What is Mercury?

Mercury is a naturally occurring element that can exist in various forms, including metallic mercury or “quicksilver”, organic forms such as methylmercury, and inorganic mercury compounds. Mercury enters air, water, and soil either through natural processes (off-gassing from soil, soil erosion, groundwater movement in mercury-rich strata, and volcanic eruptions) or through human activity (mining operations, gold ore processing, alumina smelting, chlorine gas production, coal or waste burning, and battery manufacturing).

Metallic mercury (Hg) is a shiny, silvery-white metal that is more than 13 times heavier than water; it is the only metal that is liquid at room temperature. Because of its low viscosity it is hard to contain and tends to break into smaller beads of liquid. Metallic mercury has been used for decades in oral thermometers, sphygmomanometers, wall thermostats, fluorescent light bulbs, electric light switches, and other purposes. It also has been used by some in ethnic, religious, cultural practices and folk medicines.

In water, mercury particulates settle to the bottoms of rivers, lakes, and bays where they can remain in the sediments for many years. Water and soil microorganisms methylate the mercury in sediments by combining it with carbon, creating an organic form called methylmercury (MeHg or CH₃Hg⁺). Methylmercury is the form of mercury that is most readily absorbed into biological tissues and is the most toxic to humans. In the environment small plants and fish gradually accumulate methylmercury in their cells, and then larger fish consume large quantities of these plants and fish. Since fish are not able to eliminate methylmercury from their bodies, the concentrations of methylmercury bio-accumulates in the larger fish and increase up through the food chain through bio-magnification, resulting in potential human exposures through consumption of fish or shellfish.

Inorganic mercury describes a category of mercury compounds that includes mercuric chloride, mercuric acetate, mercuric sulfide, and other compounds. Mercuric chloride is the most common of the inorganic mercury’s. Exposures to inorganic mercury compounds are the least common. The most likely source of exposure to inorganic mercury is through the use of homeopathic remedies or skin bleaching creams.

Mercury Exposure

Because mercury occurs naturally in the environment, everyone is routinely exposed to low levels in their air, water, and food. However, some people may be exposed to higher levels of mercury through their individual activities, which may include:

- Having large numbers of dental amalgam fillings
- Recent application of mercury-containing paint or caulk
- Use of elemental mercury in a school laboratory
- Participating in rituals that use mercury
- Taking herbal remedies that contain mercury
- Eating fish or shellfish containing elevated levels of methylmercury
- Breathing vapors from spilled mercury or having skin contact with mercury or its compounds
- Breathing vapors or dust in outdoor air coming from mining or smelting activities, municipal waste incineration, or industries that burn coal or other fuels containing mercury
- Using inappropriate and/or outdated medical treatments containing metallic mercury or mercury compounds (as with calomel skin care products, laxatives, or teething powders)
Mercury Toxicity

Like many chemicals, mercury can enter the body through ingestion, inhalation, or dermal absorption. Whether an exposure to the various forms of mercury will harm a person's health depends on a number of factors. People may be exposed to mercury in any of its forms under different circumstances. The factors that determine how severe the health effects from mercury exposure are include, the chemical form of mercury; the dose; the age of the person exposed (the fetus is the most susceptible); the duration of exposure; the route of exposure - inhalation, ingestion, or dermal contact, and the overall health of the person exposed.

The nervous system is very sensitive to mercury; both metallic mercury vapor and methylmercury can cross the blood-brain barrier and, at high exposure levels for extended periods, can cause permanent damage to the brain and kidneys. It is uncertain whether exposure to inorganic mercury compounds can cause significant brain damage since they do not readily cross the blood-brain barrier.

Acute inhalation exposure to high levels of metallic mercury vapor can cause nausea, vomiting, diarrhea, headache, chills, dry cough, eye irritation, abdominal pain, anorexia, and increases in blood pressure or heart rate. Two to three days later, exposed individuals may experience soreness, swelling, bleeding, and ulceration of the gums, and skin rashes.

Acute ingestion of liquid elemental mercury is poorly absorbed and therefore poses only limited risk of toxicity. Individuals with gastrointestinal abnormalities (fistula, perforation) may sequester mercury and have subsequent absorption.

Acute dermal contact with liquid mercury has been associated with a dermatitis characterized by a papular erythema.

Chronic exposures to metallic mercury vapors or organic mercury such as methylmercury can affect many parts of the neurologic system, causing signs or symptoms, including personality changes (irritability, shyness, nervousness, or reduced self-confidence), tremors, constriction of the visual fields, hearing deficits, muscle incoordination, numbness and/or paresthesia in the hands or feet, insomnia, anorexia, and difficulties with memory.

Pregnant women eating large amounts of fish, highly contaminated with methylmercury in Minamata Bay, Japan, in the 1950s and 1960s, resulted in an outbreak of severe neurologic diseases. Although Minamata disease affected all age groups, infants appeared to be most severely affected, with varying degrees of infantile paralysis, muscle spasticity and rigidity, equilibrium disturbances with difficulty standing or walking, sensory disturbances in the arms and legs, numbness of the lips and tongue, eye movement and visual field disturbances, and hearing impairment.

Chronic use of imported “beauty” creams or skin-lightening creams, containing mercurous chloride (calomel) or homogenized with metallic mercury, may cause extreme fatigue, weakness, insomnia, severe headache, sore throat, cough, short-term memory loss, weight loss, irritability, constipation, muscle aches in arms and legs, a metallic taste in the mouth, loss of sense of taste, and paresthesia in the hands and feet.

Because mercury of all types tends to accumulate in the kidneys, these organs are prone to being damaged by excessive exposures; renal effects may include polyuria, polydypsia, and albuminuria. If the exposure is not prolonged or severe, the kidneys are likely to recover once the contaminant is cleared from the body. Metallic and inorganic forms of mercury are eliminated from the body in both urine and feces, while organic mercury is eliminated primarily in the feces. There is no information to show that mercury causes cancer in humans or animals.
Laboratory Tests

Mercury in urine is used to test for exposure to metallic mercury vapor and to inorganic forms of mercury. Measurement of mercury in whole blood or scalp hair is used to monitor exposure to methylmercury, but hair analysis is not useful for assessing recent exposures. Urine is not useful for determining whether exposure to methylmercury has occurred. Levels found in blood, urine, and hair may be used together to predict possible health effects that may be caused by the different forms of mercury.

Urine mercury levels are preferred for assessing acute and/or chronic metallic or inorganic mercury exposures. A 24-hour urine specimen collected in an acid-washed plastic container is the preferred specimen. A first morning void can provide a reasonably close approximation of the urine mercury level when corrected for urine creatinine. The mean total mercury in urine is 4–5 µg/L, and in people who don’t eat fish, the mean is approximately 2 µg/L. The normal range is generally considered to be 0–10 µg/L (or 0–5 µg/L for non-fish-eaters). Urine levels of 20–50 µg/L are not uncommon in occupational exposures. Levels from 50–200 µg/L generally start producing some early signs of toxicity in sensitive individuals, and levels over 200 µg/L produce worsening signs and symptoms of toxicity. Levels over 800 µg/L are entering the potentially lethal range.

<table>
<thead>
<tr>
<th>Urinary Mercury Concentration (µg/L)</th>
<th>Signs &amp; Symptoms</th>
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<tbody>
<tr>
<td>&lt; 20</td>
<td>• None</td>
</tr>
<tr>
<td>20-100</td>
<td>• Decreased response on tests for nerve conduction, brain-wave activity, and verbal skills</td>
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<tr>
<td></td>
<td>• Early indication of tremor on testing</td>
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<tr>
<td>100-500</td>
<td>• Irritability, depression, memory loss, minor tremor, other nervous system disturbances</td>
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<tr>
<td></td>
<td>• Early signs of disturbed kidney function.</td>
</tr>
<tr>
<td>500-1,000</td>
<td>• Kidney inflammation</td>
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<tr>
<td></td>
<td>• Swollen gums</td>
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<tr>
<td></td>
<td>• Significant tremor and nervous system disturbances</td>
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Mercury has a short half-life in blood (3 days), so blood analysis may be performed during the first 3 days after an acute high level exposure. Interpretation of blood mercury levels may be complicated by dietary sources of mercury. Blood samples should be collected in a metal-free vacutainers® containing heparin and then refrigerated. Mean total mercury levels in whole blood vary from 1–8 µg/L and levels up to 10 µg/L are considered to be within the normal range. Individuals with high fish consumption rates may have blood mercury levels of up to 200 µg/L, but these levels in a pregnant woman could put her fetus at significantly increased risk for adverse effects. Consequently, women who are pregnant or may become pregnant should avoid eating fish frequently found to have increased concentrations of mercury such as swordfish, shark, king mackerel, gulf tilefish, marlin, and orange roughy. They should also avoid eating any type of fish caught from within the Lavaca Bay prohibited area.

Elemental Mercury Treatment and Management

Symptomatic patients who have experienced acute high-dose elemental mercury inhalation exposure should receive supportive care and be monitored for development of acute pneumonitis and pulmonary edema in a hospital setting. For severe symptoms and highly elevated circulating levels of elemental mercury, chelation may be required. Agents, such as dimercaptosuccinic acid (DMSA) contain sulphhydryl groups, which bind mercury ions and facilitate their excretion through urine and feces. These drugs may be expensive and are not always covered by health insurance.
Consult your regional Poison Control Center, 1-800-222-1222, or a medical toxicologist experienced in chelation therapy for decisions regarding administration of chelation therapy.

For more information contact:
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1100 West 49th Street, MC 1964
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1-800-588-1248
http://www.dshs.state.tx.us/epitox

References


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