

Features

Mercury Research Bears Fruit in the Amazon

Kelly Haggart

In a small village beside a river in the heart of the Brazilian Amazon, 26 women keep a conscientious daily record of everything they eat for a year. They also let their hair grow. By the end of the year, they have produced detailed food diaries and long strands of hair for the Brazilian and Canadian scientists investigating high levels of toxic mercury in the region.

The women provide so much information through their enthusiastic record-keeping and hair-growing that it takes Brazilian doctoral student Carlos Passos six months to enter it all into a database. But when the results are analyzed, the researchers are intrigued by a finding of potentially wide importance: Fruit consumption has influenced mercury levels in the women's hair. Could fruit turn out to offer some protection from the mercury contaminating the fish that they eat?

"Hair grows at the rate of about a centimetre a month," says biologist Donna Mergler, emeritus professor at the Université du Québec à Montréal who has studied toxins such as mercury for 40 years. "So we cut the strands of hair into centimetres and examined the relationship between what the women had eaten and their mercury levels. And we found that those who ate more fruit had less mercury, for the same amount of fish.

"This was very exciting, and it was a new finding that we could not have found without the participation of the women of the village. There's no way a scientist can get data like that any other way," she says. "And it's obviously a very important finding, not only for the Amazon but for everywhere, if we can find the mechanism."

Her fellow mercury researcher Marc

Lucotte, a biogeochemist who heads UQAM's Institute of Environmental Sciences, also credits the unflagging food diarists for the success of the study. "This formidable database is absolutely extraordinary, and has helped us draw the conclusions that we've drawn," he says. "It would have cost us a lot of money to do this ourselves, to go from one family to the next and make sure we knew what they were eating."



Members of a family are cleaning fish for their own consumption.

Halfway through the year, Elizete Gaspar, a Brazilian graduate student working with Dr. Mergler on the food survey, asked the women if they had wearied of the effort. They insisted they enjoyed it, that gathering at 4 p.m. every day at the health clinic had become a pleasant social event. They ticked off items on a checklist and then wrote in details, such as which of the 40 local fish species they had eaten in the past 24 hours. The village midwife discussed their entries with them, and helped those who had difficulty writing complete the form.

"And the women told Elizete," Dr. Mergler recalls, "that 'doing this also makes us realize the relationship between the food that we eat and our health. So no, no! We want to continue!'"

On the Mercury Trail

It was the connection between food, health, and the environment that first brought researchers to the village of Brasília Legal in the early 1990s. Scientists from UQAM teamed up with counterparts from the Universidade Federal do Pará to investigate the source of mercury contaminating the Tapajós River, a major tributary of the Amazon in northern Brazil.

The hundreds of thousands of small-scale miners who converged on the area after a gold rush began in the late 1970s were thought to be the chief culprits. These garimpeiros use mercury, which combines easily with other metals, to extract gold from river sediment. But for every kilogram of gold obtained, the process releases into the environment an estimated kilogram of mercury, one of the most poisonous natural substances on earth.

The researchers trundled up and down the river in boats that became their temporary homes and field labs, testing mercury levels in soil, river sediment, water, and fish. They were startled to discover that mercury levels were relatively constant along the river, even hundreds of kilometres downstream of the main gold-panning areas. This evidence led them to identify another, even bigger cause for concern: "slash and burn" agricultural practices that were causing widespread erosion. As new settlers streamed into the region, the rainforest was being cleared for pasture and farmland at a rapid rate. Tropical downpours washed topsoil from the newly deforested land into rivers, eroded riverbanks — and unleashed terrestrial mercury on a massive scale.

Mercury in soil is usually harmless,

PHOTO: FRÉDÉRIC MERTEINS, THE INTERNATIONAL DEVELOPMENT RESEARCH CENTRE



Passos CJ, Sampaio da Silva D, Mergler D, Mertens F, Guimarães JRD, Saint-Charles J, Lucotte M, Lemire M, Fillion M, Farella N, Davidson R (2005) O mercúrio no Tapajós. Gráfica Brasil.

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because most plants can't absorb it, but it becomes hazardous once it enters aquatic systems. "Tropical soils contain very high levels of natural mercury," Dr. Lucotte explains, "but when you cut down the forest, this mercury is released into the river. Then it's transformed by bacteria in the water into what we call a "bioavailable" form, which gets into the food chain." Fish take up some of this methylmercury, as this most toxic form of the element is called, through eating plankton. However, it is the carnivores, the fish who eat other fish, who are most contaminated as the mercury travels up the food chain.

Canada's International Development Research Centre, a Crown corporation that supports research in developing countries, began funding the Tapajós mercury studies in 1994. Thus began a long-running project called Caruso, which expanded beyond Brasília Legal and spawned numerous offshoots as it evolved over the years. It drew in researchers from a variety of disciplines and from other institutes,

including the Biodôme de Montréal and the Universidade do Rio de Janeiro. It also provided a rich training ground for a sizable number of Brazilian and Canadian graduate students, more than half of whom have been women.

"People are sensible"

None of the residents of Brasília Legal were showing signs of severe exposure to mercury, which attacks the nervous system and brain, and can be fatal. However, the researchers were taken aback to find that villagers with hair mercury levels of 15 parts per million (ppm) did exhibit early symptoms of mercury poisoning, such as problems with co-ordination, manual dexterity, and vision. This was well below the 50 ppm deemed safe by the World Health Organization, suggesting that mercury could damage health even below this internationally accepted threshold.

In studying the mercury content of the local fish, the researchers found that

predatory species were much more contaminated than plant-eating varieties. The villagers were involved from the outset in seeking solutions. At a community workshop, a suitably positive slogan for a fish-dependent population was worked out: "Eat more fish that don't eat other fish." Villagers also felt posters would help spread the message. Three white fish were displayed against a red, a yellow, and a green background to represent the descending order of hazard. (Later, a cartoon booklet would also prove effective in communicating the message.) The "red" category contained the predatory fish best eaten infrequently, while the "green" group included herbivores that could be consumed 10 times as often as carnivores. "Fish don't have the amount of mercury stamped on their forehead, so this allowed a notion of quantity that was helpful," Dr. Mergler says.

The results were spectacular. In 1995, the researchers tested the mercury levels of 47 people and recorded their fish con-

sumption for the previous week. When the same people were tested five years later, they were eating the same quantity of fish as before but their mercury levels had fallen by 40%. "People are sensible," Dr. Mergler says. "It shows that when people are part of a research project, they can appreciate the findings."

Soon afterward, the 26 women who kept the year-long food diaries brought to light the potential importance of including fruit in the mix. The same finding was confirmed in a larger-scale study in the region undertaken by Carlos Passos, who is now doing post-doctoral research into the possible reasons. More research on fruit and mercury needs to be done, and in other parts of the world as well, before a protective effect can be clearly established and declared universally valid.

The Invisible Power of Women

Women were key in communicating the crucial message about modifying fish consumption, both to their families and other villagers. For a start, they tended to be less skeptical than men about the threat posed by mercury. Women also made most family food decisions and were at the centre of most social webs in the village. The researchers found that the real focal points in the village — the "opinion leaders" whose views carried the most weight on important matters pertaining to health and environmental degradation — were often women, rather than the official village chief or local priest one might have expected. In her PhD thesis, Elizete Gaspar calls this "the invisible power of women."

UQAM communications professor Johanne Saint-Charles worked on an exhaustive study of village "discussion networks" in collaboration with Frédéric Mertens of the Universidade de Brasília. Already a biology professor, Dr. Mertens had become so fascinated by social networks that he decided to focus on them in doing a second PhD. The researchers charted the communications pathways linking the 158 adult residents of Brasília Legal, which had a total population of 544. They mapped who talked to whom about mercury, fish, and health, later expanding the study to five other villages.

They found that men mostly talked to other men, and women to other women, about these issues. But the men who did list their wives as being among their "discussion partners" were the ones who actually changed their fish-eating habits. "Those wives were also the women who had more education," Dr. Saint-Charles says. "In Amazonia, this means that they had some high school." For women, the correlation between power and education is found almost everywhere in the world, she says, though the same does not hold true for men.

The researchers also found that women act as intermediaries, allowing different groups to communicate with one another, especially about eating habits. Even in a small community, factors such as work and socioeconomic status, location in the village, and religious affiliation had created distinct "discussion networks." More often than not, women were at the hub of the networks, and provided links to other groups.

Among men, the "opinion leaders" on the mercury issue were those who earned a living from fishing. Among women, teachers and health workers were especially influential, particularly the village midwife. "She gets to know all the women and has access to most of the houses," Dr. Saint-Charles says. "And since medical help is far — it's not easy to get to the nearest town — she has a lot of influence in the community."

Other women whose views were widely respected included those who grew medicinal plants in their backyards. "People go and ask for those — a lot of trading of plants goes on in the community," says Dr. Saint-Charles, who for the past year has headed a centre based at UQAM known by the acronym CIN-BIOSE. (Co-founded 20 years ago by Dr. Mergler, the Centre for Interdisciplinary Research on Biology, Health and the Environment specializes in training women scientists. "We don't specifically study gender," Dr. Saint-Charles says, "but gender is part of whatever we study.")

From science to action

The dazzling successes of the Caruso

project also brought home its limitations, Dr. Lucotte says. "I was so frustrated to be doing all this nice work in one village of 500 people, when all around the system was collapsing. In the 15 years I've been working in the Amazon, I've seen so much degradation, so much virgin forest cut down, so many more poor people living there. It was extremely frustrating to see that we could do great things, but with a limited number of people."

He was also frustrated not to be tackling mercury problems at home in Canada with the same comprehensive, interdisciplinary approach. He finally did get that chance when he received funding to investigate mercury contamination in four Canadian communities, in Quebec, New Brunswick, and Labrador. This recently completed five-year project was done under the auspices of the Collaborative Mercury Research Network (COMERN), which Dr. Lucotte leads, drawing on lessons learned in the Amazon. In three of the four case studies in Canada, he says, "we were pleased to find virtually no problem with mercury." However, he does advise recreational fishers in Abitibi, Quebec, to moderate their consumption of the big predatory fish they like to catch in the summer, which expose them to high levels of mercury.

Earlier this year, the researchers learned that their work in the Amazon can continue to evolve, thanks to a new Canadian fund supporting global health research, which is administered by IDRC. Dr. Lucotte is the lead Canadian researcher in a Brazilian-Canadian team that has received one of the first Teasdale-Corti grants, worth \$1.6 million over four years. In a program called "Poor Land Use, Poor Health," they will work with communities throughout the Tapajós watershed to get to the root of the mercury problem by encouraging land uses that promote reforestation. Dr. Lucotte enthuses about this opportunity "to go from science to action, and not only to witness the degradation of the land and say, 'The mercury in your fish comes from cutting down your forest,' but to be able to say, 'Why don't we plant some useful trees, which will also keep the mer-

cury in the soil from leaching into the aquatic system?”

The new program also seeks to combat Chagas disease, a debilitating and sometimes fatal illness that affects 16 million to 18 million people in Latin America. The disease is transmitted by an insect that reproduces in palm trees, which are one of the first trees to grow back after tropical forests have been cleared by burning. Although palm trees have many uses, providing cooking oil and roofing material, they are best kept at a distance from homes. Other varieties, which can provide fruit, nuts, or wood for canoes, can be planted more safely close to houses.

“The idea is to find good reasons for people not to destroy the forest,” Dr.

Lucotte says. “It should be a win-win situation: better health, less mercury, less Chagas disease, and more wealth now that they have these useful trees.” The researchers and villagers have a long list of species to choose from in this region of high biodiversity. One of the favoured trees may turn out to be the ingá, an indigenous species that produces a fruit that figured prominently in the food diaries kept by Brasília Legal’s 26 tireless volunteers.

“The first step now is to identify not only the communities to work with but also the key people in those communities, who will help us talk to other communities,” Dr. Lucotte says. “It’s almost a caricature, but it’s true: Women talk more than men. It’s interesting that in all our social networks, we always identify more

women than men who are ‘opinion leaders.’ So probably, once again, women will play a very important role.” ❧

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Further Reading and Resources:

CARUSO: www.unites.uqam.ca/gmf/caruso/caruso.htm

COMERN: www.unites.uqam.ca/comern

CINBIOSE: www.cinbiose.uqam.ca

IDRC: www.idrc.ca

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