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Measuring mercury: Common test may overestimate exposure from dental amalgam fillings

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A common test used to determine mercury exposure from dental amalgam fillings may significantly overestimate the amount of the toxic metal released from fillings, according to University of Michigan researchers.

Scientists agree that dental amalgam fillings slowly release mercury vapor into the mouth. But both the amount of mercury released and the question of whether this exposure presents a significant health risk remain controversial.

Public health studies often make the assumption that mercury in urine (which is composed mostly of inorganic mercury) can be used to estimate exposure to mercury vapor from amalgam fillings. These same studies often use mercury in hair (which is composed mostly of organic mercury) to estimate exposure to organic mercury from a person's diet.

But a U-M study that measured mercury isotopes in the hair and urine from 12 Michigan dentists found that their urine contained a mix of mercury from two sources: the consumption of fish containing organic mercury and inorganic mercury vapor from the dentists' own amalgam fillings.

"These results challenge the common assumption that mercury in urine is entirely derived from inhaled mercury vapor," said Laura Sherman, a

postdoctoral research fellow in the Department of Earth and Environmental Sciences and lead author of a paper in the journal *Environmental Science & Technology*. A final version of the paper was published online March 20.

"These data suggest that in populations that eat fish but lack occupational exposure to mercury vapor, mercury concentrations in urine may overestimate exposure to mercury vapor from dental amalgams. This is an important consideration for studies seeking to determine the health risks of mercury vapor inhalation from dental amalgams," said U-M biogeochemist Joel D. Blum, a co-author of the paper and a professor in the Department of Earth and Environmental Sciences.

The study by Sherman, Blum and their colleagues demonstrates that mercury isotopes can be used to more accurately assess human exposure to the metal—and the related health risks—than traditional measurements of mercury concentrations in hair and urine samples. Specifically, isotopes provide a novel chemical tracer that can be used to "fingerprint" both organic mercury from fish and inorganic mercury vapor from dental amalgams.

Mercury is a naturally occurring element, but more than 2,000 tons are emitted into the atmosphere each year from human-generated sources such as coal-fired power plants, small-scale gold-mining operations, metals and cement production, incineration and caustic soda production.

This mercury is deposited onto land and into water, where micro-organisms convert some of it to methylmercury, a highly toxic organic form that builds up in fish and the animals that eat them, including humans. Effects on humans include damage to the central nervous system, heart and immune system. The developing brains of fetuses and young children are especially vulnerable.

Inorganic mercury can also cause central nervous system and kidney damage. Exposure to inorganic mercury occurs primarily through the inhalation of elemental mercury vapor. Industrial workers and gold miners can be at risk, as well as dentists who install mercury amalgam fillings—though dentists have increasingly switched to resin-based composite fillings and restorations in recent years.

About 80 percent of inhaled mercury vapor is absorbed into the bloodstream in the lungs and transported to the kidneys, where it is excreted in urine. Because the mercury found in urine is almost entirely inorganic, total mercury concentrations in urine are commonly used as an indicator, or biomarker, for exposure to inorganic mercury from dental amalgams.

But the study by Sherman, Blum and their colleagues suggests that urine contains a mix of inorganic mercury from dental amalgams and methylmercury from fish that undergoes a type of chemical breakdown in the body called demethylation. The demethylated mercury from fish contributes significantly to the amount of inorganic mercury in the urine.

The U-M scientists relied on a natural phenomenon called isotopic fractionation to distinguish between the two types of mercury. All atoms of a particular element contain the same number of protons in their nuclei. However, a given element can have various forms, known as isotopes, each with a different number of neutrons in it nucleus.

Mercury has seven stable (nonradioactive) isotopes. During isotopic fractionation, different mercury isotopes react to form new compounds at slightly different rates. The U-M researchers relied on a type of isotopic fractionation called mass-independent fractionation to obtain the chemical fingerprints that enabled them to distinguish between exposure to methylmercury from fish and mercury vapor from dental amalgam fillings.

More information: www.lsa.umich.edu/earth/people …
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Provided by University of Michigan