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COMMUNITY-DIRECTED RISK ASSESSMENT OF MERCURY EXPOSURE: GOLD MINING, FISH, AND UNSUSPECTED ETHYLMERCURY

The interesting paper by Peplow and Augustine (1) addressed an issue important to Amazonian populations: self-diagnosis of environmental and public health problems. The case of the Kwakoegron community of Maroons is particularly interesting because of their awareness of research needs, health priorities, and need for risk assessment programs regarding mercury (Hg) contamination. Based on the research results (and understanding the hair Hg numbers), the villagers "proposed an intervention plan contemplating: (1) routine analysis of Hg exposure to monitor trends and track the effects of exposure-reduction efforts; (2) routine health assessments to determine the effects of Hg exposure, particularly in children less than 5 years of age; and (3) fish advisories based on fish biology and trophic level.…"

I fully agree with the paper's conclusions in the specific confine of their objectives, but I would like to share a broader perspective of issues related to Hg exposure, fish consumption, and alluvial gold mining. For subsistence, fish is a central dietary item of Amazonian villagers (which might be the case with the Kwakoegrons) and, regardless of gold mining activities, they bioconcentrate methylmercury as a secondary constituent (2). The Kwakoegrons' mean hair Hg concentration (4.41 $\mu g \cdot g^{-1}$) denotes regular fish consumption that is much lower than the mean reported for neighboring Rio Negro riverines (3), who are without neurological problems and eat fish from waters with no history of gold mining activity. Although Peplow and Augustine's paper clearly discussed how Hg gets in fish, there is evidence that Hg released from gold amalgamation is only a tiny fraction of the natural Hg in Amazon soil (4). Furthermore, there are no significant differences in mean fish Hg concentration in rivers with and without gold mining activities (5). Actually, the Hg methylation activity (necessary for Hg to gain access to the aquatic food web) explained by Peplow and Augustine is disrupted during river bank dismounting or bottom-sediment scarification (by dredges) commonly applied in alluvial gold extraction in Amazon rivers.

I do not dispute the research findings of neurobehavioral tests in Amazonian fish eaters (the one reporting significant alterations and those showing no effect of fish Hg and not referred to in the paper), but it is important to note that neuropathies associated with food and nutrition in the last two decades have not implicated fish-eating habits (6).

The largest neuropathy outbreak in Cuba was associated with poor nutrition, and endemic TAN (tropical ataxic neuropathy also known as "konzo") is associated with unprocessed cassava cyanogens (6). It should be noted that TAN has never been diagnosed in the Amazon, perhaps because fish provide the necessary sulfur-containing amino acids fundamental in detoxifying excess cyanogens in daily cassava consumption.

Peplow and Augustine covered well the risk involved in Hg exposure during early life, especially the vulnerability of young children (< 1 y of age) when the blood–brain barrier is not fully developed and the complicating factors associated with neurodevelopment are manifested several years after exposure. In this respect, the first line of Hg (ethylmercury) exposure is the use of thimerosal-containing vaccines (7), not direct consumption of fish. Currently, this type of vaccine (because of its low cost) is used only in underdeveloped countries and I suppose that might be the case in Suriname. It will not be long before thimerosal-containing vaccine and early exposure to injected ethylmercury become an issue in Central and South America.

Concerned scientists are interested in the issues discussed by Peplow and Augustine. However, I question whether the complexity involving methylmercury transport in the aquatic food web (and wild fishing choices) and Hg exposure that includes maternal milk of fish-eating mothers and preservatives like thimerosal (used in vaccines) is sufficiently discernible by villagers to distinguish the hazardous forms of Hg (inorganic, fish methylmercury, and injected ethylmercury) exposure and dosage. Instead of concern for environmental issues, we could inadvertently instill alarm about Hg and disrupt subsistence fish eating, breastfeeding, and immunization programs.

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REPLY:

The capacity of scientists to contribute to the resolution of a problem with societal dimensions is negated when highly credentialed and well-respected experts bolster conflicting political and social positions. Dr. Dórea's argument that fish-eating communities in Suriname are not susceptible to the neurobehavioral effects of mercury exposure is an example. On the other side of the argument are equally credentialed and well-respected experts who argue there is no lower threshold to mercury toxicity (1). Grandjean and Kjellstrom and colleagues reported that developmental effects become apparent at levels of approximately one part per million of mercury in hair, or 5.8 µg/L in cord blood (2–4).

The argument that the estimated 30–60 tons of mercury being discharged into the environment each year by mining in Suriname is "only a tiny fraction of the natural mercury that occurs in soil" is another case in point. The release of mercury from natural sources in soil remains about the same over time (5), whereas mercury concentrations in the environment are increasing: this increase is ascribed to mining (6).

Also, the expectation that social or political solutions to a health problem with technical and scientific dimensions can or should be based on scientific consensus is unreasonable. In the case of highly complex and comprehensive social issues, scientific consensus is rarely achieved on an adequate timescale.

The question here is one of "specialized knowledge" when scientists argue that only scientific experts can make wise decisions. The fact is scientific knowledge can only guide, not dictate, societal decisions. It is our opinion that the mercury controversy has little to do with science and everything to do with an ethical and political debate over the allocation of resources, their extraction, and their effects on indigenous communities.

In general, Dr. Dórea argues against involving indigenous people in the resolution of the prob-

lem of risk from mercury exposure based on the assertion that the complexity is "not discernible by villagers." Indigenous communities argue that the unique cosmology of forest people, who do not see a clear-cut distinction between the sphere of nature and the sphere of society, is not discernible to Western scientists. Scientists face a huge credibility problem with indigenous peoples because of this position.

This problem is commonly framed entirely in the negative, with indigenous individuals and communities and organizations experiencing scientific research and development as something done by scientists to indigenous peoples. Indigenous leaders no longer want to be the objects of research. The community-driven approach that we described in our paper referenced by Dr. Dórea changes that perspective. It reframes research, development, and the solution to problems as positive. It affirms scientists as experts and indigenous people as equals.

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