



PUBLIC HEALTH STATEMENT

Uranium

Division of Toxicology and Human Health Sciences

February 2013

This Public Health Statement is the summary chapter from the Toxicological Profile for Uranium. It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFAQs™, is also available. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present. For more information, call the ATSDR Information Center at 1-800-232-4636.

Overview

We define a public health statement and show how it can help you learn about uranium.

Introduction

A public health statement summarizes information about a hazardous substance. The information is taken from a toxicological profile developed by ATSDR's Division of Toxicology and Human Health Sciences (DTHHS). A toxicological profile is a thorough review of a hazardous substance.

This toxicological profile examines uranium. This public health statement summarizes the DTHHS findings on uranium, describes the effects of exposure to it, and describes what you can do to limit that exposure.

Uranium at hazardous waste sites

The U.S. Environmental Protection Agency (U.S. EPA) identifies the most serious hazardous waste sites in the nation. U.S. EPA then includes these sites on the National Priorities List (NPL) and targets them for federal clean-up activities. U.S. EPA has found uranium in at least 67 of the 1,699 current or former NPL sites.

The total number of NPL sites evaluated for uranium is not known. But the possibility remains that as more sites are evaluated, the number of sites at which uranium is found may increase. This information is important; these future sites may be sources of exposure, and exposure to uranium may be harmful.

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Why a uranium release can be harmful

When a contaminant is released from a large area such as an industrial plant or from a container such as a drum or bottle, it enters the environment. But such a release does not always lead to exposure. You normally are exposed to a contaminant when you come in contact with it. That contact—and therefore that exposure—can occur when you breathe, eat, or drink the contaminant, or when it touches your skin. However, since uranium is radioactive, you can also be exposed to its radiation if you are near it.

Even if you are exposed to uranium, you might not be harmed. Whether you are harmed will depend on such factors as the dose (how much), the duration (how long), and how you happen to contact it. Harm might also depend on whether you have been exposed to any other chemicals or radioactive materials, as well as your age, sex, diet, family traits, lifestyle, and state of health.

A Closer Look at Uranium

Overview

This section describes uranium in detail and how you can be exposed to it.

What is uranium?

Uranium is a naturally occurring radioactive element. Natural uranium is a mixture of three isotopes: ^{234}U , ^{235}U , and ^{238}U . The most common isotope is ^{238}U ; it makes up about 99% of natural uranium by mass.

All three isotopes behave the same chemically, but they have different radioactive properties.

The half-lives of uranium isotopes (the amount of time needed for half of the isotope to give off its radiation and change into a different element) are very long. The least radioactive isotope is ^{238}U with a half-life of 4.5 billion years.

Depleted uranium is a mixture of the same three uranium isotopes, except that it has very little ^{234}U and ^{235}U . It is less radioactive than natural uranium.

Enriched uranium is another mixture of isotopes that has more ^{234}U and ^{235}U than natural uranium. Enriched uranium is more radioactive than natural uranium.

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How is uranium used?

Uranium is almost as hard as steel and much denser than lead. Natural uranium is used to make enriched uranium; depleted uranium is the leftover product.

Enriched uranium is used to make fuel for nuclear power plants.

Depleted uranium is used as a counterbalance on helicopter rotors and airplane control surfaces, as a shield to protect against ionizing radiation, as a component of munitions to help them penetrate enemy armored vehicles, and as armor in some parts of military vehicles.

Where is uranium found?

Uranium can be released into the environment through wind and water erosion and volcanic eruptions.

Industries involved in mining, milling, and processing of uranium can also release it into the environment. Inactive uranium industries may continue to release uranium into the environment.

Possible Sources	Outcome
Air: In the air, uranium exists as dust.	The very small particles of uranium found in dust can fall onto water, plants, and land. Rain increases the amount of uranium in air that can settle to the ground.
Water: Uranium can be found in drinking water; higher levels tend to be from wells drilled in uranium-rich rock formations.	Uranium in surface water can be transported large distances. Some of the uranium in water will stick to sediment and other particles in the water.
Soil: Uranium is naturally present in nearly all rocks and soils.	Uranium deposited on land can mix into soil, wash into surface water, or stick to plant roots.
Food: Human daily intake has been estimated to range from 0.9 to 1.5 micrograms of uranium per day ($\mu\text{g/day}$).	Uranium can stick to plant roots. Unwashed potatoes, radishes, and other root vegetables are a primary source of uranium in the diet.

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How Can You Be Exposed to Uranium

Primary uranium exposure sources

For most people, food and drinking water are the main sources of uranium exposure.

Root crops such as potatoes, parsnips, turnips, and sweet potatoes contribute the highest amounts of uranium to the diet. The amount of uranium in these foods is directly related to the amount of uranium in the soil in which they are grown.

Other uranium exposure sources

People who work with materials and products that contain uranium may be exposed at work. This includes workers who mine, mill, or process uranium or make items that contain uranium. People who work with phosphate fertilizers may also be exposed to higher levels of uranium.

People who live near uranium mining, processing, and manufacturing facilities could be exposed to more uranium than the general population.

People may also be exposed if they live near areas where depleted uranium weapons are used.

Secondary uranium exposure sources

In most areas of the United States, low levels of uranium are found in the drinking water. Higher levels may be found in areas with elevated levels of naturally occurring uranium in rocks and soil.

How Uranium Can Affect Your Health

Overview

This section looks at how uranium enters your body and potential uranium health effects found in human and animal studies.

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How uranium enters your body

Uranium can enter your body from the air, water, food, or from dermal contact.

Possible Sources	Possible Exposure Pathway
Air	Only about 0.76–5% of the uranium a person breathes will get into the bloodstream through the respiratory tract (nose, mouth, throat, lungs). Some uranium compounds are slowly cleared from the lungs.
Food and water	Only about 0.1–6% of the uranium a person ingests will get into the bloodstream through the gastrointestinal tract (mouth, stomach, intestines). Uranium compounds that dissolve in water enter the bloodstream more easily than uranium compounds poorly soluble in water.
Dermal contact	A very small amount of uranium can be absorbed through the skin; water-soluble uranium compounds are the most easily absorbed.

How uranium leaves your body

Most of the inhaled and ingested uranium is not absorbed and leaves the body in the feces. Absorbed uranium leaves your body in the urine. Some inhaled uranium can stay in the lungs for a long time.

Uranium that is absorbed is deposited throughout the body; the highest levels are found in the bones, liver, and kidneys. Sixty-six percent of the uranium in the body is found in your bones. It can remain in the bones for a long time; the half-life of uranium in bones is 70–200 days (this is the amount of time that it takes for half of the uranium to leave the bones). Most of the uranium that is not in bones leaves the body in 1–2 weeks.

Introduction to uranium health effects

Natural and depleted uranium have the identical chemical effect on your body.

The health effects of natural and depleted uranium are due to chemical effects and not to radiation.

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Main uranium health effects

Uranium's main target is the kidneys. Kidney damage has been seen in humans and animals after inhaling or ingesting uranium compounds. However, kidney damage has not been consistently found in soldiers who have had uranium metal fragments in their bodies for several years. Ingesting water-soluble uranium compounds will result in kidney effects at lower doses than following exposure to insoluble uranium compounds.

Workers who inhaled uranium hexafluoride have experienced respiratory irritation and accumulation of fluid in the lungs. However, these effects were attributed to the irritant hydrofluoric acid rather than the uranium.

Inhaled insoluble uranium compounds can also damage the respiratory tract.

Other uranium health effects

No health effects, other than kidney damage, have been consistently found in humans after inhaling or ingesting uranium compounds or in soldiers with uranium metal fragments in their bodies.

Rats ingesting uranium over a long time had neurobehavioral changes and changes in the levels of certain chemicals in the brain.

Uranium has been shown to decrease fertility in some studies of rats and mice; other studies have not found this effect.

Very soluble uranium compounds on the skin caused skin irritation and mild skin damage in animals.

Uranium and cancer

Neither the National Toxicology Program (NTP), International Agency for Research on Cancer (IARC), nor the EPA have classified natural uranium or depleted uranium with respect to carcinogenicity.

Children and Uranium

Overview

This section discusses potential health effects of uranium exposure in humans from when they are first conceived to 18 years of age, and how you might protect against such effects.

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Exposure effects for children generally

No data describe the effects of exposure to uranium on children or young animals. Although we think that children would likely show the same health effects as adults, we do not know whether children are more susceptible than adults to uranium effects.

What about birth defects?

We do not know whether uranium can harm an unborn child. No scientifically strong human study that has shown birth defects due to uranium exposure has been identified.

Some studies in animals exposed to high levels of uranium during pregnancy, which caused toxicity in the mothers, have resulted in early deaths and birth defects in the young. It is not clear if this can happen in the absence of effects on the mother. Other studies have not found birth defects.

In some rat studies, enriched uranium exposure during pregnancy caused changes in brain function in the offspring. Similar studies found changes in the ovaries of the female offspring.

One study reported that giving a high amount of uranium to newborn rats altered the tooth formation.

How Can You Lower Your Exposure to Uranium

Food

Avoid eating root vegetables grown in soils with high levels of uranium. Consider washing fruits and vegetables grown in that soil and discard the outside portion of root vegetables.

Drinking water

Consider having your water tested if you suspect that your drinking water might have elevated levels of uranium. If elevated levels are found, consider using bottled water.

If you live near a hazardous waste site

If you live near a hazardous waste site with high amounts of uranium that are not controlled, do not let your children play outside in the dirt. Children put dirt in their mouths, and uranium is in this dirt. Also, make sure your children wash their hands often, especially before eating.

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Medical Tests to Determine Uranium Exposure

Overview

Natural uranium is in your normal diet, so there will always be some level of uranium in all parts of your body. If in addition you are exposed to depleted uranium, it adds to the total uranium level in your body. We identify medical tests that can detect whether uranium is in your body, and we recommend safe toxic-substance practices.

Uranium can be measured in blood and urine

Uranium can be measured in blood, urine, hair, and body tissues. Normally, urinary sampling is the preferred method for assessing uranium exposure. The amount of radiation from uranium in your body can also be measured.

Most tests are for total uranium; however, expensive tests are available to estimate the amounts of both natural and depleted uranium that are present.

What the uranium exposure tests might show

Most uranium leaves the body within a few days. High amounts in your urine might show that you have been exposed to high amounts of uranium within the last week or so.

Federal Government Recommendations to Protect Human Health

Overview

One way the federal government promotes public health is by regulating toxic substances or recommending ways to handle or to avoid toxic substances.

The federal government regulates toxic substances

Regulations are enforceable by law. The U.S. EPA, the Occupational Safety and Health Administration (OSHA), the Nuclear Regulatory Commission (USNRC), and the Food and Drug Administration (FDA) are some federal agencies that have adopted toxic substances regulations.

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The federal government recommends safe toxic substance practices

The Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH) have made recommendations about toxic substances. Unlike enforceable regulations, these recommendations are advisory only.

Toxic substance regulations

Regulations and recommendations can be expressed as “not-to-exceed” levels, that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value usually based on levels that affect animals; levels are then adjusted to help protect humans. Sometimes, these not-to-exceed levels differ among federal organizations. Different organizations use different exposure times (an 8-hour workday or a 24-hour day), different animal studies, or emphasize some factors over others, depending on their mission.

Check for regulation updates

Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with the federal agency or organization that issued the regulation or recommendation.

Some regulations and recommendations for uranium include:

Federal Organization	Regulation or Recommendation
U.S. Environmental Protection Agency (EPA)	The U.S. EPA has established a maximum contaminant level of 0.03 mg/L and set a maximum contaminant level goal of no uranium in drinking water.
Occupational Safety and Health Administration (OSHA)	OSHA set a legal limit for worker exposure to uranium in workplace air of 0.05 mg uranium/m ³ for soluble uranium and 0.25 mg uranium/m ³ for insoluble uranium averaged over an 8-hour work day.

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National Institute of Occupational Safety and Health (NIOSH)	NIOSH recommends that worker exposure to uranium in workplace air not exceed an exposure limit of 0.05 mg uranium/m ³ for soluble uranium and 0.2 mg uranium/m ³ for insoluble uranium averaged for up to a 10-hour work day. NIOSH also recommends that exposure to soluble uranium not exceed 0.6 mg U/m ³ for more than 15 minutes.
U.S. Nuclear Regulatory Commission (USNRC)	The USNRC has established derived air concentrations of 0.0005, 0.0003, and 0.00002 microcuries/m ³ , averaged for a working year of 2,000 hours for workers exposed to a form of uranium that is excreted at fast, medium, and slow rates, respectively.

Additional Information

Overview

Where to find more information about uranium.

Whom to contact first

If you have questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below.

Additional information from ATSDR

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses that result from exposure to hazardous substances.

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**Where to
obtain
toxicological
profile copies**

Toxicological profiles are also available online at www.atsdr.cdc.gov and on CD-ROM. Request a copy of the ATSDR ToxProfiles CD-ROM by

- Calling the toll-free information and technical assistance number at 1-800-CDCINFO (1-800-232-4636),
- E-mailing cdcinfo@cdc.gov, or
- Writing to

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences
1600 Clifton Road NE
Mailstop F-57
Atlanta, GA 30333
Fax: 1-770-488-4178

For-profit organizations should request final toxicological profile copies from

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000
Web site: <http://www.ntis.gov/>

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