

Mercury Screening for At-Risk Populations

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ABSTRACT

This article discusses the risks associated with mercury exposure, particularly focusing on at-risk populations in Canada, such as those living in remote areas, individuals living near toxic spills, and those who rely on fish consumption year-round. It underlines the detrimental health effects of mercury exposure, including liver and kidney damage, neurological changes, and developmental issues. The lack of awareness and screening for elevated mercury levels is identified as a significant issue along with the need for greater education regarding possible exposures to mercury. A screening pathway is proposed to aid primary care providers in identifying individuals at risk of elevated mercury levels, with the aim of preventing long-term health complications. Overall, the paper highlights the importance of proactive measures to mitigate mercury exposure and safeguard public health.

Key Words Mercury exposure, mercury poisoning, screening for mercury

Specific populations across Canada have a higher risk of being exposed to mercury depending on where they live.¹ Some at-risk populations may include individuals who rely on fish as a main food source and live near mines or areas with high industrial pollution.² Mercury is a naturally occurring toxin that bioaccumulates and biomagnifies within its host.³ In the context of toxicity to humans, we are looking at organic mercury, specifically methyl mercury, which is a result of the transformation of inorganic mercury by aquatic life.³ Mercury emissions can be transported through land and water processes, which significantly impacts the level of exposure populations may have.² High mercury levels are becoming more prevalent in Canada, specifically in remote areas due to the increase in industrialization and the growing release of mercury from anthropogenic sources.^{1,2} Elevated mercury levels have consequential health impacts, including liver and kidney damage if exposed over the long term.³ In Canada, Indigenous populations have higher rates of chronic kidney disease and kidney failure, which can be further exacerbated by mercury exposure.⁴ Elevated levels of mercury can also cause neurological changes, such as neuromuscular alterations, memory loss, and thyroid disorders.⁵ Many individuals with mercury exposure have suffered from Minamata's disease evidenced by auditory and vision changes, numbness, and weakness.³ In Japan, there was a mercury poisoning incident where exposed individuals suffered from Minamata's disease, long-term psychiatric symptoms including impaired mood and behavioural

issues, as well as fetuses that presented with cerebral palsy-like symptoms.² Chronically elevated mercury levels, even moderately elevated, can significantly impair one's mental health.⁶ Elevated mercury during pregnancy is also detrimental and has been associated with microcephaly, blindness, and other physical disabilities in fetuses.⁵

Health Canada directed a biomonitoring screening program with Indigenous populations which showed significantly high levels of mercury.⁷ Obtaining more information on mercury levels in Canadians was recommended to serve as an indication of potential exposure, as well as surveying demographics and socioeconomic information regarding fish consumption.⁸ Health Canada¹ also reviewed mercury levels in the general public in 2016, which showed less than the acceptable levels of mercury. The participation of the general public creates a gap in knowledge surrounding those who may be more prone to elevated levels, such as those who live around mercury-polluted sites or those who consume fish year-round. Not only is there a lack of recent data on mercury levels in Canadians, but primary care providers (PCPs) are often not familiar with screening and testing for elevated mercury. In a study conducted in 2023, 82% of PCPs never ordered blood work on mercury levels.⁹ Another significant result from this study is that no healthcare provider who participated in the survey is confident with analyzing elevated mercury levels.⁹ The purpose of this paper is to provide insight into the importance of screening for potentially elevated mercury in the population that may be at risk.

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SIGNIFICANCE

A news article about the situation in Grassy Narrows First Nation sheds light on the severe repercussions of mercury exposure.¹⁰ The Grassy Narrows incident involved Indigenous individuals from Grassy Narrows and Wabaseemoong First Nations who were exposed to mercury waste dumped into the surrounding river system.¹⁰ Many individuals affected by these exposures exhibited symptoms consistent with Minamata's disease, including weakness, numbness, and sensory impairments.³ Tragically, in the aftermath of this crisis, there was a notable surge in suicides among adolescents and children in subsequent years.¹¹ A study conducted by Mergler and colleagues¹¹ delved into three generations—grandmothers, mothers, and children—to investigate potential links between mercury exposure and suicide. The findings of this study indicated a correlation between maternal, prenatal, and childhood mercury exposure and psychological distress. Furthermore, maternal fish consumption during pregnancy was identified as a significant contributor to behavioural patterns in children.¹¹ This emphasizes the enduring impact of mercury exposure across generations and underscores the urgent need for comprehensive measures to address its devastating consequences on mental health and well-being. In May 2024, a news article showed that mercury poisoning near Grassy Narrows is being further exacerbated by current industrial pollution.¹² Sulfate and organic matter from industrial waste have been found in the English-Wabigoon River.¹² Sulphate specifically worsens methyl mercury levels that are already present by feeding the bacteria that produce methyl mercury from inorganic forms in the environment.¹² This process displays secondary re-emission processes which involve redistributing mercury through environmental mechanisms.²

Many people residing in the Northern Ontario (NO) region regularly incorporate fish into their diets, with some considering it a fundamental aspect of their lifestyle.¹ Mercury, a toxic metal, accumulates within organisms over time, underlining the importance of considering the duration of fish consumption.^{3,12} There is a growing concern regarding the potential risks associated with prolonged or habitual exposure to mercury through fish consumption, particularly for fetal development.¹⁴ This concern is amplified in regions like NO, where many inhabitants rely heavily on fish as a primary food source throughout the year.¹⁵ The prevalence of elevated mercury levels is increasing across Canada, particularly in remote areas such as NO.¹

According to Health Canada,⁸ there is a recognized need for more comprehensive data on mercury levels in the Canadian population, which could serve as an indicator of potential exposure. This entails gathering demographic and socioeconomic information regarding fish consumption patterns. These recommendations underscore the importance of monitoring potentially elevated mercury levels, particularly among pregnant and breastfeeding individuals in NO. While various guidelines on fish consumption are accessible through reputable sources such as Canadian government websites, Food Guide Ontario, and the Guide to Eating Ontario Fish, it is crucial to acknowledge the variability of

mercury levels in fish across different lakes and species.¹⁶ There is therefore a need for continued research and vigilance in monitoring and regulating fish consumption to mitigate potential health risks, particularly in vulnerable populations like those in NO.

Health Canada has developed an equation for assessing exposure and determining acceptable fish intake. However, the primary sources of fish and data used for these calculations often do not encompass the popular fish species found in the inland lakes of NO.¹⁶ Mercury levels vary from lake to lake and among different fish species,¹ rendering reliance on generic fish consumption guidelines challenging. For instance, certain guidelines may present conflicting information regarding mercury levels in specific fish, depending on their geographical origin.

The mercury content in particular fish species from the Great Lakes may diverge from those in smaller lakes, even within the same species.¹⁶ While resources such as the Guide to Eating Ontario Fish¹ offer valuable insights, data gaps exist, particularly for lakes where information is not readily available. Several factors contribute to this data deficiency, including the vast number of lakes in Ontario, the financial constraints associated with surveying each lake, the logistical challenges of reaching remote locations, and the availability of qualified scientists. According to Health Canada,¹ a safe level of mercury within the human body is less than 20 µg/mL and for pregnant populations and those under 18 years of age, under 8 µg/mL is recommended. In New York, the health department suggests that a safe mercury level is under 5 µg/mL, and anything above must be reported to the health authorities.¹⁷ Expecting clinicians to possess expertise in the specific mercury levels of various lakes and fish species is unrealistic. Consequently, the onus of ensuring safe fish consumption falls upon the individuals consuming these sources. However, this task becomes exceedingly arduous when individuals lack access to resources for determining safety or when data on specific lakes or fish species is absent. Considering the myriad health benefits associated with consuming fish,⁵ and the cultural significance of fish consumption in certain communities, the healthcare system must prioritize measures for preventing high mercury exposure and supporting vulnerable populations in making informed dietary choices.

Mercury exposure, stemming from various sources including fish consumption, traditional subsistence living, and pollution, poses a significant risk to individuals, particularly in northern regions such as those inhabited by Canada's Indigenous populations.³ Factors contributing to heightened vulnerability in northern communities include their higher latitudinal positioning, heavy reliance on fish as a primary nutritional source, contamination of water bodies, and interconnected ecosystems.³ Prolonged mercury exposure can lead to detrimental effects on vital organs, as previously mentioned.³ This is particularly concerning for NO given the elevated risk factors for chronic kidney disease (CKD), diabetes, metabolic syndromes, mental health issues, and immune-mediated kidney diseases among Canadian Indigenous populations.⁴

Of notable concern is the rising incidence of kidney failure requiring dialysis among rural Indigenous populations, which correlates with the damaging impact of mercury exposure on

renal health.⁴ In pregnant individuals, mercury readily crosses the placenta, resulting in fetal exposure levels surpassing those of the mother.⁵ Excessive fetal mercury exposure has been linked to severe consequences¹³ such as microcephaly, blindness, and other physical disabilities.⁵ These findings underscore the critical need for proactive measures to mitigate mercury exposure in vulnerable populations, particularly in the antenatal and postpartum periods, to safeguard both maternal and fetal health.

A study conducted in 2023 revealed that a significant portion of healthcare professionals lacked familiarity with the Guide to Eating Ontario Fish, which is the sole guide to relevant mercury levels in fish in Ontario.⁹ Only 8% of respondents reported being very familiar with this resource. Another notable finding is that a significant majority of PCPs (82%) never ordered blood work for mercury levels. Interestingly, 86% of respondents never request mercury blood tests, with a mere 3.5% occasionally doing so. Moreover, 79% of PCPs admitted to having no confidence whatsoever in reading and interpreting mercury levels, while only three expressed some level of confidence. None of the surveyed PCPs reported feeling confident in analyzing elevated mercury levels. These PCPs clearly require more support, resources, and education.⁹

Several barriers were identified that hinder PCPs from ordering blood work for mercury levels, including uncertainty about when to order such tests and how to interpret the results, limited access to resources for blood drawing, concerns about exceeding their scope of practice, and the absence of recommendations prompting them to do so. An interesting observation from the data is that a common barrier to mercury screening is the lack of discussion surrounding the topic. Notably, the Ontario Perinatal Record features an extensive medical history questionnaire that includes a section on nutrition but does not specifically address fish consumption.¹⁸ In the 2023 survey, participants were asked to suggest educational resources that would aid in screening for and identifying elevated mercury levels. Recommendations included in-service training, lunch-and-learn sessions, handouts, the development of screening pathways or guidelines, medical directives for ordering mercury-level blood work, and webinars. These suggestions point to the need for enhanced education and awareness regarding mercury testing. Overall, while participants acknowledged the importance of mercury testing, they emphasized the necessity for greater education and awareness in this area. It must be noted that naturopathic doctors were not involved in this study, and further studies including them are warranted. Having said that, alongside midwives, physicians, and nurse practitioners, naturopathic doctors' laboratory requisitions are now covered through non-insured benefit plans.¹⁹ This concept is critical for the general public to be aware of, especially since many naturopathic doctors are the sole PCPs in rural locations.²⁰

The study conducted by the researchers in 2023 resulted in the creation of a pathway (Figure 1) for PCPs to use when screening for mercury levels in their perinatal population.^{9,21} It should be noted that safe fish consumption guides vary from province to province and are generally in English or French and in electronic format.¹ This causes more barriers for users who do not have access to the Internet, or who do not speak English or French, again disengaging

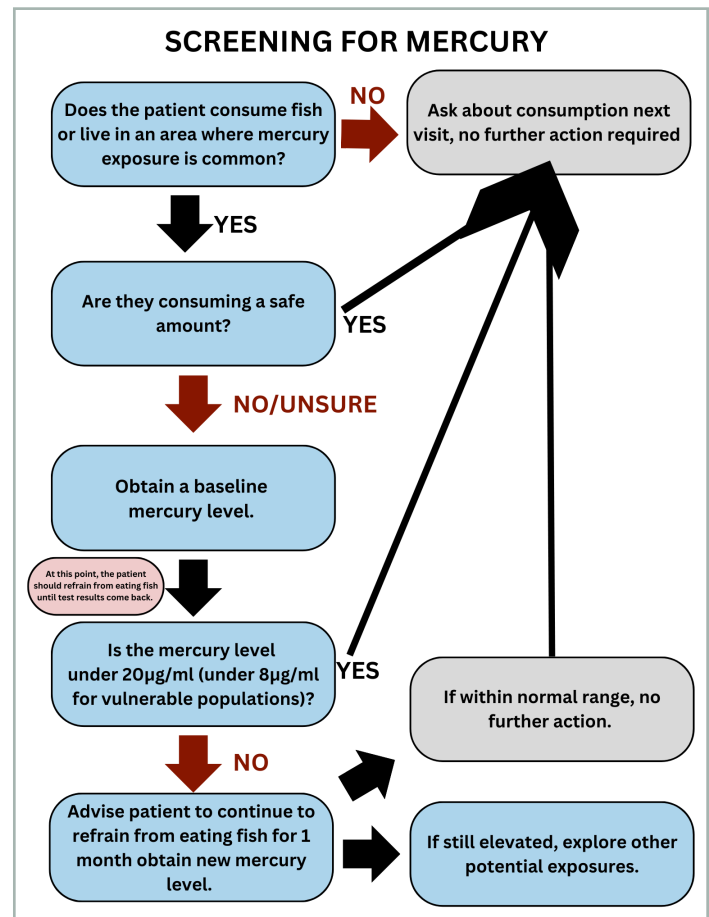


FIGURE 1 Mercury screening pathway.²¹

rural Indigenous communities. This puts pressure on PCPs to screen and educate their patients appropriately. Individuals should not be deterred from eating fish, as there are substantial benefits,⁵ especially in certain cultures. The healthcare system must therefore prioritize the prevention of high mercury levels and actively promote awareness to assist vulnerable individuals. In addition to this, advisories such as mercury-polluted waters or watersheds must be readily shared with those who live off the land or interact with such bodies of water. Lastly, the notion of randomly testing large numbers of people for mercury is unrealistic. Proper screening of individuals should be conducted, which can be done with a few questions as reiterated in the pathway (see Figure 1).²¹

CONCLUSION

Heightened mercury levels pose significant and enduring health risks to individuals. PCPs play a crucial role in monitoring and screening for this toxin, yet identified barriers hinder their effectiveness in doing so. The implementation of a screening pathway along with education can prevent long-term complications related to high exposure to mercury.

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CONFLICTS OF INTEREST DISCLOSURE

We have read and understood the *CAND Journal's* policy on conflicts of interest and declare that we have none.

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