Methylmercury
An environmental neurotoxic with an economic punch.

Methylmercury is an organic compound consumed by humans from eating fish. The compound is toxic and can be detrimental to infant IQ. Overall, the toxin also desecrates an economy through costs to businesses and consumers.

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Mercury’s IQ Attacking Accumulation

To eat or not to eat? For most people it’s a simple question with a simple answer. To eat. However, for some people—those who have diets high in fish and shellfish—this question possesses a harder punch. Any person who eats fish will consume traces of methylmercury—an organic compound found in fish. While in small quantities, the compound causes almost no effect; in higher concentrations it could devastate one’s health, and IQ, especially in infants. The effects of methyl mercury in fish can not only destroy a person’s health it also wrenches the economy through governmental regulation and costs.

Fish Consumption: The Issue

To begin, fish and shellfish play an important part in the human diet. Fish contain healthy Omega-3 fatty acids which are helpful to neurological development. However, all fish and shellfish contain some level of methylmercury. While the Omega-3 acids are good for health especially in nursing and pregnant women, as they support the neurological development of infants, high concentrations of methylmercury can destroy an infant’s IQ. According to a study done by the Environmental Health Perspectives (ehp) levels of mercury in concentration of just over 5.8μg/L of umbilical cord blood in maternal women results in a loss of IQ for the fetus.
In such small concentration, mercury is harmful to people, and in this way consumption of fish and thus methylmercury, creates a food safety issue.

Relatedly, while infants are principally affected by exposure to methylmercury the compound does affect other age levels as well. The EPA and FDA published advisories in 2004 about methylmercury and fish consumption. The advice was meant to target, women of childbearing age, pregnant women, nursing mothers, and young children. While targeted towards these audiences the EPA also warns that women without symptoms of high levels of mercury concentration could still pass effects onto developing fetuses (Human). When thinking of this advisory, it is easy to question “how do you know how much mercury is in fish?”. To answer this question some background is needed. First, mercury in fish is obtained through a process known as bioaccumulation. This process occurs when bacteria and microscopic organisms change mercury in soil and sediment into methylmercury. Fish then eat these organisms, and the fish in turn are consumed by larger fish, resulting in a higher concentration. The bioaccumulation process is shown in the following diagram (Human).
Similarly, as fish eat each other as they move up the food chain the concentration of methylmercury increases. Advisories are also given to show which fish tend to have higher levels of mercury, and which are safer to consume. Tables like the ones below from the FDA and Drugline.com show the levels of mercury in each type of fish. This particular table shows the data collected for just the fish containing the four highest concentrations of methylmercury (Food).

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>MERCURY CONCENTRATION (PPM)</th>
<th>NO. OF SAMPLES</th>
<th>SOURCE OF DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MEAN</td>
<td>MEDIAN</td>
<td>STDEV</td>
</tr>
<tr>
<td>MACKEREL KING</td>
<td>0.730</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>SHARK</td>
<td>0.979</td>
<td>0.811</td>
<td>0.626</td>
</tr>
<tr>
<td>SWORDFISH</td>
<td>0.995</td>
<td>0.870</td>
<td>0.539</td>
</tr>
<tr>
<td>TILEFISH (Gulf of Mexico)</td>
<td>1.450</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

One big way businesses are affected by methylmercury appears in environmental regulation. Since mercury is a "quicksilver" or a metal that is liquid at room temperature it can evaporate at low temperatures and travel through the atmosphere. Mercury is commonly released into the atmosphere through coal burning power plants (Trasande). Likewise, the ehp also cites that the toxicant can also be found in the environment through inorganic salts and organic
compounds such as methylmercury. Since power plants burn coal for fuel, and it releases mercury into the atmosphere businesses must be regulated, causing an increased cost in production. On another note, businesses also see an impact on healthcare costs for those affected by mercury toxicity in costs for testing, and then medical treatment (Mercury). Overall, many people and various parts of the economy are affected by concentration of methylmercury in fish.

**Economic Standpoint: Costs/Benefits**

Consumption of methylmercury through fish not only impacts people and health, it also impacts the economy. Whether it is through medical costs for toxic exposure, increased costs of production for polluting power plants, or overall decrease in earnings by individuals, methylmercury seeps through a country's economy and leeches valuable economic resources.

First, methylmercury poisoning creates expensive medical costs. According to the Electronic Library of Construction Occupational Safety and Health, effects of poisoning can appear gradually. The symptoms in adults include shaking hands, eyelids, lips, tongue, jaw, headaches, trouble sleeping, memory loss, irritability, and loss of intelligence. People seen with these symptoms need to be tested for mercury poisoning with a focus mainly on the brain and nervous system. Treatment can consist of medication used to pull mercury out of the body through fluids. Some injuries can be permanent and thus costs from permanent neurological effects can be high including: medications, and therapy (Mercury).

On another level, economic costs from methylmercury are seen in the increased costs of production of businesses that must cut their pollution output. Since power plant emissions release a large amount of mercury into the air which then condenses into soil and contributes the methylmercury concentration in fish, it is a source that needs regulating. On that note, it is
expensive for plants to invest in new technologies to cut the emissions they release. In January 2003, the U.S. environmental agency proposed reversing strict controls on emissions, through the “Clear Skies Act”. The act, however, failed as it would slow the progress of reducing mercury levels in the atmosphere. It would have, however stimulated the economy by reducing power plant costs, and thus power costs to consumers (Trasande). Based on regulations, the economy see the impact whether through the businesses pay higher costs for technology, or people get sick and medical costs result.

In relation to cost, a third economic cost results from an individual’s decrease in overall earnings based on a loss in IQ from mercury poisoning. From a study based on the Environmental Health Perspectives, research showed that based on decreases in IQ people were expected to earn less income over their lifetime. Economically, a decrease in income will lead to less economic growth because it is less income an individual can spend in the economy as a consumer. The ehp developed a formula to find the economic costs for the effects of methylmercury. The formula uses an EAF or environmentally attributable fraction. The researchers used the Institute of Medicine’s approach to using the EAF, it assesses the fractional contribution of the environment to causation of an illness. The actual value for an EAF is determined as the percentage of the diseases category that taking away the environmental risk factors would eliminate. The entire formula goes as follows:

Costs = disease rate × EAF × population size × cost per case

By using this formula the researchers at ehp, estimated that in the year 2000, the total cost of the decrease in IQ from methylmercury exposure resulted in $8.7 billion dollars. The results are based off their sample they pulled and a finding of about 320,000 to 640,000 babies born with
umbilical cord-mercury blood levels higher than the value of 5.8μg/L—the value at which IQ begins to decline from methylmercury exposure. Below, the map shows the differences in average concentration of mercury in people’s blood in the United States (Economic). Conclusively, these high results prove that an economic problem exists related to loss of IQ from exposure.

In all, since medical costs continue to rise across the world, economic cost of medicine for poisoned people hurts consumers. Businesses feel the punch by increased regulations on their emissions. Similarly, consumers also feel the regulation costs through power bills. Finally, our society and economy as a whole gets stung from mercury poisoning by a decreases in the amount of money earned and spent in the economy, from a drop in IQ points for children born with high levels of exposure. From these three costs, the economy quivers with negativity, from methylmercury.

**Policy: Government Intervention**

First of all, since mercury poses a problem for fish consumers, it becomes a food safety issue. This makes it an issue even outside of just environmental protection. For an extensive period of time coal has been a terrific source for energy in our ever-growing world. In the United States alone coal serves as a major source of energy for power plants specifically. When power plants burn coal to utilize the energy stored in the fossil fuel mercury is released. It is important to remember that mercury is a quicksilver—a metal that is liquid at room temperature.
Furthermore, when humans intake high concentrations of mercury the metal can destroy neurological functions. The following picture from the EPA depicts the amount of pollutants in the air that are produced by power plants. We can see that plants produce 50% of the mercury in our atmosphere. This risk creates an issue that the government must regulate to protect people.

One action the government took to ensure protection from mercury is the Mercury and Air Toxic Standards (MATS), set up in December 2011. In these standards the Environmental Protection Agency (EPA) works to limit emissions from coal fired power plants (Coal). The MATS set two separate standards for mercury emissions. One, for older plants with less technology, emissions have to be limited to 0.013 pounds/Gigawatt-hour, as of 2013. Second, the standards also call for all new power plants to limit emissions to a later adjusted value of 0.003 pounds/gigawatt-hour, compared to the original limit of 0.0002 pounds/gigawatt-hour (Coal). When the standards were released power plants were outraged. Based on the article the technology to cut emissions would cost U.S. power plants $9.6 billion a year. While this seems like a huge sum, the cut down in emissions would result in benefits from decreased costs in healthcare, and heightened expected lifetime earnings for the average number of people affected by mercury each year. This benefit sum would range close to $37 billion, starting in 2016—the year after the MATS have to be applied (Coal). Below is a picture of a typical coal power plant’s process of limiting emissions using Sorbent Injection Additive methods (About). Midwest Energy Emissions Corp. is a company that manufactures
products specifically designed for power plants. Their products are a line of mercury capture systems that help plants achieve the limits on emissions set by the EPA’s MATS standards.

Another big influence the government has imposed to help control mercury emissions falls under the Clean Air Act. According to the EPA’s website, when the act was amended in 1990, the administration was given power to regulate mercury emissions from power plants. Based on the study completed by the EPA 75 tons of mercury was found in the coal used by power plants to produce energy. Through production it was found that two thirds of this mercury
evaporates into the air; that is fifty tons a year. Under the Clean Air Interstate Rule the government further regulates power plant emissions of toxins. It is important to remember that in the long run, our U.S. economy as well as the global economy suffers more from the side-effects of high mercury emissions, than from the direct costs for pollution control. This was the largest air pollution restricting legislation as of 2008(Controlling). Projected statistics from the EPA estimate annual economic benefits beginning in 2015 of $85 to $100 billion in health benefits. This sum is a substantial economic weight lifted simply by reducing the emissions of pollutants in our atmosphere.

Overall, since fifty percent of mercury found in our environment result from emissions from power plants and the burning of fossil fuels, government regulation can destroy the effects caused by methymercury exposure. Between the MATS standards, the Clean Air Act and the CAIR, methylmercury costs from healthcare, loss of economic stimulation due to less income from decreased IQ, and environmental costs could be near an end. Perhaps in the future the question of consuming fish could see much less consideration. Until then, “Bon Appetite”—just don’t pass the shark.
Works Cited


"Economic Evaluation of Health Consequences of Prenatal Methylmercury Exposure in France."


