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Benzene and Cancer Risk

What is benzene?

Benzene is a colorless, flammable liquid with a sweet odor. It evaporates quickly when exposed to air. Benzene is formed from natural processes, such as volcanoes and forest fires, but most exposure to benzene results from human activities.

Benzene is among the 20 most widely used chemicals in the United States. It is used mainly as a starting material in making other chemicals, including plastics, lubricants, rubbers, dyes, detergents, drugs, and pesticides. In the past it was also commonly used as an industrial solvent (a substance that can dissolve or extract other substances) and as a gasoline additive, but these uses have been greatly reduced in recent decades.

Benzene is also a natural part of crude oil and gasoline (and therefore motor vehicle exhaust), as well as [cigarette smoke](#)¹.

How are people exposed to benzene?

The main way people are exposed is by breathing in air containing benzene. Benzene can also be absorbed through the skin during contact with a source such as gasoline, but because liquid benzene evaporates quickly, this is less common.

People can be exposed to benzene:

- At work
- In the general environment
- Through the use of some consumer products

The highest exposures have typically been in the workplace, although these have

decreased greatly over the last several decades due to federal and state regulations. Some other exposures have also gone down over time, such as the amount of benzene allowed in gasoline.

Workplace exposures

Workers in industries that make or use benzene may be exposed to this chemical. These include the rubber industry, oil refineries, chemical plants, shoe manufacturers, and gasoline-related industries. Benzene is also used to make some types of lubricants, dyes, detergents, drugs, and pesticides. Other people who may be exposed to benzene at work include steel workers, printers, lab technicians, gas station employees, and firefighters. Federal regulations limit exposure to benzene in the workplace (see below).

Community exposures

People can be exposed to benzene in the environment from gasoline fumes, automobile exhaust, emissions from some factories, and waste water from certain industries. Benzene is commonly found in air in both urban and rural areas, but the levels are usually very low. Exposures can be higher for people in enclosed spaces with unventilated fumes from gasoline, glues, solvents, paints, and art supplies. Areas of heavy traffic, gas stations, and areas near industrial sources may also have higher air levels.

[Cigarette smoking](#)² and [secondhand smoke](#)³ are important sources of exposure to benzene. Cigarette smoke accounts for about half of the exposure to benzene in the United States. Benzene levels in rooms containing tobacco smoke can be many times higher than normal.

People can also be exposed to benzene in contaminated drinking water and some foods (although the levels are usually very low).

Does benzene cause cancer?

Benzene is known to cause cancer, based on evidence from studies in both people and lab animals. The link between benzene and cancer has largely focused on [leukemia](#)⁴ and other cancers of blood cells.

What do studies show?

Researchers use 2 main types of studies to try to determine if a substance causes

cancer.

- **Studies in people:** One type of study looks at cancer rates in different groups of people. Such a study might compare the cancer rate in a group exposed to a substance to the cancer rate in a group not exposed to it, or compare it to the cancer rate in the general population. But sometimes it can be hard to know what the results of these studies mean, because many other factors might affect the results.
- **Lab studies:** In studies done in the lab, animals are exposed to a substance (often in very large doses) to see if it causes tumors or other health problems. Researchers might also expose normal human cells in a lab dish to the substance to see if it causes the types of changes that are seen in cancer cells. It's not always clear if the results from these types of studies will apply to humans, but lab studies are a good way to find out if a substance might possibly cause cancer.

Often neither type of study provides conclusive evidence on its own, so researchers usually look at both human and lab-based studies when trying to figure out if something causes cancer.

Studies in people

Rates of [leukemia](#)⁵, particularly [acute myeloid leukemia \(AML\)](#)⁶, have been found to be higher in studies of workers exposed to high levels of benzene, such as those in the chemical, shoemaking, and oil refining industries.

Some studies have also suggested links to [childhood leukemia](#)⁷ (particularly AML) as well as [acute lymphocytic leukemia \(ALL\)](#)⁸, [chronic lymphocytic leukemia \(CLL\)](#)⁹, and other blood-related cancers (such as [multiple myeloma](#)¹⁰ and [non-Hodgkin lymphoma](#)¹¹) in adults. However, the evidence is not as strong for these cancers.

There is much less evidence linking benzene to any other type of cancer.

Studies done in the lab

When inhaled or swallowed, benzene has been found to cause different types of tumors in lab animals such as rats and mice. These results support the finding of an excess risk of leukemia in humans. However, most studies in humans have not found an increased risk of cancers other than leukemia among people with higher exposures.

Benzene has been shown to cause chromosome changes in bone marrow cells in the

lab. (The bone marrow is where new blood cells are made.) Such changes are commonly found in human leukemia cells.

What expert agencies say

Several national and international agencies study substances in the environment to determine if they can cause cancer. (A substance that causes cancer or helps cancer grow is called a *carcinogen*.) The American Cancer Society looks to these organizations to evaluate the risks based on evidence from laboratory, animal, and human research studies.

Based on animal and human evidence, several expert agencies have evaluated the cancer-causing potential of benzene.

The **International Agency for Research on Cancer (IARC)** is part of the World Health Organization (WHO). One of its goals is to identify causes of cancer. IARC classifies benzene as “carcinogenic to humans,” based on sufficient evidence that benzene causes acute myeloid leukemia (AML). IARC also notes that benzene exposure has been linked with acute lymphocytic leukemia (ALL), chronic lymphocytic leukemia (CLL), multiple myeloma, and non-Hodgkin lymphoma.

The **National Toxicology Program (NTP)** is formed from parts of several different US government agencies, including the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). The NTP has classified benzene as “known to be a human carcinogen.”

The US **Environmental Protection Agency (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 benzene as a known human carcinogen.

(For more information on the classification systems used by these agencies, see [Known and Probable Human Carcinogens](#)¹².)

Does benzene cause any other health problems?

Benzene is a potentially dangerous chemical. High levels of exposure can cause both short-term and long-term health effects.

Short-term effects

Breathing in high doses of benzene can affect the nervous system, which can lead to drowsiness, dizziness, headaches, tremors, confusion, and/or unconsciousness. Consuming foods or fluids contaminated with high levels of benzene can cause vomiting, stomach irritation, dizziness, sleepiness, convulsions, and rapid heart rate. In extreme cases, inhaling or swallowing very high levels of benzene can be deadly.

Exposure to benzene liquid or vapor can irritate the skin, eyes, and throat. Skin exposure to benzene can result in redness and blisters.

Long-term effects

Long-term exposure to benzene mainly harms the bone marrow, the soft, inner parts of bones where new blood cells are made. This can result in:

- Anemia (a low red blood cell count), which can cause a person to feel weak and tired.
- A low white blood cell count, which can lower the body's ability to fight infections and might even be life-threatening.
- A low blood platelet count, which can lead to excess bruising and bleeding.

There is also some evidence that long-term exposure to benzene might harm reproductive organs. Some women who have breathed in high levels of benzene for many months have had irregular menstrual periods and ovary shrinkage, but it is not known for sure if benzene caused these effects. It is not known if benzene exposure affects the fetus in pregnant women or fertility in men.

Are benzene levels regulated?

Several government agencies regulate benzene levels and exposures.

The Occupational Safety & Health Administration (OSHA) is the federal agency responsible for health and safety regulations in most workplaces. OSHA limits exposure to benzene in the air in most workplaces to 1 ppm (part per million) during an average workday and a maximum of 5 ppm over any 15-minute period. When working at potentially higher exposure levels, OSHA requires employers to provide personal protective equipment such as respirators.

The EPA limits the percentage of benzene allowed in gasoline to an average of 0.62% by volume (with a maximum of 1.3%).

The EPA limits concentrations of benzene in drinking water to 5 ppb (parts per billion). Some states may have lower limits. Likewise, the US Food and Drug Administration (FDA) sets a limit of 5 ppb in bottled water.

The Consumer Product Safety Commission (CPSC) considers any product containing 5% or more by weight of benzene to be hazardous, requiring special labeling.

Can I limit my exposure to benzene?

If you are concerned about benzene, there are several ways you can limit your exposure.

Stay away from cigarette smoke. If you are a smoker, [try to quit](#)¹³. Cigarette smoke is a major source of benzene exposure.

Try to limit gasoline fumes by pumping gas carefully and using gas stations with vapor recovery systems that capture the fumes. Avoid skin contact with gasoline.

When possible, limiting the time you spend near idling car engines can help lower your exposure to exhaust fumes, which contain benzene (as well as other potentially harmful chemicals).

Use common sense around any chemicals that might contain benzene. Limit or avoid exposure to fumes from solvents, paints, and art supplies, especially in unventilated spaces.

If you are exposed at your workplace, talk to your employer about limiting your exposure through process changes (such as replacing the benzene with another solvent or enclosing the benzene source) or by using personal protective equipment. If needed, the Occupational Safety & Health Administration (OSHA) can provide more information or make an inspection.

What should I do if I've been exposed to benzene?

For short-term exposure to high levels of benzene, the Centers for Disease Control and Prevention (CDC) recommends getting away from the source of benzene, removing any clothing that may have benzene on it, washing exposed areas with soap and water, and getting medical care as soon as possible.

If you think you may have been exposed to benzene over a long period of time, speak to a doctor. Benzene can be measured in the blood or breath, and breakdown products

of benzene can be measured in the urine. These tests can only detect recent exposures to benzene. They cannot predict possible health effects.

Hyperlinks

1. www.cancer.org/cancer/cancer-causes/tobacco-and-cancer.html
2. www.cancer.org/cancer/cancer-causes/tobacco-and-cancer.html
3. www.cancer.org/cancer/cancer-causes/tobacco-and-cancer/secondhand-smoke.html
4. www.cancer.org/cancer/leukemia.html
5. www.cancer.org/cancer/leukemia.html
6. www.cancer.org/cancer/acute-myeloid-leukemia.html
7. www.cancer.org/cancer/leukemia-in-children.html
8. www.cancer.org/cancer/acute-lymphocytic-leukemia.html
9. www.cancer.org/cancer/chronic-lymphocytic-leukemia.html
10. www.cancer.org/cancer/multiple-myeloma.html
11. www.cancer.org/cancer/non-hodgkin-lymphoma.html
12. www.cancer.org/cancer/cancer-causes/general-info/known-and-probable-human-carcinogens.html
13. www.cancer.org/healthy/stay-away-from-tobacco/guide-quitting-smoking.html
14. <http://www.atsdr.cdc.gov/>
15. <http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=38&tid=14>
16. <https://www.epa.gov/>
17. <https://water.epa.gov/drink/contaminants/basicinformation/benzene.cfm>
18. <http://www.cdc.gov/niosh/>
19. <http://www.cdc.gov/niosh/topics/benzene/>
20. <https://www.osha.gov/>
21. <https://www.osha.gov/SLTC/benzene/>

Additional resources

Along with the American Cancer Society, other sources of information and support include:

Agency for Toxic Substances and Disease Registry (ATSDR) Toll-free number: 1-888-422-8737 (1-888-42-ATSDR) Website: www.atsdr.cdc.gov (<http://www.atsdr.cdc.gov/>)¹⁴ ToxFAQs for benzene: www.atsdr.cdc.gov/toxfaqs/tf.asp?id=38&tid=14

(<http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=38&tid=14>)¹⁵

Environmental Protection Agency (EPA) Toll-free number (Safe Drinking Water Hotline): 1-800-426-4791 Website: www.epa.gov (www.epa.gov)¹⁶ Benzene in drinking water: <http://water.epa.gov/drink/contaminants/basicinformation/benzene.cfm> (water.epa.gov/drink/contaminants/basicinformation/benzene.cfm)¹⁷

National Institute for Occupational Safety and Health (NIOSH)

Toll-free number: 1-800-232-4636 (1-800-CDC-INFO) Website: www.cdc.gov/niosh (<http://www.cdc.gov/niosh>)¹⁸ Benzene page: www.cdc.gov/niosh/topics/benzene (<http://www.cdc.gov/niosh/topics/benzene>)¹⁹

Occupational Safety & Health Administration (OSHA) Toll-free number: 1-800-321-6742 (1-800-321-OSHA) Website: www.osha.gov (www.osha.gov)²⁰ Benzene page: www.osha.gov/SLTC/benzene/ (www.osha.gov/SLTC/benzene/)²¹

**Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at 1-800-227-2345 or visit [www.cancer.org \(#/cancer/cancer-causes/benzene\)](http://www.cancer.org/#/cancer/cancer-causes/benzene).

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