



## TOX IMPACT STATEMENT

### Mercury: A Long-Appreciated Hazard

*Approved by SOT Council, May 2018*

#### The Problem

The Hatter in Lewis Carroll's *Alice's Adventures in Wonderland* and *Through the Looking Glass* was based on English hatters who were frequently poisoned by mercuric nitrate, which was used in the felting process. In earlier times, alchemists used mercury to extract gold, and Georgian physicians administered mercury to cure medical problems such as constipation and syphilis. Mercury, named quicksilver by Aristotle, was described by Pliny as an occupational scourge to miners in Spain; only criminals and slaves were employed in the notorious Almaden mines.

Mercury (Hg) is a naturally occurring element which 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 children *in utero* and early in life. Mercury may have toxic effects on the nervous, digestive, and immune systems and on the lungs, kidneys, skin, and eyes. It is considered by the World Health Organization as one of the top 10 chemicals or groups of chemicals of major public health concern. In the general population, exposure occurs predominantly to the organic form of mercury, methylmercury, through secondary exposure through the consumption of fish and shellfish, where methylmercury is a contaminant.

#### Role of Toxicology

Toxicologists have played a major role in identifying the health risks associated with exposure to methylmercury. In 1953, a large epidemic of birth defects was observed in Minamata, Japan. Initial causes were attributed to an infectious disease or malnutrition, which were soon discounted as causes when it was recognized that fish eaten by the villagers were highly contaminated by methylmercury. Research led by toxicologists at the University of Rochester subsequently focused on the ill effects of methylmercury poisoning in an Iraqi population exposed accidentally in 1971–1972. The outbreak was the result of eating homemade bread prepared from wheat treated with a methylmercury fungicide. A series of studies concluded that the major site of action of methylmercury was the central nervous system, resulting in aberrant neurodevelopment upon prenatal exposure.

While these studies on acute, high exposures have been informative, subsequent emphasis shifted to the effects of low-grade chronic exposures to methylmercury and their potential to induce

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subtler symptoms and clinical findings. The effects on intellectual function in children from prenatal methylmercury exposure via maternal fish consumption have been the subject of two major prospective longitudinal studies in the Seychelles and the Faroe Islands.

Recent work has indicated the complexity of evaluating the potential adverse effects of consumption of methylmercury in fish. This is in large part due to the potential that many cognitive deficits induced by methylmercury may be mitigated by the concurrent maternal intake of long-chain polyunsaturated fatty acids which are present in fish. For example, a 20-year, long-term study of methylmercury in the Seychelles of a primarily fish-eating population focused on the potential associations between prenatal exposures and subsequent cognitive development. These studies have consistently found no significant associations of prenatal methylmercury exposure with various age-appropriate measures of cognitive and motor function. However, opposite effects have been reported in an Arctic Inuit population on the Faroe Islands. In addition to other cultural differences, a different source of methylmercury exposure characterizes the Faroe Island cohort, where the exposures are via whale meat and blubber, which can include additional contaminants, such as polychlorinated biphenyls. This cohort has shown deficits in motor function, attention, and verbal behavior.

High levels of blood methylmercury levels in developing children remain a major public health issue and may harm developing nervous systems, requiring continued research to better define the potential risks of dietary methylmercury intake.

### **Impact of Public Health**

Fish consumption safety is an important issue considering as many as three billion people worldwide depend on fish as a daily dietary source of protein. Exposure to methylmercury remains a major health concern, especially for the developing central nervous system. A National Academy of Sciences expert panel reviewed these studies, concluding that the weight-of-evidence supports methylmercury's adverse health effects. The US Environmental Protection Agency's *Mercury Study Report to Congress* estimates that eight percent of US women of childbearing age have blood Hg concentrations exceeding safe levels. Thus, an estimated 300,000 newborns in the United States alone may have an increased risk of learning disabilities associated with *in utero* methylmercury exposure, and the global health impact is far greater considering numerous populations rely on fish consumption as their main dietary source.

Exposure to high levels of several other mercury species can affect brain, heart, kidney, lung, and immune system function in people of all ages. The toxicological risk assessment has led to awareness of the need to better control the potential environmental sources of mercury. Mercury released into the air ultimately deposits in the watershed where it is converted to methylmercury by microorganisms, and methylmercury is bioaccumulated in fish and shellfish. Reduced

## *Mercury: A Long-Appreciated Hazard*

airborne mercury emission will, in the long term, result in lower levels of dietary methylmercury intake and reduce the risks associated with this environmental pollutant.

### **References and Resources**

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