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

Air Pollution and Your Health

Air pollution is a familiar environmental health hazard. We know what we're looking at when brown haze settles over a city, exhaust billows across a busy highway, or a plume rises from a smokestack. Some air pollution is unseen, but its pungent smell alerts you.

When the National Ambient Air Quality Standards were established in 1970, air pollution was regarded primarily as a threat to respiratory health. Over the next decades as air pollution research advanced, public health concern broadened to include cardiovascular disease; diabetes; obesity; reproductive, neurological, and immune system disorders; and cancer. In 2013, the International Agency for Research on Cancer of the World Health Organization (WHO) classified air pollution as a human carcinogen.

Over its 50-plus year history, NIEHS has been a leader in air pollution research. The institute continues to fund and conduct research into how air pollution affects health and the population groups who are most affected.

What Is Air Pollution?

Air pollution is a mix of hazardous substances from both human-made and natural sources. Some dangerous substances are released into the air naturally, such as ash and gases from volcanic eruptions. Other emissions can be caused by both human and natural activity, such as smoke from wildfires, which are often started by people; and methane, which comes from decomposing organic matter in soils as well as animal feedlots.

The primary sources of human-made air pollution are vehicle exhaust; fuel oils and natural gas to heat homes; by-products of manufacturing and power generation, particularly coal-fueled power plants; and fumes from chemical production.

TRAP and Its Components

Traffic-Related Air Pollution (TRAP), from motor vehicle emissions, contains most of the elements common to all air pollution, including various forms of carbon, nitrogen oxides, sulfur oxides, volatile organic compounds, polycyclic aromatic hydrocarbons, fine particulate matter, and ground-level ozone.

Noxious gases, including carbon dioxide, carbon monoxide, nitrogen oxides (NOx), and sulfur oxides (SOx), are components of motor vehicle emissions and byproducts of industrial processes.

Particulate matter (PM), made of chemicals such as sulfates, nitrates, carbon, or mineral dusts, are created during the combustion of fossil fuels and organic matter.

Volatile organic compounds (VOC) are released during the combustion of fossil fuels, and given off by paints, cleaning supplies, pesticides, and even craft materials like glue.

Polycyclic aromatic hydrocarbons (PAH) are organic compounds released during combustion, power generation, and some manufacturing. PAHs are also found in particulate matter.

Ozone, an atmospheric gas, is created when pollutants emitted by cars, power plants, refineries, and other sources chemically react in the presence of sunlight. We call this smog.

Learn more about common air pollutants from the U.S. Environmental Protection Agency (EPA) at https://epa.gov/criteria-air-pollutants.

PO Box 12233 • Research Triangle Park, NC 27709
Phone: 919-541-3345 • **https://niehs.nih.gov**

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How Air Pollution Affects Health

Fine particulate matter (PM 2.5) is 30 times thinner than a human hair and can be inhaled deeply into lung tissue. It accounts for most health effects[3] due to air pollution in the U.S. Other significant contributors and outcomes follow.

Respiratory disease

Air pollution can affect lung development and is associated with emphysema,[4] asthma, and chronic obstructive pulmonary disease[5] (COPD). PM and nitrogen oxide have been linked to chronic bronchitis.[6]

How your genes interact with the environment also plays a critical role in the health of your respiratory system. NIEHS-funded research discovered that people with specific gene variants[7] that made them more likely to have lung inflammation had a greater chance of suffering from asthma if they lived close to major roadways.

Cardiovascular disease

Air pollution can aggravate your heart and cardiovascular system in many ways. PM 2.5 can impair blood vessel function[8] and speed up calcification in arteries.[9]

National Toxicology Program

According to a systematic review, TRAP exposure increases a pregnant woman's risk for dangerous changes in blood pressure, known as hypertensive disorders, which are a leading cause of preterm birth, low birth weight, and maternal and fetal illness and death.[1]

The 14th Report on Carcinogens, prepared by NTP on behalf of the U.S. Department of Health and Human Services, lists 15 PAHs as carcinogens.[2]

Researchers also found:

- Short-term daily exposure to nitrogen oxides by post-menopausal women can increase the risk of hemorrhagic stroke.[10]
- For a cross-section of older Americans, exposure to TRAP can result in lowered levels of high-density lipoprotein (HDL),[11] sometimes called good cholesterol, increasing their risk for cardiovascular disease.

Cancer

Many types of cancer are associated with air pollution.

- Researchers found that occupational exposure to benzene, an industrial chemical and component of gasoline, can cause leukemia and is associated with non-Hodgkin's Lymphoma.[12]
- A long-term study, 2000-2016, found an association between lung cancer[13] incidence and increased reliance on coal for energy generation.
- The risk of developing breast cancer from exposure to air pollution is of special concern. A study of more than 57,000 women found living near major roadways may increase a woman's risk for breast cancer.[14]

Whom Does Air Pollution Affect the Most?

Pregnant women and children

Air pollution has been shown to have many negative effects for pregnant women and their fetuses.

- Prenatal exposure to PAHs was associated with various prenatal and childhood neurological problems, such as brain development effects, slower processing speed, and attention-deficit and hyperactivity disorder (ADHD) symptoms.[15]
- Prenatal exposure to particulate matter was associated with low birth weight.[16]
- Women exposed to high levels of PM 2.5 during pregnancy, particularly in the third trimester, may have up to twice the risk of having a child with autism.[17]
- Second and third trimester exposure to PM 2.5 might increase the chance of those children having high blood pressure in early life.[18]
- In California's agricultural San Joaquin Valley, women exposed to high levels of carbon monoxide, nitrogen oxide, or nitrogen dioxide during their first eight weeks of pregnancy were more likely to have a baby with neural tube defects.[19]

The Children's Health Study

Begun in 1992 at the University of Southern California, this study is one of the largest on the long-term effects of air pollution on children's respiratory health. With major funding from NIEHS, it includes data collected from more than 11,000 children in 16 communities across Southern California. Published findings include:

- Higher air pollution[20] levels increase short-term respiratory infections, which lead to more school absences.
- Children who play several outdoor sports[21] and live in communities with high ozone are more likely to develop asthma.
- Children living near busy roads[22] are at increased risk for asthma.
- Children with asthma who were exposed to high levels of air pollutants were more likely to develop bronchitis[23] symptoms.
- For more information: https://healthstudy.usc.edu

Older adults

In older adults, long-term exposure to TRAP may significantly hasten physical disabilities.[24] The risk is more pronounced among racial minorities and lower-income people. PM 2.5 is associated with accelerated memory problems and Alzheimer's-like brain declines[25] among women 65 years of age and older.

Rural dwellers

Many people believe that air pollution is an urban problem. But rural residents, especially those in agricultural areas, also face health risks from air pollution.

- An NIEHS-funded study found that concentrations of PM 2.5 in rural Washington state were comparable to those in urban Seattle, resulting in increased asthma symptoms for rural children[26] that include wheezing, nighttime waking, and limitations on activities.
- Large-scale animal feeding operations might compromise regional air quality through emission of pollutants, such as ammonia gas[27] and methane. A study found acute lung function problems in children with asthma in such areas.

NIEHS and Community Involvement

NIEHS has a long history of direct involvement in communities, from close cooperation with native peoples in identifying the sources and impacts of pollution on tribal lands, to understanding issues of environmental justice in inner cities, to citizen science initiatives that improve the quality of data crucial to air pollution research. Among these initiatives, researchers found:

- Breathing dust from mine tailings, created by active and abandoned mining operations, affects lung function.[28] NIEHS grant recipients address health hazards in disadvantaged communities, such as among Native American people in the West, through culturally relevant health communication.
- NIEHS also helps residents of Imperial County, California, track air pollution through a network of 40 community-run monitors. In this county, long-term improvements in air quality were associated with significant lung-function improvement[29] in children.
- Community-level tactics[30] can also help reduce exposure to TRAP:
  - Using high-efficiency particulate air (HEPA) filtration.
  - Building land-use buffers and vegetation barriers.
  - Improving urban design with gardens, parks, and street-side trees.
  - Creating active-travel options, such as bicycling and walking paths.

Why Improving Air Quality Matters

Success stories in cleaning up our air demonstrate the benefits of these efforts for public health.

- Among children in Southern California, decreases in ambient nitrogen dioxide and PM 2.5 were associated with fewer cases of asthma.[31]
- In the Los Angeles region, bronchitis symptoms declined[32] as pollution levels dropped.
- When fossil-fuel power plants close, nearby air pollution is reduced. A study found the incidence of preterm births[33] went down within 5 kilometers of retired coal and oil-powered plants.
- An NIEHS-funded study found that a mixture of several B vitamins may protect DNA[34] from changes attributable to PM 2.5 air pollution.

Resources

- AirNow, a tool developed in partnership by several government agencies, allows anyone to monitor air quality in real time anywhere in the U.S. Simply enter a zip code, as indicated on the website. https://airnow.gov
- EPA's Air Sensor Toolbox provides information on the operation and use of air sensor monitoring systems for technology developers, air quality managers, citizen scientists, and the public. https://epa.gov/air-sensor-toolbox

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

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