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

Arsenic and Your Health

Arsenic is a naturally occurring, semimetallic element widely distributed in the Earth's crust. Arsenic levels in the environment can vary by locality, and it is found in water, air, and soil. There are two general forms of arsenic:

- **Organic** arsenic compounds contain carbon. There is no relation between organic arsenic and "organic" food, which refers to food produced using no synthetic fertilizers or pesticides.
- **Inorganic** arsenic compounds do not contain carbon. Research indicates that inorganic arsenic is more toxic and its associated health effects are more severe.

Arsenic is toxic to humans and can affect people of any age or health status.

Because of its significance in global public health problems, studies of arsenic, arsenic metabolism, and the health effects associated with arsenic exposure are conducted by the National Institute of Environmental Health Sciences (NIEHS), particularly through its Superfund Research Program (SRP).

Many scientists, pediatricians, and public health professionals are concerned about the health effects of low-level exposures to arsenic in people. These health effects may be barely noticeable at first, but if exposure continues, severe long-term effects may result. There is particular concern for infants and children exposed to arsenic in drinking water and some foods during their development.

How do people come in contact with arsenic?

The most common source of arsenic in people is contaminated drinking water. Because arsenic occurs naturally, waters that come in contact with particular rocks and soils may contain it. Arsenic levels tend to be higher in groundwater sources, such as wells, than surface sources, such as lakes or reservoirs.

Arsenic in drinking water is a problem in more than 70 countries around the world, including Argentina, Bangladesh, Cambodia, Chile, China, India, Mexico, Pakistan, Vietnam, and the United States.[1]

Arsenic may be found in certain foods. Because of arsenic's presence in soil and water, food from plants that were irrigated with contaminated water or that uptake arsenic from soil, such as rice, may contain it. Arsenic is more common in foods grown in geographical areas with higher environmental levels.

The U.S. Food and Drug Administration monitors the food supply in general and tests foods for arsenic and other contaminants. It prioritizes monitoring arsenic levels in specific foods that are more likely to be eaten by young children, such as infant rice cereal.

Contamination from mining and fracking, coal-fired power plants, arsenic-treated lumber, and arsenic-containing pesticides also contributes to increased levels of arsenic in certain locations.

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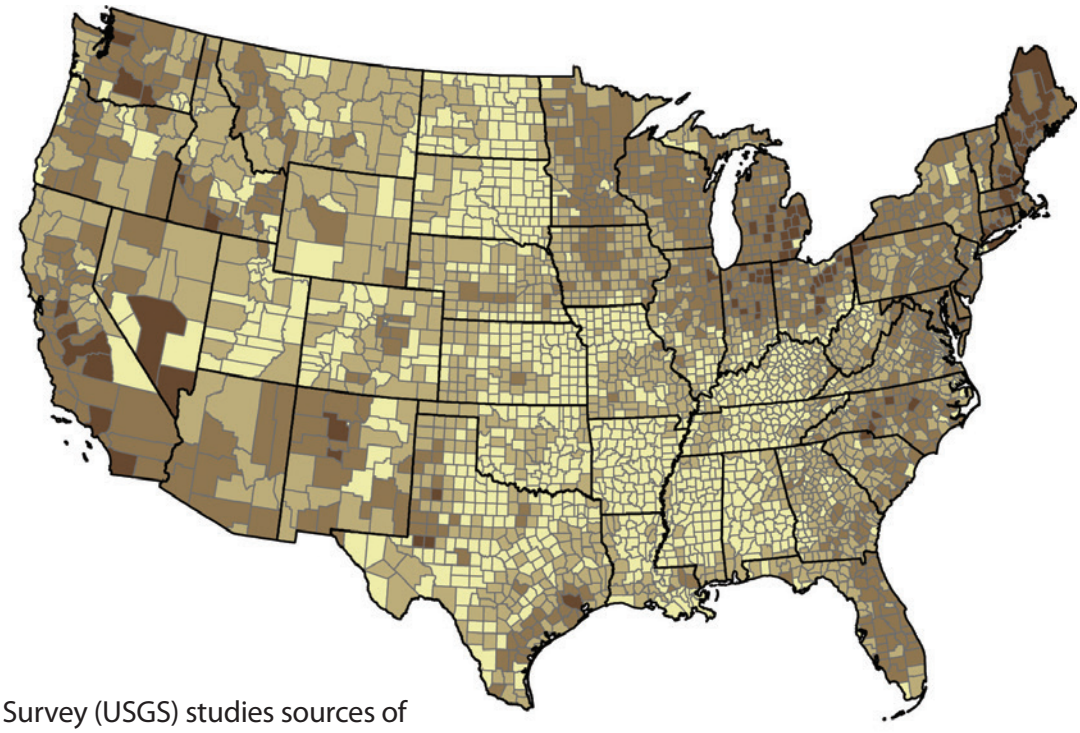
Where is arsenic found in the U.S.?

This map shows estimates of how many private domestic well users in each county may be drinking water with high levels of arsenic.



Credit: U.S. Geological Survey

The United States Geological Survey (USGS) studies sources of arsenic to aid in the management of water resources. In the U.S., higher levels of naturally occurring arsenic are more common in parts of the West, Southwest, Midwest, and the Northeast, but can occur almost anywhere.

The maximum level of inorganic arsenic permitted in U.S. drinking water is 10 micrograms per liter (µg/L, also called parts per billion). This standard is set by the U.S. Environmental Protection Agency (EPA) for public drinking water. Some states, such as New Jersey, have more stringent drinking water standards for arsenic.

USGS has analyzed water samples from more than 5,000 wells across the U.S. and determined that at least 7% of the wells had arsenic levels above the current standard of 10 µg/L. USGS also estimates that about 2.1 million people in the U.S. may get their drinking water from private domestic wells considered to have high concentrations of arsenic.[2]

Is there a standard for well water?

There are no arsenic water standards for private wells — the EPA does not regulate them — but its drinking water rule provides a standard by which to measure water quality in wells.

Arsenic levels can vary from well to well, even if located in the same general area.

How can I find out if there is arsenic in my drinking water?

Because arsenic in solution is tasteless, colorless, and odorless, testing is needed for detection. If your home is on a public water system, you can ask for a water quality report.

If your home is not on a public water system, you can get your water tested for arsenic. You can find well water testing programs by clicking on your state in the map on this EPA webpage: https://www.epa.gov/privatewells/private-drinking-water-well-programs-your-state.

How can I remove arsenic from my drinking water?

Certain filtration systems can remove arsenic from water. Consider methods such as reverse osmosis, ultrafiltration, or ion exchange. Cartridge filters in pitchers are not sufficient for removing arsenic. Contact your local health department for recommended procedures.

You cannot remove arsenic by boiling water. Additionally, chlorine bleach disinfection will not remove arsenic. Water softeners are also not a way to remove arsenic from drinking water.

Does arsenic affect your health?

Arsenic is a known human carcinogen associated with skin, lung, bladder, kidney, and liver cancer.[3] Long-term exposure to arsenic, even at lower levels, can increase the risk of other types of chronic disease.[4]

Arsenic can affect a broad range of organs and systems including:

- Cardiovascular system
- Endocrine system
- Immune system
- Liver, kidney, and bladder
- Nervous system
- Prostate glands
- Respiratory system
- Skin

NIEHS, particularly through SRP grant recipients, has conducted arsenic research in areas such as the following.

Child development and pregnancy

Children are at increased risk to health from exposure to arsenic because they eat and drink more per pound of body weight than adults. Early-life exposure to arsenic is linked to an increased risk of infection, lung and liver function, neurodevelopment and cognitive effects, and skin changes, according to the American Academy of Pediatrics.

Arsenic exposure in early life may lead to other health problems later in life. SRP-supported researchers at the University of California, Berkeley, found an increased incidence of lung and bladder cancer in adults exposed to arsenic early in life, even up to 40 years after high exposures ceased. These findings provide rare human evidence that an early-life environmental exposure can be associated with a high risk of cancer as an adult.[5]

Preterm birth, which occurs before 37 weeks of pregnancy, is a risk factor for newborn mortality and adverse health effects in childhood and later in life. In a study of pregnant women in Bangladesh, NIEHS-funded researchers identified elevated blood levels of several chemicals, particularly arsenic, barium, and titanium, as key drivers of preterm birth risk.[6]

Chronic diseases

Several studies, including a review of the literature, suggest an association between low-to-moderate levels of arsenic and metabolic diseases, such as diabetes.[7]

A scientific statement by the American Heart Association, supported by some NIEHS-funded researchers, states that even low-level exposure to contaminant metals — arsenic, cadmium, and lead — contributes to cardiovascular disease, especially coronary heart disease and stroke.[8] Scientific statements provide current knowledge about the topic and outline areas needing additional research.

Dietary considerations

Two randomized clinical trials found that folic acid supplements may reduce blood arsenic levels and make it easier to excrete arsenic through urine in people chronically exposed to arsenic-contaminated drinking water.[9] One of those trials showed that taking 400 micrograms a day of folic acid, which is the U.S. Recommended Dietary Allowance, for 12 weeks reduced the average blood arsenic levels in a Bangladesh study population by 14%.[10]

Fundamental research

Researchers have long known that both short-term and long-term exposure to arsenic can cause health problems, and they continue to learn more about how arsenic works in the body — what is referred to as its modes of action.

For example, researchers are finding that arsenic, even at low levels, can interfere with the body's endocrine system. The endocrine system is what keeps our bodies in balance and guides growth and development. In several cell culture and animal models, arsenic has been found to act as an endocrine disruptor, which may underlie many of its health effects.[11] Endocrine-disrupting chemicals are natural or human-made chemicals that may mimic, block, or interfere with the body's hormones.

Other modes of action are also likely contributors to arsenic's health effects.

Health disparities

Exposure can be from naturally occurring arsenic that is not removed from drinking water or industrial processes that release arsenic into the environment. Health disparities related to arsenic are influenced by differing protective actions taken by individuals and communities, such as testing and treating water and soil.

SRP-supported researchers at Columbia University found that people belonging to racial and ethnic minorities in the U.S. are exposed to significantly higher arsenic concentrations in their drinking water compared with non-Hispanic White residents.[12]

A later study looked at the effect of the EPA arsenic rule, first enforced in 2006, that lowered the regulatory standard for arsenic in public water systems from 50 to 10 µg/L. Researchers found its implementation successfully reduced arsenic exposure through drinking water for communities across the United States.[13] Despite this decline, public drinking water arsenic concentrations remained higher for some places, including areas in the Southwest, Pacific Northwest, and Central Midwest. Likewise, communities with smaller populations and reliance on groundwater as a drinking water source were more likely to have higher arsenic levels.[14]

Arsenic research helps communities

NIEHS-funded researchers have worked closely with affected communities in the U.S. and abroad to address their concerns and provide them with important information regarding potential exposure to arsenic and its health implications.

For example, SRP-supported researchers evaluated private well testing, and barriers to that testing, in parts of the Northeastern U.S. They also helped empower well water users with tools needed to keep drinking water safe, including a website, community toolkit, and online application.[15]

SRP-supported researchers at the University of New Mexico worked closely with Indigenous partners to show how weathering of the metal mixtures in the millions of tons of mining waste has produced potentially harmful nanoparticles. Health studies reveal that exposure to these metal mixtures may increase the risk of multiple chronic diseases, including cardiovascular disease.[16]

At least 30 million people in Bangladesh are exposed to arsenic in their drinking water. Levels of arsenic in some locales there have been measured at over 3,000 µg/L. NIEHS-funded researchers working in-country found that arsenic education, coupled with water testing programs, can increase knowledge about arsenic in the population, and result in reduced exposures, when safe drinking water sources are made available.[17]

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For more information on the Superfund Research Program at the National Institute of Environmental Health Sciences, visit **https://niehs.nih.gov/research/supported/centers/srp**.

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