PHYSICIANS FOR SOCIAL RESPONSIBILITY

MERCURY #4 FACTSHEET

Health Effects of Methylmercury

ENVIRONMENT AND HEALTH PROGRAM

Mercury is a naturally occurring metal. It can take a variety of forms, including the familiar silvery metal elemental form, inorganic salts that have been used in medications and industrial compounds, and organic forms. A spectrum of human health effects has been observed following mercury exposure, with the severity depending on the type of mercury, the amount, and the timing of exposure.[1] Though some people may come in contact with elemental or inorganic mercury in their homes or workplaces, by far the most common type of mercury exposure is dietary exposure to methylmercury, an organic form that is a common contaminant of fish and shellfish.

Methylmercury is formed when elemental mercury—such as that emitted from industrial smokestacks or spilled from broken thermometers—makes its way into rivers, lakes, and oceans. There, aquatic microbes convert it to methylmercury through a biochemical reaction. Methylmercury then accumulates in many edible freshwater and ocean fish species. It is estimated that human activities such as mining, trash incineration, and burning coal to produce electricity have tripled the amount of mercury released into the environment annually.[2]

How Does Methylmercury Exposure Affect Human Health?

Methylmercury was first made in the laboratory in the mid 19th century,[3] but when two laboratory workers died of methylmercury poisoning, the compound was abandoned for decades. It made a comeback in the 20th century as a potent antifungal agent, but again was abandoned after several serious poisoning episodes affected thousands of people from the 1950s to the 1970s. While several organ systems in the body can be affected by methylmercury, the major target system is the central nervous system, and the most vulnerable life stage is fetal.[4] Data are accumulating that suggest that the cardiovascular system may also be an important target for methylmercury toxicity at low levels of exposure. Adverse effects differ depending upon the age at exposure.

Effects on the Fetus

Methylmercury is a potent neurotoxicant that interferes with brain development. It readily crosses the placenta, and fetal blood levels are equal to or slightly higher than maternal levels. It is actively transported into the brain, where it interferes with nerve cell differentiation and division by binding to DNA and RNA. It also interferes with nerve cell migration and prevents the development of normal brain structure. High-dose exposures during fetal development can result in low birth weight, small head circumference, severe mental retardation, cerebral palsy, deafness, blindness, and seizures. Severely affected children may be born to mothers who exhibited no symptoms of methylmercury exposure during pregnancy.

Lower-dose prenatal exposure from maternal consumption of fish and marine mammals may cause more subtle neurodevelopmental damage that is not expressed until later in childhood. Recent epidemiologic studies of infant-mother pairs in the Faroe Islands have found deficits on neurobehavioral tests, particularly on tests of attention, fine motor function, language, visual-spatial abilities (e.g., drawing), and memory that correlate with prenatal mercury exposure.[5] A similar investigation of infant-mother pairs in Seychelles failed to find a correlation.[6] The National Research Council did an exhaustive evaluation of the studies and concluded that the conflicting results might be due to differences in methodology, types of exposures, and populations studies, but that the proper public health approach was to use the positive Faroe Island studies as the basis for setting safe exposure levels.[7]

In addition to exposure *in utero*, infants and children ingest methylmercury from breast milk and other foods in their diet. Young children and infants are potentially more susceptible to neurotoxicity from methylmercury than older children and adults because the brain continues to grow and develop dramatically for the first several years of life. Children also may have higher exposures than adults pound for pound, because a child eats more food relative to his or her body weight than an adult does. As a result, they may have higher exposure and thus higher risk than adults do.[8]

Adult Neurological Effects

The mature nervous system can be adversely and permanently affected by methylmercury. Autopsy results have shown that methylmercury causes nerve cell death and scarring in selected areas of the brain.[9] Symptoms are nonspecific, often

delayed for months following exposure, and the severity of effects increases with increased exposure. Effects with low to moderate chronic exposure range from paresthesias (abnormal sensations such as numbness and tingling of fingers, toes, mouth, and lips) to ataxia (stumbling or clumsy gait) and generalized weakness, to decreased vision and hearing, spasticity, tremor, and finally coma and death with higher, more acute exposures. Diagnosis depends on the clinician having a high index of suspicion, identifying the source of exposure, and evaluating blood and hair mercury levels. Recent clinic-based studies have raised concern that high-end fish consumers in the United States may be ingesting enough methylmercury to cause clinical illness.[10]

Cardiovascular Effects

Data are evolving in support of a link between methylmercury exposure and increased risk of high blood pressure, heart-rate abnormalities, and heart disease.[11] These effects are seen following exposure during fetal development, as well as in adulthood. While studies conflict, it is of particular concern since the effects may occur at levels similar to those known to cause neurological damage. More research is required to define these effects fully.

How Widespread Are the Effects of Mercury Contamination and Exposure?

Mercury contamination in fish across the United States is so pervasive that health departments in 45 states have issued fish consumption advisories.[12] In addition, 11 states have consumption advisories for every inland water body for at least one fish species, and eight states have statewide coastal marine advisories for king mackerel. To date, 11 states have also issued advisories urging women and children to limit consumption of canned tuna.

A new study released by the Centers for Disease Control and Prevention details the levels of mercury and 115 other environmental contaminants measured in the blood and urine from a representative sample of American adults and children. According to the second National Report on Human Exposure to Environmental Chemicals, almost 8% of women of childbearing ages (16 to 49) have levels of mercury that exceed what is considered safe for a fetus.[13] Across the entire U.S. population, this could mean that millions of children are at risk.

References

1. UNEP. 2003. Global Assessment of Mercury. Geneva:United Nations Environment Programme. Available: http://www.chem.unep.ch/mercury/Report/GMA-report-TOC.htm [accessed 14 January 2004].
2. ATSDR. 1999. Public Health Statement for Mercury. Atlanta, GA:Agency for Toxic Substances and Disease Registry. Available: http://www.atsdr.cdc.gov/toxprofiles/phs46.html [accessed 14 January 2004].
3. Clarkson TW. 2002. The three modern faces of mercury. Environmental Health Perspectives 110(Suppl 1):11–23.
4. ATSDR. 1999. Toxicological Profile of Mercury. Atlanta, GA: Agency for Toxic Substances and Disease Registry. Available: http://www.atsdr.cdc.gov/toxprofiles/tp46.html [accessed 19 Dec 2003].
5. Grandjean P, Weihe P, White RF, Debes F, Araki S, Yokoyama K, et al. 1997. Cognitive deficit in 7-year-old children with prenatal exposure to methymercury. Neurotoxicology and Teratology 19(6):417-428. Steuerwald U, Weihe P, Jorgensen PJ, Bjerve K, Brock J, Heinzow B, et al. 2000. Maternal seafood diet, methylmercury exposure, and neonatal neurologic function. The Journal of Pediatrics 136(5):599–605.
6. Myers GJ, Davidson PW, Cox C, Shamlaye CF, Palumbo D, Cernichiari E, et al. 2003. Prenatal methylmercury exposure from ocean fish consumption in the Seychelles child development study. The Lancet 361:1686–1692.
7. Committee on the Toxicological Effects of Methylmercury, National Research Council. 2000. Toxicological Effects of Methylmercury. Washington, DC:National Academy Press.
8. U.S. EPA. 1997. Mercury Study Report to Congress, Volume VII: Characterization of Human and Wildlife Risks from Mercury Exposure in the United States. EPA-452/R-97-009. Washington, DC:U.S. Environmental Protection Agency.
9. ATSDR. Toxicological Profile of Mercury. 1999. Atlanta, GA: Agency for Toxic Substances and Disease Registry. Available: http://www.atsdr.cdc.gov/toxprofiles/tp46.html [accessed 19 Dec 2003].
10. Hightower JM and Moore D. 2003. Mercury levels in high-end consumers of fish. Environmental Health Perspectives 111(4):604–608.
11. Committee on the Toxicological Effects of Methylmercury, National Research Council. 2000. Toxicological Effects of Methylmercury. Washington, DC:National Academy Press.
12. U.S. EPA. 2003. Update: National Listing of Fish and Wildlife Advisories. EPA-823-F-03-003. Washington, DC:U.S. Environmental Protection Agency. Available: http://www.epa.gov/ost/fish [accessed 14 January 2004].
13. Schober SE, Sinks TH, Jones RL, Bolger PM, McDowell M, Osterloh J, et al. 2003. Blood mercury levels in U.S. children and women of childbearing age, 1999-2000. Journal of the American Medical Association 289(13):1667–1674.

This is a publication of Physicians for Social Responsibility. For reprint information, please contact PSR, 1875 Connecticut Avenue, NW, Suite 1012, Washington, DC 20009; Phone: 202-667-4260; Fax 202-667-4201; Email: psrnatl@psr.org; Website: www.psr.org

Contributors

Katherine M. Shea, M.D., M.P.H., Medical Consultant
Karen L. Perry, M.P.A., Deputy Director, Environment and Health Program
Mona Shah, M.P.H., Intern

For additional information:
www.mercuryactionNOW.org
www.EnviroHealthAction.org

1985 NOBEL PEACE PRIZE

PSR
Physicians for Social Responsibility
1875 Connecticut Avenue, Suite 1012 • Washington, DC 20009
U.S. Affiliate of IPPNW