

CH0006 / CHEMICAL / Heavy Metals

Mercury

Definition

Mercury is a naturally occurring element that is found in air, water and soil. Exposure to mercury – even small amounts – may cause serious health problems and is a threat to the development of the foetus in utero and for children early in life (WHO, 2017).

Reference

WHO, 2017. Mercury and Health. World Health Organization (WHO). www.who.int/news-room/fact-sheets/detail/mercury-and-health Accessed 25 November 2019.

Annotations

Synonyms

Quicksilver.

Additional scientific description

Mercury (chemical symbol Hg, atomic number 80) exists in various forms: elemental mercury (metallic or vapour) and inorganic mercury compounds (to which people may be exposed, for example, through their occupation); and organic mercury compounds (for example, methylmercury, to which people may be exposed through their diet). These forms of mercury differ in their degree of toxicity and toxic effects (WHO, 2017).

Mercury occurs naturally in the Earth's crust (UNEP, 2018). It is released into the environment from volcanic activity, weathering of rocks and as a result of human activity. Human activity is the main cause of mercury releases, particularly coal-fired power stations, residential coal burning for heating and cooking, industrial processes, waste incinerators and as a result of mining for mercury, gold and other metals (WHO, 2017). Mercury has been used in dental amalgam for tooth fillings. Methylmercury has a history as fungicide. Organic mercury compounds are used as protective agents in biochemistry.

Mercury may have toxic effects on the nervous, digestive and immune systems, and on lungs, kidneys, skin and eyes. The World Health Organization considers mercury to be one of the top ten chemicals or groups of chemicals of major public health concern. People are mainly exposed to mercury in the form of methylmercury, an organic compound, when they eat fish and shellfish that contain this compound (WHO, 2017).

Once in the environment, elemental mercury can be transformed into methylmercury and consumed by phytoplankton in seawater and by sulphate-reducing bacteria in freshwater sediments. Methylmercury then bioaccumulates (the process by which an organism contains progressively higher concentrations of the substance than its surroundings) in fish and shellfish. Methylmercury also biomagnifies up food chains: for example, large predatory fish are more likely to have high levels of methylmercury as a result of eating many smaller fish that have acquired methylmercury through ingestion of plankton (WHO, 2017).

Use of elemental mercury in some traditional therapies, religions and practices (e.g., Santería, Espiritismo) represents a risk of exposure due to the practice itself or from accidental spills. However, the extent of the problem is unknown. Use of mercury-containing beauty creams, hair treatment and other cosmetic products may cause significant exposure (WHO, 2017).

Health effects from mercury (WHO, 2007) are summarised as follows:

- Inhalation of mercury vapour can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, and may be fatal. The inorganic salts of mercury are corrosive to the skin, eyes and gastrointestinal tract, and may induce kidney toxicity if ingested.

- Neurological and behavioural disorders may be observed after inhalation, ingestion or dermal application of different mercury compounds. Symptoms include tremors, insomnia, memory loss, neuromuscular effects, headaches and cognitive and motor dysfunction. Mild subclinical signs of central nervous system toxicity can be seen in workers exposed to an elemental mercury level in the air of 20 µg/m³ or more for several years. Kidney and immune effects have been reported. There is no conclusive evidence linking mercury exposure to cancer in humans.
- Children are especially vulnerable to mercury and may be exposed directly by eating contaminated fish. Methylmercury bioaccumulated in fish and consumed by pregnant women may lead to neurodevelopmental problems in the developing foetus. Transplacental exposure is the most dangerous, as the foetal brain is very sensitive. Neurological symptoms include mental retardation, seizures, vision and hearing loss, delayed development, language disorders and memory loss. In children, a syndrome characterised by red and painful extremities called acrodynia has been reported to result from chronic mercury exposure.

Metrics and numeric limits

Guidance values are complex but in summary the following may be helpful:

- Drinking-water: 0.006 mg/l (6 µg/l) for inorganic mercury (WHO, no date).
- Provisional tolerable weekly intake: for methylmercury in food of 1.6 µg/kg body weight (JECFA, 2007).
- Air: lowest-observed-adverse-effect level (LOAELs) for mercury vapour are around 15–30 µg/m³ (WHO, 2000).

Key relevant UN convention / multilateral treaty

Minamata Convention on Mercury (UNEP, 2013).

Examples of drivers, outcomes and risk management

All humans are exposed to mercury. Factors that determine whether health effects occur, and their severity include: the chemical form of mercury concerned; the dose; the age or developmental stage of the person exposed (the foetus is most susceptible); the duration of exposure; and the route of exposure (inhalation, ingestion or dermal contact) (WHO, 2017).

Generally, two groups are more sensitive to the effects of mercury. Foetuses are most susceptible to developmental effects due to mercury potentially leading to impaired neurological development with cognitive thinking, memory, attention, language, and fine motor and visual spatial skills affected. The second group is people who are regularly exposed (chronic exposure) to high levels of mercury (such as populations that rely on subsistence fishing or people who are occupationally exposed). Among selected subsistence fishing populations, between 1.5/1000 and 17/1000 children showed cognitive impairment (mild mental retardation) associated with the consumption of fish containing mercury (WHO, 2017).

A significant example of mercury exposure affecting public health occurred in Minamata, Japan, between 1932 and 1968, where a factory producing acetic acid with a mercury catalyst discharged inorganic mercury into Minamata Bay. The bay was rich in fish and shellfish, providing the main livelihood for local residents and fishermen from other areas. For many years, no one realised that the fish were contaminated with mercury, and that it was causing a strange disease in the local community and in other districts. At least 50,000 people were affected to some extent and more than 2000 cases of Minamata disease were certified. Minamata disease peaked in the 1950s, with severe cases suffering brain damage, paralysis, incoherent speech and delirium. The continued release of mercury into the environment from human activity, the presence of mercury in the food chain, and the demonstrated adverse effects on humans are of such concern that in 2013 governments agreed to the Minamata Convention on Mercury. The Convention obliges Parties to take a range of actions, including to address mercury emissions to air and to phase-out certain mercury-containing products (WHO, 2019).

There are several ways to prevent adverse health effects of mercury, including promoting clean energy, stopping the use of mercury in gold mining, eliminating the mining of mercury and phasing out non-essential mercury-containing products.

- Promote the use of clean energy sources that do not burn coal. Burning coal for power and heat is a major source of mercury. Coal contains mercury and other hazardous air pollutants that are emitted when the coal is burned in coal-fired power plants, industrial boilers and household stoves (WHO, 2017).
- Eliminate mercury mining and use of mercury in gold extraction and other industrial processes. Mercury is an element that cannot be destroyed; therefore, mercury already in use can be recycled for other essential uses, with no further need for mercury mining. Mercury use in artisanal and small-scale gold mining is particularly hazardous, and health effects on vulnerable populations are significant. Non-mercury (non-cyanide) gold-extraction techniques need to be promoted and implemented, and where mercury is still used, safer work practices need to be employed to prevent exposure (WHO, 2017).
- Phase out use of non-essential mercury-containing products and implement safe handling, use and disposal of remaining mercury-containing products including batteries, measuring devices, such as thermometers and barometers, electric switches and relays in equipment, lamps (including some types of light bulbs), dental amalgam (for dental fillings), skin-lightening products and other cosmetics and pharmaceuticals (WHO, 2017).
- Establish a sentinel system to detect hazardous substances.

References

- JECFA, 2007. Methylmercury. Joint FAO/WHO Expert Committee on Food Additives (JECFA). apps.who.int/food-additives-contaminants-jecfa-database/chemical.aspx?chemID=3083 Accessed 25 November 2019.
- UNEP, 2013. Minamata Convention on Mercury. United Nations Environment Programme (UNEP). www.mercuryconvention.org Accessed 25 November 2019.
- UNEP, 2018. Global Mercury Assessment 2018. United Nations Environment Programme (UNEP). <https://wedocs.unep.org/bitstream/handle/20.500.11822/27579/GMA2018.pdf?sequence=1&isAllowed=y> Accessed 22 September 2020.
- WHO, no date. Mercury. Guidelines for Drinking-Water Quality: 389-90. World Health Organization (WHO). www.who.int/water_sanitation_health/water-quality/guidelines/chemicals/mercury-fs-new.pdf?ua=1 Accessed 25 November 2019.
- WHO, 2000. Air quality guidelines for Europe, Second Edition. European series, no. 91. World Health Organization (WHO). www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf?ua=1 Accessed 25 November 2019.
- WHO, 2007. Preventing Disease through Healthy Environments – Exposure to mercury: a major public health concern. World Health Organization (WHO). <https://www.who.int/ipcs/features/mercury.pdf?ua=1> Accessed 22 September 2020.
- WHO, 2017. Mercury and Health. World Health Organization (WHO). www.who.int/news-room/fact-sheets/detail/mercury-and-health Accessed 25 November 2019.
- WHO, 2019. Strategic planning for implementation of the health-related articles of the Minamata Convention on Mercury. World Health Organization (WHO). apps.who.int/iris/bitstream/handle/10665/329449/9789241516846-eng.pdf?ua=1 Accessed 25 November 2019.

Coordinating agency or organisation

World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO).