

## Fish consumption in pregnancy and fetal risks of methylmercury toxicity

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### ABSTRACT

**QUESTION** Because I practise in a rural area with a large number of lakes, I have patients planning pregnancy who consume relatively large amounts of fish harvested by their families. What should be my advice to them?

**ANSWER** A recent Motherisk study has shown that fairly commonly these women's mercury levels exceed the threshold level for cognitive effects. Women should not consume excessive amounts of seafood in pregnancy (ie, no more than 2 weekly average size servings). Hair mercury level above 0.3 µg/g indicates a potentially excessive body burden.

### RÉSUMÉ

**QUESTION** Je pratique la médecine dans une région rurale où se trouvent beaucoup de lacs, et plusieurs de mes patientes qui planifient une grossesse consomment d'assez grandes quantités de poissons pêchés par les membres de leur famille. Quels conseils devrais-je leur donner?

**RÉPONSE** Une récente étude par Motherisk révèle qu'il est assez fréquent de trouver chez ces femmes des taux de mercure qui dépassent le seuil recommandé pour éviter des effets cognitifs. Les femmes ne devraient pas consommer des quantités excessives de poissons durant la grossesse (c.-à-d. pas plus de 2 portions moyennes par semaine). Un taux de mercure capillaire de plus de 0,3µg/g indique une charge corporelle potentiellement excessive.

Fish and other forms of seafood are important components of healthy diets.<sup>1</sup> Fish consumption is particularly advantageous for pregnant women because it contains relatively high concentrations of ω-3 polyunsaturated fatty acids not commonly found in other foods, as well as proteins that are essential for the developing fetal brain.<sup>2-4</sup> The predominant drawback of fish consumption for expectant mothers is that some species of fish contain organic mercury at concentrations sufficient for high consumption to cause adverse developmental effects to the unborn child.<sup>5,6</sup> Methylmercury, the form of environmental mercury most detrimental to humans, is produced from inorganic mercury by the action of anaerobic organisms that live in aquatic environments.<sup>7</sup> Because fish have limited ability to eliminate this contaminant, methylmercury bioaccumulates at highest concentrations in muscle of large and old predatory fish.<sup>8</sup>

### Key studies

The best evidence for methylmercury toxicity in the fetus comes from well-publicized incidents in Minamata, Japan,<sup>9-13</sup> and Iraq.<sup>14-17</sup> Using data collected after the Iraqi disaster, Clarkson and colleagues defined threshold toxicologic levels associated with severe adverse effects to the fetus as low as 10 µg/g in maternal hair.<sup>18</sup> We recently performed a systematic review of all relevant research on humans and the effects of prenatal mercury exposure through fish consumption on

neurodevelopment after fetal exposure, and have defined a lowest observable adverse effect level of hair mercury concentrations for adverse effects on child neurodevelopment resulting from fetal exposure.<sup>19</sup>

Maternal mercury content in hair was chosen as the biomarker for the extent (dose) of exposure to methylmercury because these values were reported by most studies, reflect longer exposure periods than do maternal whole blood values, and represent a less invasive method of sampling for concerned women who are planning to become pregnant. Overall, 48 articles met the inclusion criteria for our systematic review.<sup>19</sup> Of the 48 articles, 30 were of longitudinal and 18 were of cross-sectional design. Of the 30 longitudinal articles, 11 involved work done in the original Seychelles Child Development Nutrition Study conducted in the Seychelles. Eight articles were of studies conducted in the main Faroe Islands study and 2 were from the second Faroe Islands longitudinal study. Another 2 articles described a longitudinal study conducted in the United States. Finally, 2 of the included articles were of studies conducted in New Zealand and 2 were of studies done in Poland.

All 48 of the included studies evaluated the risk of prenatal methylmercury exposure on neurodevelopment. Of the 18 cross-sectional studies, 12 articles reported on



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adverse dose-dependent effects. Of the 9 longitudinal studies analyzed, 5 studies found a detectable effect of methylmercury on brain function of the children.

From a comprehensive review of the data, it was apparent that neurodevelopmental abnormalities occurred in children after a range of gestational exposures from maternal consumption of highly contaminated fish: maternal hair 0.3 to 12.7 µg/g, cord blood 0.75 to 25.7 µg/L, maternal blood 3.8 µg/L.<sup>19</sup>

Data from the National Health and Nutrition Examination Survey conducted in the United States between 1999 and 2000 show that consuming fish 1 to 2 times a month corresponds to a geometric mean total mercury concentration of 0.20 µg/g in hair and 1.05 µg/L in blood for women of reproductive age. Consumption of fish 3 or more times a month corresponds to a geometric mean mercury content of 0.38 µg/g in hair and 1.94 µg/L in blood. Avoiding fish consumption corresponded to a mean total mercury content of 0.11 µg/g in hair and 0.51 µg/L in blood.


The threshold of 0.3 µg/g of mercury in maternal hair was selected by us from all of the studies analyzed because in the cross-sectional studies there were different adverse neuropsychologic end points detected when maternal hair mercury levels exceeded 0.3 µg/g.

### Relevance of this threshold to Canada

Subsequently, we studied hair mercury concentrations among women of reproductive age in relation to fish intake in Ontario.<sup>20</sup> Three groups of women were studied: women who had called the Motherisk Program for information on the reproductive safety of consuming fish during pregnancy (n=22), a group of Japanese men and women residing in Toronto who consumed much larger than average amounts of fish (n = 23), and a group of Canadian women of reproductive age not seeking advice (n=20). Mercury concentrations in hair samples were measured using inductively coupled plasma mass spectrometry. Seafood consumption habits were recorded for each participant. Based on the types of fish consumed and consumption frequencies, the estimated monthly intake of mercury was calculated. Hair mercury concentrations were correlated to both the number of monthly seafood servings and the estimated ingested mercury dose.

There were significant correlations between fish servings and hair mercury (Spearman  $r=0.73$ ,  $P<.0001$ ) and between amounts of consumed mercury and hair mercury concentrations (Spearman  $r=0.81$ ,  $P<.0001$ ). Nearly two-thirds of the Motherisk callers, all of the Japanese women, and 15% of the Canadian women of reproductive age had hair mercury above 0.3 µg/g, which was shown by us to be the lowest observable adverse effect level in the large systematic review of all perinatal studies.<sup>19</sup>

### Conclusion

Because of very wide variability, general recommendations for a safe number of fish servings might not be sufficient to protect the fetus. Analysis of hair mercury might be warranted before pregnancy in selected groups of women who consume more than 12 oz of fish per week, as dietary modification can decrease body burden and ensure fetal safety. 

### Competing interests

None declared

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## MOTHERISK

Motherisk questions are prepared by the Motherisk Team at the Hospital for Sick Children in Toronto, Ont. Dr Koren is Director of the Motherisk Program.

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Do you have questions about the effects of drugs, chemicals, radiation, or infections in women who are pregnant or breastfeeding? We invite you to submit them to the Motherisk Program by fax at 416 813-7562; they will be addressed in future Motherisk Updates.

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