



World Health
Organization

PREVENTING DISEASE THROUGH HEALTHY ENVIRONMENTS

EXPOSURE TO MERCURY: A MAJOR PUBLIC HEALTH CONCERN

Mercury is highly toxic to human health, posing a particular threat to the development of the child *in utero* and early in life. It occurs naturally and exists in various forms: *elemental* (or metallic); *inorganic* (e.g. mercuric chloride); and *organic* (e.g., methyl- and ethylmercury). These forms all have different toxicities and implications for health and for measures to prevent exposure.¹ Elemental mercury is a liquid that vaporizes readily. It can stay for up to a year in the atmosphere, where it can be transported and deposited globally. It ultimately settles in the sediment of lakes, rivers or bays where it is transformed into methylmercury, absorbed by phytoplankton, ingested by zooplankton and fish, and accumulates especially in long-lived predatory species, such as shark and swordfish.²

Mercury releases

- Natural: volcanic activity, weathering of rocks, water movements, biological processes
- Human activities: combustion of fossil fuels (specially coal), electricity-generating power stations, gold and mercury mining, manufacture of cement, pesticides, chlorine, caustic soda, mirrors and medical equipment, industrial leaks, dentistry, waste and corpse incineration
- Remobilization of historic sources: mercury in soil, sediment, water, landfill, waste

Sources of exposure to mercury

Industrial processes

Most of the mercury in the environment results from human activity, particularly from coal-fired power stations, residential heating systems and waste incinerators. Mercury is also present as a result of mining for mercury, gold (where mercury is used to form an amalgam before being burnt off), and other metals, such as copper, zinc and silver, as well as from refining operations.

Food

Eating contaminated fish and shellfish is the main source of methylmercury exposure, especially in populations that rely heavily on consumption of predatory fish. Cooking does not eliminate mercury from fish. WHO is preparing a guidance document for risk managers that will use national exposure assessments to determine the appropriate risk management options, bearing in mind the nutritional benefits of fish consumption. In addition, WHO is launching an initiative to estimate the global burden of foodborne disease, including the burden of disease from ingested mercury.

WHO Guidance Values - Provisional tolerable weekly intake

In 2004 the Joint FAO/WHO Expert Committee on Food Additives (JECFA) established a tolerable intake of 1.6 µg/kg bodyweight per week for methylmercury in order to protect the developing fetus from neurotoxic effects.³ In 2006, JECFA clarified that life-stages other than the embryo and fetus may be less sensitive to the adverse effects of methylmercury.⁴ For adults, up to about twice the tolerable intake per week would not pose any risk of neurotoxicity. However available data did not allow firm conclusions to be drawn for children (up to about 17 years), as they may be more sensitive than adults. Hence the tolerable intake established in 2004 applies also to children.

Health care

Significant releases of mercury to the environment result from the use of thermometers and blood pressure monitors, and from the incineration of medical waste.^{5,6} Health-care facilities may be responsible for as much as 5% of all mercury released in wastewater.

Dental amalgam is a potentially significant source of exposure since it can contain up to 50% elemental mercury. It is released as vapour, ions or fine particles and may be inhaled or ingested. Although no adverse health effects have been proven, use of dental amalgam is declining rapidly. Amalgam may represent an occupational risk for dentists and can cause release of mercury to the atmosphere during cremation.

Thiomersal (sodium ethylmercurythiosalicylate or thimerosal), which contains 49.6% ethylmercury, has been used as a vaccine preservative since the 1930s. As ethylmercury does not accumulate and is actively excreted via the gut, the health risk from this exposure is low. Concerns were raised in 1999 about the cumulative amount of mercury in infant immunization schedules. In 2006 the WHO Global Advisory Committee on Vaccine Safety concluded that there were no reasons to change current immunization practices.⁷ However, WHO continues to review the evidence for pre-term and malnourished infants.

Traditional practices

Use of elemental mercury in some 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. The use of mercury-containing beauty creams, hair treatment and other cosmetic products may cause significant exposure.

WHO Guideline Values

Water: 1 µg/litre for total mercury ⁸

Air: 1 µg/m³ (annual average) ⁹

WHO estimated a tolerable concentration of 0.2 µg/m³ for long-term inhalation exposure to elemental mercury vapour, and a tolerable intake of total mercury of 2 µg/kg body weight per day. ¹⁰

Health Effects

- Elemental and methylmercury are toxic to the central and peripheral nervous system. The 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.¹¹
- 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 20µg/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 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 fetal 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 characterized by red and painful extremities called acrodynia has been reported to result from chronic mercury exposure.
- Biological measurement of mercury, for example in hair and blood, allows exposure to be quantified and linked to possible health effects. It also permits estimates of the burden of disease (BoD). WHO is applying its BoD framework approach to better quantify the health impacts.

WHO recommendations

National, regional and global actions, both immediate and long-term, are needed to reduce or eliminate releases of mercury and its compounds to the environment. WHO is committed to work with the health sector and national, regional and global health partners to:

- reduce mercury exposure;
- eliminate the use of mercury wherever possible;
- promote the development of alternatives to the use of mercury.

Elimination of mercury-related diseases requires strategic action to:

- Conduct national assessments of mercury usage and disposal and implement educational activities for the health, environment and other sectors.¹²
- Promote the use of mercury-free alternatives, e.g. for manometers and thermometers, and ensure that mercury-containing devices are taken back by the manufacturer or properly disposed off.
- Develop mercury clean-up and waste-handling, storage and safe-handling procedures; promote environmentally sound management of health-related waste containing mercury (as set out in the UN Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal).
- Encourage countries to develop and implement policies and legislation on mercury; highlight the role of the health sector in dealing with mercury-containing material, health-care waste and emission reduction; and promote effective ways to control mercury emissions from cremation.
- Encourage international agencies to work with manufacturers, wholesalers and retailers to develop and make widely available inexpensive mercury-free products, and facilitate their procurement.
- Assist countries in preparing advice for pregnant and lactating women and children, about the risks and benefits of fish consumption, indicating the type of fish that may be eaten and how often. WHO strongly recommends breastfeeding since the presence of methylmercury in breast milk is not sufficient to outweigh its benefits.
- Identify traditional practices, folk medicines and cosmetics involving mercury, and disseminate information on mercury hazards, exposure prevention and how to clean up spillages.
- Promote long-term monitoring (including biological measurements of exposure) and programmes to reduce occupational exposure.

References

1. IPCS (2000) International Chemical Safety Cards 0056, 0978, 0979, 0980, 0981, 0982 and 0984. Geneva, World Health Organization, International Programme on Chemical Safety. <http://www.who.int/ipcs/publications/icsc/en/index.html>
2. IPCS (1990) Methylmercury. Geneva, World Health Organization, International Programme on Chemical Safety (Environmental Health Criteria 101). <http://www.inchem.org/documents/ehc/ehc/ehc101.htm>
3. JECFA (2004) Methylmercury. In: Safety evaluation of certain food additives and contaminants. Report of the 61st Joint FAO/WHO Expert Committee on Food Additives. Geneva, World Health Organization, International Programme on Chemical Safety. WHO Technical Report Series 922 pp 132-139. http://whqlibdoc.who.int/trs/WHO_TRS_922.pdf
4. JECFA (2006) Methylmercury. Summary and conclusions of the 67th Joint FAO/WHO Expert Committee on Food Additives. Geneva, World Health Organization, International Programme on Chemical Safety. WHO Technical Report Series 940 (in press). www.who.int/ipcs/food/jecfa/summaries/summary67.pdf
5. WHO (2005) Policy Paper: Mercury in Health Care. Geneva, World Health Organization (WHO/SDE/WSH/05.08). http://www.who.int/water_sanitation_health/medicalwaste/mercury/en/index.html
6. WHO (2005) Affordable Technology: Blood pressure measuring devices for low resource settings. Geneva, World Health Organization. <http://whqlibdoc.who.int/publications/2005/9241592648.pdf>
7. WHO (2006) Statement on Thiomersal. WHO Global Advisory Committee on Vaccine Safety. Geneva, World Health Organization. http://www.who.int/vaccine_safety/topics/thiomersal
8. WHO (2004) Guidelines for Drinking-water quality 3rd edition. Geneva, World Health Organization. http://www.who.int/water_sanitation_health/dwg/GDWQ2004web.pdf
9. WHO (2000) Air Quality Guidelines for Europe. Copenhagen, World Health Organization Regional Office for Europe
10. IPCS (2003) Concise International Chemical Assessment Document 50: Elemental mercury and inorganic mercury compounds: human health aspects. Geneva, World Health Organization, International Programme on Chemical Safety. <http://www.who.int/ipcs/publications/cicad/cicads>
11. IPCS (1991) Inorganic mercury. Geneva, World Health Organization, International Programme on Chemical Safety (Environmental Health Criteria 118). <http://www.inchem.org/documents/ehc/ehc/ehc118.htm>
12. WHO (2005) Mercury Training Module. WHO Training Package for the Health Sector. Geneva, World Health Organization.

© World Health Organization 2007
All rights reserved.

All reasonable precautions have been taken by the World Health Organization to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damaged arising from its use.

Printed by the WHO Document Production Services, Geneva, Switzerland