# Info-MADO

## Newsletter of the Nunavik Department of Public Health on reportable diseases

VOL. 2, NO. 4
DECEMBER 2014

## MERCURY AND DESCRIPTION OF TWO RESEARCH PROJECTS RESULTING IN REPORTS ON BLOOD MERCURY IN NUNAVIK

Written by Sylvie Ricard,
Environmental-Health Officer, NRBHSS[1]
In collaboration with Dr. Mario Brisson, Medical Advisor, NRBHSS,
Suzanne Côté and Caroline Moisan, Research Professionals,
CHUQ[2] Research Centre

### STATEMENT ON REPORTS ON BLOOD MERCURY IN NUNAVIK IN 2013 AND THE FIRST QUARTER OF 2014

In Nunavik during 2013, 12 cases of chemical *MADO*s (*maladies à déclaration obligatoire*) [reportable diseases] exceeded the reportable limit for blood mercury (60 nmol/L). For the period from January 1 to July 31, 2014, 21 episodes involving blood mercury were entered into the chemical-*MADO* register for the Nunavik region. The majority of those episodes were consecutive to a blood specimen taken in the context of two research projects being carried out on the territory of Nunavik (see the project descriptions further below).

### PROBABLE SOURCES OF MERCURY, HEALTH EFFECTS AND PREVALENCE DATA FOR NUNAVIK

Mercury (Hg) is a toxic heavy metal that exists in three forms: elementary, inorganic and organic, the latter also known by the term methyl mercury (MeHg). Mercury released into the atmosphere is primarily elementary gaseous mercury, whereas that released in water is generally inorganic. When one of these forms enters an aquatic ecosystem, the mercury is transformed into MeHg by microorganisms. MeHg accumulates in the tissues of living organisms and is bioamplified in animals at higher trophic levels, such as predatory fish and marine mammals. MeHg has a very high affinity for proteins and tends to accumulate in the muscle tissue, i.e., the meat, of those animals.

Most traditional foods in Nunavik have low levels of mercury. Beluga meat (raw, cooked and dried, the latter also known as *nikku*) is the food that contributes most to the blood-mercury levels of *Nunavimmiut*, particularly on the Hudson Strait, the region where it is consumed most often. Beluga liver and kidney, seal liver and kidney, and lake trout (the oldest specimens) also have high levels. However, contrary to the meat, a very high proportion of the mercury found in the liver and kidneys of marine mammals is in inorganic form, which is known for being less readily absorbed by the digestive tract than is MeHg.

An individual's exposure to mercury can be acute or chronic. Two major episodes of acute exposure are identified in the literature, first in the rural areas of Iraq and, more recently, in Japan's Minamata Bay. The symptoms that arose in those situations were generally linked to serumal concentrations higher than 1,000 nmol/L. The central nervous system is principally affected: sensorial changes in the extremities, narrowed visual field, cerebellar ataxia, hearing and visual impairment, muscular weakness, tremors, etc. Chronic exposure, where serumal concentrations of mercury are distinctly lower, is the form most often encountered in Nunavik. The harmful effects caused by chronic exposure may appear at any age. However, the foetus is particularly sensitive, and exposure during the prenatal period, often at levels that involve no clinical consequences for the mother, could lead to subtle effects that appear later on in childhood, such as difficulties involving attention, memory, language and so forth. Exposure to mercury during pregnancy has also been linked to premature births. Other effects have been documented consecutive to exposure in children and adults (Table 1).

[1] Nunavik Regional Board of Health and Social Services

[2] University of Quebec Hospital Centre

P.O. Box 900
Kuujjuaq, Québec J0M 1C0
**Tel.: 819 964-2222 / 1 844 964-2244**
**Confidential Fax: 1 866 867-8026**

NUNAVIK REGIONAL BOARD OF HEALTH AND SOCIAL SERVICES
RÉGIE RÉGIONALE DE LA SANTÉ ET DES SERVICES SOCIAUX NUNAVIK

**Table 1: Effects linked to chronic exposure, at blood-mercury levels lower than 1,000 nmol/L**

| | |
|---|---|
| Children/Prenatal exposure | ♦ Shortened pregnancy, premature birth<br>♦ Later in childhood:<br>• Subtle difficulties in attention, memory, language, intellectual and visual-spatial performance, processing of sensorial information, balance and motor skills<br>• Increased risk of hyperactivity and attention problems |
| Children/Postnatal exposure | ♦ Reduced variability of heart rate<br>♦ Development delays in fine motor skills |
| Adults | ♦ Increased blood pressure<br>♦ Reduced variability of heart rate |

Source: Pirkle *et al.*, in progress

The health survey among Nunavik Inuit, *Qanuippitaa?*, conducted in 2004, revealed an average mercury level of 86 nmol/L among adults (see Table 2). That represents a significant reduction ($p < 0.001$) relative to the average rate observed during the Health Québec survey of 1992 (average of 103.8 nmol/L), possibly reflecting a reduction in the consumption of traditional foods.

**Table 2: Average rates of blood mercury, population aged 18 to 74 years, Nunavik, 1992 and 2004**

| | Health Quebec Survey 1992 | | | Nunavik Inuit health survey *Qanuippitaa?* 2004 | | | | |
|---|---|---|---|---|---|---|---|---|
| | n | Ave. | Confidence interval (CI) 95% | n | Ave. | Confidence interval (CI) 95 % | Min. | Max. |
| Mercury (nmol/L) | 492 | 103.8 | 96.6-110.9 | 917 | 86.0 | 80.0-91.9* | 0.4 | 1,200.0 |

* Significant difference between the two surveys, $p < 0.001$.
Source: Dewailly *et al.*, 2007.

Guidelines as well as a decision-making algorithm (Pirkle *et al.*, in progress) were developed by a team of experts to guide the interventions of Nunavik health professionals among patients with high levels of mercury. As the foetus is the most at risk of suffering harmful effects after exposure, the recommendations particularly target pregnant women and those of childbearing age, even though other recommendations are also provided for the rest of the population. With a half-life of 70 to 80 days for MeHg, nutrition advice at the beginning of pregnancy can substantially reduce the foetus' exposure to mercury. All the recommendations take into account that traditional foods constitute an important element of Inuit culture and are an important source of several nutrients essential to health, particularly during pregnancy (omega-3 fatty acids, vitamin D, iron, etc.).

The guidelines, accompanied by the algorithm, are still at the draft stage, but the final versions should be available shortly. Since January 2014, certain professionals have nevertheless received the preliminary version on the occasion of a case that exceeded the threshold to help them manage their patient.

3. The survey is the most recent conducted on the territory. It provides information on the state of health and well-being, socio-demographic conditions, lifestyle, nutrition, and physical and social environments of more than 1 000 individuals aged 15 years and over from the 14 Nunavik communities.

## RESEARCH PROJECTS UNDER WAY IN NUNAVIK

### 1. *Evaluation of the program for distribution of Arctic char among pregnant women of Nunavik*

In September 2011, the Inuulitsivik Health Centre, jointly with the NRBHSS, began the free distribution of Arctic char among pregnant women. The Arctic Char Distribution Program promotes the consumption of a nutritionally rich food low in mercury in order to improve the health of pregnant women and that of their unborn children. The program is still in the development stage and is currently only offered in the Hudson villages. Before broader deployment, a research project was set up to evaluate the program. The principal objective of that project, which is under the responsibility of Dr. Michel Lucas of the CHUQ research centre, is to determine whether the program for the distribution of Arctic char helps reduce concentrations of blood mercury and improves the nutritional status and the well-being of pregnant women of Nunavik (and by the same token, that of their newborns).

A questionnaire is administered to the participants during the first or second trimester of pregnancy and again between the 36$^{th}$ week of gestation and the first or second month after childbirth during a face-to-face interview with a research nurse. It includes detailed questions on lifestyle, health, eating habits and socio-demographic characteristics. A blood specimen is taken to determine whether the program for the distribution of Arctic char leads to changes in overall state of health, blood levels of mercury and lead, and status of nutritional biomarkers. The parameters measured include fatty acids, certain micronutrients (vitamin D, selenium) and anemia indicators, immune function and metabolism. Further, the research nurse consults the mother's and newborn's medical records to gather information on obstetrical history (height, weight, weight gain, etc.), chronic diseases (such as diabetes, anemia, etc.) and the newborn's characteristics (weight, vital status at birth, etc.).

The sample consists of 130 pregnant Inuit women, 71 of whom receive Arctic char under the distribution program. This research project, under way since the summer 2013, ended in the fall 2014 on the occasion of a final visit to Nunavik during which the pregnant women were seen for the second time. A second blood specimen was then taken and the abovementioned parameters were measured anew.

### 2. *Study on child development in Nunavik: follow-up to adolescence*

The goal of the Nunavik Child Development Study, or NCDS, under the responsibility of Dr. Gina Muckle, researcher at the CHUQ research centre and professor at Laval University, is to document the long-term effects of pre- and postnatal exposure to environmental contaminants (PCBs, pesticides, mercury, lead, etc.) in Nunavik. The study began in 1994 with the Cord Blood Monitoring Program, during which specimens of umbilical-cord blood were taken from pregnant women of Nunavik. The children of those women were monitored during early childhood, at 5 years and at 11 years, with the entire process lasting from 1996 to 2009.

Those same children are now aged 16 to 19 years, and another follow-up is presently under way. The follow-up consists of evaluating the adolescents' lifestyle, physical and psychological health, and cognitive and behavioural development. A blood specimen also enables documenting exposure to mercury and lead as well as other organic contaminants

That phase began in 2013 with 61 participants recruited on the Ungava coast followed by 81 participants recruited on the Hudson coast in 2014. The recruitment of a total of 200 adolescents is expected by 2016. The next data-gathering sessions will be held in January 2015 on the Ungava coast and then in January 2016 on the Hudson coast.

---

[4] Arctic char (*Salvelinus alpinus*, anadromous subspecies) is of historical importance for the Inuit; it plays an important role in their subsistence, as it is a source of abundant food and is accessible in Arctic environments. Moreover, this fish is a traditional food prized by the Inuit, is nutritionally rich (i.e., an excellent source of omega-3 fatty acids and a good source of selenium) and is relatively free of contaminants.

## Process for the Results of Blood Tests for a Chemical Substance in a Nunavik Patient

Two situations generally arise:

***Situation #1:***

A physician requests a blood test for a chemical substance (mercury, lead or other) for a patient. If the parameter measured exceeds the Québec *MADO* reportable threshold, both the physician who received the result and the accredited laboratory that analyzed the specimen are required to report the *MADO* to the regional director of Public Health. According to the powers conferred to him[5] by the *Public Health Act*, the director of Public Health may carry out an inquiry, often through an inquiry questionnaire, and formulate recommendations (nutrition advice, control examination, etc.).

***Situation #2:***

An individual participates in a research project aimed at documenting concentrations of chemical substances in his blood. The blood specimen is taken by a research nurse. The results of the tests are communicated by the research team according to various procedures, depending on the research protocol and the consent form signed by the participant:

a) Directly to the participant and his health professional[6];

   ***This is the case with the Nunavik Child Development Study in terms of only the results of the complete blood count.***

b) directly to the participant only if the results exceeded a critical threshold defined by the researchers, as well as to his health professional[6];

c) directly to the participant with the recommendation to share the results with his health professional.

   ***This is the case with the research project aimed at evaluating the program for the distribution of Arctic char among pregnant women.***

If the parameter measured exceeds the Québec *MADO* reportable threshold, both the health professional, if he received the results, and the accredited laboratory that analyzed the specimen are required to report the *MADO* to the regional director of Public Health.

In the context of the two research projects under way in Nunavik and described above, the participants might not always share their results with their family physician. In such a case, the report to the regional director of Public Health can only originate from the laboratory and will not indicate the family physician's name. To carry out the investigation, the letter sent by the Department of Public Health (which contains the patient's results besides the reportable threshold, the recommendations and an inquiry questionnaire) must therefore be addressed to the head nurse of the CLSC of the patient's home community. This particular procedure explains how a test result may be obtained by the regional director of Public Health and communicated to a Nunavik health professional without the latter being aware that a blood specimen has been taken from his patient and with no note in the medical record permitting the tracing of that information.

## *MADO*s of Physical or Chemical Origin (Chemical *MADO*)

The complete list of *MADO*s intended for physicians, other health professionals and laboratories, as well as the report forms, are available online at the following link: www.msss.gouv.qc.ca/professionnels/mado/declarer.php.

---

[5] In the interest of simplicity, the masculine form is used in this text to denote either gender.

[6] Where consent was granted to share these results with the health professional

**Sources:**


- Dewailly É. *et al*. Monitoring of environmental pollutants in maternal blood in Nunavik: time trend assessment and evaluation of the Arctic Char program. Northern Contaminants Program, Synopsis of research for 2013/2014.
- Dewailly É. *et al*. Exposure to food chain contaminants in the Canadian Arctic: spatial and time trends. Northern Contaminants Program, Proposal for 2014/2015.
- Dewailly E. *et a*l. 2007. Enquête de santé auprès des Inuits du Nunavik *Qanuippitaa ?* How are we ? 2004: Exposure to environmental contaminants in Nunavik: metals. Nunavik Regional Board of Health and Social Services and Institut national de santé publique du Québec, 13 p.
- Lauwerys R., and D. Lison. 2007. Toxicologie industrielle et intoxications professionnelles. Masson, 5th edition.
- Muckle G. Nunavik Child Cohort Study (NCCS): follow-up with late adolescents. Northern Contaminants Program, Proposal for 2013/2014.
- Pirkle C. *et a*l. (in progress) The complex balance between mercury exposure and country foods benefits – Comprehensive guidelines for health practitioners in the Arctic.
- Jetté M., Santé Québec. 1994. Et la santé des Inuits, ça va ?: Rapport de l'enquête Santé Québec auprès des Inuits du Nunavik, 1992. Government of Québec, Santé Québec.