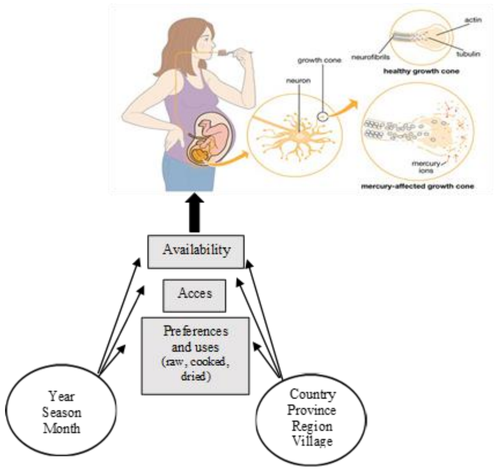
Exposure to mercury in Nunavik: Geographical and temporal trends among pregnant women

de Moraes Pontual M (1), Ayotte P (1,2), Furgal C (3), Pirkle C (4), Boyd A (5), Muckle G (1,6), Avard E (7), Kwan M (7), Ricard S (8), Gauthier MJ (8), Beaulne C (8), Lemire M (1)

1.Chaire Nasivvik, Axe santé des populations et pratiques optimales en santé, Centre de recherche du CHU de Québec – Université Laval, Quebec, QC. 2. Institut national de santé publique du Québec, QC. 3. Indigenous Environmental Studies & Sciences Program, Trent University, ON. 4. Health Policy and Management, Office of Public Health Studies, University of Hawai'i at Manoa, Honolulu, Hawai. 5. Washington State University, Pullman, WA, United States. 6. École de psychologie, Université Laval, Québec, QC. 7. Nunavik Research Centre, Makivik Corporation, Kuujjuaq, QC. 8. Nunavik Regional Board of Health and Social Services, Kuujjuaq, QC,.

Introduction

- Mercury (Hg) is widespread environmental contaminant, which is known to travel to the poles and accumulate as methylmercury (MeHg) in the aquatic food chain.
- MeHg exposure in the Inuit population of Nunavik is still among the highest in the world.
- **Exposure to MeHg may vary according to the ecosystems where the Inuit villages are established** and to the animal species available and consumed locally. Furthermore, since their availability varies over months, **MeHg exposure can also vary from month to month**.
  - MeHg exposure is known to be higher in the Hudson Strait villages where beluga meat, an important dietary source of MeHg, is often consumed.
- There are still knowledge gaps with respect to geographic and temporal variations in MeHg exposure in Nunavik and about local country foods responsible for MeHg exposure.
- The fetal life is a critical moment to prevent MeHg exposure in order to prevent neurodevelopmental outcomes later in childhood.
- **Country foods nutritional benefits greatly contribute to healthy pregnancies and babies.**



Objectives

1. **To characterize geographic and temporal variations in MeHg exposure among Inuit pregnant women from Nunavik;**
2. **To better identify country foods responsible for these variations;**
3. **Based on these results, develop food questionnaire tools to better identify pregnant women at risk of elevated exposure to MeHg according to their eating habits.**

Methods

- This research is part of the project *Nutaratsaliit qanuingisiarningit niqituinnanut* - Pregnancy wellness with country foods, a cross-sectional study conducted between October 2016 to March 2017.
- 97 pregnant women from the 13 Nunavik communities were recruited (Table 1).
- Inclusion criteria: to be pregnant, 16 years of age and older, considered as Inuk and currently living in Nunavik.

Figure 2: Study regions

Data sources:

- Hair samples: total Hg by cm (retrospective exposition by months)
- Blood samples: total Hg (3 last months), total selenium, selenoneine and hemoglobin
- Data extraction form (from medical records)
- Questionnaires:
  - Socio-demographic
  - Food frequency questionnaires
    - Traditional foods by seasons

Statistical analysis:

- Descriptive analyses were used to illustrate the distribution of blood and hair Hg data (data presented here).
- Non-parametric ANOVA (Wilcoxon each pair test) were used to examine the associations between Hg biomarkers (hair and blood) and regions.
- Analyses of variances for repeated measures will be performed to identify temporal variations in hair Hg concentrations.
- Latent Class Growth Analysis will be conducted in order to identify distinct subgroups of pregnant women following similar patterns of hair mercury variations over months.

Results
(preliminary findings for objective 1)

Table 1: Number of pregnant women eligible and recruited in Nunavik between October 2016 and March 2017

Region	Number of pregnant women eligible (estimated)	Number of pregnant women recruited	% of participation
Hudson Bay region	99	38	38
Hudson Strait region	77	37	48
Ungava region	55	22	40
TOTAL	231	97	42

Table 2: Blood and hair MeHg geometric mean and percentage of participants above guidelines for blood Hg

N	Age Mean (range)	Blood Hg µg/L Geo mean (range)	Blood Hg ≥ 8 µg/L (Health Canada guideline)	Hair Hg (1st cm) µg/g Geo mean (range)
97	25 [16 - 40]	4.28 [0.80 - 40.1]	**23 %**	1.86 [0.32 – 23.2]

Figure 3.1: Example of three participants' hair Hg monthly profile from one village with one peak in MeHg exposure between September and June

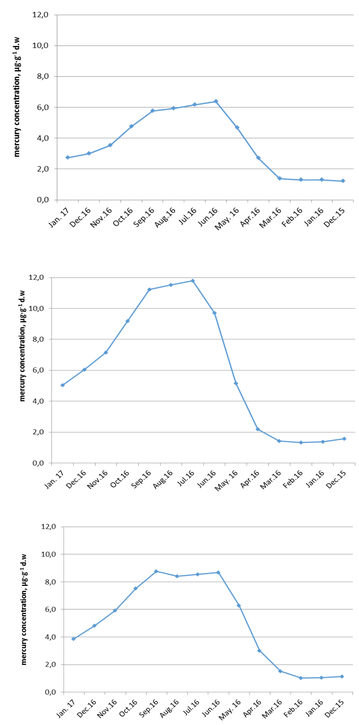


Figure 3.1: Example of two participants' hair Hg monthly profile from another village with several peaks in MeHg exposure

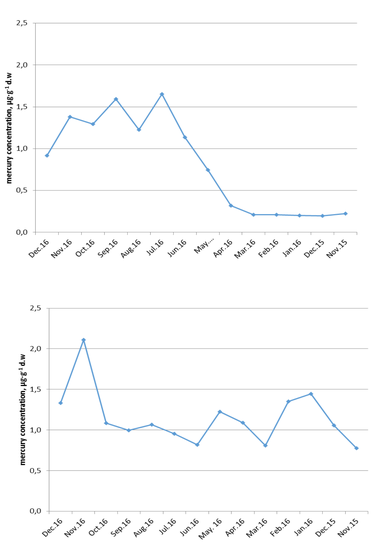
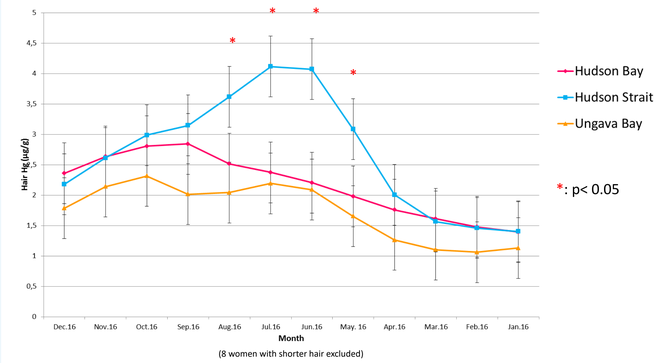


Figure 4: Average temporal MeHg exposure by Nunavik regions (n=89)



(8 women with shorter hair excluded)

Table 2: Blood MeHg geometric mean by region (n=97)

Region	Blood Hg, Geo Mean (µg/L)
Hudson Bay region	4.91 [0.80 - 40.1]
Hudson Strait region	4.02 [1.00 - 26.1]
Ungava region	3.77 [1.00 - 16.00]

No regional difference in hair and blood Hg were observed at the recruitment time (Oct 2016 – March 2017). However, hair Hg was significantly more elevated in the Hudson Strait villages between May and August 2016.

Conclusion

- Up to 23% of participants still had blood Hg levels above the Health Canada guideline.
- Sequential hair Hg analyses show important monthly and regional variations in exposure:
  - ✓ May – August: highest MeHg exposure & higher in the Hudson Strait villages
  - ✓ Oct – March: lowest MeHg exposure in all regions
- Further analysis will be conducted :
  - to identify distinct subgroups of pregnant women following similar patterns of hair mercury variations over months
  - to identify local foods responsible for them
- Results suggest that future biomonitoring studies should consider seasonality in country foods consumption and related MeHg exposure.
- **Better characterizing MeHg exposure will help developing screening tools and prevention strategies to minimize exposure to MeHg while promoting local country foods in Nunavik**.

Acknowledgements

- Thanks extended to pregnant women participants, project partners, hospitals and midwifery centers.

Study funded by:

25 ANS YEARS Programme de lutte contre les contaminants dans le Nord Northern Contaminants Program

NASIVVIK Chaire de recherche en approches écosystémiques de la santé nordique

- We especially thank the Nunavik Research Centre of the Makivik Corporation for the hair Hg analysis.

LP Société Makivik Makivik Corporation

Contact

mariana.de-moraes-pontual.1@ulaval.ca
melanie.lemire@crchudequebec.ulaval.ca

References

1. AMAP A. assessment 2011: mercury in the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. 2011;193.
2. Braune B, Chételat J, Amyot M, Brown T, Clayden M, Evans M, et al. Mercury in the marine environment of the Canadian Arctic: Review of recent findings. Sci Total Environ. 2015;509-510:67-90.
3. Dolbec J, Mergler D, Larribe F, Roulet M, Lebel J, Lucotte M. Sequential analysis of hair mercury levels in relation to fish diet of an Amazonian population, Brazil. Sci Total Environ. 2001;271(1-3):87-97.
4. Jacobson J, Muckle G, Ayotte P, Dewailly É, Jacobson S. Relation of Prenatal Methylmercury Exposure from Environmental Sources to Childhood IQ. Environmental Health Perspectives (Online). 2015;123(8):827.
5. Lemire M, Kwan M, Laouan-Sidi AE, Muckle G, Pirkle C, Ayotte P, et al. Local country food sources of methylmercury, selenium and omega-3 fatty acids in Nunavik, Northern Quebec. Sci Total Environ. 2015;509-510:248-59.
6. Morrissette J, Takser L, St-Amour G, Smargiassi A, Lafond J, Mergler D. Temporal variation of blood and hair mercury levels in pregnancy in relation to fish consumption history in a population living along the St. Lawrence River. Environ Res. 2004;95(3):363-74.
7. Pirkle CM, Muckle G, Lemire M. Managing mercury exposure in northern Canadian communities. CMAJ : Canadian Medical Association journal. 2016;188(14):1015.