ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Lead: Health Information Summary

Lead is a naturally occurring metal that is widely distributed throughout nature in a variety of minerals. It has been used in the production of storage batteries, gasoline additives, pigments and ceramics, bullets, solder for pipes and in food containers, lead piping, with brass and bronze as alloys, and in electronic circuits. Lead-acid batteries are still lead's most important use. Its use as a pigment has decreased dramatically in recent years. The maximum allowable level of lead in paint is now 0.06 percent. Lead as a gasoline additive for on-road motor vehicles and in solder for food cans has been completely banned. Lead remains in fuel for some specialty uses, such as race cars, aircraft and farm vehicles.

Exposure to lead can occur from ingesting food, water, dust and, especially in the case of children, lead paint. Inhalation of airborne particles and industrial emissions can also occur. Even though lead compounds are relatively insoluble in water, toxic lead levels can occur due to the corrosive effects of acidic, soft water (low mineral content) on lead-lined tanks, brass plumbing fixtures, lead pipes and lead-containing solder in water distribution systems. Although the principal route of lead exposure for most individuals is through the consumption of food and beverages, the majority of environmentally related lead toxicity is the result of ingestion of lead-based paint by children. Other sources of lead exposure include working with stained-glass and pottery glazes; target shooting; soldering for metal or electronics fabrication; and car or boat repair.

Data from a dietary survey collected in the early 1990s, after lead in food containers was eliminated, indicates that lead intake from food ranged from 1.8 to 4.2 micrograms per day (ug/day).

Health Effects

Absorption/Metabolism

Based upon studies with adult human volunteers, it has been estimated that approximately 10 percent of an oral intake of lead is absorbed through the stomach. This percentage can rise considerably after a period of fasting. Children can absorb up to 50 percent of an oral dose. Absorption of inhaled airborne lead ranges from approximately 30-50 percent. Absorption through the skin is not a significant exposure route for lead.

Most lead in the body is stored in the bone, about 90 percent for adults and 70 percent for children. Some of this lead in bone readily exchanges with blood lead, but most of it remains for

decades. However, even inert bone lead can be mobilized by such factors as pregnancy, lactation, chronic disease, broken bones, and other factors causing physical stress. There is evidence that adequate intake of the essential minerals calcium and iron can somewhat reduce both the absorption and toxicity of lead.

Short-Term (Acute) Effects

Overexposure to lead is commonly assessed by the blood lead level. Lead in blood has a half-life of about one month so it reflects relatively recent exposure. An elevated blood lead level for children is considered to be one that exceeds 5 micrograms per deciliter of blood (ug/dL). For the current U.S. population of children ages one through five, 2.5 percent of that age group exceeds a blood lead level of 5 ug/dL, which is equivalent to approximately 450,000 children. A blood lead level in a child greater than 45 ug/dL is generally the level at which medical intervention to remove lead by chelation is indicated. For adults, the level of concern is a concentration above 25 ug/dL. According to regulation, workers must be removed from the source of exposure if their blood lead level reaches 50 ug/dL.

Acute lead toxicity as a result of a single exposure is rare these days because of our knowledge of its effects and the subsequent reductions made in environmental lead sources and concentrations. However, acute exposure to very high levels can result in changes in brain function (encephalopathy) leading to convulsions, coma and death.

Long Term (Chronic) Effects

The classic signs of chronic lead poisoning are loss of appetite, metallic taste, severe constipation, anemia, pallor, malaise, weakness, insomnia, headache, nervous irritation, muscle and joint pain, fine tremors, brain disorders and colic (abdominal cramps). Some individuals develop weakness in the extensor muscles of the arm and leg, leading to "wrist drop" or "foot drop."

The above symptoms would only be evident at relatively high blood lead levels, exceeding 30 ug/dL blood lead level in a child, and are seldom seen today. Adults with these severe symptoms of toxicity have not been seen in workers with blood lead levels less than 40 ug/dL.

Research indicates that the developing central nervous system (CNS) is the most sensitive target for lead, with children being much more sensitive to neurological and behavioral effects than adults. The most serious CNS effects at low blood lead level levels in children include hyperactivity, poor classroom behavior, and decreased IQ scores. An IQ reduction of between one and three points has been measured in studies as blood lead level increases from 10 ug/dL to 20 ug/dL. Although small reductions in IQ may not be significant on an individual basis, this can have more serious consequences as a population-wide effect.

High lead exposure can be acutely toxic to the kidneys. The acute toxicity is reversible although continued exposure can cause permanent toxic effects. Kidney toxicity has generally been seen in workers with blood lead level exceeding 60 ug/dL. Animal studies have confirmed lead's toxicity to the kidney. Other systems that can be adversely affected by lead include the gastrointestinal system, thyroid and adrenal glands, joints, and testes.

Lead exposure can cause anemia because it inhibits the body's ability to make hemoglobin. Several studies have also shown an association between lead exposure and increases in blood pressure

Carcinogenic (cancer causing) Effects)

Several studies involving rats and mice have associated tumor formation, most often in the kidney, with ingestion of soluble lead salts. The results have been criticized because of the very high doses given to the animals. However, based upon sufficient evidence in animal studies, the Environmental Protection Agency has classified lead as a Group B2, probable human carcinogen.

Reproductive/Developmental Effects

Lead readily crosses the placenta and there is evidence that exposure to high levels as seen in occupationally exposed workers increases the risk of spontaneous abortion, miscarriage and stillbirth. There is limited evidence that fetal lead exposure can increase the risk of reduced birth weight and premature birth. Human studies indicate the lead may have toxic effects on sperm starting at blood lead level levels of around 40 ug/dL.

There is an extensive body of evidence from human studies associating prenatal lead exposure to deficits and delays in intelligence, motor skills, and behavior. Some studies following children over time found that the differences persisted as they grew older. Animal studies support the evidence from human studies of behavioral effects from prenatal lead exposure.

Health Standards and Criteria

The primary origin of lead in drinking water is through corrosion of lead-containing plumbing; pipes, solder, and lead alloys such as brass and bronze. The factors that contribute to lead leaching into the water include corrosivity of the water, metals used in the pipes, amount of time the water contacts the pipes, and temperature of the water. Lead pipes were once extensively used in water systems, and only since 1986 has lead solder in water distribution systems been banned. Water systems throughout the country are in the process of trying to identify and replace lead pipe.

The EPA's strategy for controlling lead in public water supplies involves the development of a level in drinking water, which when exceeded, requires the installation of corrosion control technologies. This "action level" is currently set at 15 ug/L. Corrosion control technologies often use chemicals that form a coating on the inside of plumbing systems, thereby reducing the amount of lead that enters the water system. Another method is to add chemicals to make the water less acidic (raise the pH).

The EPA has established a Maximum Contaminant Level Goal (MCLG) for lead in drinking water at 0 ppb based on the toxicity of lead to the fetus and young children at extremely low levels of exposure. MCLGs are non-enforceable standards for drinking water set at levels at which no adverse health effects are expected to develop.

Since excess lead in drinking water is usually due to it leaching from the plumbing system into water that has been sitting for several hours in the pipes, running the water for 30 to 60 seconds before using it for drinking or cooking will often significantly reduce lead levels.

The Occupational Safety and Health Administration (OSHA) enforceable standard (permissible exposure limit or PEL) for lead in workplace air is 50 micrograms per cubic meter (ug/m3) averaged over eight hours. The ambient air (i.e., non-occupational) standard is 1.5 ug/m3.

For more information, please contact the DES Environmental Health Program, 29 Hazen Drive, Concord, NH 03302-0095; (603) 271-4608.

Suggested Reading and References

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