ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Arsenic: Health Information Summary

INTRODUCTION

Arsenic is a naturally occurring metal-like element common in certain rocks, including New Hampshire bedrock. It is produced commercially as a byproduct of refining other metals. Arsenic is used in automobile batteries, light emitting diodes (LEDs), and to tan animal hide. Arsenic was used extensively in pesticides until the late 1960s; most agricultural uses have now been banned. Arsenic was also a major component of the preservative solution chromated copper arsenate (CCA) used in "pressure-treated" lumber. Use of CCA essentially ended as of 2004. Arsenic is also found as a contaminant in coal ash.

Arsenic in drinking water may be due to either man's past activities or the leaching of arsenic from rocks. In most cases of arsenic contamination of drinking water, it is difficult to distinguish whether the source is man-made or natural. Although arsenic levels in water are generally low, drinking water obtained from wells drilled in arsenic-containing bedrock may have relatively high concentrations from arsenic leaching from the rock.

Arsenic is found in organic and inorganic forms. Most of the arsenic in drinking water is inorganic arsenic that may be present as a combination of arsenic species called arsenate (As V) and arsenite (As III). The percentages of each form in water are important to know if you wish to remove arsenic from drinking water, as some treatment methods require an additional treatment process to change As III to As V so it can be removed. Both forms of arsenic have similar toxicity except at very high doses, in which case the body excretes As III more slowly than As V. Arsenic has no color, taste or odor at the concentrations found in drinking water; therefore testing is the only reliable way to determine if it is present.

For the general population, food is the most significant source of arsenic exposure. Most foods contain low levels of arsenic taken up from the soil. However, rice has been found to accumulate relatively higher arsenic levels than most other plant-based food sources. Research is ongoing to determine whether the additional arsenic intake from rice, prepared foods made from rice, such as rice cereals, rice "milk," and brown rice syrup, is high enough to pose any health risks. For the present, researchers recommend that those who consume high levels of rice-based products, especially infants and young children, moderate their consumption. Some fish and shellfish build up arsenic in their tissues, but almost all of it is in an organic form known as arsenobetaine that is considered to be non-toxic.

The U.S. Food and Drug Administration (FDA) notes that health effects from organic arsenic are an emerging area of science for which they are monitoring research. The total adult daily dietary intake of the inorganic forms of arsenic in the typical US diet averages in the range of about 8 to 14 micrograms (µg). However, for those with private bedrock wells, exposure to arsenic from drinking water can exceed the intake from food.

HEALTH EFFECTS

Absorption

After absorption, arsenic distributes throughout the body and some may accumulate in the nails, hair, bone and skin. Most of the arsenic taken into the body is excreted within one week of exposure. Although there are only a few studies on arsenic absorption through the skin, they indicate that only a small percentage is absorbed by this route.

Some studies of occupational exposure to arsenic dust have reported increased levels of contact dermatitis. Similar effects on the skin from bathing with arsenic contaminated water have not been observed. Bathing with contaminated water exposes skin to very dilute levels of arsenic compared to concentrated arsenic-dust in the work place. Skin effects are often the first observable sign of arsenic toxicity. Researchers have generally considered skin effects to result from ingested arsenic rather than exposure and absorption through the skin.

Short -term (acute) Effects

Oral exposure to arsenic at levels much higher than those typically found in the environment may result in symptoms soon after ingestion. Symptoms include abdominal pain, vomiting, and diarrhea. Eventually shock, coma, and death may follow. It is estimated that 70,000 µg (0.0023 ounces) of arsenic can be a fatal dose; indicating that arsenic is considered extremely toxic from acute exposure.

Long-term (chronic) Effects

The most sensitive observable signs of chronic arsenic poisoning involve the skin. First, a freckling of small dark spots may appear on the trunk, neck, face, arms and legs. Next, skin-thickening and small corn-like growths can develop, especially on the palms of the hand and soles of the feet. With higher exposures, other effects may include numbness, tingling or burning sensations in the arms and legs, fluid accumulation causing swelling in the face and ankles, diarrhea, stomach cramps, and anemia. Eventually, liver, kidney, and central nervous system damage may occur. Recent evidence indicates that arsenic may increase the risk of several other diseases including diabetes, lung, and cardiovascular disease. Basic research suggests that arsenic is an endocrine disrupting substance. It may cause some diseases by interfering with chemical messengers such as hormones that act as signals in the body to regulate many processes.

Carcinogenic (cancer-causing) Effects

Corns resulting from arsenic exposure may ultimately develop into non-melanoma forms of skin cancer. Researchers have also observed a relationship between higher levels of arsenic in drinking water and an increased risk of bladder, lung, kidney, liver, and prostate cancer. The evidence for skin, bladder, and lung cancer are the strongest. Data from occupational studies demonstrate a strong association between inhalation of inorganic arsenic and lung cancer. Arsenic was a Group A (known human carcinogen) under the old U.S. Environmental Protection Agency (EPA) classification system and would fit into the “human carcinogen” classification group under the current EPA cancer guidelines, but has not been formally reclassified to date. EPA is currently reviewing both cancer and noncancer arsenic health risk information for their Integrated Risk Information System (IRIS) in order to update its toxicity values. This effort is expected to take several more years to complete.

Teratogenic/Reproductive Effects

A few studies of children exposed to differing levels of arsenic in drinking water showed an association between higher arsenic exposure and a reduction in IQ test scores. Exposure to higher levels of arsenic in drinking water as fetuses and young children has been associated with an increase in several forms of lung disease for them in adulthood.

In a study of New Hampshire pregnant women, exposure of the women to higher arsenic concentrations was associated with a greater risk of infections in their children during the first year of life, particularly infections requiring medical treatment.

In studies conducted on animals, birth rates were lower and fetal malformations were increased in animals with higher exposure than is typically found in drinking water.

HEALTH STANDARDS AND CRITERIA

The federal drinking water standard, a Maximum Contaminant Level (MCL), for arsenic was originally set at 50 ppb in 1975. MCLs are enforceable drinking water standards for public water supplies, determined by balancing the adverse health effects of a particular chemical against the feasibility and costs of treating contaminated water, and a consideration of the lowest level at which a chemical can be detected in water. Subsequent studies conducted found strong associations between arsenic exposure from drinking water and an increased risk of cancer of the lung and bladder. Therefore, in 2001, the EPA reduced the federal MCL for arsenic to the current level of 10 ppb. The regulations also revised the Maximum Contaminant Level Goal (MCLG) from 50 ppb to zero. MCLGs are health-based non-enforceable guidelines. Exposure assumptions used to calculate MCLs and MCLGs include consuming two liters (0.53 gallons) of water per day by a 70 kilogram (154 lb) adult for a 70-year exposure duration. The cancer risk for arsenic of 3 in 1,000 at its MCL for a 70-year exposure is relatively high compared to the cancer risk for other substances at their MCLs. Setting the MCL at 10 ppb was a compromise between protecting public health and the increasing treatment costs for public water supplies at proposed lower standards.

In 2019, due to concern about the relatively high lifetime cancer risk at the current MCL and research indicating additional noncancer effects at lower arsenic concentrations, the State of New Hampshire reduced its MCL to 5 ppb. The new MCL is scheduled to go into effect for New Hampshire public water systems beginning in 2021.

Because only a small percentage of arsenic in water is absorbed through the skin, NHDES has established a guideline of 250 ppb arsenic in water as a concentration above which we recommend treating all water entering the home (point-of-entry treatment) rather than just water used for consumption (point-of-use treatment). Although occasional ingestion of a small amount of bath water by young children is not a concern, it should be discouraged as a regular bath activity.

There are no regulations for arsenic levels in the U.S. food supply. However, the FDA has recommended limits for arsenic in infant rice cereals and apple juice.

ARSENIC-CONTAINING PRESSURE TREATED WOOD

Pressure-treated wood, once commonly used to build decks, playground equipment and other outdoor structures was preserved with chromated copper arsenate (CCA). Sale of CCA treated products for homeowner use ended in 2004. Although the pressure-treated wood now sold no longer contains CCA, exposure may occur from existing structures built with CCA-treated lumber. People who work on CCA-treated wood structures should take certain precautions to limit exposure to sawdust, which may be breathed in or incidentally ingested. Whenever possible, work outdoors to avoid indoor accumulation of sawdust from CCA-treated wood. Never dispose of CCA-treated wood by burning it.

Some of the arsenic in pressure-treated wood can leach out and contaminate the soil beneath structures. A small percentage of the arsenic on the surface of the wood can be wiped off and absorbed through the skin or ingested by young children, who tend to have frequent hand-to-mouth activity. Precautions to reduce exposure include not growing edible plants below and in the immediate vicinity of CCA-treated decks or allowing children to play in those same areas. Results of research conducted by the EPA and the Consumer Product Safety Commission (CPSC) demonstrated that using a non-toxic non-slippery sealant such as an oil-

based stain every one-to-two years on CCA-treated wood structures, such as decks and playground equipment, can minimize leaching of arsenic, reducing exposure.

For more detailed information on safe practices at work and home when using CCA-treated wood, please refer to the EPA web site at www.epa.gov and search for "chromated arsenicals."

MEDICAL TESTING FOR ARSENIC EXPOSURE

Because arsenic is cleared from the blood in only a few hours, blood arsenic is generally not a useful measurement of exposure. Measurement of arsenic in urine is considered the most reliable indicator of recent arsenic exposure if testing is done no more than a few days after exposure ceases. Consumption of fish or shellfish within two days before a urine test occurs can influence the results because of the organic arsenic present in these foods. Therefore, they should be avoided before you are evaluated for exposure to inorganic arsenic.

Some arsenic is stored in parts of the body rich in the protein keratin such as hair, finger- and toe-nails. Levels in these tissues can be a useful indicator of past (6-12 months) exposure, but results can be misleading because arsenic tends to strongly bind externally to hair and nails. Arsenic bound externally to hair and nails is not absorbed.

TESTING FOR ARSENIC IN WATER

Since private wells are not subject to regular testing as are public water supplies, NHDES recommends that all private well owners have their water tested for arsenic if they have not done so previously. Retesting is recommended at 3 to 5 year intervals. In testing of bedrock wells serving residences in New Hampshire, approximately 30 percent exceeded 5 ppb of arsenic, indicating that a substantial percentage of the public may be exposed to arsenic from private water supply wells above the revised MCL. Although bedrock wells appear to be at greater risk due to naturally occurring arsenic leaching from rock, dug or shallow wells are more likely to be impacted by man-made contamination. Dug wells located in former agricultural land, particularly fruit orchards or potato fields, crops for which arsenic-containing pesticides were often heavily used, are more likely to be at risk.

The State Laboratory's "standard analysis" for drinking water includes analysis for arsenic or individual analysis for arsenic is an option. A list of New Hampshire certified commercial water testing laboratories is available on the NHDES website at des.nh.gov.

FOR MORE INFORMATION

Additional information on water testing and treatment options can be obtained from the NHDES Drinking Water and Groundwater Bureau (603) 271-2513 and on the NHDES web site.

For health information, contact the Environmental Health Program at (603) 271-6802.

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Note: This fact sheet is accurate as of August 2020, and scientific information available after this date may render this information inaccurate or incomplete.