozen fruits and vegetables (over packaged or processed foods), offering families a list of low-cost options.
- To reduce exposure to inorganic arsenic, which can be found in rice-based products and may also contaminate some private water wells:
 - **Rinse rice before cooking, and consider cooking in an excess of water, then pouring off when cooked. Sushi rice and basmati rice tend to have relatively lower arsenic content, while brown rice tends to be higher.**
 - Rice cereal fortified with iron is a good source of nutrients, but it should not be the only source, and does not need to be the first source. Other options for first foods include oat, barley, and multigrain cereals.
 - Reduce rice-based snacks in favor of fresh fruits and vegetables.
 - Families with water wells should test for arsenic (and other key parameters) as directed by the [US Environmental Protection Agency](#).

FOR MORE INFORMATION

The following resources offer additional information regarding food safety:

- [Food Additives and Child Health](#) – AAP Policy Statement
- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Food Additives: What Parents Should Know](#) – HealthyChildren.org
- [Food Safety](#) – US Department of Agriculture
- [Heavy Metals in Baby Foods and Fruit Juices](#) – PEHSU Resource

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Lead



KEY POINTS

- The most common sources of lead exposure in children are lead-laden dust and paint chips from deteriorating lead paint on interior surfaces. Children living in poverty and children living in pre-World War II housing are at increased risk.
- Lead acts as a neurotoxicant to the developing brain, resulting in potentially irreversible damage, even at low blood lead levels (BLL).
- Pediatricians should assess for lead risks in children 6 years and younger.
- Disparities persist that disproportionately expose low-income, minority, and marginalized children to lead.

CLINICAL GUIDANCE

- Lead impacts the developing brain and can lead to cognitive impairment with decreased IQ. This can result in poor academic achievement, shortened attention span, and abnormal behaviors.
- Lead can impact other organs including the kidneys, blood, bones, and reproductive tract.
- Symptomatic high-dose lead exposure may present as headaches, abdominal pain, loss of appetite, vomiting, constipation, clumsiness, agitation, decreased activity, stupor, coma, and convulsions.

Treat acutely symptomatic children as medical emergencies. Implement medical assessment and management. Separate them immediately from further exposure to lead to prevent further injury.

Prevention is key!

- Risk assessments for sources of lead in the child's environment should be completed at well-child visits between 6 months and 6 years (Bright Futures). If concerned about lead-based paint or other source of lead, obtain a BLL and provide family with anticipatory guidance on reducing sources of lead exposure.
- Consult local health departments or regional Pediatric Environmental Health Specialty Unit (PEHSU) to determine recommendations for obtaining BLLs in your jurisdiction. Note that:
 - Children with Medicaid must receive a BLL at 12 and 24 months (or once between 24 and 72 months if no previous record exists).
 - Children with developmental disorders, pica behavior, or poor cognitive abilities are at increased risk for lead exposure and may warrant monitoring with BLLs.
 - Recent immigrants, refugees, or international adoptees should be tested at the earliest opportunity.

To diagnose elevated BLLs:

- Use a venous BLL — it's the Gold Standard.
- If a finger-stick or capillary sample was used for a screening test, confirm elevated levels with a venous sample to rule out potential contamination

The management of elevated BLLs is multifaceted.

- The current reference value for BLL = 3.5 μ g/dL (representing the top 97.5%tile of BLLs).
- Any child with a confirmed venous BLL \geq 3.5 μ g/dL should be directed to case management and exposure mitigation:
 - Take an environmental history to identify and eliminate the source of lead.
 - Implement mitigation measures in the home, such as dust precautions, removing shoes at the threshold of the domicile before going inside, careful and frequent handwashing, damp mopping floors, washing windowsills, baseboards, and plastic toys, etc.
 - Some health departments have lead programs that provide lead inspections of the home for children with elevated BLLs.
 - Home remediation should be performed by a Lead-Safe Certified contractor.
 - Provide nutritional counselling to ensure adequate intake of calcium, vitamin D, and iron. Iron supplementation may be warranted if deficiency confirmed on lab test.
 - Additional evaluation (eg, abdominal radiograph) may be warranted based on the history.
 - Follow-up BLLs at recommended intervals depending on their initial BLL.
 - Perform a structured developmental screening per recommendations in Bright Futures. Refer the child to Early Intervention or other therapeutic program.
 - Consult with a toxicologist or a PEHSU about chelation therapy for children with BLL >45 mcg/dL.
- Immigrant, refugee, and internationally adopted children may be at increased risk for lead exposure and should be tested for elevated blood lead concentrations when they arrive in the US.

FOR MORE INFORMATION

The following resources offer additional information regarding lead toxicity and exposure:

- [Prevention of Childhood Lead Toxicity](#) – AAP Policy Statement
- [Recommendations on Medical Management of Childhood Lead Exposure and Poisoning](#) – PEHSU Resource
- [Childhood Lead Poisoning Prevention](#) – CDC Resources
- [Lead Exposure and Lead Poisoning](#) – AAP Resources
- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Pediatric Environmental Health Specialty Units](#)
- [Blood Lead Levels in Children: What Parents Need to Know](#) – HealthyChildren.org
- [Bright Futures](#) – Prevention and health promotion for infants, children, adolescents, and their families

PROMOTING HEALTHY
ENVIRONMENTS FOR CHILDREN

Outdoor Air Pollutants



KEY POINTS

- Ambient air pollution is increasingly recognized as a preventable risk factor for a spectrum of pediatric health concerns.
- Air pollution exposures are widespread, and children are uniquely vulnerable, because they spend more time outside and breathe faster (inhaling more pollutants per pound of body weight) than adults, and because their bodies are still developing.
- Current levels of air pollutants are associated with many pediatric morbidities, including asthma incidence and prevalence, adverse birth outcomes, behavioral and cognitive development, and pediatric cancers, as well as with increased risk for a range of chronic diseases in adult life.
- Negative effects start during preconception and can last through childhood and adulthood.
- People from racial and ethnic minority groups, and low-income communities are disproportionately exposed to air pollution through geographic proximity vehicular traffic and polluting industrial facilities. Improving air quality is an environmental justice and child health equity imperative.
- Exposure to air pollution during pregnancy may lead to low birth weight, small size, and preterm birth.

CLINICAL GUIDANCE

Outdoor air pollution consists of a complex mixture of pollutants found in ambient air. Exposure occurs when children breathe, but pollutants are also found in contaminated soil, water, vegetation, and fish. Preventing exposure, most importantly reducing sources of air pollutants, can lead to improved health outcomes.

- Recognize air quality concerns and resources in your practice area and for individual patients.
- Advise families to work with schools to reduce exposure to diesel exhaust from idling school buses.
- Be aware that children may experience worsening asthma symptoms, wheezing and coughing, decreased lung function, and upper airway infections due to increased exposure to outdoor air pollutants.
- Help families of children with asthma to assess their environment for asthma triggers and develop a plan for minimizing exposure to these triggers, including air pollutants
- Offer families resources about the local air quality index (AQI) which can be found online at <https://www.airnow.gov>, in weather apps, or the local newspaper.

- Use the AQI as a tool in educating families about potential protective behaviors, including curtailing outdoor physical activity when air quality is poor. On summer days when ozone levels are expected to be high, outdoor activities can preferentially be scheduled in the morning, as levels in the summer tend to be highest in the afternoon. The AQI may be most useful in especially vulnerable patients with medical risk factors, including pregnant people, young children, children with asthma, and children with a history of preterm birth.
- Serve as a role model and practice model in reducing contributions to poor air quality by using and promoting active transport (eg, walking, cycling) and alternative transportation to gasoline-powered motor vehicles.

BACKGROUND INFORMATION

By 2016, approximately 300 million children worldwide were living in areas with extreme outdoor air pollution. The categories of pollutants include:

- Criteria pollutants that come from power plants, motor vehicles, industrial operations, burning organic materials, coal, smelters, and pulp and paper mills. (The [Clean Air Act](#) requires the US EPA to set National Ambient Air Quality Standards for 6 [Criteria Air Pollutants](#) which can be harmful to public health and the environment. The criteria pollutants are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide.)
- Toxic air pollutants from vehicle exhaust, large and small industrial facilities, indoor sources, volcanoes, and forest fires.
- Greenhouse gases (GHGs), which are heat-trapping gases released in the atmosphere primarily from burning fossil fuels. GHGs are responsible for climate change, a significant threat to children's health and well-being.

The Clean Air Act and its amendments set standards for air pollutants; regulate geographic areas with poor air quality, cars, trucks, and greenhouse gases; and reduce toxic air pollutants.

FOR MORE INFORMATION

The following resources offer additional information regarding outdoor air pollutants:

- [Ambient Air Pollution: Health Hazards to Children](#) – AAP Policy Statement
- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Air Now](#) – Air Quality Index (AQI)
- [Learn about the Particle Pollution and Your Patients' Health](#) – US EPA
- [Patient Exposure and the Air Quality Index](#) – US EPA
- [American Lung Association](#)
- [EJSCREEN: Environmental Justice Screening and Mapping Tool](#) – US EPA
- [Envirofacts](#) – US EPA
- [Toxic Release Inventory](#) – US EPA
- [Criteria Air Pollutants](#) – US EPA

PROMOTING HEALTHY
ENVIRONMENTS FOR CHILDREN

Personal Care Products



KEY POINTS

Personal care products, items used to clean or care for the body (e.g., soaps, cosmetics, sunscreen), may contain chemicals that can potentially impact health. Safer options are available for children and families. Pediatricians can counsel parents and caregivers about potential risks of personal care products.

CLINICAL GUIDANCE

Hygiene products, cosmetics, and sunscreens contain chemicals that children may be exposed to topically and, occasionally, through unintentional inhalation or ingestion. Even for products with FDA or CPSC approval, families should select products carefully, as common chemicals found in these products may impact health. Some examples include phthalates, parabens, and antimicrobial agents. Some imported products may be contaminated with heavy metals.

Prevention is key!

- **Safe Storage:** Personal care products should be kept out of reach of young children.
- **Safer Cleaning:** Advise families to use proper handwashing procedures with plain soap and water, rather than using antibacterial soap.
- Use fluoridated toothpaste without triclosan or other antibacterial compounds. Toothpaste should be used in small quantities, followed by rinsing and spitting. Adult supervision when children brush is recommended until at least age 6.
- **Shop smart:** Check labels and choose products that do not contain phthalates, parabens, triclosan, or synthetic fragrances. If unsure, choose “fragrance-free” products or those without strong scents.
- Plant-based oils such as cocoa butter and coconut oil can be safe alternatives to products that contain multiple ingredients.
- **Safer Beauty:** Minimize use of cosmetic products in children. Chemical hair straighteners, home permanent kits, and alcohol-based hair sprays should be avoided for children. Some cosmetics and eyeliner manufactured in foreign countries may have lead or other heavy metals, and should be avoided.
- Young children with hand-to-mouth behaviors should not use nail polish. Water-based nail polishes may be safer choices for children.
- **Sun Protection:** It's great to be outside and it's important to do so safely to avoid sunburning. Wear protective clothing, including long sleeves and pants, sunhats, and sunglasses; and seek shade when possible. Children should use a broad-spectrum sunscreen with an SPF of 15 to 30 on exposed areas of skin. Mineral-based sunscreen (e.g., zinc oxide) is preferable to chemical-based sunscreen (e.g., oxybenzone). To avoid inhalation, suggest the use of lotions, or, if using a spray, spray onto hands and then apply to child.
- It is important to be mindful of cultural practices that may confer safety risks.

Clinical effects:

- Several compounds in personal care products, including phthalates and parabens, are known to interfere with the endocrine system. Reducing exposures in children and pregnant persons is particularly important.
- Chemicals used in some nail primers are corrosive and can cause significant skin and nail bed irritation, as well as chemical burns from unintentional ingestion or inhalation.
- Hair straightener and home permanent chemicals can irritate the skin and mucosa, trigger allergic reactions, and their use can lead to chemical inhalation.
- Exposure to lead and other heavy metals confers neurodevelopmental toxicity, and there is no known safe level of exposure to these metals.

FOR MORE INFORMATION

The following resources offer additional information regarding personal care products:

- [*Pediatric Environmental Health, 4th Edition*](#) – AAP Policy Manual
- [Environmental Working Group Skin Deep Database](#)
- [Cosmetic Ingredient Review](#)
- [Chemical Inspection and Regulation Service](#)

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Taking an Environmental History



KEY POINTS

An environmental history is a basic component of a complete pediatric history.

- Areas of inquiry include age and condition of the home and childcare environment; secondhand smoke exposure; exposure to gas stoves; dietary exposure to mercury in fish, and to arsenic in rice products and juice; exposure to ultraviolet radiation; exposure to noise; and parental/teen occupations and hobbies.
- Questions can be incorporated into health supervision visits, as well as visits for illnesses with known or potential environmental causes.
- Questions about the environment are also appropriate when symptoms are unusual, persistent, or when multiple people in the home (or childcare setting, school, etc.) have similar symptoms.
- Questions should take into account the child's age and developmental stage.
- Information from an environmental history may help prevent or mitigate hazardous exposures.

CLINICAL GUIDANCE

Learning more about a child's environment allows pediatricians to identify possible exposures and prevent severe illness or injury. Environmental histories include questions about:

- **The home:** Ask whether there is enough heat in the winter and access to cooling in the summer; if gas stoves are used for supplemental heat; if there are working smoke detectors and carbon monoxide detectors; if renovations are planned or ongoing; if the home has lead paint or mold; where chemicals such as pesticides are stored; and if the family has HVAC with MERV 13 or higher or portable air cleaners for poor air quality days or secondhand smoke.
- **Tobacco smoke exposure, use, and/or use of alternative nicotine products by household members:** Tobacco use inside the home results in second- and third-hand smoke exposure to children and other family members. Provide guidance to help smokers quit; if quitting is not possible at this time, smokers can be counseled to reduce exposure to other family members.
- **Water sources:** Ask about water source (including municipal supply, well water, bottled water) and possible contaminants with guidance about resources and mitigation.
- **Exposures from food:** Encourage breastfeeding for infants and young children. Promote a diet rich in fruits, vegetables, protein, and calcium. Discuss food choices and preferences to determine potential exposures such as mercury in certain fish species and arsenic in rice products and juice.
- **Sun exposure:** Promote playing outside but doing so safely to reduce skin cancer risk.

- **Noise exposure:** Ask about noisy sleep machines and toys; discuss limiting exposure from earphones, headphones, or personal listening devices to decrease risks to hearing. Promote quieter environments to enhance learning, and to decrease physiologic stress and psychological harm.
- **Pesticides:** Ask about pest management practices, safe storage of pesticides, spraying or other application of lawn/landscaping chemicals and pesticides, and use of insect repellants.
- **Exposures resulting from household member occupations and hobbies:** Ask about potential hazards from occupations and hobbies while offering guidance to reduce or eliminate childhood exposure. Ask about the presence of firearms in the home, and counsel parents who do keep guns to store them unloaded in a locked case, with the ammunition locked separately.

BACKGROUND INFORMATION

Pediatricians can use environmental histories to learn about children's environments. When available, this can be supplemented with a home visit through the health department or community health workers. Information can help pediatricians understand a child's physical surroundings and offer guidance to reduce or eliminate exposure to hazards. Regional Pediatric Environmental Health Specialty Units (PEHSUs) can assist in obtaining an environmental history and addressing exposure concerns.

FOR MORE INFORMATION

The following resources offer additional information regarding taking an environmental history:

- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Bright Futures Guidelines and Pocket Guide](#)
- [Pediatric Environmental Health Specialty Units](#) – PEHSU
- [Pediatric Environmental Health Toolkit Training Module](#) – ATSDR
- [National Environmental Education Foundation](#) – NEEF
- [PEHSU Fact Sheet: Arsenic in Food](#) – PEHSU Resource

PROMOTING HEALTHY
ENVIRONMENTS FOR CHILDREN

Ultraviolet Radiation



KEY POINTS

Being outdoors has significant health benefits. While encouraging children and adolescents to play and exercise outside, it is important to make sure that they do so safely – overexposure to ultraviolet radiation (UVR) can negatively impact health.

- Overexposure to UVR from the sun and artificial sources raises the risk of skin cancer, the most common form of cancer.
- Although cancer is not common in young people, melanoma is one of the most common cancers in teens and young adults.
- Protection from UVR exposure starting in early childhood reduces the risk for skin cancer in adulthood.
- Pediatricians can play key roles in counseling children and families to reduce UVR exposure.

CLINICAL GUIDANCE

Reducing overexposure to UVR is a key step needed to reduce the risk of skin cancer and other adverse health effects.

Prevention is key!

- Avoid intentional sunbathing and indoor tanning.
- Wear clothing (preferably long-sleeved and long-legged) and hats to protect skin from UVR. A hat with a 3" all-around brim can shade the neck and cheeks.
- Remember that shade or clouds reduce but do not eliminate exposure. Practice sun safety even on cloudy days, when in shady spots, and during the winter.
- Wear water-resistant sunscreen, specifically sun protection factor (SPF) 15 or higher, with broad spectrum (UVB and UVA) coverage, and sunglasses. Before use, check the expiration date and read the label directions. Apply on all skin areas not covered by clothing at least 15 minutes before going outside and reapply every 2 hours, or after swimming or sweating. Mineral-based sunscreen (e.g., zinc oxide) is preferable to chemical-based sunscreen (e.g., oxybenzone).
- Lips also need protection. Apply a lip balm with SPF of 15 or above.
- Pay attention to the [UV Index](#) and aim to avoid the sun during peak hours (10 AM – 4 PM).
- Keep infants younger than 6 months out of direct sunlight.

UVR affects the skin, eyes, and immune system.

- Skin impacts include erythema and sunburn, tanning, phototoxicity, photoallergy, skin aging (photoaging), nonmelanoma skin cancer, and melanoma.
- UVR rays can cause photokeratitis and focal burns to the retina, and are a risk factor for cataract development in adults.
- The immune system impacts include skin cancer induction and immune suppression, both of which can lead to skin cancer.

Pediatricians will rarely encounter patients with nonmelanoma skin cancer or melanoma. High risk patients (with pigmentation disorders or a family history of skin cancer) should be followed in collaboration with a dermatologist.

Activities and sports are strongly encouraged — families should aim to do these outside during lower UV index times, in the shade, and when properly clothed.

FOR MORE INFORMATION

The following resources offer additional information regarding UVR:

- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Fun in the Sun: Keep Your Family Safe](#) – AAP Patient Education
- [Skin Cancer](#) – American Cancer Society
- [Skin Cancer](#) – CDC
- [National Council on Skin Cancer Prevention](#)
- [Skin Cancer Foundation](#)
- [Intergovernmental Panel on Climate Change](#)
- [Sun Safety](#) – US EPA
- [Sun Protection in Schools](#) – WHO

PROMOTING HEALTHY
ENVIRONMENTS FOR CHILDREN

PFAS: Perfluoroalkyl and Polyfluoroalkyl Substances



KEY POINTS

- PFAS are a large group of human-made chemicals produced in the US since the 1950s. They have been used in thousands of products due to their resistance to water, oil, fire, stains, and friction.
- Due to the strong chemical bond between the fluorine and carbon atoms in PFAS, these compounds are persistent in the environment, resistant to degradation, and can readily migrate through soil into groundwater and drinking water sources.
- The 2 most commonly studied PFAS are Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA), which have been mostly phased out of production and use in the US but are still found in the environment.
- The most likely exposure route for these chemicals is ingestion of food and drinking water. While exposure to PFOA and PFOS from today's consumer products is thought to be low, other PFAS are still found in consumer products such as fast-food containers, stain-repellent textiles, and water-repellant clothing.
- Due to their ubiquitous nature, PFAS can be detected in the blood of nearly all people. The biological half-life depends upon the characteristics of the PFAS (eg, length of the carbon chain) and, for some PFAS, is quite long, sometimes years.
- Epidemiologic studies in humans suggest a link with PFAS exposure and high cholesterol, increases in liver enzymes, altered thyroid function, increased risk of high blood pressure or pre-eclampsia in pregnant women, decreased immune response to some vaccines, small decreases in birth weight, and certain cancers (eg, kidney, testicular).

CLINICAL GUIDANCE

In epidemiologic studies, as noted above, PFAS have been associated with human health effects. The most important step for families is to reduce sources of exposure when possible.

Prevention is key!

- For contaminated water:
 - In *known cases* of drinking water contamination, using PFAS-free bottled water for drinking and mixing formula may help reduce exposure until the drinking water system has addressed the PFAS contamination. Families using bottled water should consult their child's pediatrician about the need for supplemental fluoride, if the water used does not contain adequate concentrations of fluoride to prevent dental caries.
 - Water filters that are certified to remove PFAS are also available for homes. Installing a home water filtration system, if monitored, maintained, and used properly, can reduce PFAS levels. However, these filters may not reduce PFAS below guidance levels. How much PFAS is removed by filtration is determined by 1) the PFAS levels, 2) the type of filter, and 3) how well the filter is maintained.

- Families who are using water to prepare their infant's daily formula should switch to PFAS-free bottled water or switch to filtered water using a filter certified to remove PFAS. As above, the pediatrician should be consulted regarding the need for supplemental fluoride.
- Alternative water sources for showering or bathing are not necessary because these chemical contaminants are not absorbed through the skin.
- Families can limit exposure from consumer and food products by:
 - Routine wet dusting and wet mopping in the home to get rid of household dust (as PFAS and other chemicals and allergens can build up in dust).
 - Cut back on the use of certain fast food nonstick containers, such as microwave popcorn packaging.
 - Replace old/cracked or flaking nonstick cookware (use safer alternatives like iron or stainless steel).
 - Check local fish, wildlife, meat, and dairy advisories if consuming locally sourced foodstuffs.
- For patients with concerns about PFAS exposure, important components of the patient visit include identifying and reducing current sources of environmental exposure, and promoting standard, age-appropriate preventive care measures for health and wellness.
- Some states require municipal water systems to test for the presence of several PFAS, given the absence of federal regulations (as of January 2023) and notify customers if the municipal water system tests positive for elevated levels of PFAS (or any other regulated contaminant). However, families may not receive the notice or, if they do, may not understand its implications or ignore it.
- Breastfeeding is recommended for infants, even when it has been learned that drinking water may have been contaminated with one or more PFAS. Although some environmental pollutants, such as PFAS, can pass to the infant through human milk, the advantages of breastfeeding continue to far outweigh any known risks in nearly every circumstance. However, if a family is known to have been chronically exposed to PFAS in highly contaminated drinking water or other known sources, the clinician should have a discussion with them, weighing their preferences and the advisability of breastfeeding.
- Although PFAS can be measured in blood, these tests are generally only available from relatively few, specialized laboratories. Other testing barriers include costs of testing and questions of health insurance coverage, complex technical issues regarding laboratory testing proficiency, and access of disadvantaged families living in environmental justice communities to such testing. Routine measurement of serum PFAS is not recommended as the results do not provide clinical information to guide medical management or predict future health effects. However, if a family is known to have been chronically exposed to high levels of PFAS in drinking water or other sources, the clinician should have a discussion with them, weighing their preferences and the advisability of such testing.
- Regardless of PFAS blood level, the best next step for concerned patients is to reduce future sources of exposure. There are currently no evidence-based treatments for removal of PFAS from the body.
- If a family is known to have been chronically exposed to high levels of PFAS in drinking water or from other known sources, monitoring of blood lipid profile and cholesterol levels should be conducted once in children ages 9-11 years old and again between ages 17-21 years on the schedule recommended by the American Academy of Pediatrics (<https://www.healthychildren.org/English/healthy-living/nutrition/Pages/Cholesterol-Levels-in-Children-and-Adolescents.aspx>). For families chronically exposed to high levels of PFAS who have a family history of dyslipidemia, cholesterol and lipid profile screening of children 2 years and older is advisable, unless they have already been screened within the preceding 5 years or are already diagnosed and receiving treatment.
- Currently, there is no evidence to support obtaining blood work to look for end-organ effects of PFAS exposure in otherwise healthy, asymptomatic children. Laboratory testing should be dictated by standard of practice- the patient's medical history, physical exam findings, and age (standard preventive services and screening tests are recommended).

FOR MORE INFORMATION

The following resources offer additional information regarding PFAS:

- [Guidance on PFAS Exposure, Testing, and Clinical Follow-Up \(2022\)](#) – National Academies of Sciences, Engineering, and Medicine
- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [PFAS: Limiting Children’s Exposure to “Forever Chemicals”](#) – HealthyChildren.org
- [PFAS Resources](#) – PEHSU Program
- [PFAS and Children’s Health](#) – NIEHS
- [Per- and Polyfluoroalkyl Substances \(PFAS\) and Your Health](#) – ATSDR

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Climate Change



KEY POINTS

The earth's climate has progressively warmed in the last century.

- Human activities, and especially the burning of fossil fuels, have contributed to observed global warming.
- Reliance on fossil fuels drives climate change and produces particulate matter (PM) that contaminates the air. PM is associated with adverse health effects. Transitioning to clean energy will improve air quality, improve health outcomes, and mitigate climate change.
- Children, and particularly those living in low wealth households or are otherwise socially disadvantaged, may be more likely to have their health put at risk from extreme events such as floods, heat waves, and hurricanes due to greater exposure and fewer resources available to build resilience.
- Pediatricians can take action to protect their practices and their patients from the effects of climate change and advocate for greater adoption of cleaner forms of energy.

CLINICAL GUIDANCE

Children under 5 may bear as much as 88% of the global burden of disease from climate change.

- Extreme events such as heatwaves, hurricanes, severe storms, wildfires, and droughts place children at risk. These events can result in injury and death, loss or separation from caregivers, exposure to infectious diseases, increased risk of exposure to chemicals and biological contamination, exposure to mold, and mental health consequences such as posttraumatic stress disorder (PTSD), toxic stress, depression, and adjustment disorder.
- Heat waves can cause heat related illnesses and worsen chronic conditions.
- Children may lose homes and access to school after extreme weather events and wildfires.
- Extreme weather events can cause food and water insecurity, and increased risk for water- and food-borne illnesses.
- Many children and their families may have insufficient resources following weather-related disasters.
- Global warming has expanded the range of insect disease vectors, including the tick that transmits Lyme disease.
- Heavy downpours increase risk of waterborne disease outbreaks, especially among children who rely on private well water.
- Wildfires produce immense amounts of smoke that can reduce air quality and pose health risks for all children, and especially for those with respiratory diseases such as asthma.
- Global climate change has near- and long-term impacts on child health and wellbeing.

- Heat, drought, floods, and fires make growing food more difficult and increase risks of nutritional deficiencies in children.
- Children's optimal development occurs with stable families, schools, neighborhoods, and communities. Climate change threatens these foundations of children's mental and physical health and well-being, which places children at risk for long-term physical and mental health issues.

PREVENT HARMS FROM CLIMATE CHANGE IN CHILDREN

- Help families prepare for extreme heat, reduced air quality, extreme weather events, and [vector-borne illness](#), which may include
 - Identifying means of avoiding extreme heat.
 - Encouraging development of family escape plans from wildfire and extreme weather events.
 - Advising on prevention of mosquito and tick bites.
 - Educating families about the US EPA's [Air Quality Index](#).
 - Acknowledging eco-grief and normalizing the need for mental health services.
- Make your office a model of sustainability. Incentivize carpooling, minimize waste, and explore opportunities for energy efficiency in building operations as well as renewable energy.
- Learn about plant-based diets and how decreasing meat consumption can help mitigate climate change and improve health.

CHILD HEALTH BENEFITS OF CLIMATE ACTION

Many of the most problematic child health issues, including asthma, obesity, and mental and neurodevelopmental disorders, may benefit from climate action.

- Reducing fossil fuel combustion reduces air pollution that contributes to as many as 1 in 5 children nationally developing asthma.
- Greater use of active transportation to school can promote healthier BMIs.
- Plant forward diets, especially those with limited processed meat, generate fewer greenhouse gas emissions that cause climate change and can promote better health outcomes.
- Greenspace in cities, which can lower energy consumption in buildings, improve air quality, and reduce urban temperatures and runoff, has been associated with better mental health and physical health in children.

As advocates for children, pediatricians have a critical role to play in the societal response to climate change.

- Pediatricians are trusted experts in child health. Modeling sustainable lifestyles can influence coworkers and patients.
- Post and distribute culturally and linguistically competent educational materials and talk with families about the relationship between climate change and child health, and actions that reduce climate change.
- Support youth, medical students, residents, and medical societies in child health advocacy through actions that address climate change.
- Advocate for more sustainable practices in healthcare at hospitals and clinics.
- Support the inclusion of climate and health in medical and pediatric residency curricula.
- Offer expert testimony, speak at hearings, and write op-eds on health threats from climate change.

FOR MORE INFORMATION

The following resources offer additional information regarding climate change:

- [Climate Change](#) – AAP Resources
- [Climate Checkup for Children’s Health: Little Changes With Big Impact](#) – HealthyChildren.org
- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Climate Change Toolkit](#) – American College of Physicians
- [Practice Greenhealth](#)
- [My Green Doctor](#)

PROMOTING HEALTHY
ENVIRONMENTS FOR CHILDREN

Carbon Monoxide



KEY POINTS

- Carbon monoxide (CO) is an invisible, odorless, and tasteless toxic gas.
- Common fuel-burning sources of CO include furnaces, gas stoves, portable electric generators, and motor vehicles.
- Children and families' health can be critically impacted by CO exposures.
- Primary prevention of CO poisoning requires limiting exposure to known common fuel-burning sources' emissions.

CLINICAL GUIDANCE

- The route of exposure to CO is through inhalation. When in the bloodstream, CO causes decreased oxygen delivery to the body's tissues.
- The health effects from acute CO exposure range from flulike symptoms such as headache, dizziness, nausea, fatigue, weakness, drowsiness, confusion, and irritability, to coma and death from prolonged or intense exposure.
- Infants and children have an increased susceptibility to CO toxicity because of their higher metabolic rates. Fetuses are especially vulnerable.
- Unintentional exposure to CO can be largely attributed to faulty or improperly vented gas or gasoline fueled appliances, solid fuel appliances (eg, wood burning stoves), clogged chimneys, smoke inhalation from fires, motor vehicle exhaust, and tobacco smoke.
- The risk from CO poisoning increases after disasters, when gasoline-powered generators may be more frequently used to supply power.
- Patients who have been exposed to CO should be immediately removed from the source and into fresh air. Call 911 for emergency assistance.

Prevention is key!

- Help families identify possible CO sources within their homes. These could include fuel-burning appliances, fireplaces and woodstoves, space heaters, barbecue grills and hibachis, motor vehicles, electric generators and other power equipment, and boats.
- Advise families of the following:
 - Battery-operated CO detectors should be installed in the hallway near every separate sleeping area of the home, on every floor of a home including the basement, and near attached garages. CO detectors should also be installed in the indoor sections of boats. CO detectors should be checked regularly to ensure they are operating correctly. (CO detectors may be available free of charge to those in need through fire departments, local governments, or regional American Red Cross chapters.)

- All fuel-burning appliances and equipment should be checked professionally once a year or as recommended by the manufacturer.
- Chimneys should be cleaned annually.
- Installation of an exhaust hood is recommended above all gas stoves to decrease indoor air pollution and decrease the risks from CO poisoning.
- Generators, barbecue grills, and hibachis should never be used indoors.
- Gas cooking stovetops and ovens should not be used for supplemental heat.
- Never leave any motor vehicle running in the garage or other enclosed space. CO can accumulate even when a garage door is open.
- Space heaters should be properly vented.

Physicians should consider CO exposure when members of the same household present with similar nonspecific symptoms. Diagnosis requires the measurement of blood COHb to determine if the patient has elevated concentrations. Once diagnosed, treatment may include supplemental oxygen, ventilatory support, and monitoring cardiac dysrhythmias. Use of hyperbaric oxygen decreases recovery time.

BACKGROUND INFORMATION

According to the Centers for Disease Control and Prevention, each year, more than 400 Americans die from unintentional CO poisoning not linked to fires, more than 100,000 visit the emergency room, and more than 14,000 are hospitalized.

FOR MORE INFORMATION

The following resources offer additional information regarding carbon monoxide:

- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Carbon Monoxide's Impact on Indoor Air Quality](#) – US EPA
- [Carbon Monoxide Poisoning](#) – CDC

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Noise



KEY POINTS

Excessive noise exposure is an underrecognized individual and public health problem that affects people of all ages.

- Noise can be defined as unwanted or objectionable sound.
- Occupational noise is experienced in the workplace; environmental noise includes noise from outdoor and indoor settings; recreational noise comes from sought-after activities and events such as listening to music on personal listening devices (PLDs), attending parties, dances, concerts, and sports events; fireworks; and recreational firearm use.
- Sensorineural hearing loss, often coming from excessive occupational or recreational noise exposures, is usually irreversible.
- Environmental noise can affect hearing, learning, sleep, and quality of life; result in a physiological stress response; and cause psychological harm.
- Noise exposure can start in infancy and effects are cumulative across the lifespan. Therefore, attention to noise in everyday activities is needed starting early in life.
- Pediatricians should consider “excessive noise” among the list of modifiable environmental exposures to discuss with children and families.

CLINICAL GUIDANCE

- Excessive and/or prolonged exposure to high volumes — generally from occupational or recreational exposures — can result in hearing loss, tinnitus, and/or hyperacusis (a heightened sensitivity to everyday sounds).
- Noise risk is based on both the level and the duration of noise. The louder the sound, the shorter the amount of time it takes for damage to occur. The longer the exposure, the greater the risk for hearing loss. The frequency of noise exposure — ie, how often it occurs — is also important.
- Environmental noise — or “noise pollution” — is common: vehicular traffic, railways, airplanes, video games, toys, and appliances, are part of everyday life.
- Even small amounts of hearing loss can have profound, negative effects on speech acquisition, language comprehension, communication ability, classroom learning, and social development.
- Infants and young children must rely on adults to remove them from noisy situations.
- Children and teenagers often may not recognize hazardous noise exposures, including from headphones, or attending concerts and dances.

Prevention is key!

Preserving hearing is a lifelong endeavor. Pediatricians can potentially lessen harms by raising awareness of children's specific vulnerabilities to noise.

- Include hearing health and preventing hearing loss on the well visit agenda.
- The most prevalent exposure encountered is likely to be from PLDs. Headphones and PLDs are increasingly used, even by small children. Pediatricians can discuss potential hazards and safe use of PLDs with patients and families when taking a history or when examining ears.
- Share suggestions with families:
 - Avoid loud environments and noises. It is especially important to shield children from impulse noise (eg, firearms, explosives).
 - Generally speaking, if an environment sounds too loud for an adult, it probably is too loud for a child. "Too loud" can mean having to raise your voice to speak with someone just an arm's length away.
 - For young children especially, avoid or leave excessively noisy venues, such as concerts, sporting events, or fireworks displays, or use hearing protection such as protective earmuffs. Earplugs can be used but may pose a choking hazard to young children.
 - Reduce the volume on televisions, computers, radios, and PLDs.
 - Take listening breaks.
 - Use headphones and earbuds with caution.
- Several studies show potential benefits in the use of infant sleep machines. One study, however, raised potential concern about sound levels from these devices. Therefore, if these devices are used, it may be safer to locate them as far away as possible from the infant, set the volume as low as possible, and limit duration of use.
- Pay attention to the volume of sound in all environments where you see patients.
- Hearing protection can be made available to families and health care providers in hospital settings when needed. Ear plugs can be provided for patients undergoing an MRI scan.

To identify hearing concerns,

- Pediatricians can consider recommending formal hearing evaluations for children with a history of excessive noise exposure or for children with tinnitus or hyperacusis.
- A child with 1 or more risk factors on a hearing risk assessment should have ongoing developmentally appropriate hearing screening and at least 1 diagnostic audiology assessment by age 24 to 30 months. The Joint Committee on Infant Hearing (JCIH) recommends a 1-3-6 guideline: All infants should be screened by 1 month of age; those who do not pass screening should have a comprehensive audiological evaluation by 3 months of age; infants with confirmed hearing loss should receive appropriate intervention at no later than 6 months of age.
- Parental concern about a child's hearing, speech, or language delay indicates a need for further evaluation.

ADDITIONAL INFORMATION

- Sensorineural hearing loss (SNHL) is caused by damage to the hair cells of the cochlea or to the auditory nerve. Excessive noise exposure is one cause of SNHL. Damage to hair cells is permanent and usually cannot be restored with medical treatment.
- Several studies confirm that hearing loss is common in children, adolescents, and young adults. Recent data suggests that about 1 in 6 middle and high school students have evidence of hearing loss. Noise exposure is a likely contributor to hearing loss in some of these students.

- Hearing loss is the third most common chronic physical condition in US adults. Hearing loss is linked to cognitive decline, Alzheimer's disease, dementia, and Parkinson's disease.
- Studies in the United States and internationally demonstrate sociodemographic disparities in noise exposure. Most studies show that exposures are higher in people of lower socioeconomic status and in those belonging to historically marginalized racial and ethnic groups.

FOR MORE INFORMATION

The following resources offer additional information regarding noise:

- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Loud Noise Can Cause Hearing Loss](#) – CDC National Center for Environmental Health
- [Hearing Loss in Children](#) – CDC
- [Make Listening Safe](#) – WHO
- [Children and Noise Training Module](#) – WHO
- [Noise and Hearing Loss Prevention](#) – National Institute for Occupational Safety and Health

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Indoor Air Pollutants



KEY POINTS

Indoor air quality affects children's health.

- Children spend 80% to 90% of their time indoors and therefore are frequently exposed to pollutants in indoor air.
- Major sources of indoor air pollutants include tobacco smoke, gas and wood stoves, pets and pests, mold, furnishings, and construction materials.
- The most important step to reduce the concentration of indoor air pollutants in the home is to prohibit smoking indoors. Additional key steps for improving indoor air quality include reducing other sources of common pollutants and ensuring adequate ventilation.
- If a child presents with persistent or unusual respiratory symptoms, clinicians should consider exposure to an indoor air pollutant as a possible cause.

CLINICAL GUIDANCE

Indoor air pollution can be related to a wide range of activities and products including secondhand and thirdhand smoke, natural gas and wood fires, cleaners, furniture and fabric treatments, mold, and other chemicals. Exposure occurs when children breathe airborne pollutants, which may be particulates, gases, vapors, or biological materials. Inhalation of air pollutants can lead to various health effects such as upper and lower respiratory tract symptoms. Mucocutaneous exposure to some air pollutants can lead to irritation of the eyes, nose, and throat.

Prevention is key!

- To improve indoor air quality, reduce sources of pollutants and optimize ventilation.
- Addressing the source of exposure is more effective than trying to clean the air. Work with the family to identify possible indoor air pollutants and discuss steps to reduce or eliminate exposure to these pollutants.
- Encourage families to:
 - Eliminate smoking in any environment where children live and play.
 - Install carbon monoxide detectors and smoke alarms on each sleeping level of the home.
 - Use integrated pest management to eliminate pests safely.
 - Have furnaces, wood stoves, and fireplaces checked yearly by a professional to make sure they are clean and running efficiently.
 - Keep the home environment dry and fix all water leaks promptly.

- For homes with an attached garage, be sure that the door between the garage and home is kept closed tightly. Never leave any motor vehicle running in the garage or other enclosed space.
- Replace ammonia-containing and other toxic household cleaning supplies with less toxic alternatives, such as vinegar and water solution, or baking soda and water.
- If possible, store leftover chemicals such as paints, varnishes, solvents, and adhesives in a shed or area that is not frequently visited.
- Children should not be exposed to mothballs, or to clothes or bedding that have been stored with mothballs, as these may contain dangerous chemicals.
- Avoid chemical air fresheners and scented candles, as they do not improve air quality and may release many chemicals into the air. To avoid potential exposure to phthalates, do not purchase products with “fragrance” on the label as these may contain phthalates.
- Opening doors and windows, and operating ventilation systems for 48 to 72 hours after the installation of new furnishings or carpet may help reduce exposures to synthetic materials used in these items.

Air cleaners and purifiers

Air filters/cleaners should not be the only strategy used to reduce indoor air pollutants but may be an adjunct to source control and adequate ventilation.

- Some studies have documented that portable HEPA (high efficiency particulate air) purifiers can reduce indoor concentrations of particulate matter by about 25% to 50% and reduce asthma symptoms and exacerbations.
- Air cleaners must be maintained per manufacturer’s instructions to ensure proper functioning.
- Ionizers and other ozone-generating air cleaners are not recommended for use in homes or schools. Under some conditions, these devices can release enough ozone indoors to lead to health effects.

FOR MORE INFORMATION

The following resources offer additional information regarding indoor air pollution:

- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Indoor Air Quality Information Clearinghouse](#) – US EPA
- [Air Cleaners and Air Filters in the Home](#) – US EPA
- [American Lung Association](#)
- [Indoor Air Quality Scientific Findings Resource Bank](#)
- [Pediatric Environmental Home Assessment Form](#)
- [US Consumer Product Safety Commission](#)

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Insect Repellents



KEY POINTS

Bites from mosquitoes, biting flies, and other insects can be irritating to children, and, in some cases, can cause serious illness.

- Insect repellents can help reduce the incidence of diseases such as West Nile Virus, Lyme Disease, malaria, Zika, and others.
- When used properly, repellents can safely help protect children from insect bites and the diseases they may carry.
- Insect repellents work by keeping bugs away rather than killing them.

CLINICAL GUIDANCE

- Insect repellents can reduce the incidence of harmful diseases spread by ticks, mosquitoes, and other pests.
- They repel insects that bite but not insects that sting. Biting insects include mosquitoes, ticks, fleas, chiggers, and biting flies. Stinging insects include bees, hornets, and wasps.
- Products containing DEET are the most effective mosquito repellents currently available. DEET is also an effective repellent for a variety of other insect pests, including ticks. DEET should be used in areas where there is concern about illness from insect bites.
- The concentration of DEET in a product affects the amount of the time that the product repels insects. For example, 10% DEET provides protection for about 2 hours; 30% DEET protects for about 5 hours.
- When used on children, insect repellents should contain no more than 30% DEET.
- Reports of adverse effects associated with DEET are rare. If used appropriately, DEET does not present a health risk.
- Picaridin and other repellents are also deemed safe and effective by the [US Environmental Protection Agency](#).
- Where possible, reduce tick and mosquito habitats (eliminate standing water, prune overhanging branches, maintain reasonable lawn height, and remove debris).
- Prevent mosquitoes from entering indoor areas by using screens on windows and doors, and using air conditioning, if available.
- Products not proven effective against mosquitoes include wristbands soaked in chemical repellents and ultrasonic devices that give off sound waves designed to keep insects away.

Tips to share with families about applying insect repellents to children:

- Wearing long sleeves, long pants, socks, and closed shoes can reduce the need for insect repellent.
- Using mosquito netting over baby carriers and strollers can also reduce the need for insect repellent.

- Choose products in the form of sticks, lotions, or unpressurized sprays. Avoid products that combine repellents with sunscreen. If using a separate sunscreen product, apply sunscreen first and insect repellent second. Apply DEET only once a day.
- Read the label and follow all directions and precautions.
- Only apply insect repellents on the outside of clothing and on exposed skin. Do not apply under clothing.
- Use just enough repellent to cover clothing and exposed skin. Using more does not make the repellent more effective.
- Keep all products out of young children's reach.
- Help apply insect repellent on young children. Supervise older children when using these products.
- Never spray insect repellent directly onto a child's face. Instead, spray a little on your hands first and then rub it on the child's face.
- Do not apply to eyes, mouth, cuts, wounds, or irritated skin, and use sparingly around ears.
- Avoid applying repellent to children's hands; children sometimes put hands in their mouth and eyes.
- Weigh the risks of exposure to potentially serious illness spread by insects and the possible risk of absorbing chemicals into the body. Parents of newborns and premature infants should be especially cautious when deciding whether to apply DEET or other chemicals on their child's skin.
- Do not use products containing oil of lemon eucalyptus (OLE) or para-menthane-diol (PMD) on children under age 3 years.
- Apply spray repellents in open areas to avoid breathing them in.
- Wash children's skin with soap and water to remove any repellent when they return indoors and wash their clothing before it is worn again.
- Avoid repellent candles which may trigger breathing problems when fumes are inhaled.
- If you live in an area where ticks are present:
 - If children have been playing outdoors, their skin should be checked at the end of the day and any ticks safely removed.
 - The most effective repellent for ticks is permethrin. Permethrin should not be applied to skin but on clothing and gear.

If a child has a reaction to insect repellent, such as a rash, remind family members to:

- Stop using the product and wash the child's skin with soap and water.
- Contact Poison Help at <https://triage.webpoisoncontrol.org/-/exclusions> or 1-800-222-1222, or contact the child's doctor.
- Remind them to bring the repellent container when getting medical support.
- Call 911 if there is a serious reaction such as trouble breathing or a seizure.

ADDITIONAL INFORMATION

Common "Natural" insect-repellent ingredients include citronella, geranium, peppermint, and soybean oil. These ingredients are deemed safe but have not been approved for effectiveness by the EPA. If there are concerns about a serious insect-borne illness such as Lyme disease in an area known to have ticks, or if traveling to a part of the world with a high prevalence of malaria, then DEET, picaridin, or another approved effective product should be used.

In recent decades, climate change has led to an increased prevalence of vector-borne diseases including malaria and Lyme disease. The prevalence of these diseases is expected to increase unless measures to mitigate the effects of climate change are successfully undertaken.

FOR MORE INFORMATION

The following resources offer additional regarding insect repellents:

- [*Pediatric Environmental Health, 4th Edition*](#) – AAP Policy Manual
- [Choosing an Insect Repellent for Your Child](#) – HealthyChildren.org
- [Find the Repellent that is Right for You](#) – US EPA
- [Using Insect Repellents Safely and Effectively](#) – US EPA

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Pesticides



KEY POINTS

A pesticide is a substance or mixture of substances intended to reduce the impact of insects, animals, unwanted plants, fungi, or other microorganisms.

- Pesticides are used widely in homes, businesses, and agriculture.
- When used appropriately, pesticides can have beneficial effects, including assisting in the prevention of the spread of disease and improving crop yields.
- Because of their widespread use (in homes, yards, schools, and parks) and pervasive presence in the environment and food supply, most children are exposed to pesticides, including during critical periods of development. Pesticides can be toxic to children and adults.
- Children in agricultural communities are at increased risk of exposure due to proximity to agricultural fields and take-home exposures from caregiver's work.
- Parents and families can take steps to help reduce children's potential exposure to pesticides.
- Research indicates that there may be life-long consequences resulting from exposure to certain pesticides.

CLINICAL GUIDANCE

Children can inhale, ingest, or touch pesticides leading to clinical effects.

- Low-dose chronic exposures during early life (preconception, pregnancy, early childhood) has been linked to neurocognitive and neurobehavioral deficits, childhood cancers (leukemia, brain cancer), and adverse birth outcomes such as reduced growth and preterm birth.
- Symptoms of an acute pesticide poisoning depend on the specific pesticide but can include headache, dizziness, tremors, fever, miosis, nausea, abdominal pain, flulike symptoms, and diarrhea with possible anxiety and restlessness.

When an acute poisoning is suspected or has occurred:

- Regional Poison Centers can help with patient evaluation and management. Contact <https://www.poison.org> or 800-222-1222.
- Serious poisonings should be managed with the guidance of a medical toxicologist and/or the regional Poison Center.
- The label of the chemical should be obtained whenever possible. The US EPA-mandated label contains concise information on ingredients, symptoms and signs, treatment guidelines, and a toll-free number for manufacturer assistance.
- In an agricultural exposure, the local county cooperative extension service may be able to provide valuable information about the local crops, chemical usage patterns, and modes of application.
- The identification and elimination of the source of the exposure may prevent future exposures of other children and adults.

Prevention is key!

- Inform families about [Integrated Pest Management](#) (IPM). IPM is an approach to controlling pests with a mix of nonchemical methods and safer chemicals, to provide the least toxic pathway to pest control.
 - Key steps of IPM include sealing cracks and holes that serve as pest entryways, storing food in sealed containers, cleaning up spills, and removing clutter (hiding places for pests).
 - If chemical treatments are needed, choose less-toxic options and time their use to be most effective (and when children are not present).
- Encourage safe pesticide practices, including:
 - Follow all instructions on the label of any pesticides used.
 - Store pesticides safely: keep in an area that children cannot access and do not put pesticides in unmarked containers, or in food or drink jars.
 - Do not use bug bombs or foggers inside the home.
 - For lawns and gardens, use nonchemical pest control methods whenever possible.
 - Keep children and their toys indoors when there is nearby aerial spraying or spraying that may drift near the home.
 - Do not enter a field that has been posted with signs indicating pesticide treatment.
 - Children and teenagers should avoid work that involves mixing or spraying pesticides.
 - If working with or exposed to pesticides, change clothes and wash with soap and water before picking up or playing with children.
 - Do not use pesticides from work in or around the house.
 - Dispose of pesticides safely.
 - Work with schools to ensure safer pesticide use practices.
- When shopping for fresh produce, consider choosing organic foods (when possible) to decrease risk of exposure, as children and adults who eat organic foods have lower levels of pesticide metabolites in their system.
- Wash all fruits and vegetables with running water before consuming.

ADDITIONAL INFORMATION

With the exception of poison baits, as little as 1% of pesticides applied indoors reach the targeted pest. The rest may contaminate surfaces and air in the treated building. Outdoor pesticides may fall on nontargeted organisms, plants, animals, and outdoor furniture and play areas. Material from the outdoor environment can be tracked indoors and add to exposure from dust, floors, and carpets. Pesticides applied outdoors may contaminate groundwater, rivers, or wells.

FOR MORE INFORMATION

The following resources offer additional information regarding pesticides:

- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [Citizen's Guide to Pest Control and Pesticide Safety](#) – US EPA
- [Do you really need to use a pesticide?](#) – US EPA
- [Recognition and Management of Pesticide Poisonings, 6th Edition](#) – US EPA
- [National Pesticide Information Center](#)
- [Texas Agricultural Extension Service, Physician's Guide to Pesticide Poisoning](#)

PROMOTING HEALTHY ENVIRONMENTS FOR CHILDREN

Plasticizers



KEY POINTS

- Plasticizers are common additives in plastic and rubber materials. They are used to make the polymers or resins more flexible or rigid.
- Commonly used plasticizers include phthalates and bisphenol A (BPA).
- Plasticizers may leach from products causing adverse effects on human health. This is a particular concern in plastic products used for food storage and food preparation.
- Heat can cause or increase the leaching of BPA and phthalates from plastic materials.
- Families can take steps to decrease their exposure to plasticizers.

CLINICAL GUIDANCE

Prevention is key!

- Advise families on ways to reduce exposure to plasticizers:
 - Avoid microwaving food or beverages (including infant formula and pumped human milk) in plastic, if possible.
 - Do not microwave or heat plastic cling wrap. If plastic wrap must be used, ensure that it does not touch the food.
 - Do not put plastic food containers or utensils in the dishwasher.
 - Use alternatives to plastic, such as glass or stainless steel, when possible.
 - Look at the recycling code on the bottom of products to find the plastic type and avoid plastics with recycling codes 3 (phthalates), 6 (styrene), and 7 (bisphenols) unless plastics are labeled as “biobased” or “greenware,” indicating that they are made from plants and do not contain bisphenols.
 - Encourage handwashing with soap and water before handling foods and/or drinks.
 - Wash all fruits and vegetables in cold running water before consuming.
 - Make sure pacifiers and bottle nipples are phthalate- and BPA-free.
 - Buy bisphenol and phthalate-free toys.
 - Prioritize fresh or frozen fruits and vegetables (over canned or processed foods) when possible.
 - Wet dusting/mopping in the home helps remove household dust, where plasticizers and other chemicals can build-up.
 - Choose “fragrance free” personal care products and household products.

- Although low concentrations of BPA have been detected in human milk, breastfeeding a baby is one way to reduce exposure to plasticizers. The American Academy of Pediatrics recommends exclusive breastfeeding for 6 months. Breastfeeding should be continued, with the addition of complimentary foods around 6 months, at least through the first 12 month of age and thereafter as long as mutually desired by the mother and child.

Possible health concerns related to exposure to common plasticizers include endocrine disruption, obesogenic activity, and neurodevelopmental disruption.

BACKGROUND INFORMATION

As technology for creating plastics evolved, chemicals such as phthalates and bisphenol A (BPA) were used to create more economical, accessible containers for food and drink, as well as in hygiene and beauty products. Studies show that these chemicals enter the food, drinks, and products they hold, particularly when heated. Efforts by the US Environmental Protection Agency have led to the classification of many subsets of these chemicals as toxic, requiring appropriate labeling when used in plastics, lotions, toiletries, and cosmetics.

FOR MORE INFORMATION

The following resources offer additional information regarding plasticizers:

- [Pediatric Environmental Health, 4th Edition](#) – AAP Policy Manual
- [BPA Fact Sheet](#) – NIEHS
- [Phthalates Fact Sheet](#) – CDC