

Health in the Arctic Circle

High levels of toxic contaminants have been recorded in several Arctic regions. But the full health effects of exposure to these chemicals are only just emerging. Paul Webster meets the scientists studying the Arctic Circle, and finds that evidence of ill-health among Inuit communities is growing.

After decades probing links between toxic chemical contamination in the Canadian Arctic and health effects on the Inuit who live there, toxicologist Eric Dewailly has finally got an opportunity to confirm his theories. Aboard the ice-breaker *Amundsen*, commissioned by the Canadian government to probe toxic contamination in the Arctic, Dewailly's team gained unprecedented access to many of the world's remotest Inuit villages, where diets heavily depend on local animals, fish, and marine mammals.

With atmospheric and ocean currents pushing high levels of toxic contaminants—including agricultural pesticides, mercury from smokestacks, and industrial chemicals—steadily northward, Dewailly and collaborators have found record levels of contamination in numerous Arctic hotspots. These toxins have been linked to neurological, developmental, and physical defects, especially in children, triggering alarm among 4 million or so people that live around the circumpolar world.

The findings have spurred Canadian, Danish, and US health-research agencies to fund international collaborations to investigate the problem. "The big question for Arctic health researchers now is what health effects such high levels of contamination are having on Arctic people", says Dewailly, who is based at the University of Laval, in Quebec City.

In a 1993 study, which paved the way for a major expansion in related research, Dewailly found a statistically significant association between exposure to polychlorinated biphenyls (PCBs), a family of now-banned compounds used as electrical insulators until the mid-1970s, and male newborn

length. 3 years ago, he linked maternal exposure to PCBs and the pesticides DDE and DDT to immune-system damage among 199 1-year-old children in the three largest Inuit communities along the coast of Hudson's Bay in Nunavik, Quebec's Arctic region. "We concluded the contamination could be a risk factor for acute otitis media in Inuit infants", says Dewailly.

Since then, he has studied early infections in 700 5-year-olds and found evidence to support his previous findings. "These data suggest the association is stronger than we first thought", he adds.

As the *Amundsen* followed its path into the famed Northwest Passage last fall, Dewailly and his team were able to extend their investigations in several new directions, including the measurement of cardiac health, long considered a vital marker for contamination effects. "We want to see if we can replicate observations from Finland that blood pressure is responsive to mercury exposure", says Dewailly, "and to check whether cardiac variability is a good marker of contamination effects among Inuit children."

Child psychologist Gina Muckle accompanied Dewailly on the *Amundsen* to assess neurobehavioural effects. Her previous work on the cohort of 1-year-old children in whom Dewailly observed immune-system damage identified significant associations between lead exposure and reaction speed, tremors, and body sway. Muckle says her work showed for the first time that PCB exposure was linked to subtle abnormalities in body posture and balance.

The ship travelled down the mountainous coast of Arctic Quebec's

Ungava Bay gathering data from people in Inuit villages for a large study aimed at identifying the possible effects on 300 9-year-old children whose mothers' blood showed high toxic contamination during pregnancy. "Previous studies show these contaminants will trigger emotional and developmental effects", explains Muckle. "We'll see if we can replicate those effects."

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Inuit children are showing the effects of maternal exposure to contaminants

The attention aboard the *Amundsen* to neurodevelopmental effects on Inuit children follows a series of recent studies of Nordic people on the Faroe Islands between Scotland and Iceland. These studies linked 878 pregnant women's consumption of pilot whale meat and consequent high exposure to methylmercury—a contaminant found in the natural environment and emitted in incinerator and coal-burning electrical-station smokestacks—both to their children's heart weaknesses and to their delayed brain reactions to audio signals.

Investigator Pal Weihe at the Faroese Hospital System's occupational health department concluded that because

the children were studied at age 14 years, some of the neurotoxic effects from intrauterine methylmercury exposure are irreversible.

Levels of PCBs in the blood of pregnant Faroese women have been calculated to be as much as four times higher than those in other studies of PCB impacts on human neurodevelopment conducted in the USA, Holland, Germany, and Quebec. But Arctic Canada and the Faroe Islands are not the only northern regions home to heavy human contamination.

In a recent comparative analysis of concentrations of 14 types of PCBs and 13 pesticides in maternal blood produced for the Arctic Monitoring Assessment Program (AMAP), an Oslo-based initiative of the Arctic Council, a treaty organisation including Canada, Denmark, Iceland, Finland, Norway, Russia, Sweden, and the USA. Inuit mothers on the west coast of Greenland showed the Arctic's highest contamination with PCBs and many pesticides.

A forthcoming study of the role of various PCB types as risk factors for osteoporotic fractures among menstruating and menopausal Inuit women in Greenland, again led by researchers at Laval University, found they are almost three times more prone to bone fractures than Caucasian women in Quebec.

Henning Sloth Peterson, a family physician in Nuuk, Greenland's capital, coordinates AMAP research—including work for the Laval and Aarhus research groups—across the vast country. The job takes him across most regions of Greenland twice a year, travelling by plane, ship, snowmobile, and dogsled. "It's a very exciting way to do science", he says. He has travelled with Inuit hunters and has close contact with local people in the most remote areas; he says the enthusiasm of the communities to help with his research is amazing. "The high participation rates make the research findings all the more valid", he notes.

The Arctic dilemma

Jens Hansen, a researcher at the University of Aarhus who heads AMAP's Human Health Effect Monitoring Program, says the accumulation of evidence implicating local food in human health effects in many northern regions has created an "Arctic dilemma" for communities dependent on hunting and fishing for food. "Our conclusion at the moment is that contaminant exposure for Arctic people is at the levels where we are seeing effects", he says. "But we also know that traditional foods deliver significant health and cultural benefits. The dilemma is whether to recommend people begin altering their diets." Hansen notes that between 80% and 100% of Greenlanders are over the WHO threshold for daily mercury intake.

With northern research programmes and numerous human-effect observations well-established in the Faroes, Greenland, and Canada, attention has turned in recent years to Russia, the largest Arctic nation. A 5-year AMAP study funded by the Global Environmental Facility recently surveyed human and environmental exposure to hexachlorobenzene (HCB), hexachlorocyclohexane (HCH), dioxins, DDT, PCBs, oxychlorodane, toxaphene, mirex, mercury, cadmium, lead, and brominated flame retardants across the entire Russian Arctic.

Study leader Valery Chashchin of the Northwest Public Health Research Centre in St Petersburg says the Chukchi people on the coast of the Chukotka region, adjacent to Alaska in Russia's far eastern Arctic, showed the heaviest contamination, a finding in keeping with work underway in Alaska probing the high contamination levels in the Aleutian and other island communities westward across the Bering Sea.

In Chukotka, about 5% of the population have some of the highest PCB contamination levels ever seen, and breast-milk concentrations of the insecticide HCH and the fungicide HCB

were 30 and five times higher, respectively, than in Arctic Canada, says Chashchin. Both chemicals were used in indigenous people's homes in the past, and PCBs were indiscriminately dumped along Russia's Arctic coasts.

Chashchin says comparisons of contamination data with information reported in health interviews suggests that exposure to some contaminants may be linked to reproductive effects such as stillbirths, birth defects, low birthweight, and spontaneous abortions.

The AMAP study also noted an apparent association between reduced numbers of male births and increases in Arctic maternal blood concentrations of lead and some types of PCBs.

Study co-author Jon Øyvind Odland of the Institute of Community Medicine at the University of Tromsø in Norway says a re-evaluation of an enlarged dataset from AMAP's Russian study is underway, and although the data is still under evaluation, evidence of a changed sex ratio, possibly related to PCB exposure, is growing.

In Moscow, Mikhail Todyshev, vice president of the Russian Association of Indigenous Persons of the North, says Soviet-era medical and social services have collapsed in the Russian Arctic, making the risks from contaminant exposure all the more acute. "There is no funding within Russia to even monitor contamination", worries Todyshev. "Implementing strategies to avoid further exposure through substitute food, and environmental cleanup, is out of the question."

That's an assessment Jens Hansen of AMAP's Human Health sadly agrees with. "In most of the affected countries, the Arctic dilemma—whether or not to recommend Arctic indigenous people move away from their traditional diets—is discussable. In the Russian Arctic, it's not. To survive, people there have no choice but to eat the food they can catch."

Paul Webster