National Institute of Environmental Health Sciences
Your Environment. Your Health.

Children's Health: Why the Environment Matters

We all want our children to thrive where they live, learn, and play. But anything unsafe to touch, breath, or swallow affects children more than adults because, pound for pound, their contact with harmful chemicals is greater. Therefore, children are more likely to have health problems triggered by exposure to harmful environmental factors, like smog.

Discoveries from scientific research about how the environment affects our health are a basis for strategies to help us protect children from harmful exposures. Protecting children's environmental health requires collaboration among communities, health professionals, and local, state, and federal governments.

Growth and development

Research shows contact with harmful environmental chemicals in the earliest stages of human development – including before birth – influences whether some diseases may happen later in life. In children, protective bodily systems, such as those that filter pollutants from inhaled air and process chemicals, are not fully functional. During growth periods, environmental chemicals may affect normal development. By learning more about these developmental origins of health and disease, we can both reduce children's chances of poor health and improve their growth and quality of life.

What causes children's health problems?

Doctors and scientists do not always know what causes a disease or disorder. Some health conditions are genetic, passing from grandparents to parents to children. Some health problems may be caused by unsafe chemicals in the environment. Most scientists agree that diseases are probably caused by gene and environment interactions. Since we cannot do much to change our genes, we believe knowing about and reducing harmful environmental exposures offers hope for preventing some health problems.

What does NIEHS research tell us about children's health?

NIEHS is committed to understanding how the environment affects children's development and health. Children's environmental health research funded by the institute focuses on preconception, prenatal, and childhood environmental exposures to certain chemicals, pollutants, nutrients, and activities. It addresses a broad range of issues. Many factors contribute to children's health, and research areas often overlap. Determining what chemical exposures may harm children requires a variety of research approaches.

NIEHS invested more than $1 billion over the past 10 years in children's environmental health research, awarding about $100 million in grants each year. This investment leads to discoveries about health effects and environmental factors, such as those presented next.

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Health effects

Asthma is triggered by mold, air pollution, cockroach allergens, tobacco smoke, and other exposures. A study found infants living in homes with high levels of mold from water damage were more likely to develop asthma by age 7.[1] Children with higher blood vitamin D levels had fewer asthma symptoms, particularly in obese children.[2]

Autism spectrum disorder (ASD) is a condition marked by difficulty interacting with other people and restrictive or repetitive patterns of behavior. Certain genetics combined with exposure to air pollution during pregnancy is linked to an increased chance of ASD in children.[3] Pregnant mothers exposed to pesticides, or who have inflammation from infections, diabetes, or obesity, also have a higher chance of having a child with ASD.[4] Research also shows that pregnant mothers who take folic acid may decrease the chance their children will develop autism.[5]

Childhood cancer occurrence may be increased by exposure to chemicals in the environment. Vitamins, including folic acid, taken by women before they become pregnant and during pregnancy may reduce the chance of their children developing leukemia.[6] Research shows a greater chance of developing leukemia in children whose fathers were exposed to pesticides around the time of conception, or whose mothers were exposed to pesticides during pregnancy.[7]

Neurodevelopmental disorders, such as decreases in IQ, problems with fine motor skills, and symptoms of attention deficit hyperactivity disorder (ADHD), have been found in children whose mothers were exposed to high levels of flame retardants, such as polybrominated diphenyl ethers (PBDEs), while pregnant.[8] Children are also more likely to have lower IQs or symptoms of anxiety, depression, or ADHD after prenatal exposure to common air pollutants known as polycyclic aromatic hydrocarbons (PAHs).[9] PAHs were found to have a greater effect on behavioral development among children whose mothers were also under stress while pregnant.[10]

Fathers', not only mothers', exposures can affect their children's health. Men who had phthalates, chemicals found in plastics, in their urine were more likely to have children with increased anxiety, depression, and related physical symptoms. This finding suggests preconception exposures may affect sperm, and later the children's neurodevelopment.[11]

Vaccine effectiveness may be decreased by exposure to common chemicals. In Bangladesh, among school-aged children who consumed high levels of arsenic through drinking water, the mumps vaccine does not work as expected.[12] Children exposed to high levels of perfluorinated compounds (PFCs), chemicals commonly used to repel stains or grease, had weaker immune systems, with reduced protectiveness by vaccines.[13]

Obesity is generally attributed to an unhealthy diet and lack of exercise, but chemicals in the environment, known as obesogens, may interfere with weight control. For example, strong evidence links breathing tobacco smoke, which contains many chemicals, while pregnant to later childhood obesity.[14]

Environmental factors

As previous examples show, scientists may discover a health effect is linked to a certain exposure. But some environmental exposures are linked to several different health problems, as the next examples demonstrate.

Air pollution can harm more than your lungs. Research correlates high air pollution with more miscarriages.[15] Prenatal exposure to air pollution was associated with changes in children's brain structures, as shown by imaging with MRI technology.[16]

Improvement in air quality is beneficial. Women in Beijing, assessed during their eighth month of pregnancy when government intervention temporarily decreased air pollution during the 2008 Olympics, had babies with

healthier birth weights than women exposed to typical air pollution during the same dates.[17] In smog-prone Los Angeles, reduced air pollution correlated with a 20% drop in new asthma cases in children.[18]

Arsenic occurs naturally in soil and groundwater. It is also used in products, such as pesticides and wood preservatives. Scientists at NIEHS found that mice prenatally exposed to arsenic in drinking water displayed signs of early puberty and became obese as adults.[19] Other research showed early life exposure to arsenic may lead to decreases in IQ and immune system dysfunction.[20]

Endocrine disruptors are chemicals, found in everyday products, that can mimic or interfere with the body's hormones, altering the optimal balance needed for proper development and good health.

- **Dioxins** are mainly produced by improperly burning garbage. These compounds persist in the environment, contaminating air, soil, and water. Early life exposure can delay puberty and increase the chance of cancers developing, such as breast and ovarian cancer.[21]
- **Lavender and tea tree oils** may be considered natural, but they can interfere with hormones. Used alone or in hygiene, aromatherapy, and other products, they mimic estrogen. Studies link them with breast enlargement in young boys[22] and early breast development in girls.[23]

- **Phthalates** are compounds used in many personal products, such as nail polish and shampoo. Studies show an association between exposure to phthalates during pregnancy and increased risk of childhood asthma.[24] And they are associated with delayed puberty in girls.[25]

Electronic waste (e-waste) recycling is a global issue. Proper e-waste recycling may reduce both exposures to harmful substances and health problems in pregnant women and children.[26]

Flame retardants, used in consumer and industrial products, can be inhaled or absorbed through the skin. Evidence links them with a range of effects in children, such as lower IQ and increased hyperactivity.[27]

Lead can cause permanent cognitive and health damage. Even low lead levels in children's blood is associated with behavioral problems, delayed puberty, and decreased hearing, cognitive scores, and growth or height.[28]

Healthful prenatal nutrition, with reduced exposure to harmful chemicals, increases the chance of having healthy babies who grow up better able to cope with stressors later in life.[29]

Current children's health research programs at NIEHS

Children's environmental health relies on research that expands knowledge, reduces uncertainty, and furthers collaboration.

NIEHS Children's Environmental Health Translation Centers – Through developing and testing tools, methods, and activities for translating and disseminating research information, this program will support scientists, health care professionals, and communities. Strategies may include courses for medical staff, new ways to report personalized data, and risk communication tactics.

Environmental Influences of Child Health Outcomes (ECHO) – Launched in 2016, this seven-year initiative will investigate how a range of environmental exposures from conception through early childhood may influence the health of children and adolescents. Research will include upper and lower airway health and development, obesity, and brain and nervous system development.

ECHO will also build pediatric clinical research networks in rural and medically underserved areas, so that children from these communities can participate in clinical trials.

Project TENDR: Targeting Environmental Neuro-Developmental Risks – This collaboration of leading scientists and health professionals addresses children's risk for developing brain and nervous system disorders, including autism, attention deficit hyperactivity disorder, intellectual disabilities, and other learning and behavioral problems.

National Toxicology Program (NTP) studies on crumb rubber – Crumb rubber is found in artificial turf, a common play surface, and it can cling to clothing, hair, and skin. It may be accidentally swallowed due to its small size. As groundwork for future health studies, NTP's preliminary research found:

- Crumb rubber consists of many substances, such as polycyclic aromatic hydrocarbons, metals, plasticizers such as phthalates, and bisphenol A.
- No evidence of toxicity in mice from ingestion of crumb rubber. Analysis of blood and urine showed internal levels of crumb rubber constituents were very low. No health problems were observed.
- Crumb rubber, under certain experimental conditions such as high heat, leached chemicals that caused cell death in cell culture studies.

NTP did not assess health effects of long-term exposure to crumb rubber, nor did they evaluate carcinogenicity of crumb rubber chemicals.

For more information on the National Institute of Environmental Health Sciences, go to **www.niehs.nih.gov**.

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