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Arsenic and Cancer Risk

What is arsenic?

Arsenic is a natural element that can be found in rocks and soil, water, air, and in plants and animals. People can also be exposed to arsenic in the environment from some agricultural and industrial sources.

Although it is sometimes found in its pure form as a steel grey metal, arsenic is usually part of chemical compounds. These compounds are divided into 2 groups:

- **Inorganic compounds** (arsenic combined with elements other than carbon): These compounds are found in industry, in building products (such as some “pressure-treated” woods), and in arsenic-contaminated water. This tends to be the more toxic form of arsenic and has been linked to cancer.
- **Organic compounds** (arsenic combined with carbon and other elements): These compounds tend to be much less toxic than the inorganic arsenic compounds and are not thought to be linked to cancer. Organic compounds are found in some foods, such as fish and shellfish.

How are people exposed to arsenic?

Arsenic occurs naturally in the environment. We normally take in small amounts in the air we breathe, the water we drink, and the food we eat. People can also be exposed to arsenic in some other ways, such as in some man-made products.

In food

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Natural arsenic levels tend to be higher in drinking water that comes from ground sources, such as wells, as opposed to water from surface sources, such as lakes or reservoirs.

At work

Arsenic has not been produced in the United States since 1985, although it is still imported from other countries. In the past, workers in smelters and in plants that manufactured, packaged, or distributed products that contained arsenic had high exposures from breathing in arsenic fumes and dust.

Arsenic was a common ingredient in many pesticides and herbicides in the past. People who made, transported, applied, or worked around these products may have been exposed to higher levels of arsenic. Inorganic arsenic compounds have not been used in pesticides in the US since 1993, and organic compounds have been phased out of pesticides (with one exception used on cotton plants) as of 2013.

Today workplace exposure to arsenic can still occur in some occupations that use arsenic, such as copper or lead smelting, and wood treating. Regulations are in place to limit this workplace exposure.

In the community

People who live near current or former industrial or agricultural sources of arsenic can be exposed to higher levels by inhaling fumes or eating contaminated food.

Industrial buildings such as wood preservative and glass factories can contaminate nearby air, soil, and water. Communities near smelters, or near farm fields or orchards where arsenic pesticides were used, may also have contaminated soil.

Burning fossil fuels (such as coal) and tobacco can also release small amounts of arsenic into the air.

In pressure-treated wood

Some arsenic compounds, such as chromated copper arsenate (CCA), have been used as preservatives to help protect wood from rot and insects. CCA was used to pressure-treat lumber that was used in some home foundations, decks, fences, playgrounds (play sets), and other structures for many decades.

The use of CCA in pressure-treated lumber for most residential (home) uses was stopped at the end of 2003, although it is still used for industrial purposes. This was done because of concerns that some of the arsenic might leach out of the wood and enter the soil or be absorbed through the skin when the wood is touched. Wood that is frequently touched by children, such as that found in some playground equipment, is a special concern.

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IARC classifies **arsenic** and **inorganic arsenic compounds** as “carcinogenic to humans.” This is based on sufficient evidence in humans that these compounds can cause:

- Lung cancer
- Bladder cancer
- Skin cancer

IARC also notes links in some studies to:

- Kidney cancer
- Liver cancer
- Prostate cancer

IARC classifies the **organic arsenic compounds** dimethylarsinic acid (DMA, also known as cacodylic acid) and monomethylarsonic acid (MMA) as “possibly carcinogenic to humans.”

IARC classifies **other organic arsenic compounds** as “not classifiable as to their carcinogenicity in humans.”

For more detailed information, see the IARC monograph [Arsenic and Arsenic Compounds](#).

The US National Toxicology Program (NTP)

The NTP is formed from parts of several different government agencies, including the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). In its most recent *Report on Carcinogens*, the NTP classifies **arsenic and inorganic arsenic compounds** as “known to be human carcinogens.”

For more detailed information, see the NTP’s *Report on Carcinogens* entry on [Arsenic and Inorganic Arsenic Compounds](#).

US Environmental Protection Agency (EPA)

The EPA maintains the Integrated Risk Information System (IRIS), an electronic database that contains information on human health effects from exposure to various substances in the environment. The EPA classifies inorganic arsenic as a “human carcinogen,” based on evidence in human studies of links to lung, bladder, kidney, skin, and liver cancers.

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Are arsenic levels regulated?

Because arsenic has been linked to cancer and other health effects, several US government agencies regulate arsenic levels and exposures, a few of which are described here.

In drinking water: The Environmental Protection Agency (EPA) limits the maximum level of arsenic allowed in US drinking water to 10 micrograms per liter ($\mu\text{g/L}$), or 10 parts per billion (ppb).

For bottled water, the Food and Drug Administration (FDA) has set a limit of 10 ppb.

In certain foods: There are no federal limits for arsenic in most foods, although the FDA has issued (or proposed) guidance for industry on limits (“action levels”) in certain foods that are more likely to contain arsenic. For example, the FDA has issued guidance to manufacturers to not exceed inorganic arsenic levels of 100 ppb in infant rice cereals. It has also issued draft guidance to not exceed inorganic arsenic levels of 10 ppb in apple juice. These are recommendations for manufacturers and are not legally enforceable.

In the community: The EPA has set limits on the amount of arsenic that industrial sources can release into the environment, and has restricted the use of arsenic in pesticides.

At work: The Occupational Safety & Health Administration (OSHA), the federal agency responsible for health and safety regulations in most workplaces, limits workplace exposure to inorganic arsenic to 10 micrograms per cubic meter of air, averaged over an 8-hour period. When working at potentially higher exposure levels, OSHA requires employers to provide personal protective equipment such as respirators.

Can I limit my exposure to arsenic?

Arsenic is a naturally occurring element, so it’s not possible to avoid it completely. Most arsenic compounds have no smell or taste, so usually you can’t tell if arsenic is in your air, food, or water. Still, there are some things you can do that may lower your exposure.

In drinking water

Public drinking water systems in the US are required to test for arsenic and to keep it below a certain level (10 parts per billion, or ppb). If your drinking water comes from a public source, you can find out about the levels of certain substances in your drinking water, including arsenic, by contacting your local water system. You can also contact the EPA’s Safe Drinking Water Hotline at 1-800-426-4791 for information about drinking water safety.

If you get your water from a private source such as a well, you may want to have your water tested for arsenic levels.

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According to the FDA, cooking rice in larger amounts of water (similar to how pasta is cooked) can lower the amount of inorganic arsenic in rice by about half, but this type of cooking can also lower its nutrient value, especially for white rice. The FDA also notes that rinsing rice before cooking has very little effect on arsenic levels, and it can also lower its nutrient value.

Concerns have also been raised about arsenic levels in some **fruit juices** (particularly apple juice). The FDA has tested the arsenic levels in many apple juice products and has stated that it is confident in the overall safety of apple juice for children and adults. The AAP does not have specific recommendations regarding arsenic in fruit juices, but it has stated that children don't need to drink fruit juice to have a well-balanced, healthy diet. The AAP recommends limiting the intake of all sweet beverages, including juice, because of the risk for poor nutrition, obesity, and childhood cavities.

At work

If you are concerned about arsenic exposure in your workplace, discuss the situation with your employee health and safety representative or your employer. Ways to reduce or prevent exposure can include using personal protective equipment and using safer work practices. If needed, OSHA, the federal agency responsible for health and safety regulations in most workplaces, can provide more information or make an inspection.

From pressure-treated wood

Some pressure-treated lumber products contain an inorganic arsenic compound known as CCA. The sale of CCA-treated lumber for most residential (home) uses was stopped at the end of 2003. However, many structures such as home foundations, decks, fences, or playground play sets that contain CCA-treated lumber are still in use.

A special concern is the use of CCA-treated lumber around children, especially in play sets. Children might swallow small amounts of arsenic if they put their hands in their mouths after touching the wood or the soil around it.

If you aren't sure if a wooden play set contains arsenic, contacting the play set manufacturer might help you find out. But if this information isn't available, it's safest to assume that it does.

To reduce exposure, the **US Consumer Product Safety Commission (CPSC)** recommends that parents and caregivers make sure children's hands and other exposed body parts are thoroughly washed with soap and water after playing on all pressure-treated wood playground equipment. It has also been suggested that children not eat while on wooden playground equipment.

The CPSC also recommends that CCA-treated wood not be used where routine contact with food or animal feed can occur, such as in areas used to plant vegetables, fruits, or herbs. If you have a garden vegetable planter made with CCA-treated wood, put a plastic liner in it before filling it with soil to reduce exposure to CCA.

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Centers for Disease Control and Prevention (CDC)

Arsenic Fact Sheet: www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

ToxFAQs for Arsenic: www.atsdr.cdc.gov/toxfaqs/TF.asp?id=19&tid=3

Food and Drug Administration (FDA)

Arsenic in Food and Dietary Supplements: www.fda.gov/food/metals/arsenic-food-and-dietary-supplements

National Cancer Institute (NCI)

Arsenic: www.cancer.gov/about-cancer/causes-prevention/risk/substances/arsenic

National Toxicology Program (NTP)

Report on Carcinogens: Arsenic and Inorganic Arsenic Compounds:

<https://ntp.niehs.nih.gov/ntp/roc/content/profiles/arsenic.pdf>

World Health Organization (WHO)

Fact Sheet on Arsenic: www.who.int/en/news-room/fact-sheets/detail/arsenic

Consumer Product Safety Commission (CPSC)

CCA-Pressure Treated Wood: www.cpsc.gov/s3fs-public/270_0.pdf

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US Environmental Protection Agency. Integrated Risk Information System: Arsenic, inorganic CASRN 7440-38-2. 1995. Accessed at https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=278#tab-2 on January 23, 2019.

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US Food and Drug Administration. Guidance for Industry: Action Level for Inorganic Arsenic in Rice Cereals for Infants. August 2020. Accessed at <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-action-level-inorganic-arsenic-rice-cereals-infants> on August 5, 2020.

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