Mercury Contamination, Exposures and Risk:

A New Global Picture Emerges

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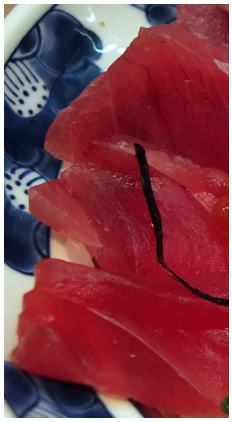

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Zero Mercury Working Group
www.zeromercury.org
December 2012

Mercury is a well-known and dangerous toxic pollutant that contaminates fish around the world. There has been a 3-fold increase in mercury since pre-industrial times and a recent study indicates that mercury accumulation in the oceans correlates with the rising tide of mercury pollution. Mercury has no respect for national or regional boundaries. It can travel long distances through the atmosphere and deposit far from its original source, where bacteria absorb it and convert it to a very toxic form, methylmercury, which works its way up the food chain into humans.

Until now, there has not been a comprehensive, global picture of mercury levels in seafood. The renowned research group, Biodiversity Research Institute (BRI), has closed this gap by creating a new extensive global data base on mercury in fish and other marine life. In their new report, entitled ***Mercury in the Global Environment: Patterns of Global Seafood Mercury Concentrations and their Relationship with Human Health,*** BRI uses the data base to describe the worldwide extent of mercury contamination, based on thousands of scientific reports collected from around the globe. Importantly, the report also identifies which types of seafood and other marine life have relatively high concentrations of mercury - critical knowledge when trying to reduce mercury exposures and risks for those who eat seafood.

To complement the fish contamination data from BRI, the Zero Mercury Working Group (ZMWG) commissioned a report entitled ***An Overview of Epidemiological Evidence on the Effects of Methylmercury on Brain Development, and a Rationale for a Lower Definition of Tolerable Exposure.*** This report examines the most recent health studies on mercury and finds that the current health benchmarks for mercury levels in fish are outdated and inadequate. Taken together, these two new reports suggest that not only is mercury contamination widespread, but the levels in fish are of greater concern than previously imagined.

Mercury – More Dangerous Than Previously Thought

Over the past half-century, large scale exposure incidents in Japan and Iraq have focused the medical community's attention on the toxic effect of methylmercury on human health. Furthermore, recent epidemiological studies of the impacts of lower-level mercury exposure through fish consumption have clarified what many had long feared: human health is compromised even by very small concentrations of mercury.

The public health challenges posed by methylmercury in seafood are complex. While fish consumption provides important nutritional benefits, including omega 3 benefits, the risk from higher concentrations of mercury in some seafood species is undeniable. Seafood varieties can differ by at least 100-fold in their average mercury content. About 70 percent of all seafood contains relatively low levels of mercury; however, larger predatory fish such as swordfish, shark and certain species of tuna have higher mercury concentrations and are often included in government fish consumption advisories. These advisories target women of childbearing age and young

children, who are most at risk; but anyone who eats a lot of fish may be at greater risk if they consistently eat too much high-mercury fish, so seafood lovers need to pay close attention to mercury content.

However, the solution is not for people to stop eating seafood. Instead, the international community needs to reduce and where possible eliminate mercury pollution entering our global environment, in order to eventually reduce mercury concentrations in fish. In the meantime, because fish consumption has major health benefits, people should eat plenty of fish and shellfish, but choose low-mercury varieties.

New Health Data Demand New Mercury Health Benchmarks

Current national and international limits on mercury levels in fish – 0.5 parts per million (ppm) for most fish, 1.0 ppm for large predatory species – are NOT safety limits, they are enforcement tools; and current government benchmarks for exposure to methylmercury (the US EPA Reference Dose (RfD) of 0.1 µg/kg body weight (bw)/day and the World Health Organization Provisional Tolerable Weekly Intake of 1.6 µg/kg bw/week) are based on currently considered, but outdated scientific evidence. More recent studies have found adverse effects below exposure levels considered "safe" just a few years ago. Several of these studies clearly show that the consumption of ordinary amounts of fish with higher mercury levels can cause health risks to the developing foetus and children.

As a result, the report commissioned by ZMWG suggests that the current RfD should be reviewed in light of new scientific evidence, and as an example, could justifiably be reduced to 25 per cent of the current Reference Dose, to 0.025 µg /kg bw/day. Such a reduction would be a reasonable response to the most current information on the health effects of mercury, incorporating a margin of uncertainty to account for known and unknown inter-individual variables that affect risk, while balancing risk against the nutritional benefits of fish consumption.

Implications of New Health Benchmarks for Fish Consumption: How Much Could You Eat?

Our analysis below explores the implications for fish consumption advice if the RfD were to be revised, using 0.025 µg /kg bw/day, as an example. Table 1 presents the likely limits to fish consumption that would be required at different concentrations of methylmercury in order to stay below this example of a revised health benchmark. These meal limits are presented in the context of current global fish concentrations for both low-mercury species (Figure 1) and high-mercury species (Figure 2). Concentration data were taken from the BRI report. It's important to note that the BRI report mentions that some other types of common seafood such as shellfish have generally lower concentrations of mercury.

Mercury Concentration in Fish (mg Hg/kg fish)	Fish Meals per Week	
	Current EPA RfD ($1.0x10^{-4}$ mg/kg)	Example revised RfD ($2.5x10^{-5}$ mg/kg)
0.01	unrestricted	unrestricted
0.015	unrestricted	4
0.02	unrestricted	3
0.03	unrestricted	2
0.04	unrestricted	2
0.05	5	1
0.11	2	1
0.15	2	no consumption
0.22	1	no consumption
0.95	no consumption	no consumption

Table 1. Recommended fish meals per week by mercury concentration in fish muscle for US EPA RfD and using the example of a revised RfD. Assumes 60kg woman eating meals of 6oz (170.1g) fish. For this table, "unrestricted" consumption is defined as more that 5 fish meals per week.

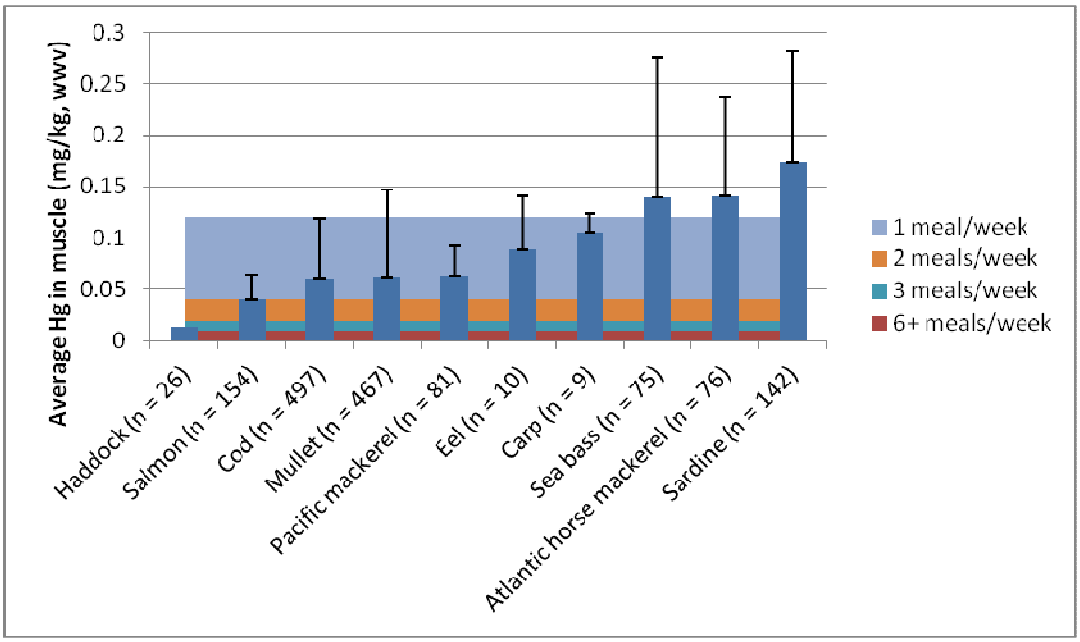

Figure 1. Average mercury concentration in lower mercury species group, with recommended meals per day based on the example of a revised RfD assuming 60kg person eating 6oz (170.1g) fish meals. n=sample size.

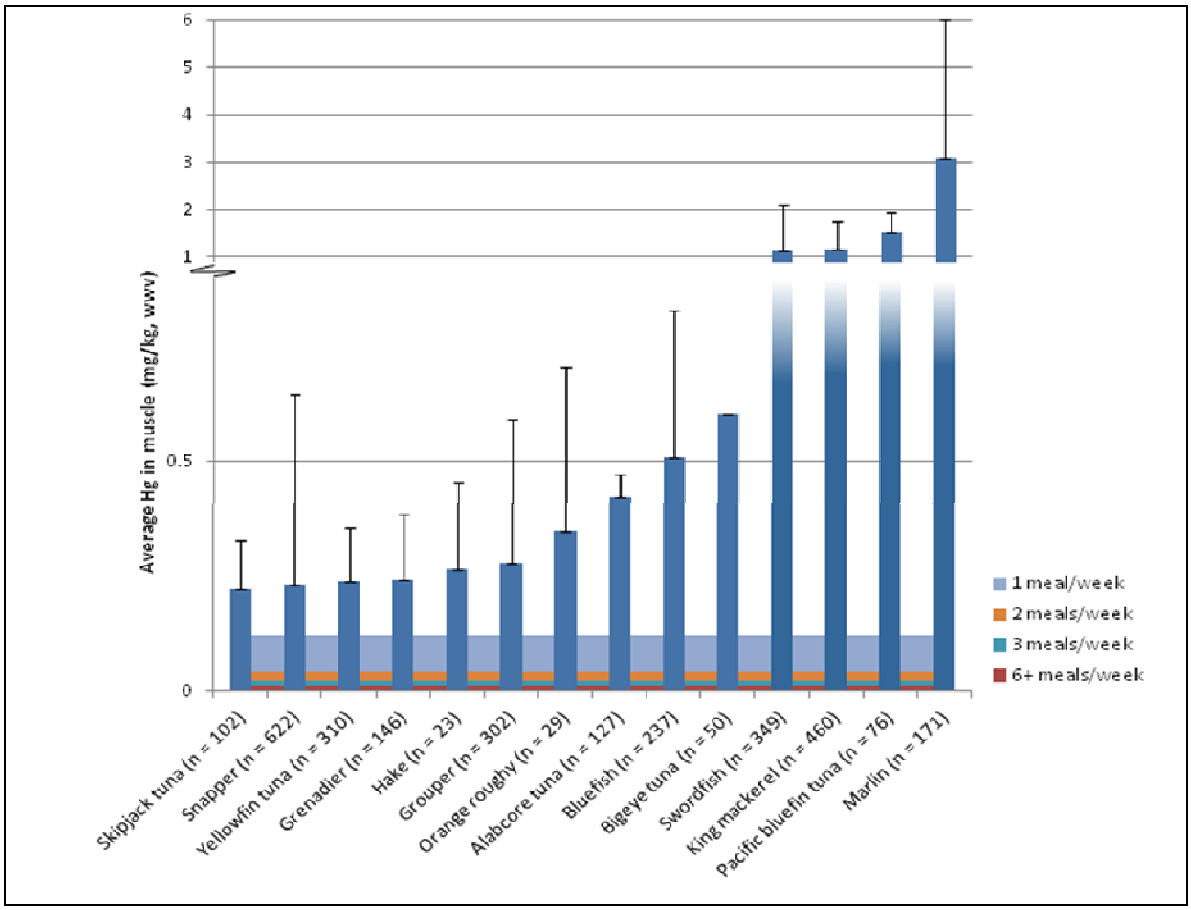

Figure 2. Average mercury concentration in higher mercury species group, with recommended meals per day based on the example of a revised RfD assuming 60kg person eating 6oz (170.1g) fish meals. n=sample size.

Summary and Recommendations – A strong effective Global Mercury Treaty is needed

There are a number of measures that governments and other stakeholders can take to reduce methylmercury exposure risks to people the world over, both in the short and long term:

- Measures must be taken immediately to reduce mercury pollution in the global environment, which will eventually reduce concentrations in fish. Recent scientific findings show that mercury pollution trends are contributing to measureable increases of mercury in the world's oceans each year. They also project that levels of mercury in the Pacific Ocean will increase by 50% by 2050 if current pollution trends continue unabated (Sunderland, E.M. et al, 2009). This is a clear call-to-action for governments to take decisive action to reduce mercury pollution.

  Since mercury is a global pollutant, there is no substitute for international resolve and action. The U.N. Environment Programme Governing Council (UNEP GC) is preparing a legally binding treaty "…which will ultimately reduce exposure to mercury globally." Countries must agree on effective mercury reduction measures and develop a strong global legally binding instrument during the fifth and final round of negotiations in Geneva in January 2013. The mercury treaty should protect human health and the global environment from the release of mercury and its compounds by minimizing, with the goal of eliminating, mercury uses in products and processes as well as mercury releases to air, water and land.

- Even with strong actions by governments, it will take some time for mercury pollution to be reduced in the global environment. So we can expect mercury contamination of fish to persist in the short-term. During this period, the primary strategy for reducing methylmercury exposure risks is to reduce consumption of fish with higher mercury concentrations. To do this, governments should measure the concentrations of mercury in commonly consumed fish species and publicize the results. Such risk communication efforts should also aim to educate consumers, particularly women of childbearing age, children and those who eat large quantities of fish, to choose low-mercury varieties of fish and shellfish and thereby gain the many benefits of fish consumption while minimizing the risks.

- National governments and the World Health Organization would need to review current health-based intake levels of methyl mercury and revise as needed, to reflect the current scientific understanding of risks from methyl mercury. Our analysis suggests that a level of 0.025 µg/kg bw/day, (i.e. one-quarter of the current US EPA Reference Dose), would be justified based on available information.

- Governments and other stakeholders should examine the data gaps as highlighted in the BRI report in terms of mercury concentrations in fish in different regions, and take measures to create a more complete set of data. Such a data set could then serve as a baseline to assess the effectiveness of the future mercury treaty.

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