COMMERCIAL FISH: EAT UP, DESPITE LOW LEVELS OF MERCURY

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Even though the world's fish contain slight amounts of mercury, eating lots of fish carries no detectable health risk from low levels of the substance, even for very young children and pregnant women, concludes the most comprehensive study of the subject yet.

The findings come from a nine-year University of Rochester study conducted in the Republic of the Seychelles, an island nation in the Indian Ocean where most people eat nearly a dozen fish meals each week and whose mercury levels are about 10 times higher than most U.S. citizens. Indeed, no harmful effects were seen in children at levels up to 20 times the average U.S. level. The work is published in the August 26 issue of the Journal of the American Medical Association.

"We look at the Seychelles people as a sentinel population," says pediatric neurologist Gary Myers, who examined the children. "If somebody who eats fish twice a day does not show effects from mercury exposure, it's unlikely that somebody who eats fish twice a week will be affected. And the fish they eat in the Seychelles contains the same amount of mercury as fish sold at supermarkets and eaten in the United States."

Adds first author Philip Davidson, an expert on developmental disabilities who designed a battery of the most sophisticated tests available to examine the children: "What we found in the Seychelles is applicable to every woman, every man, and every child around the world who eats ocean fish."

In the United States the green light applies only to fish bought and sold commercially, at grocery stores, supermarkets, fish shops, and in restaurants. Those fish are already regulated based on their mercury levels, and current regulations are sufficient to safeguard frequent fish eaters against mercury exposure, say the investigators. Consumers still should follow advisories about eating fish caught in lakes and rivers, since there are hundreds of polluted waterways whose fish are dangerous to eat in abundance, often because of other pollutants such as PCBs.

The Seychelles study began in 1989, when Rochester researchers, with decades of expertise studying mercury exposure, chose the nation of about 65,000 people as an ideal site to study the effects of mercury exposure (see sidebar). Myers enrolled 779 newborn children, about half the births on the islands that year. From the children's mothers, Myers and the team took samples of hair, which lock in a record of mercury exposure of the child during gestation.

A neurologist, a childhood development expert, and nurses then studied the children at 6, 19, 29 and 66 months of age, visiting their homes, talking to their parents, and performing nearly three dozen sensitive developmental and neurological tests designed to detect subtle effects of mercury exposure. The analysis included noting when the children learned to walk and talk, measurements of reflexes, word recognition, and social behavior, and the best neuropsychological tests yet developed to evaluate children at these
ages. At each interval, the results of the longitudinal study have been consistent: no ill effects from a high-fish diet. The JAMA paper details the 66-month evaluation, which included 711 of the original children.

Mercury is a deadly neurotoxin that at high levels kills nerve cells, causing blurry vision, lack of coordination, slurred speech, and even death. Children exposed to high levels of the compound pre-natally can suffer slowed development, blindness, cerebral palsy, and other birth defects.

While high amounts of mercury are obviously toxic, scientists for years have debated the health effects of lower levels. Late last year, the federal Environmental Protection Agency (EPA) proposed slashing the amount of mercury that is acceptable for people to ingest from 30 micrograms per day, the level recommended both by the World Health Organization and the federal Agency for Toxic Substances and Disease Registry, to just six. If the Food and Drug Administration (FDA) follows this guideline, it will need to slash the current level of mercury allowable in ocean fish that are sold in the United States below the current level of 1 part per million (ppm).

That action would take off the market a significant proportion of the fish now available, especially large predatory fish like swordfish, shark, and red snapper, and could even affect tuna. The team fears that it might also convince consumers who associate mercury with health dangers to limit their intake of fish, a remarkably healthy form of nutrition. Under the proposed rules, scientists estimate that the average person would be able to eat only a few ounces of fish per week before bumping up against the new limit.

"Eating lots of ocean fish isn't much of a hazard compared to missing out on the benefits from not eating fish," says Thomas Clarkson, professor of environmental medicine and an internationally recognized authority on mercury. Clarkson is principal investigator of the study, which is being funded by the National Institutes of Health, the Food and Drug Administration, and the Republic of the Seychelles.

"A slew of scientific reports have shown that eating fish helps protect against cardiovascular disease and enhances brain development before and after birth. Fish is a rich source of low-fat protein and is full of fatty acids known to lower cholesterol. Overstating the almost negligible risk of mercury could adversely affect millions of people who face the risk of heart disease," says Clarkson. He adds that FDA's current guideline already helps people avoid excessive mercury exposure, which would be a danger primarily for someone eating frequent meals of fish like swordfish and shark.

Fish are the primary source of exposure to mercury around the world. Scientists estimate that about half the mercury in the Earth and its atmosphere originates from natural sources such as volcanoes that belch massive quantities of the substance. Man-made sources include coal-fired power plants, smoke from burning cigarettes, and incinerators that burn items like fluorescent bulbs, batteries, and mercury thermometers. Mercury vapor enters the atmosphere and falls in rainwater to the Earth. Then, in a poorly understood process in the oceans and other bodies of water, microbes play a key role, transforming the mercury into a substance known as methyl mercury, which works its way up the food chain and accumulates primarily in large predatory fish, though methyl mercury is found in virtually all fish around the globe.

While the study focused on healthy fish from ocean waters, its implications spill over into the freshwater arena too. Mercury is one of many pollutants that limit consumption of fish from lakes and rivers across the nation, and individual states rely on federal guidelines when developing recommendations on how many fish can be eaten per week or month. If federal agencies lower the level of mercury they say is
acceptable in the diet, that would likely force states to recommend that residents eat fewer fish from local waters.

The Rochester team is continuing the study and is currently analyzing the same group of children at eight years of age. The scientists are also working with nutrition experts from the University of Ulster in Northern Ireland to explain an unexpected finding: As mercury levels in the children went up, so did their performance on tests.

That link could be due to several factors, scientists say. "Certainly no one thinks that the increased performance is due to mercury," says Davidson. The scientists caution that the most obvious explanation -- that fish is so nutritious that those children who ate more were healthier than those who didn't -- hasn't been established because the study was not designed to look at such a link. But these results do show that the tests the team used are sensitive enough to detect very subtle neurological and psychological effects in children, says Davidson.

The Rochester findings are in contrast to those by a team from the University of Odense in Denmark. That team recently studied a population in the Faroe Islands, near Iceland, that is exposed to mercury mainly by eating whales as well as fish. Those scientists found that children who were exposed to mercury pre-natally had slight abnormalities in development at age seven.

The Rochester scientists feel those findings may be relevant to people who eat whale meat but are not convinced they apply to people eating fish and not whale. Whale meat contains other toxins and pollutants, like PCBs, and is higher in mercury than fish. Another key difference is that a community often eats an entire whale in a short period of time, causing a spike in mercury levels that may affect the body differently than lower levels.

The White House has organized a meeting for November where the two teams and other scientists are expected to discuss the varying results.

Besides Clarkson, Davidson, and Myers, the team also included Christopher Cox, associate professor of biostatistics; University of Rochester researchers Catherine Axtell, Jean Sloane-Reeves, Elsa Cernichiari, Anna Choi, and Yining Wang; Conrad Shamlaye of the Republic of Seychelles Ministry of Health; Larry Needham of the U.S. Centers for Disease Control and Prevention; and Maths Berlin of the University of Lund in Sweden.

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**HOW MUCH MERCURY IS TOO MUCH? QUESTIONS AND ANSWERS**

*How is mercury exposure measured?*
Scientists determine a person's exposure to mercury by measuring the content in a strand of hair. By comparing these levels to the results of very sophisticated batteries of tests, scientists try to determine the lowest level that might be harmful.

*At what level does mercury become harmful?*
The World Health Organization's guidelines maintain that the lowest level that could possibly be harmful to humans is 5 parts per million (ppm). This level is based on scientific results from the 1960s that placed the level at which risk begins at 50 ppm for most people; WHO then applied a safety factor of 10,
deciding that a level of 5 or less is safe for even the most vulnerable populations. Now the University of Rochester team has conducted an extensive study in the Seychelles Islands of the most sensitive population -- young children -- where the average level is about 7 ppm, about 10 times the level of the U.S. population. The scientists found no harm from mercury at levels up to 15 ppm, nearly twice the average Seychelles level and about 20 times higher than the average U.S. level.

How do these numbers translate into people's lives? Scientists typically calculate how much mercury a person could ingest each day before bumping up into the danger zone, and then regulatory agencies issue advisories based on those numbers. In the past, using the WHO guideline, EPA has recommended that a person ingest no more than 30 micrograms of mercury per day. Based on estimates of U.S. fish consumption, FDA recommended that only commercial fish with less than 1 ppm of mercury be sold. Nearly all fish caught in the oceans meet this criterion.

Are these recommendations being changed? Possibly. Late last year the EPA recommended to Congress that the tolerable daily intake of mercury be dropped to just one-fifth the current allowable level, to about 6 micrograms per day. For Americans to reach this level, FDA would need to slash the amount of mercury acceptable in commercial fish. This would cut the proportion of some ocean fish that could be sold and would put pressure on sources of mercury, such as coal-fired power plants, to reduce mercury emissions.

How does the Seychelles data affect the proposed changes? The new EPA number is based on data the Rochester group collected in Iraq after a mercury poisoning event in 1972. The researchers believe the Seychelles data, which do not support lowering the recommended daily intake of mercury, is far superior. "There are many reasons you shouldn't determine human health risk based on the Iraqi data," says Clarkson. "That was a poisoning event, much different from a low-level exposure to mercury, and the mercury source was contaminated grain, not fish, which is how most people are exposed. In addition, the possible risk at low levels was determined by just a few cases.

"People have been taking our old data from Iraq and coming out with very low numbers for tolerable exposure. We who had done the study knew their numbers were not very solid. That's why we undertook this extensive Seychelles study."

WHY GO TO THE SEYCHELLES TO STUDY MERCURY EXPOSURE?

Some factors that make the Seychelles an ideal site to study the effects of mercury exposure:
- The people eat a lot of fish, oftentimes twice a day. Mothers in the study ate an average of 12 fish meals per week.
- There are no local sources of mercury pollution. The population's exposure to mercury comes almost completely from ocean fish, which have about the same amount of mercury throughout the world.
- The nation boasts high-quality free medical care and education.
- Most people born on the islands stay there, making the population easy to track over a number of years. (Investigators were able to evaluate about 90 percent of the original children five and one-half years after the study began.)
Women drink and smoke very little, eliminating those habits as factors in their children's pre-natal development.

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