Nituuchischaayihtitaau Aschii

Multi-community environment-and-health longitudinal study in Eeyou Istchee: Eastmain and Wemindji

Technical report: summary of 2007 activities, results and recommendations

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Cree Board of Health and Social Services of James Bay

Public Health Report Series 4 on the Health of the Population
Cree Board of Health and Social Services of James Bay

May 2011

Nituuchischaayihtitaau Aschii

MULTI-COMMUNITY ENVIRONMENT-AND-HEALTH LONGITUDINAL STUDY IN EEYOU ISTCHEE: EASTMAIN AND WEMINDJI

Technical report: summary of 2007 activities, results and recommendations

CINE

Institut national de santé publique Québec

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Unité connaissance-surveillance

Centre de Recherche du Pavillon CHUL
Unité de recherche en santé publique

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Cree Board of Health and Social Services of James Bay

Public Health Report Series 4 on the Health of the Population
Cree Board of Health and Social Services of James Bay **May 2011**

Nieboer E, Dewailly E, Egeland GM, Château-Degat M-L, Bonnier-Viger Y. Nituuchischaayihtitaau Aschii. Multi-community environment-and-health longitudinal study in Eeyou Istchee: Eastmain and Wemindji. Technical report: summary of 2007 activities, results and recommendations. Nieboer E, Robinson E, Petrov K, editors. Public Health Report Series 4 on the Health of the Population. Chisasibi, QC: Cree Board of Health and Social Services of James Bay; 2011.

To obtain a copy of this report, please contact:

Public Health Department of the Cree Territory of James Bay
Cree Board of Health and Social Services of James Bay

Fax: (514) **861-2681** or (418) 923-2564

e-mail: **cree.public.health@ssss.gouv.qc.ca**

www.creehealth.org

Series editor & coordinator: **Jill Torrie**
Public Health Department of the Cree Territory of James Bay
torrie.jill@ssss.gouv.qc.ca

Cover design & final layout: **Katya Petrov**
katyapetrov@sympatico.ca

Photos: **Reggie Tomatuk**

ISBN (print): 978-2-550-61859-1
ISBN (PDF): 978-2-550-61860-7
Legal deposit: 2nd trimester 2011
National Library of Canada, 2011
Bibliothèque Nationale du Québec, 2011

EDITORS

Evert Nieboer

Elizabeth Robinson

TEXT EDITOR

Katya Petrov

AUTHORS

Yv Bonnier-Viger

Marie-Ludivine Château-Degat

Éric Dewailly

Grace M. Egeland

Evert Nieboer

In collaboration with:

Maya Andonov

Elhadji Annasour-Laouan-Sidi

Pierre Ayotte

Michel G Bergeron

Jean-Luc Bernier

Fernand Bertrand

Luc Bissonnette

Maurice Boissinot

Sophie Campagna

Suzanne Côté

David Dannenbaum

Émilie Counil

David Dannenbaum

Michael A Drebot

Annie Ferland

Julie Fontaine

Alanah Heffez

Vicky Huppé

Louise Johnson-Down

Pierre Julien

Natalie Kishchuk

Benoît Lamarche

Pierre Lejeune

Benoît Lévesque
Michael D Libman
Kai Makowski
Ian Martin
Momar Ndao
Martin Noël
Alexandra-Christina Paunescu
Françoise Proust
Elizabeth Robinson
Isabelle St-Cyr
Bouchra Serhir
Jill Torrie
Beatriz Valera
Brian J Ward

STUDY INVESTIGATORS AND COLLABORATORS (2007-2008)

Principal Investigators

Yv Bonnier-Viger, CBHSSJB, Chisasibi, QC
Marie-Ludivine Château-Degat, URSP-CHUQ, Sainte-Foy, QC
Éric Dewailly, INSPQ-CHUQ, Sainte-Foy, QC
Grace M. Egeland, CINE, McGill University, Montreal, QC
Evert Nieboer, McMaster University, Hamilton, ON

Co-investigators

Pierre Ayotte, INSPQ-CHUQ, Sainte-Foy, QC
Luc Bissonnette, CRI-CHUQ, Sainte-Foy, QC
Maurice Boissinot, CRI-CHUQ, Sainte-Foy, QC
Benoît Lévesque, INSPQ-CHUQ, Sainte-Foy, QC
Jill Torrie, CBHSSJB, Montreal, QC
Leonard J. S. Tsuji, University of Waterloo, Waterloo, ON
Claude Thellen, INSPQ, Sainte-Foy, QC

Project Manager

Mathieu Trépanier, CBHSSJB, QC

Clinical Supervisor

Suzanne Côté, URSP-CHUQ, Sainte-Foy, QC

Collaborators

Belkacem Abdous, URSP-CHUQ, Sainte-Foy, QC
Brandy-Lee Abraham, CBHSSJB, Eastmain, QC
Anne Andermann, CBHSSJB, Montreal, QC
Elhadji Annassour-Laouan-Sidi, URSP-CHUQ, Sainte-Foy, QC
Laura Atikessé, CBHSSJB, Montreal, QC
Michel G. Bergeron, CRI-CHUQ, Sainte-Foy, QC
Fernand Bertrand, Hôpital Laval, Sainte-Foy, QC
Delanna G. Blackned, CBHSSJB, Wemindji, QC
Cynthia Bou Khalil, CINE, McGill University, Montreal, QC
John Brown, Cree Nation of Eastmain, QC
Sophie Campagna, URSP-CHUQ, Sainte-Foy, QC
Dorianne Cheezo, CBHSSJB, Eastmain, QC
Johanne Cheezo, Cree Nation of Eastmain, QC
Iain Cook, CBHSSJB, Montreal, QC
Suzanne Côté, URSP-CHUQ, Sainte-Foy, QC
Michel Couillard, INSPQ, Sainte-Foy, QC
Louis-Frédéric Daigle, URSP-CHUQ, Sainte-Foy, QC
Daneen Denomme, CINE, McGill University, Montreal, QC
Véronique Doutreloux, URSP-CHUQ, Sainte-Foy, QC
Michael A. Drebot, Public Health Agency of Canada, Winnipeg, MN
Christine Egner, URSP-CHUQ, Sainte-Foy, QC
Julie Fontaine, URSP-CHUQ, Sainte-Foy, QC
Marie Gaudreau, URSP-CHUQ, Sainte-Foy, QC
Elmer Georgekish, CBHSSJB, Wemindji, QC
Joey Georgekish, Cree Nation of Wemindji, QC

Caitlin Gilpin, CBHSSJB, Wemindji, QC
Rita Gilpin, CBHSSJB, Eastmain, QC
Sally Gilpin, CBHSSJB, Eastmain, QC
Vicky Huppé, CRICHUQ, Sainte-Foy, QC
Maxime Jacob, CBHSSJB, Québec, QC
Louise Johnson-Down, CINE, McGill University, Montreal, QC
Pierre Julien, CRML, CHUQ, Sainte-Foy, QC
Natalie Kishchuk, Kirkland, QC
Benoît Lamarche, INAF, Laval University, Sainte-Foy, QC
Alain Leblanc, INSPQ, Sainte-Foy, QC
Pierre Lejeune, CBHSSJB, Mistissini, QC.
Sylvie Lemelin, URSP-CHUQ, Sainte-Foy, QC
Annie Lévesque, CBHSSJB, Montreal, QC
Michael D. Libman, Montreal General Hospital, McGill University, Montreal, QC
Sherilyn Linklater, CBHSSJB, Wemindji, QC
Paul Linton, CBHSSJB, Mistissini, QC
Rabia Louchini, URSP-CHUQ, Sainte-Foy, QC
Jean-Sébastien Maguire, URSP-CHUQ, Sainte-Foy, QC
Kai Makowski, Public Health Agency of Canada, Winnipeg, MN
Mario Marchand, INSPQ, Sainte-Foy, QC
Johnny Mark, Cree Nation of Eastmain, QC
Curtis Mark-Stewart, CBHSSJB, Eastmain, QC
Daniel Mark-Stewart, Cree Nation of Eastmain, QC
Edna Mark-Stewart, CBHSSJB, Eastmain, QC
Daniel Martin, URSP-CHUQ, Sainte-Foy, QC
Ian Martin, Biological Consulting, Elora, ON
Chris Merriman, Cree Nation of Eastmain, QC
Shirlene Mistacheesick, CBHSSJB, Wemindji, QC
Gloria Moar, CBHSSJB, Eastmain, QC
Katherine Morrow, CBHSSJB, Montreal, QC
Sylvie Moses, CBHSSJB, Eastmain, QC
Guillaume Pagé, URSP-CHUQ, Sainte-Foy, QC
Aïsha Paquette Dioury, CBHSSJB, Montreal, QC
Alan Penn, CRA, Montreal, QC
Katya Petrov, Montreal, QC
Denise Ratt, CBHSSJB, Wemindji, QC
Elizabeth Robinson, CBHSSJB, Montreal, QC
Isabelle St-Cyr, CBHSSJB, Montreal, QC
Iris Sealhunter, CBHSSJB, Eastmain, QC
Bouchra Serhir, INSPQ, Sainte-Foy, QC
Gail Shashaweskum, CBHSSJB, Wemindji, QC
Kerri Stewart, CBHSSJB, Wemindji, QC
Reggie Tomatuk, CBHSSJB, Chisasibi, QC
Mathieu Trépanier, CBHSSJB, Mistissini, QC
Beatriz Valera, URSP-CHUQ, Sainte-Foy, QC
Arden Visitor, Cree Nation of Wemindji, QC
Lindsay Visitor, CBHSSJB, Wemindji, QC
Brian J. Ward, Tropical Diseases Centre, McGill University, Montreal, QC
Sheila Weapenicappo, CBHSSJB, Eastmain, QC

ACKNOWLEDGMENTS

The authors wish to thank all the participants in this study, as well as all the co-investigators and collaborators who have been involved in its realization.The Eastmain-Wemindji study was led by five principal investigators working with a large team of co-investigators (see list). Along with this core team, a number of technicians and professionals took part. They include the coordination team (project manager Mathieu Trépanier, clinical coordinator and Mobile Laboratory coordinator Suzanne Côté), the clinical field team which realized the recruitment, interviews and clinical tests (nurses Sylvie Lemelin, Marie Gaudreau, Christine Egner and Véronique Doutreloux, ultrasound technicians Louis-Frédéric Daigle, staff for interviews and recruitment: Aisha Paquette Dioury, Caitlin Gilpin, Delanna G. Blackned, Kerri Stewart, Lyndsay Visitor, Sherilyn Linklater, Shirlene Mistacheesick, Gail Shashaweskum, Denise Ratt, Edna Mark-Stewart, Iris Gilpin-Sealhunter, Sylvie Moses, Sally J. Gilpin, Curtis Mark-Stewart), the technician of The Mobile Laboratory supervising all logistical aspects of field work (Jean-Sébastien Maguire), laboratory technicians who worked in the field to carry out a number of chemical/biochemical analyses (Vicky Huppé and Guillaume Pagé), and a team of nutrition specialists who worked in the field and on subsequent data validation and analyses (Louise Johnson-Down and Cynthia Bou Khalil). Data analysis also involved professionals (Elhaji Anassour-Llaouan-Sidi and Pierre Lejeune), and graduate students (Émilie Counil, Annie Ferland, Julie Fontaine, Martin Noël, Alexandra-Cristina Paunescu, Françoise Proust and Sophie Campagna), and many of these individuals also took part in activities in the field.

We would especially like to thank the local health directors (Rita Gilpin and Elmer Georgekish), as well the staff of the Multi-Service Day Centres in both communities for their support. We would also like to recognise and thank the staff from the Cree Nations of Wemindji and Eastmain (especially John Brown, Johanne Cheezo, Joey Georgekish, Johnny Mark, Daniel Mark-Stewart, Chris Merriman, and Arden Visitor).

We would also like to acknowledge the important contribution of our communication/education team (Iain Cook, Katherine Morrow, Isabelle St-Cyr, Annie Lévesque and Dorianne Cheezo) who undertook all communication and educational activities in the field work. Finally, we would like to thank Nathalie Kishchuk for her evaluation of the program, which helped us to adjust the approach and content of this study for future communities to be visited.

The research protocol for this work received scientific review from a committee of peer researchers set up specially through the FRSQ. This work has been made possible through funding provided by the Niskamoon Corporation, as well as through various in-kind contributions from the Cree Board of Health and Social Services of James Bay (CBHSSJB), the Public Health Research Unit of Centre Hospitalier Universitaire de Québec, pavillon CHUL (URSP, CHUQ-CHUL), McMaster University and the Centre for Indigenous Peoples' Nutrition and Environment (CINE), McGill University. We would like to acknowledge all these organizations, with special thanks to the Niskamoon Corporation for making this work possible.

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1. SUMMARY

1.1 Background

Because of the 2001 Mercury Agreement, the CBHSSJB reconstituted its Mercury Program in the context of a more comprehensive environment-and-health program. One of the goals of the CBHSSJB was to set up long-term monitoring and surveillance activities focusing on mercury and other contaminants in the *Eeyou* communities. Around this same time, concerns about the health impact of mines tailings in Oujé-Bougoumou led to a study of people's exposure to contaminants there and in a control community, Nemaska. Following this, a feasibility study regarding the possibility of a broad environment-and-health study was conducted in the other Cree communities during the period November 2003 to the end of March 2004 and provided valuable feedback. Subsequently, an environment-and-health study, referred to as *Nituuchischaayihtitaau Aschii*, was proposed for funding through the Mercury Agreement. Its rationale was mainly based on the issues raised during the two previous studies, but also on the basis of known research gaps. It was to take place over a five-year period of field work, with the 2005 assessment in Mistissini constituting its pilot phase. The field work for the communities of Eastmain and Wemindji was completed during the summer of 2007.

1.2 Report outline

This current report consists of eleven chapters that provide the following information: abbreviations and glossary of Cree terms (Chapter 2); project background, objectives and scope (Chapter 3); field study methods (Chapter 4); results and discussion (Chapter 5); seroprevalence of zoonoses (Chapter 6); microbial contamination of natural water sources (Chapter 7); educational activities (Chapter 8); reporting of results (Chapter 9); project evaluation (Chapter 10); study findings and key messages (Chapter 11); and the references quoted. Supporting documentation is provided in 7 Appendices.

1.3 Study populations

The communities of Wemindji and Eastmain were successively visited during the summer of 2007. Sampling of the population followed a stratified design, considering the following age categories: children between 0 and 7 years old, children between 8 and 14 years old, teenagers and adults between 15 and 39 years old, and adults over 40 years old. The selection of participants within each age stratum was done using simple random sampling, without replacement.

1.4 Dietary habits

Traditional food is enjoyed more frequently by adults over 40 years of age than younger individuals. They eat more game, fish, birds, and berries than younger adults or children. These foods are an excellent source of good (healthy) fats, proteins, iron, and zinc. However, the study showed that in general, people in Eastmain and Wemindji eat too much unhealthy fat (including *trans* fats from store-bought baked goods). Blood levels of a good type of fat (omega-3 fatty acids) reflect the consumption of wild animals (fish and game), and increased with age, which is consistent with the higher consumption of traditional food observed in older age

groups. On the other hand, unwanted industrial *trans* fats (in fries, industrially prepared and packaged foods, etc.) showed the opposite trend, with higher levels found in the younger age groups. Also, a high proportion of children (more than 50%) reported consuming sweet drinks, with an average of 2.2 cans per day in Wemindji and 1.3 cans per day in Eastmain accounting for more than 10% of energy intake. The fact that teenagers have higher levels of *trans* fats in their bodies and a high intake of sugar suggests that they are at increased risk of developing heart diseases and diabetes in the future. Finally, the average daily consumption of fibre and vegetables is low, which could increase the risk of chronic diseases such as diabetes and cancer of the bowel. Also, since fruit and vegetable consumption is low, some vitamin and mineral intakes are too low based on the diet of study participants.

Despite the fact that healthy traditional food is still part of the diet (especially in older age groups), a transition toward a more unhealthy diet high in sugar, saturated fat and *trans* fat is observed, especially in young people; this could have negative health impacts in the future.

1.5 Physical activity

Physical activity was assessed using a questionnaire. Unfortunately, we did not have enough participants to show trends for this in Wemindji and Eastmain. However, in Mistissini, the results suggest that the dedicated walkers are enjoying the health benefits of their physical activity and that physical activity in general can improve health status in *Eeyouch.*

1.6 Environmental contaminants

The environment is contaminated with different chemicals originating from human activities. Some of these contaminants called “persistent organic pollutants” (POPs) accumulate in fatty tissues of animals and humans, are difficult to break down, and are transported long distances by water and air. Consequently, they are found in environments where they were not initially released, such as in the North. Examples of POPs are PCBs, organochlorine pesticides (a class of pesticides formerly used but now banned since the late 70s-80s), some industrial by-products/waste such as dioxins, and other types of domestic or industrial chemicals such as water and stain repellents or fire retardants that tend to leach out of plastics and textiles or from electronic devices. The environment is also contaminated with toxic metals which tend to accumulate in the liver and kidneys as well as in the flesh of animals and humans, rather than in fatty tissues. These include mercury (mainly methyl mercury, the organic form of mercury), cadmium and lead. Most of these contaminants (POPs and mercury) are found in the food chain (i.e., in fish and fish-eating birds, as well as in other wild animals). Because of their persistence, they tend to accumulate in higher concentrations in predators and older animals. Careful statistical (factor) analysis of the Eastmain and Wemindji data confirmed that exposure to PCBs and pesticides occurs by way of traditional foods.

Concentrations of POPs and toxic metals were measured in the blood plasma of the Eastmain and Wemindji study participants. Since older adults (40 years and older) have consumed more wild animals during their

lifetime, they generally show higher concentrations of PCBs, organochlorine pesticides and mercury in their bodies. However, these contaminants represent a health concern mainly for pregnant women and their babies, and young children. Fortunately, women of childbearing age and young children had relatively low levels of mercury, PCBs and organochlorine pesticides; neither were they a health concern for the majority of participants, perhaps with the exception of mercury. When combining the data for Eastmain, Wemindji and Mistissini, there is a suggestion in the present study of a small increase in blood pressure associated with mercury levels in blood and some negative impact on heart rate (beat) variability. Lead exposure is not a big issue in Eastmain and Wemindji, likely due to a decrease in the use of lead shot. Cadmium exposure (toxic to the kidneys) is mostly related to smoking, an avoidable source. Since some participants exceeded levels of concern for cadmium exposure, this reinforces the fact that people should quit smoking to avoid adverse health effects. Exposure to other industrial contaminants such as stain repellents and dioxins is similar to levels observed in other First Nations communities elsewhere in Canada, and shows similar associations with fish/game consumption and age, except for fireproofing agents which showed no association with consumption of traditional foods, suggesting other sources of exposure. Fire-proofed household goods are suspected.

Our findings suggest that exposure to environmental contaminants through the consumption of traditional foods still occurs in the Eastmain and Wemindji populations. The concentrations observed are not alarming but warrant monitoring, especially to track changes in contaminant levels associated with industrial developments (both remote and in *Eeyou Istchee*). **However given the known benefits of traditional foods, their consumption should still be encouraged.**

1.7 Health status

In this study, many clinical tests were carried out in order to provide a "snapshot" of the Eastmain and Wemindji population health status, with an emphasis on certain chronic diseases or health conditions that may be related to lifestyle habits as well as the environment. Osteoporosis is a condition that appears mostly in post-menopausal women and increases the risk of bone fractures. Fortunately, the bone ultrasound measurements in both communities indicated that the risk of breaking a bone appears to be relatively low among *Eeyou* women compared to Québec City females. Pooling data from all three communities visited, overt hypothyroidism seems higher than expected among both men and women. However, additional data following completion of the study would be necessary to draw firm conclusions regarding this issue.

Thickening of the arteries (atherosclerosis) is a condition responsible for heart attacks and stroke. It was estimated in 143 participants aged 40 years and older by measuring the thickness of the carotid artery (neck artery) by ultrasound. This analysis showed that artery thickness increased with age for both men and women, and overall, this measurement suggests increased subclinical atherosclerosis in Cree people compared to healthy Caucasians. In both communities, the estimated prevalence of high blood pressure is high (more than 35%), but comparison between onsite measurements and medical file information suggests that this condition is adequately diagnosed and stabilized for most people. High blood pressure was more frequent in older

people, smokers, those showing abdominal obesity and high bad cholesterol levels, and in those most exposed to mercury. For blood lipids (fats), total cholesterol was high in only a small portion of the population, but the good cholesterol (HDL) concentrations could be improved relative to the bad cholesterol (LDL) levels, especially in obese people. The observed blood lipid profiles are rather similar to those obtained in a 1991 survey, and some lifestyles interventions could be undertaken to improve these blood lipid profiles.

Rates of global obesity and abdominal obesity were higher in both communities compared to the general Canadian population. In parallel, we observed high levels of plasma insulin, mainly among women and young girls in both communities. Reducing these and other known T2D risk factors needs urgent attention.

For all age groups, obesity and elevated blood insulin levels are unhealthy conditions that lead to illness and premature death. It is known that high-fat and high-sugar diets, coupled with low physical activity, are linked to these medical conditions. Therefore, intensification of the current promotion of a healthy diet and increased physical activity is recommended, especially among younger age groups.

1.8 Zoonoses

In this study, we looked at some diseases that could be transmitted from animals to humans (zoonoses). When somebody is infected by a microbe (bacterium, parasite or a virus; referred to as zoonotic agents), it is often possible to find traces of past infections in the blood (as antibodies) even many years after the acute infection episode is over. We evaluated the seroprevalence (i.e., presence of antibodies in blood serum reflecting a past exposure to infections) of ten zoonotic agents among the general population of Eastmain and Wemindji. Overall, seroprevalence rates were similar between the two communities. Nearly half the individuals tested (n = 251; 146 women, 105 men) were positive (n = 113) for at least one zoonosis. The highest rates were for the *Leptospira* sp. (23%) and *Francisella tularensis* (17%) bacteria, and the California serogroup viruses (JC and SSH viruses) (10%). The bacterium *Coxiella burnetii* and the parasites *Toxoplasma gondii, Echinococcus granulosus*, *Toxocara canis,* and *Trichinella* sp. had seroprevalence rates of 5% or less. Overall, a positive finding was related to age, gender, hunting and owning a dog. There was no medical history suggestive of overt diseases. Nonetheless, physicians should consider these agents when confronted with difficult or confusing diagnoses. In particular, the bacterial zoonoses should be ruled out in individuals with high or prolonged fever.

In general, the results of this study component show no alarming rates of zoonotic infections, or any need for immediate action. Nevertheless, hunters and trappers seem to more at risk and should be made aware of the symptoms of these types of infections and of safe procedures for handling dead animals.

1.9 Water

We also assessed the potential microbial (bacteria and parasites) contamination of drinking water collected from natural sources (mostly from springs) during June (Wemindji) and August (Eastmain) of 2007. Standard tests for detecting total coliforms, *Escherichia coli* and enterococci, as well as new molecular microbiology

testing techniques, showed some modest biological contamination after both collection and storage (Bernier *et al.*, 2009).

Water obtained from a spring, river or lake may contain some unwanted disease-causing microorganisms when indicators of fecal contamination are detected. As a simple preventive measure, it should be boiled for at least one minute before drinking.

1.10 Conclusion

Contaminants are not a major concern for the CBHSSJB, even though they are present in the food chain. Because of the environmental changes imposed by industrial development both remote and in Eeyou Istchee, we must continue monitoring these contaminants. However, being overweight and eating an unbalanced diet are by far more important health concerns that seem to require prompt preventive action. Based on the findings summarized above, the important messages are: do not smoke, be physically active, include vitamin-rich foods in your diet, keep eating traditional food items as they are healthy, and reduce eating foods known to be unhealthy such as high-sugar, high-fat industrially-prepared foods.

2. ABBREVIATIONS AND GLOSSARY OF CREE TERMS

2.1 Agency and Program Abbreviations

AMAP:	Arctic Monitoring and Assessment Programme
FAO:	Food and Agriculture Organization of the United Nations
CBHSSJB:	Cree Board of Health and Social Services of James Bay
CDC:	Centers for Disease Control and Prevention (USA)
CHUQ:	Centre hospitalier universitaire de Québec
CINE:	Centre for Indigenous People's Nutrition and Environment
INSPQ:	Institut national de santé publique du Québec
ISO:	International Organization for Standardization
IUPAC:	International Union of Pure and Applied Chemistry
MADO:	Maladies à déclaration obligatoire
NCP:	Northern Contaminants Program
NRC:	National Research Council
UNU:	United Nations University
US EPA:	United States Environmental Protection Agency
WHO:	World Health Organization

2.2 Cree Terms

Nituuchischaayihtitaau Aschii	Learn about us and our earth
Eeyou	Cree person
Eeyouch	Cree persons
Eeyou Ayimuwin	Cree language
Eeyou Istchee	Cree Territory (Category 1, 2 and 3 lands)

Cree terms used are spelled according to Eastern James Bay Cree Dictionary – Northern and Southern Dialects (electronic version) ©2004 Cree School Board (http://www.carleton.ca/ecree/en/dictionary.html)

2.3 Abbreviations

ADE:	analysis of ecological data
AI:	adequate intake
AMDR:	acceptable macronutrient distribution range
ANOVA:	analysis of variance
Apo A1:	apolipoprotein A1
Apo B:	apolipoprotein B
As:	arsenic
BDEs:	brominated diphenyl ethers
BMD:	bone mass densitometry
BMI:	body mass index
BMR_{est}:	basal metabolic rate (estimated)
BP:	blood pressure
BUA:	broadband ultrasound attenuation
BW:	body weight
C:	cholesterol

C14: carbon 14
CA: correspondence analysis
CA-1: correspondence axis 1
CI: confidence interval
CIMT: carotid intimal-medial thickness
CMM: classical and molecular microbiology
CRP: C-reactive protein
CV: coefficient of variation
CVD: cardiovascular disease
DBP: diastolic blood pressure
DFE: dietary folate equivalent
DHA: docosahexanoic fatty acid
DL: detection limit
DLCs: dioxin-like compounds
DM: diabetes mellitus
DNA: deoxyribonucleic acid
DPD: diastolic blood pressure
DR-CALUX: dioxin-receptor chemically-activated luciferase-expression bioassay
DRI: dietary reference intake
DRC: dynamic reaction cell
EAR: estimated average recommendation
EC: *Escherichia coli*
ECD: electron capture detector
EDTA: ethylenediaminetetraacetic acid
EI: energy intake, or Enterococci
ELISA: enzyme-linked immunosorbent assay
EM-1: Eastmain-1
EPA: eicosapentaenoic fatty acid
FA: fatty acids
FAME: fatty acid methyl esters
FCIs: fecal contamination indicators
FFQ: food frequency questionnaire
GLC: gas-liquid chromatography
GC-MS: gas chromatography-mass spectrometry
HCB: hexachlorobenzene
HCH: hexachlorocyclohexane
HDL: high-density lipoprotein (so-called “good” cholesterol)
HF: high frequency
Hg: mercury
HPLC: high-performance liquid chromatography
HRGC-MS: high resolution gas chromatography-mass spectrometry
HRV: heart rate variability
HTN: hypertension
HW: highway

ICP-MS:	inductively coupled plasma mass spectrometry
IFG:	impaired fasting glucose
IGT:	impaired glucose tolerance
IgG:	immunoglobin G
IgM:	immunoglobin M
IL-6:	interleukin-6
IMT:	intimal-medial
INK:	Inkoo (virus)
IPAQ:	International Physical Activity Questionnaire
IQR:	interquartile range
IU:	international unit
JC:	Jamestown Canyon (virus)
LC-MS-MS:	liquid chromatography-tandem mass spectrometry
LDL:	low-density lipoprotein (so-called “bad” cholesterol)
LEA:	local environmental administrator
LF:	low frequency
LOD:	limit of detection
Mkt:	market
mEI:	membrane-enterococcus indoxyl- β-D-glucoside
METs:	metabolic equivalents
MF:	membrane filtration
MI:	membrane filter medium
MPN:	most probable number
MUFA:	monounsaturated fatty acids
NA:	not applicable
NHANES:	National Health and Nutrition Examination Survey
NaCl:	sodium chloride
NN:	median of all RR intervals
OCs:	organochlorines
OCPs:	organochlorine pesticides
OxLDL:	oxidized LDL
PBB:	polybrominated biphenyl
PBDE:	polybrominated diphenyl ether
PCA:	principal component analysis
PC-1:	principal component axis 1
PCBs:	polychlorinated biphenyls
PBDEs:	polybrominated diphenyl ethers
PCR:	polymerase chain reaction
PFOA:	perfluoroctanoate
PFOS:	perfluoroctane sulfonate
PFHxS:	perfluorohexanesulfonate
pNN50:	percentage of the absolute differences between successive normal RR intervals that exceed 50 msec
PON-1	paraoxonase 1

POPs: persistent organic pollutants
p,p′-DDE: dichloro-diphenyl dichloroethylene
p,p′-DDT: dichloro-diphenyl trichloroethane
PRNT: plaque reduction neutralization test
PUFAs: polyunsaturated fatty acids
Q: question
QUS: quantitative ultrasound
RAE: retinol activity equivalent
RBC: red blood cell
RDA: recommended daily allowance
rMSDD: mean squared differences of successive RR intervals
RR interval: interval between R-wave peaks
SAS: statistical analysis system
SBP: systolic blood pressure
SD: standard deviation
SDANN: standard deviation of the average normal RR intervals
SDNN: standard deviation of the normal RR intervals
SFA: saturated fatty acids
SI: stiffness index
SIDE: Software for Intake Distribution Estimation
SOS: speed of sound
SPSS: Statistical Package for the Social Sciences
SSH: snowshoe hare (virus)
T2D: type 2 diabetes
T3: 3,5,3′-triodothyronine
T4: thyroxine
TC: total cholesterol or total coliform
TCDD: 2,3,7,8-tetrachlorodibenzo-p-dioxin
TDI: tolerable daily intake
TEQs: toxic equivalent concentrations
TFA: trans-fatty acid
TG: triacylglycerol
TNF-α: tumour necrosis factor
TPOAb: thyroid peroxidise antibody
Trad. diet: traditional diet
TSH: thyroid stimulating hormone
VLF: very low frequency
WC: waist circumference

3. PROJECT BACKGROUND, OBJECTIVES AND SCOPE[1]

3.1 Background

Environmental health recognizes the close link between a healthy environment and a healthy population. This is especially true for human populations living in close contact with their environment or depending on it very closely for food sources. Hunting and fishing are activities that are part of the traditional lifestyle of *Eeyouch* and the consumption of traditional food has many advantages with regard to cultural and health aspects. It is now well documented that the loss of traditional lifestyle causes distress in populations undergoing such a cultural transition, and a decrease in the amount of traditional foods consumed will result in negative health consequences (NCP, 2003).

Traditional foods are reported to be lower in total fat, lower in saturated fats, have lower levels of sucrose, and are excellent sources of omega fatty acids, selenium, vitamins A, C, D and E, iron, zinc, copper, magnesium and manganese, as compared to non-traditional store-bought foods. Absence of *trans* fats is another advantage. These attributes are associated with lower risks of, and protection against, illnesses such as cardiovascular disease, certain cancers (e.g., colorectal and prostate), obesity and type-2 diabetes (T2D). However some cooking methods may diminish the nutritional benefits of traditional foods, and some traditional foods may also be contaminated by environmental pollutants such as toxic metals and various organic chemicals from industrial sources. Wild animals may also transmit certain diseases (called zoonoses) to humans either through the manipulation or consumption of infected specimens. Therefore, an assessment of risks and benefits associated with a traditional diet is needed in order to promote healthy lifestyles and integrate traditional habits into changing cultural lifestyles. In order to achieve this, adequate information needs to be gathered regarding current dietary habits, as a quantitative assessment of nutritional intake and status is not yet available for the *Eeyouch*. This information gap is therefore addressed in the dietary component of the study described.

It is also important to note the gap in data on the health status and exposure to contaminants of the *Eeyou* Programs such as the Northern Contaminants Program (NCP, 2003) and the Arctic Monitoring and Assessment Program (AMAP, 1998, 2003, 2009) have been developed to conduct surveys and research on northern aboriginal groups such as the Inuit, Dene and Métis, but little research has been done on the more southerly, mid-north *Eeyouch*. For example, the relatively high concentrations of polychlorinated biphenyls (PCBs) and *p,p′*-DDE (a metabolite of the insecticide *p,p′*-DDT) found in the plasma of residents of Oujé-Bougoumou was unexpected (Dewailly and Nieboer, 2005) and has been confirmed for Mistissini in 2005 (Bonnier-Viger et al., 2007). Even within the NCP and AMAP programs, gaps are still identified in knowledge

[1] This chapter is reproduced with minor changes from the first report in this series (Bonnier-Viger et al., 2007).

about or activities related to: health consequences of not eating traditional food; sources of organochlorines (OCs) and other persistent environmental contaminants; regular monitoring or surveillance of contaminants in humans; assessment of traditional food consumption patterns and regional variations and trends; toxic effects of contaminants on northern people and related health problems; effects of nutrients such as fatty acids, selenium and Vitamin E on methylmercury metabolism and toxicity; research data enabling the review of Tolerable Daily Intakes (TDIs) for northern peoples; and further research to better formulate benefit-risk messages for the consumption of traditional foods, especially for women of reproductive age (NCP, 2003). These knowledge gaps hinder an adequate risk/benefit assessment of traditional lifestyle and traditional food intake and need to be filled for adequate recommendations to be provided to aboriginal populations.

This study therefore aims at providing quantitative information that will allow these issues in *Eeyou Istchee* to be addressed over a 5-year period of field work. This large-scale environmental-health study was set up in response to the Mercury Agreement (2001) (see Section 3.1.1) in an effort to provide a follow-up to two previous studies carried out in *Eeyou Istchee*: the Oujé-Bougoumou/Nemaska study (summarized in Section 3.1.2) and the Needs and Feasibility Study (see Section 3.1.3). The first community visited was Mistissini (summer of 2005) and constituted the pilot phase of the complete study. A report on the Mistissini findings was published in 2007 (Bonnier-Viger et al., 2007). The results for the communities surveyed/screened during the summer of 2007, namely Eastmain and Wemindji, are presented in the current document. Subsequently, field work was conducted in Chisasibi and Waskaganish during the summer of 2008, and in Whapmagoostui and Waswanipi during July/August 2009.

3.1.1 The Mercury Agreement

The dual objectives of the 2001 Mercury Agreement set out a broad vision for promoting fisheries restoration within the context of protecting the health of the population[2]. The role of the Public Health Authorities is explicitly described in relation to protecting the health of the population, and implicitly understood in relation to some of the provisions for the restoration of the fisheries.

The first and second Mercury Agreements in 1986 and 2001 were developed in recognition that the construction of the La Grande Project (Phase 2), the EM-1 and the proposed EM-1a and Rupert Diversion projects, are associated with certain economic development and environment-and-health concerns. The Agreements recognize the need to economically maintain and restore *Eeyou* fisheries within a context that addresses potential environment-and-health concerns. The 1986 Agreement committed a total of $18.5 million to health and environment monitoring and studies, preventive and remedial measures and socio-cultural aspects of mercury and monitoring. The health research proportion was set at $4.1 million. The 2001 Agreement committed a total of $24 million, including $16 million for fisheries restoration and $8 million for health-and-environment studies. With similar objectives for health and environment studies to the 1986 Agreement, it is written in much greater detail and sets out a more elaborate management plan for some types of activities.

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[2] The dual intent of the 2001 Mercury Agreement is spelled out in the first two objectives:

"to support Public Health Authorities in the development and delivery of programs designed to manage the risks associated with human exposures to mercury, in a manner consistent with this Agreement, with the technical and other information they would request or which would be significant in relation to this Agreement"; and

"to restore and strengthen the Cree fisheries in ways which respond to Cree aspirations and needs, but which also adequately take into account the health risks associated with human exposure to mercury and other contaminants and which deal in a responsible and reasonable manner with the management and conservation of fish resources in the James Bay Region."

The 2001 Mercury Agreement supports two types of health studies and related activities.

1) The first type falls within the elaborated management plan set out in Section [5.2.1] of the 2001 Agreement[3].

From Section [5.2.3]:

- a) "Monitoring of *Eeyou* exposure to mercury and other contaminants;
- b) Epidemiological and toxicological studies of *Eeyouch*;
- c) Investigation of the pattern of *Eeyou* exposure to mercury;
- d) Studies of the health benefits of fish consumption;
- e) Investigation of patterns of fish consumption in *Eeyou* society."

From Section [5.3.2]:

- a) "Monitoring of mercury levels in fish, wildlife or other food consumed by the *Eeyouch*"; and
- b) "Determination of contaminants, other than mercury, in fish, wildlife or other foods consumed by the *Eeyouch*".

2) The second group of studies/activities is managed by simple proposal and board decision, and include:

a) literature reviews, investigations of risk perception and evaluation of risk-assessment approaches, pertinent to mercury and other contaminants; and b) studies of fish harvesting and distribution, information campaigns to support and implement consumption advisories, attendance at conferences, support for nutrition and health registries and assistance in creating health-related data bases (Section [5.2.4]).

Although the role of the Public Health Authorities is only recognized in relation to Section [5], their involvement is also implied, although not mentioned, in relation to several types of activities described in Section [6] of the Agreement, which deals with fisheries restoration and development, specifically:

- Wildlife enhancement schemes;
- Enhancement of camp sites for fishing purposes;
- Technical training to establish local expertise in the types of measures contemplated herein;
- The perpetuation of traditional knowledge of fishing and related activities.

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[3] Section numbers in square brackets refer to the 2001 Mercury Agreement.

For example, a wildlife enhancement scheme must involve a thorough understanding of zoonoses; enhancement of camp sites has implications for maintaining water quality; technical training will obviously include provisions for monitoring and understanding the monitoring of contaminant levels in different lakes, species and sizes of fish, and in animals and humans; and the perpetuation of traditional knowledge of fishing and related activities will happen, as stated in the Agreement's second objective, within the context of protecting the population from mercury and other contaminants.

In summary, the Agreement sets out a comprehensive vision for promoting fisheries restoration within the context of promoting and protecting the health and well-being of the population. The role of the Public Health Authorities, and thus the CBHSSJB, is explicitly implied in Section [5] and implicitly understood in relation to some of the provisions in Section [6] for the restoration of fisheries.

3.1.2 Oujé-Bougoumou/Nemaska study

The core component of the multi-community study outlined below is based on the Oujé-Bougoumou/Nemaska study "Exposure and Preliminary Health Assessment of the Oujé-Bougoumou Cree Population to Mine Tailings Residues" (Dewailly and Nieboer, 2005). The latter was conducted primarily to determine whether Oujé-Bougoumou residents were at risk of taking in contaminants related to mine tailings, namely arsenic, copper, zinc, and selenium. An array of clinical chemistry and other measures that relate to aspects of individual and community health were also conducted. The observed measures were related to information obtained in a detailed questionnaire about the type and quantity of traditional foods consumed and other personal factors such as age, gender, living in the bush, participation in hunting, smoking habits and occupation among others. An unexpected finding was the high concentrations of PCBs and OC pesticides observed in blood plasma samples of *Eeyouch*, especially for the oldest participants (the over-40 group). This study raised concerns among community members regarding environmental quality and possible effects on human health and called for a follow-up, which led to the needs and feasibility study outlined below.

3.1.3 Needs and feasibility study

Eight of the nine *Eeyou* Communities (except Nemaska) and a number of *Eeyou* entities were visited during the period from the end of November 2003 to the end of March 2004. The purpose was to share with them recent developments within the CBHSSJB to reconstitute the Mercury Working Group, the objectives and findings of the Oujé/Nemaska study and to introduce core components of the proposed multi-community study described herein and to determine their interest and willingness to participate in it. The information and direction received during the community consultation was to be used to develop a more detailed project proposal (which led to the current project). In the communities, meetings were held with the Band Councils and feedback from individual community members was obtained in open house style meetings (in Waswanipi, Waskaganish, Eastmain and Wemindji) and by way of a radio phone-in show (Chisasibi and Whapmagoostui). Such a public meeting was neither planned nor held in Oujé-Bougoumou and could not be arranged during our short visit in Mistissini. On the whole, good support was received in all communities and from *Eeyou* entities.

The most common local environment-and-health concerns noted by the communities and the *Eeyou* entities were: addressing food safety issues such as contaminants and parasites in wild meats; assessing the quality of community drinking water; the importance of including PCBs and other organic contaminants in the screening due to the results found in the Oujé/Nemaska study; and respiratory issues related to the occurrence of high levels of blowing dusts and indoor air quality (especially the presence of moisture and moulds).

3.2 Objectives and Scope

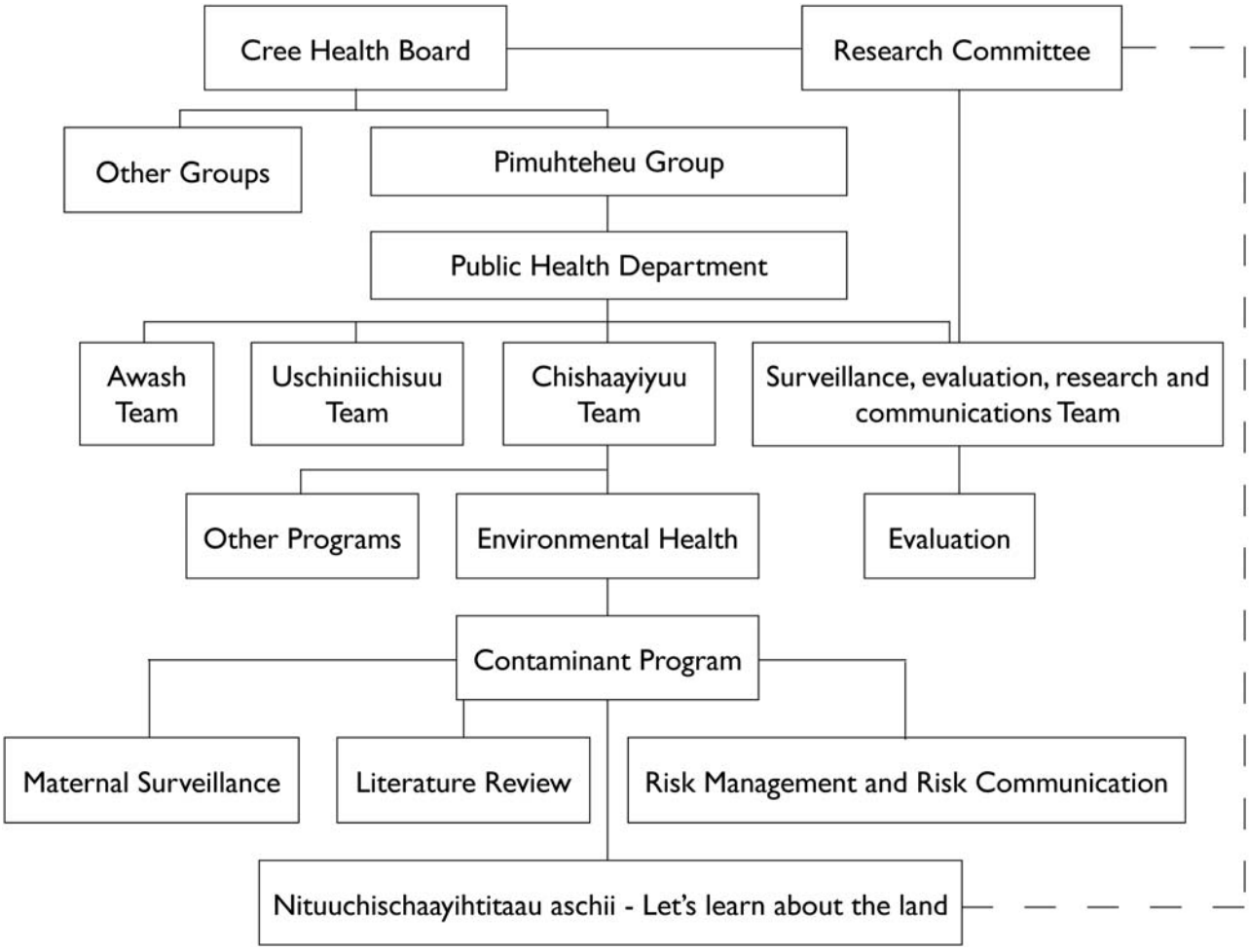
Because of the New Mercury Agreement, the CBHSSJB reconstituted its Mercury Program in the context of a more comprehensive environment-and-health program. One of the goals of the CBHSSJB is to set up long-term monitoring and surveillance activities that focus on exposure to and intake/body burden of mercury and other contaminants in the *Eeyou* communities. These activities are to be done in a manner that promotes community interest, and involvement in environment-and-health issues.

This project proposes to address several environmental-health issues as part of a core project, mainly based on the issues raised during the two previous studies, but also on the basis of known research gaps. It is being implemented over a five-year period of field work, with the 2005 assessment in Mistissini constituting its pilot phase.

3.2.1 Objectives, organization and logistics

Environmental health is one of six domains of public health in which regional public health departments are expected to develop programs and services as outlined in Quebec's National Public Health Program 2003-2012. Activities to prevent or reduce health effects of air and water pollution and of major development projects must be initiated, as well as programs to prevent exposure to toxic metals such as mercury and lead. The Public Health Department (PHD) and other workers in the CBHSSJB are also active in chronic disease prevention (diabetes, heart disease, osteoporosis, etc.) through the promotion of healthy lifestyles and environments, including the promotion of traditional and healthy diets. The organizational chart illustrated in Figure 3.1.1 shows where the current project fits into the environmental health mandate of the Public Health Department within the CBHSSJB. This project is clearly an important component of its contaminants program.

FIGURE 3.1.1 PLACEMENT OF THE MULTI-COMMUNITY STUDY WITHIN THE PUBLIC HEALTH DEPARTMENT OF THE CBHSSJB

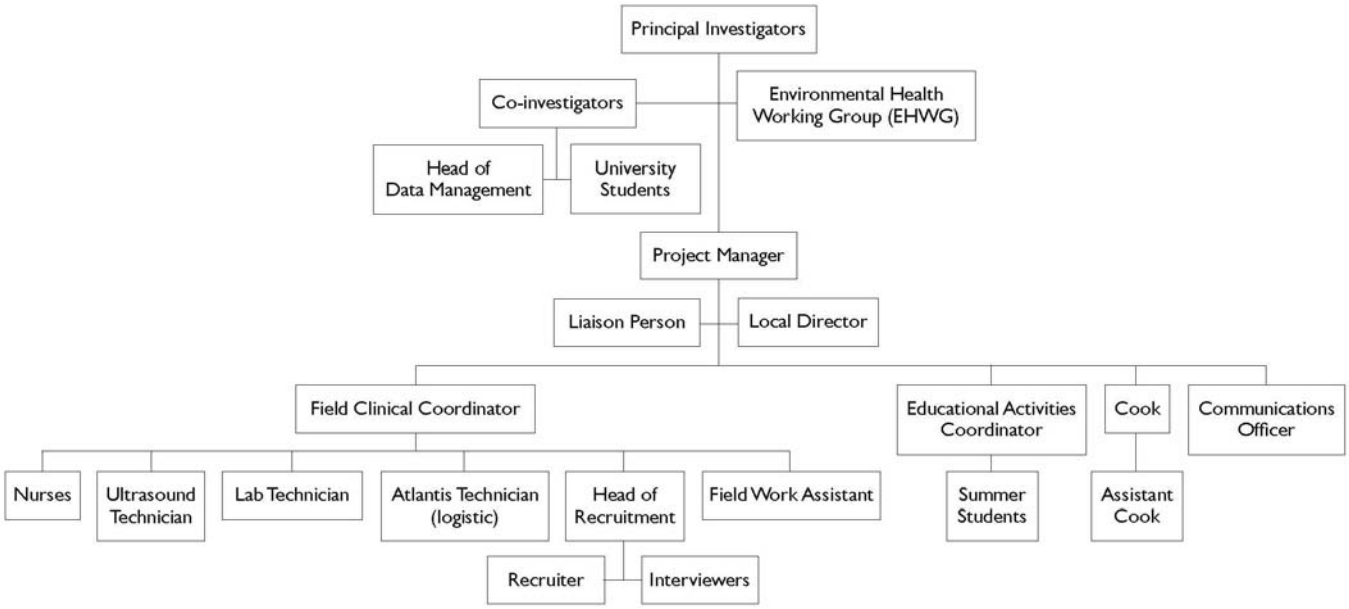


The main objectives of the project are to: assess consumption patterns of traditional and store-bought foods and their role in dietary adequacy; establish a baseline (for each community) for the exposure to mercury and other contaminants and related clinical biochemistry parameters; and facilitate community awareness about contaminants and their monitoring. Specific objectives of the project are outlined below.

1) Assess exposure to environmental contaminants and nutrient intake in relation to diet:
    - Investigation of consumption patterns of traditional and store-bought foods;
    - Assessment of environmental contaminant concentrations in blood/hair of *Eeyou* people and in traditional food items;
    - Assessment of concentrations of some essential nutrients in traditional food items and estimation of intake in the traditional *Eeyou* diet (e.g., selenium and fatty acids);
    - Assessment of the risks and benefits of the traditional diet with regards to contaminant versus nutrient content/intake.
    - Evaluation of the contribution of traditional food to dietary adequacy.
2) Investigate health effects in relation to lifestyle and environmental contaminants exposure:
    - Diabetes and fish/game and carbohydrates consumption;
    - Diabetes and environmental contaminant exposure;
    - Cardiovascular health, environmental contaminants and nutrition;
    - Osteoporosis in relation to exposure to persistent organic pollutants;
    - Endocrine effects in relation to environmental endocrine disruptors.
3) Investigate the links between wildlife health, quality of aquatic environments and human health:
    - Assess the risk of human exposure to zoonotic agents;
    - Investigate the contamination of freshwater ecosystems, the risks to human health and/or wildlife health.

To achieve the project's goals, a multi-institutional, multi-disciplinary and collaborative team has been constituted, and several sub-committees have been set up to take charge of the different aspects of the project (Figure 3.1.2).

FIGURE 3.1.2 PROJECT TEAM ORGANIZATION



With this partnership comes the expertise needed to design and conduct a study that integrates a large number of multidisciplinary activities. These include: bringing a research team along with a mobile laboratory into one or two of the communities for up to one month each year, thereby visiting all communities over a 5-year period; administering questionnaires concerning exposure, lifestyle, health, and traditional and store-bought food intake; clinical measurements and biological specimen collections; addressing community environment-and-health concerns such as parasites in traditional foods and worries about drinking water safety; and information and technology transfer on the community level. This approach is proposed to best incorporate sensitivity to the integrative life-and-world view of the *Eeyou* people, namely that there is no distinction between the well-being of the environment and human health.

The following sections describe in more detail each of the specific areas of research that are addressed in the project, including a rationale for specific research hypotheses to be addressed, as well as background information for each of the sections, when relevant.

3.2.2 Socio-demographic information

General socio-demographic parameters are important determinants of the health status of a given population. In order to be able to analyze and interpret the results obtained on environmental contaminants exposure and the nutritional and general health status of individuals, information is needed about the participants, including: gender, age, family size, etc., types of food consumed and how often, residency history and household property information, hunting and occupational details, and lifestyle issues (concerning exercise, smoking, etc.). These types of factors may affect the studied outcomes in one way or another. Furthermore, this information is also required for framing public health messages in a manner that will promote overall

nutritional health and food safety in the communities. This information is gathered with specifically designed questionnaires (mainly the individual and clinical questionnaires, see Section 4.3 and Appendix 1).

3.2.3 Dietary habits, nutritional status and lifestyle habits

The *Eeyouch* were subsistence hunters in the past, although as early as the 1700's fur trading brought a mixed economy and the introduction of western foods (Berkes and Farkas 1978). The *Eeyouch* depended on cooked meat and fish with plant sources such as blueberries, Labrador tea, pine needles and caribou stomach contents (Sinclair, 1953; Kerr, 1950). This diet was considered to be nutritionally adequate in the past (Sinclair, 1953). Recent articles by Cordain et al. (2005) and Ströhle et al. (2010) attempt to explain how the introduction of agricultural practices may have introduced foods responsible for the emergence of contemporary chronic diseases such as cardiovascular disease and diabetes (Cordain et al., 2005; Eaton et al., 2010; Ströhle et al., 2010).

Diet affects human health in several ways. Inadequate nutrient intake, excessive intake of fats and sugar, intake of harmful food additives and/or contaminants are all factors that may lead to adverse health effects. The environment-and-health study carried out here includes a strong dietary component, since exposure to environmental contaminants occurs mainly through dietary intake. Moreover, several health endpoints that are considered in this study may be affected by dietary habits, and therefore the latter need to be documented. Since there are no recent quantitative assessments of nutritional intake and status for *Eeyouch*, this study will document these important lifestyle aspects.

The study dietary component includes an assessment of the intake frequencies and amounts of traditional foods, some market foods, macronutrients and selected micronutrients in relation to recommended daily allowances for individual consumption. It also aims to determine the number of individuals having intakes below estimated average recommendations (EARs) or adequate intakes (AIs), as defined by the Dietary Reference Intakes (DRIs) (IOM, 2000a). This assessment is carried out through structured interviews and specifically designed dietary questionnaires (food frequency for market and traditional foods, 24-hour recall, Appendix 1).

3.2.4 Environmental contaminants

Toxic metals (lead, mercury, cadmium) and OCs (polychlorinated biphenyls, DDT, chlordane, mirex, etc.) are ubiquitous environmental contaminants that have been detected in biological samples from people throughout the world, and especially in aboriginal populations living at northern latitudes (Van Oostdam et al., 2005). In these populations, exposure to environmental contaminants mainly originates from the consumption of contaminated wild food, since these chemicals accumulate in the food chain. In addition to these legacy contaminants, new compounds of interest have emerged in recent years, including halogenated phenolic compounds (e.g., hydroxylated metabolites of PCBs, chlorophenols) (Sandau et al., 2000), brominated flame retardants (polybrominated diphenyl ethers, polybrominated biphenyls) (Birnbaum and Staskal, 2004) and perfluorinated compounds such as perfluoroctane sulfonate (PFOS), which was used as a water/stain repellent

(Houde et al., 2006). Exposure to environmental contaminants was reported in *Eeyouch* of the Oujé-Bougoumou and Nemaska communities of Quebec (Bussières et al., 2004; Dewailly and Nieboer, 2005). Therefore, one objective of this study was to characterize exposure of the *Eeyouch* of all communities to environmental contaminants, identify dietary sources of exposure and study possible relations with health endpoints.

In order to characterize the body burden of toxic metals and OCs, participants were asked to donate a blood sample for the analysis of lead, mercury and cadmium in whole blood and the analysis of the 14 most prevalent PCB congeners and 11 common chlorinated pesticides and metabolites in plasma. In addition, a hair sample was obtained for mercury analysis, and nail samples for selenium analysis. In order to measure the concentration of dioxin-like compounds (DLCs) in plasma samples, we used an *in vitro* bioassay referred to as DR-CALUX (the dioxin-receptor chemically-activated luciferase expression bioassay). This reporter-gene bioassay uses cells that express luciferase in response to the activation of the Ah receptor by dioxin-like compounds (DLCs). In presence of luciferin (luciferase substrate), the cells emit light proportionally to their exposure to DLCs (Pauwels et al., 2000; Ayotte et al., 2005). This method allows for the determination of DLCs at a fraction of the cost of the usual analytical method (high resolution gas-chromatography mass-spectrometry, HRGC-MS). We also tested the relationship between DLC concentrations measured by the bioassay and plasma PCB concentrations determined by HRGC-MS, since most of the dioxin-like toxic equivalents in plasma are contributed by PCBs (Ryan et al., 1997).

In the Mistissini pilot study, we also set out to determine the concentrations of 86 persistent organic pollutants (POPs) in pooled plasma samples of *Eeyouch*, in order to better characterise their body burden of old and emergent compounds of interest, and investigate the relationship of body burden to gender, age and fish consumption (Bonnier-Viger et al, 2007). Pooled samples were constituted for men and women, according to age (five categories) and fish consumption (three categories). We used a semi-automated extraction and purification procedure that yields several fractions containing the various analyses from a single plasma sample (5 mL). Fractions were analysed by HRGC-MS (Dumas et al., 2006). On this basis, the following emerging organic contaminants were added to the basic protocol; perfluoroalkyl compounds (PFOS, PFOA, PFHxS), polybrominated biphenyls (PBBs) and polybrominated diphenylethers (PBDEs).

3.2.5 Prevalence of selected biochemical, morphometric and medical outcomes

3.2.5.1 Metabolic syndrome, cardiovascular disease and diabetes

Chronic diseases are most often related to multiple causes, some of them preventable if the risk of developing a disease is identified early enough. The metabolic syndrome (Zimmet et al., 2001) represents a growing health concern since it precedes the onset of T2D as well as the development and progression of atherosclerosis and other cardiovascular diseases. It is mainly characterised by a general resistance of glucose and lipid metabolism to the action of insulin (termed insulin resistance), abdominal obesity, dyslipidemia (blood lipid imbalance) and high blood pressure (Zimmet et al., 2005).

In the last thirty years, socio-cultural and political changes along with large development projects have deeply affected the way of life of the *Eeyouch* of Northern Quebec. As a consequence of the results of a health survey carried out among the *Eeyouch* in 1982-1984 (Foggin et al., 1988), obesity, high blood pressure and diabetes were added to the list of major health problems, while they were almost unknown in the past. Preliminary results from studies carried out in the Inuit of Nunavik suggest that the coexistence of a traditional native diet rich in omega-3 fatty acids and the consumption of store-bought junk food made of refined carbohydrates (e.g., chocolate and soft drinks) might be a risk factor for the development of insulin resistance or diabetes among aboriginal peoples. These changes in risk-factor patterns are recent and are also expected in other aboriginal populations, such as the *Eeyouch*, due to the westernization of traditional diets. If these initial findings are confirmed in the *Eeyouch*, major discussions and decisions will have to take place in communities regarding dietary recommendations and food market policies.

Recently, some research groups have suggested that it is possible that exposure to some environmental contaminants may affect glucose and lipid metabolism (Heindel 2003; Grun and Blumberg 2006; Tabb and Blumberg 2006), even if such environmental exposure is not the main determinant (genetic background and lifestyle habits being important determinants affecting glucose and lipids). Also, the possibility that serum levels of PCBs and dioxin-like compounds could be causally related to the development of diabetes has been suggested, based on the observation that diabetics show higher than average concentrations of OCs in their serum when compared to non-diabetics in several populations exposed through different routes (Henriksen et al., 1997; Pesatori et al., 1998; Calvert et al., 1999; Cranmer et al., 2000; Longnecker and Michalek 2000; Longnecker and Daniels 2001; Steenland et al., 2001; Remillard and Bunce 2002; Fierens et al., 2003; Glynn et al., 2003; Rylander et al., 2005; Vasiliu et al., 2006). An alternative interpretation of the latter observation is that diabetes alters pharmacokinetics and consequently also serum OC concentrations (i.e., reverse causation) (Longnecker et al., 2001; Fierens et al., 2003). However, evidence for the causal relationship of POPs to diabetes was brought forward in a recent study carried out in Michigan in which diabetes status was related to exposure levels prevailing before the onset of the disease. This rendered the possibility of reverse causation unlikely (Vasiliu et al., 2006). The need for additional systematic studies remains today (see Rignell-Hydbom et al., 2009 and Turyk et al., 2009 for updates). These findings warrant further studies and may have special relevance for *Eeyouch*.

One aim of the present component of the *Nituuchischaayihtitaau Aschii* program is therefore to evaluate various risk factors for cardiovascular disease (CVD), namely obesity, dyslipidemia, fasting hyperinsulinemia and glycemia, in relation to n-3 (omega-3) poly-unsaturated acids (PUFAs) measured in erythrocyte membranes. These analyses are carried out in order to assess the possible effects of increased dietary carbohydrate intake, combined with elevated n-3 PUFAs from fish consumption, on the development of the metabolic syndrome. Another aim is to assess the possible relationship of environmental contaminant exposure to CVD and, as implied above, to diabetes, obesity and the metabolic syndrome as well.

3.2.5.2 Endocrine disruption

Exposure to environmental contaminants has also been related to disruption of several endocrine functions, namely disruption of steroid hormones (sex hormones) (De Rosa et al., 1998; Sonnenschein and Soto, 1998) and thyroid hormones (Langer, 2005). The design of the current study unfortunately does not allow a thorough evaluation of sex-hormone disruption (such as the serial sampling of urine and blood for hormonal cycle determinations). Nevertheless, one health endpoint related to sex-hormone disruption is being investigated in peri-menopausal women (specifically, osteoporosis) since this has been related to exposure to OCs in an earlier study (Côté et al., 2006). Additionally, the status of thyroid hormone homeostasis is investigated in men and women because disruption of thyroid hormones has been reported in experimental studies (Brouwer et al., 1998; Schuur et al., 1998a; 1998b, 1998c; Cheek et al., 1999), as well as in human populations (Koopman-Esseboom et al., 1994).

3.2.6 Exposure to microbial and zoonotic agents

3.2.6.1 Food safety: exposure to zoonotic agents

The aim of this study component was to determine the seroprevalence of eight zoonoses in *Eeyou* hunters and trappers to verify their exposure to these microorganisms. Due to their non-specific presentation, most of the infections investigated in this study are under-reported and often go unnoticed. Data were collected in the summer of 2005 from 50 subjects (active hunters/trappers and their spouses), and in 2007 from all participants 15 years or older (n = 251) in Wemindji and Eastmain. Eight zoonotic infections were investigated within the scope of the Mistissini study (Lévesque et al, 2007). Ten zoonotic infections were studied in Wemindji and Eastmain: 3 bacteria [*Coxiella (C.) burnetii, Francisella (F.) tularensis*, and *Leptospira sp];* three viruses [Sin Nombre virus, and the California serogroup viruses Jamestown Canyon (JC) and snowshoe hare (SSH) viruses]; and four parasites [*Trichinella sp., Toxoplasma (T.) gondii, Toxocara (T.) canis,* and *Echinococcus (E.) granulosus]*.

Hantavirus (Sin Nombre virus) infection was included in the study following a first-reported case in Mauricie. The other infections have been documented in the province of Québec (Lévesque et al., 1995; Tanner et al., 1987) and northern Canada (Lantis, 1981).

Leptospirosis, Q fever, trichinosis, tularemia, and more recently hantavirus infection, are included in Québec's Epidemiological Surveillance System for Mandatory Reportable Diseases (Maladies à déclaration obligatoire – MADO). However, from 1985 to 2005, none of these diseases was reported to the public health authorities in the Cree Territory (i.e., the Cree Board of Health).

3.2.6.2 Water microbiology

In the field of water microbiology, there is a need for more rapid, sensitive, specific, and affordable tests for microbial contamination, since water is an important route of transmission for some of the most widespread and debilitating diseases that afflict humans (Reiff et al., 1996). Two types of water samples were studied to evaluate the risk posed to human health: environmental samples from sites suggested by community officials, and water from storage containers with which community members collect water from natural sites. Microbial

indicators, including fecal contamination indicators and selected human pathogen microorganisms, were tested primarily by classical culture-based methods (whenever possible), but also by more rapid, specific, and adaptable molecular amplification methods.

3.3 Ethics and Confidentiality

This project involves a partnership between individual *Eeyou* First Nations, the Cree Board of Health and Social Services of James Bay, the Institute national de santé publique du Québec, Laval University, McGill University, and McMaster University. The project partners also collaborate with the Traditional Pursuits Department of the Cree Regional Authority, and to a lesser extent with the Cree Trappers Association and the Cree School Board. The latter is a partner in one of the project components, namely a science educational project for youth and students.

The project partnership between the CBHSSJB and the Universities is in the process of being formalized through a research agreement/memorandum of understanding defining the obligations and responsibilities of institutional research partners in relation to ownership of data and processes around publication. A draft agreement had been negotiated at the time of this field work in 2007, but it was held up by the CBHSSJB who first wanted to complete a novel model agreement for a project concerning anti-diabetic traditional medicine plants. The specifics of that project put a special focus on intellectual property, traditional knowledge and the potential for commercialisation. It is a complex agreement which the CBHSSJB is using as a model for all subsequent ones. As a result, that agreement has not only held up, but redefined the agreement for this project.

The issues of concern with this environment and health project focus on data management and control, as well as the whole process of developing and implementing collaborative processes for determining the issues of interest within the analysis of the data, for jointly interpreting the results for both the interests of *Eeyou* public health and academic interests, and for developing new normative patterns for planning, approving and disseminating publications. Lastly, as more analysis becomes possible as the data base grows, the project will put increasing efforts on translating these findings into actions, whether at the level of the *Eeyou* communities, the *Eeyou* region, or Québec as a whole. This is just beginning as the results from the Eastmain and Wemindji studies are being analysed and compared with those from Mistissini in 2005 and the earlier project from Oujé-Bougoumou and Nemaska in 2002.

The agreement will be signed by the institutions – the CBHSSJB, Centre Hospitalier Universitaire de Québec (CHUQ), McMaster University and McGill University – and it will cover the entire period of the study from 2005. At the same time, we have negotiated with the communities of Oujé-Bougoumou and Nemaska to incorporate denominalized data from their study (Dewailly and Nieboer, 2005) into the *Nituuchischaayitaau Aschii* database so that all of the communities are included in this environment and health survey. Thus, the data from those communities will also come under the terms of the agreement, some of which will continue to exist long after the end of the project.

Each year of this study, the proposal from 2005 is slightly revised. Although the study had made provision in 2005 to review the medical charts of consenting participants, it was only in 2007 during the analysis phase that this was deemed pertinent in order to understand underlying medical conditions and the use of medications that could be influencing certain laboratory results. The Mistissini chart review was done in 2007, while that of Wemindji and Eastmain was done during the field-work that same year.

The revisions to the proposal, along with minor revisions to the 2005 consent forms are submitted to and accepted by the Research Ethics Boards of Laval University and McGill University and shared with the Research Ethics Board of McMaster University, as well as with the Research Committee of the CBHSSJB.

Community consent is obtained through a formal Band Council Resolution. There is provision in the draft Research Agreement for the communities to control the use of their name in any publication or report published for an audience outside of *Eeyou Istchee*. As well the communities also continue to have a say, past the end of the project, in any subsequent agreements concerning the data.

Individuals sign consent forms. Four separate consent forms and information sheets were prepared for the following age groups: 0-7, 8-14, 15-17 and adults aged 18 years and older (see Appendix 2). Consent for those in the first two age groups is given by the child's guardian. Because of the complexity of the project, the challenge during the Mistissini pilot project was to explain the project in plain language and translate it into Cree while not making it too long. In Wemindji and Eastmain, a mixed media format was used. A DVD was prepared that presented the consent in either Cree or English and, while listening, the participant viewed pictures of tests or equipment as these were being mentioned in the consent. A video was also prepared for the waiting room to show participants various aspects of the entire project such as the work from inside of the laboratories.

The project has developed very explicit and detailed processes for maintaining confidentiality of information. An alphanumeric code is used to catalogue and identify questionnaires and biological samples. The participant's name does not appear on any documentation except on master sheets that link these data records to the names of individuals. These master sheets are kept confidentially by the Public Health Department of the CBHSSJB and only the individual in charge of data management for the entire project has access to them. Access to them is needed when returning results to individuals and to clarify errors as the data is being cleaned. At the end of the complete project, these master sheets will be destroyed.

Results are returned to the participants through several processes. During the actual tests, the participant is given a study 'passport' where the results, primarily of body measurements and blood pressure, are recorded directly. The person leaves with their 'passport'. Later, every participant receives one or more letters informing them about other test results which are sent out as they become available (because some of the more complex tests for contaminants are very slow to become available). For those participants who on the consent form authorize the investigators to send their abnormal results of blood and other medical tests to the local

community health center as well as to them personally, there is a follow-up of abnormal results by the clinic and the results become a part of the person's individual medical chart.

To send out the results to individuals, the data manager identifies the individuals from their study code number by linking it to their name on the confidential master list. He then prepares the letters. All the results which are outside of normal are reviewed by a public health doctor involved in the study. More complex cases are then followed up with the clinics. The individual zoonoses and clinical questionnaires were managed electronically with tablet computers. Capturing the information electronically minimizes errors, enhances confidentiality, and speeds up the data management process. However for the food questionnaires, paper copies were still used, and the information was subsequently entered into the electronic database.

The CBHSSJB manages the growing data bank for this project. The denominalised data is kept on a secure server in Chisasibi and it can be accessed by the researchers with a code through the internet. This system is working very well. At the end of the project, this denominalised data will be stored in the secure long-term data storage of the Public Health Department surveillance unit. There is provision in the Research Agreement for the researchers and the CBHSSJB to continue in relationship after the formal ending of the project in order to continue to exploit this rich data base for the benefit of the *Eeyou* communities and the research community.

Now that the results from Eastmain and Wemindji have become available, the analysis phase of the project, which began with the community consultation process in 2003-4, is finally beginning. Over the next few years, this will give the appearance of an 'explosion' of information from the project as the data from the other four communities come on line. The ethical challenge in this final phase of the project is to build the processes for a real collaboration between university-based research scientists and public health professionals to ensure that the results are used to help improve the health and living conditions of *Eeyouch* and to apply what has been learned to other communities. This is an extremely difficult challenge, but in the end it will justify the project.

4. FIELD STUDY AND STATISTICAL METHODS

4.1 Overview

This chapter presents the various protocols employed in the fieldwork. Although the methods used for each study component are described in separate sections, the details about recruitment, participation, various questionnaires and statistical treatments used are presented in an integrated fashion.

4.2 Study Population, Recruitment, Ethics and Confidentiality

4.2.1 Study population and sampling for the complete study

The complete study will focus primarily on 7 of the *Eeyou* communities, namely: Mistissini (pilot study; Bonner-Viger et al., 2007), Wemindji and Eastmain (focus of this report), Waswanipi, Waskaganish, Chisasibi, and Whapmagoostui. Chisasibi and Waskaganish were the two target communities for 2008, and Whapmagoostui and Waswanipi in 2009. Oujé-Bougoumou and Nemaska were studied in 2002 (Dewailly and Nieboer, 2005), and permission has been obtained from these two communities to combine their data with that of the current *Nituuchischaayihtitaau Aschii* study. However, the current protocol includes more health measures (e.g., bone density, heart variability, carotid artery ultrasound) and contaminant estimates (specifically, dioxins, furans and emerging contaminants).

The sample size targeted for the complete study was estimated in two ways. First, using general data of urinary arsenic determinations obtained from the Laboratoire de toxicologie de l'INSPQ. The arithmetic mean (0.25 μmol/L) and the standard deviation (0.11) of arsenic concentration in urine of non-exposed people (standard) have been used, with a statistical power of 80% (a 0.20 risk of type II error), and a 0.05 risk of type I error (two-sided test). Based on these data, it was estimated that 200 exposed (Oujé-Bougoumou) and 100 non-exposed (Nemaska) participants would allow us to detect significant differences in metal concentrations between groups. Second, using the same power and type 1 error conditions for Aroclor 1260, a geometric mean of 1.32 μg/L and a standard deviation of 1.09 μg/L (corresponding to 134 Caucasian females living in the western Canadian arctic), a minimum of 20-30 individuals in each age/gender group are required to detect a two-fold difference. On this basis, and the actual Oujé/Nemaska study experience, the plan was to sample a minimum of 150 individuals in the smallest community (Eastmain) and 300 in the largest (Chisasibi). More specifically, the following are the target numbers: 150 (Eastmain), 160 (Whapmagoostui), 200 (Wemindji and Waswanipi), 250 (Waskaganish) and 300 (Mistissini and Chisasibi). This brings the projected total to 1560.

4.2.2 Sampling and recruitment in Eastmain and Wemindji

The communities of Wemindji and Eastmain were successively visited during the summer of 2007. Sampling of the population followed a stratified design, considering the following age categories: children between 0 and 7 years old, children between 8 and 14 years old, adults between 15 and 39 years old, and adults over 40 years old. The selection of participants within each age stratum was done using simple random sampling, without replacement in order to build the lists of potential participants to be contacted by recruiters.

Weights were attributed for each stratum in order to ensure adequate population representation. The number of participants selected took into account the actual participation rate of 60% obtained during the Mistissini pilot study.

A first list of potential participants was randomly selected without replacement from the *Eeyou* Beneficiaries List for recruitment in both Wemindji and Eastmain. Based on the refusal rate, a second backup list of participants was again randomly selected using the reduced beneficiary list, excluding the individuals contacted from the first list. This approach was adopted in order to continue recruitment and to meet the target number of participants in each age category.

The *Eeyou* beneficiaries list information was updated, as needed, by qualified local research assistants who also worked as recruiters. These individuals were fluent in *Eeyou Ayimuwin* and English, and were recruited from the local community. Local radio announcements and local publicity were employed to generate and maintain public interest in the project. The local recruiters were responsible for the phone contacts and inviting the randomly selected residents to participate in the research project; they also arranged and supervised appointments. All of these steps were supervised by a field coordinator and the head interviewer.

A total of 557 *Eeyouch* from Wemindji and Eastmain were contacted, of which 352 participated (63%) voluntarily and completed the study (Tables 4.2.1A,B). The participation rate was 65.2% for Wemindji and 60.7% in Eastmain. The recruitment and participation details are summarized in Tables 4.2.2A,B.

TABLE 4.2.1A TOTAL POPULATION SIZE AND PARTICIPANTS IN THE CREE COMMUNITY OF WEMINDJI (STRATIFIED BY AGE)

Age group	Population	Invited	Participants
0-7 years	176	39	31
8-14 years	170	39	29
15-39 years	515	156	87
≥40 years	317	76	55
Total	1178	310	202

TABLE 4.2.1B TOTAL POPULATION SIZE AND PARTICIPANTS IN THE CREE COMMUNITY OF EASTMAIN (STRATIFIED BY AGE)

Age group	Population	Invited	Participants
0-7 years	62	17	16
8-14 years	90	35	23
15-39 years	269	135	70
≥40 years	171	60	41
Total	592	247	150

TABLE 4.2.2A RECRUITMENT AND PARTICIPATION DETAILS FOR THE COMMUNITY OF WEMINDJI (STRATIFIED BY AGE)

Age group	Contacted n	Out of the village n	Refused n	Other reason[a] n	Withdrawn n	Participants n
0-7 years	39	0	8	0	0	31
8-14 years	39	5	3	2	0	29
15-39 years	156	11	41	17	0	87
≥40 years	76	4	13	4	0	55
Total	310	20	65	23	0	202

a. Deceased, pregnant, unknown, not shown, disabled, too old

TABLE 4.2.2B RECRUITMENT AND PARTICIPATION DETAILS FOR THE COMMUNITY OF EASTMAIN (STRATIFIED BY AGE)

Age group	Contacted n	Out of the village n	Refused n	Other reason[a] n	Withdrawn n	Missing	Participant n
0-7 years	17	0	1	0	0	0	16
8-14 years	35	3	7	1	0	1	23
15-39 years	135	11	42	10	0	3	70
≥40 years	60	6	8	5	0	0	41
Total	247	20	58	16	0	4	150

a. Deceased, pregnant, unknown, not shown, disabled, too old

4.3 Questionnaires

The relationship between environmental contaminants and diet on the one hand, and health endpoints on the other, is affected by many parameters related to lifestyle. It is essential that these be documented within the framework of an environment-and-health study. In order to document these parameters the individual and clinical questionnaires were designed to collect information on lifestyle, occupational details, socio-demographic situations, self-reported health endpoints, etc. Dietary habits were documented using specially designed questionnaires, and handling of animals was assessed by the Zoonoses Questionnaire. The information for the Individual Questionnaire, which included the Zoonoses Questionnaire, and two questions from the Clinical Questionnaire were entered directly on a tablet computer using an automated sequence programmed in Microsoft Access.

4.3.1 Individual questionnaire

An individual exposure/lifestyle questionnaire was designed and adapted for the specific purpose of this study. Questions were asked of participants 8 years old and over about the following issues: general socio-demographics (e.g., gender, age, level of schooling, etc.), residency/household information (e.g., number of bedrooms, etc.), occupational details (e.g., working status and type of job.), hunting activities with a focus on the use of leaded ammunition, lifestyle issues (e.g., source of drinking water, smoking, etc.), perception of environmental pollution, handling of animals in relation to zoonoses for participants aged 15 years old and over, and physical activity for participants aged 15 to 69 years.

This questionnaire was administered by a local interviewer, either in *Eeyou Ayimuwin* or in English. The physical activity questionnaire is a previously validated tool to estimate physical activity (IPAC, 2005a,b). It is described in more detail in section 4.8, and was incorporated in the individual questionnaire (see Appendix 1).

4.3.2 Clinical questionnaire

A clinical questionnaire was designed and adapted for the specific purpose of this study. It was administered to women only, aged 15 years or more. It covered women's health. This questionnaire was administered by a research nurse in English, assisted by a local interpreter if the questionnaire was administered in *Eeyou Ayimuwin*. A copy is provided in Appendix 1.

4.3.3 Dietary questionnaires

Dietary intake was assessed using two semi-quantitative food frequency questionnaires (FFQs) of traditional foods (i.e., consumption of game animals, fish, birds and berries taking into account seasonal variations) and some market (store bought) food items. In addition, one 24-hour recall and repeat recalls on non-consecutive days for a 20% sub-sample were also attempted in order to model usual daily intake to evaluate adequacy (IOM, 2003). Interviewers/translators were selected from local communities and received appropriate training in dietary assessment techniques. As a quality control measure, all completed questionnaires were reviewed by research team members to ensure all questions were answered adequately and appropriately. Copies of the questionnaires are provided in Appendix 1.

4.3.4 Zoonoses questionnaire

Some diseases are carried by animals and may be transmitted to humans by contact, handling and consumption of meats and organs. Transmission of a disease from animals is referred to as zoonoses. The zoonoses questionnaire explores the contact with animals through cleaning, gutting and skinning. The presence of pets in the home is also ascertained. A copy is provided in Appendix 1 as part of the Individual Questionnaire.

4.4 Interviews and Biological Sample Collection

The interviews and collection of biological samples took place from June 4 to 30, 2007 (Wemindji) and August 3 to 21 (Eastmain). The randomly selected participants were contacted, informed about the study and their participation was requested. If consent to participate was granted, the participant was given instructions to fast overnight and an appointment was scheduled within the following days. The local interviewers assisted each participant in completing the appropriate written consent form, which was available only in English, and the various questionnaires (Appendix 1). If the participant was under 18 years of age, one of the parents or the guardian was invited to sign the informed consent form.

For participants 0 to 7 years old, blood sampling was carried out for the measurement of lead concentrations and hair sampling for mercury body burden assessment. Participants 8 years of age or over were asked to fast overnight, and during the next day's visit to the clinic, body weight, height, waist and hip circumferences and sitting height were measured and recorded by the research nurse using standardized techniques (see Section 4.6). The research nurse also collected blood, toenail and hair samples, and blood pressure/pulse and body impedance were measured. Following the blood test, a meal/snack was provided to all participants. Oral temperature was taken of all participants 15 years or over as part of the zoonoses protocol. Furthermore, the following assessments were undertaken: an ultrasound bone densitometry for women 35 to 74 years old; an ultrasound of the left and right carotids for participants 15 years old and over; and heart rate variability for participants 15 years old and over. This visit lasted approximately two and a half hours, and it was possible to schedule it either during the morning or the afternoon. As indicated, all blood samples were taken under fasting conditions. A time-reimbursement was provided to the participants at the end of their visit, and a few visits were done at the homes of participants who were not able to come to the clinic (e.g., seniors) or who requested the service. All clinical tests are summarized in Table 4.4.1, and a fuller description of the anthropometric measurements and clinical tests is provided in Section 4.6.

Six Vacutainers® of blood for a total of 43.5 mL were collected from each participant aged 15 years and over. The vials of blood were collected for the determination of the contaminants of concern, selected biochemical parameters, and markers of CVD and zoonoses. For participants 7 years old and younger, one 3-mL Vacutainers® was collected for lead assessment. For those 8 to 14 years old, a total of 19 mL was collected for the determination of the contaminants of concern, glucose, and insulin in plasma (see Table 4.2.2 for details). Biological samples (whole blood, plasma and urine) were temporarily stored in a freezer at either -20^{o}C or -80^{o}C. Urine samples (10 mL) were collected from participants aged 8 years and over to measure inorganic

arsenic, iodine and creatinine. All biological samples that were not analyzed aboard the mobile laboratory were shipped to Quebec City, where they were kept in a freezer at ≤-80°C at the Public Health Research Unit, Université Laval Medical Research Center, CHUQ, Québec. Assays of samples were restricted to information contained in the consent form.

For the hair samples, strands (about the length of a pen) were cut close to the scalp from the occipital region of the head by the research nurse. A haemostatic clamp was used to squeeze the hair sample to avoid any movement when cutting and when inserting the specimen into a plastic bag. The latter was stapled to avoid any movement during transportation and handling and was tagged with the participant's identification number, his or her birth date and the sampling date. The proximal end of the hairs (near the scalp) was clearly identified to allow the identification of the segments to be analyzed. Hair samples were obtained from every age group. A summary of biochemical and chemical analyses carried out on biological samples is provided in Table 4.4.2 and fuller descriptions of laboratory methods are provided in Section 4.5.

TABLE 4.4.1 SUMMARY OF CLINICAL TESTS BY AGE GROUP

Age group	Informed consent form	Individual questionnaire (including zoonoses)	Clinical questionnaire (women only)	24-hour recall and 2 Food Frequency Questionnaires (FFQs)	Blood sampling: Contaminants	Blood sampling: Clinical biochemistry	Hair sampling	Toenails
0-7 years old	√				Lead only		√	
8-14 years old	√	√		√[1]	√	√[2]	√[3]	√
≥15 years old	√	√[4]	√	√	√	√	√	√

1. 24-hour recall and FFQs (traditional and market) from 9 years old and over
2. Only plasma glucose and insulin, total lipids and fatty acid profile (including omega-3)
3. Added arsenic for ≥8 years old (third cm)
4. Section on physical activities to be administered to participants aged 15-69 and zoonoses to participants aged ≥15 years old

Age group	Urine (inorganic arsenic, iodine, creatinine, metabolites of contaminants)	Blood pressure/pulse	Height/weight and circumferences: waist/hip, sitting height	Body composition	2-hour Holter	Ultrasound bone densitometry	Ultrasound carotid	Oral temperature	Blood sampling: Zoonoses
0-7 years old									
8-14 years old	√	√	√	√					
≥15 years old	√	√	√	√	√	√ if a woman and ≥35-74	√	√	√

TABLE 4.4.2 SUMMARY OF CLINICAL BIOCHEMISTRY AND ENVIRONMENTAL CONTAMINANTS ANALYSES

Age group	Lead (whole blood)	Cadmium, total mercury, selenium, cobalt, copper, molybdenum, nickel, and zinc (whole blood)	Selenium (toenail)	Total mercury (hair 1st cm)	POPs (PBBs/OCs/PBDE/ Toxaphenes)	PFOS/PFOA/ PFHxS	Dioxin-like compounds (CALUX)	PON-1
0-7 years old	√			√				
8 years old and over	√	√	√	√ + arsenic (3rd cm)	√	√	√	√

Age group	Blood lipids (cholesterol, HDL, LDL, TG), total lipids, LDL phenotype	Glucose [1]	Insulin[1]	T3, T4, TSH	Inflammatory markers (TNF- α, CRPs, IL-6)	Oxidized LDL	Urine (inorganic As, iodine, creatinine, metabolites of contaminants)	Apoproteins (Apo A1, Apo B-100)
8-14 years old	Total lipids only	√	√				√	
15 years old and over	√	√	√	√	√	√	√	√

1. The samples are to be collected after 8-hour fast

Age group	Fatty acids, *trans*-fat in erythrocyte membranes	White cells	Vitamins D, E, β-carotene	Zoonotics *(Francisella tularensis, Coxiella burnetii, Leptospira* sp, Hantavirus, California virus, *Trichinella* sp, *Echinococcus, Toxocara, Toxoplasma gondii*, and *Cryptosporidium*)
8-14 years old	√			
15 years old and over	√	√	√	√

4.5 Laboratory Analyses[3]

4.5.1 Environmental contaminant determinations

Toxic metals (lead, mercury, cadmium) and organochlorines (polychlorinated biphenyls, dioxins, DDT, chlordane, mirex, etc.) are ubiquitous environmental chemicals that have been detected in biological samples from people throughout the world. In addition to these "old" contaminants, new compounds of interest have emerged in recent years, including halogenated phenolic compounds (e.g., hydroxylated metabolites of PCBs, chlorophenols), brominated flame retardants (polybrominated diphenyl ethers, polybrominated biphenyls) and perfluorooctane sulfonate and related fluorinated compounds. In order to characterise the body burden of environmental contaminants in *Eeyouch* living in Eastmain and Wemindji, participants donated a blood sample for the determination of the following: lead, mercury and cadmium in whole blood; and in blood plasma, the 14 most prevalent PCB congeners, 13 common chlorinated pesticides and their metabolites, 5 brominated organic compounds (the PBBs and PBDEs flame retardants), and 3 perfluorinated compounds (PFOS, PFOA and PFHxS) in blood plasma. Additionally, the concentrations of dioxin-like compounds (DLCs) in individual plasma samples of the *Eeyou* participants were assessed using a reporter-gene cell-based assay, namely the dioxin-receptor chemically-activated luciferase expression assay (DR-CALUX) (Ayotte et al., 2005; Pauwels et al, 2000). This method allows the determination of DLCs at a fraction of the cost of the usual high resolution mass spectrometric analytical method (HRGC-MS). A hair sample was also obtained for mercury and arsenic analyses, and nail samples for selenium analysis. Finally, a spot urine sample was obtained from each participant for arsenic, iodine and creatinine measurements. In the following subsections, the detailed analytical methods for contaminant measurements in the different matrices examined are described.

Toxic metals and persistent organic pollutants analyses were carried out by the INSPQ Human Toxicology Laboratory, which is accredited ISO 17025 by the Standards Council of Canada. The Toxicology Laboratory is also an international leader in analytical toxicology applied to human and environmental monitoring studies and a reference institution for interlaboratory comparison programs in toxic metals and organochlorines measurements. Hair mercury analyses were carried out onsite in the analytical toxicology module of the Mobile Laboratory, which was operated by the staff from the INSPQ Human Toxicology Laboratory. The DR-CALUX assay was performed in the Biomarker Research Laboratory of the INSPQ, which is located in the Human Toxicology Laboratory of the INSPQ.

[3]Method details of the zoonoses seroprevalence work are presented in Chapter 6 and of the microbial analyses of potable drinking water in Chapter 7

4.5.1.1 Metal and metalloid analyses in biological samples

Concentrations of lead (Pb), mercury (Hg), cadmium (Cd) and the other elements identified in Table 4.4.2 were determined in whole blood samples from individual participants by inductively coupled plasma mass spectrometry (ICP-MS), which allows the simultaneous determinations of several metals in their elementary form in various matrices. Blood samples are diluted in ammonium hydroxide and metals are brought to their elementary form by aspirating the sample into an argon plasma before being identified by mass spectrometry. All samples were analysed employing a Perkin Elmer Sciex Elan 6000 ICP-MS (DRC II for Hg) instrument. Detection limits were: 0.04 nmol/L for cadmium, 0.001 µmol/L for lead, 0.49 nmol/L for mercury, and 0.09 µmol/L for selenium.

Hg concentrations were also determined in hair samples. Two 1-cm segments were analysed. Hair mercury was determined by cold vapour atomic absorption spectrometry on a Mercury Monitor Model 100 instrument from Pharmacia. Each hair segment was chopped and microwave-digested using nitric acid. An aliquot was used in the actual analysis step. Accuracy and precision were measured using reference materials used in the Toxicology laboratory's Interlaboratory Comparison Program. Also, external quality control was achieved by participation in the "Programme de comparaison interlaboratoire du mercure dans les cheveux, Santé Canada, Ottawa". The detection limit with this method was 0.41 nmol/g (0.082 µg/g).

Hair samples were also analysed for arsenic (As) by ICP-MS. Samples were digested in concentrated nitric acid and then diluted twenty-fold with deionised water. An internal standard is added for improved precision. Calibration is performed under aqueous conditions. The detection limit was 0.01 µg/g with a relative coefficient of variation (CV) of 4.9%.

Selenium concentrations were also determined in toe nails by ICP-MS. Samples were digested in concentrated nitric acid and then diluted twenty-fold with deionised water. An internal standard is added for improved precision. Calibration is performed under aqueous conditions. The detection limit was 0.09 µg/g with a relative CV of 14%.

Iodine and As concentrations were determined in spot urine samples. Iodine was analysed by ICP-MS after diluting the urine specimens in a basic solution containing ammonium hydroxide. Matrix matched calibration was used. The detection limit was 0.1 µmol/L with a relative CV of 5%.

Urine inorganic As was determined by ICP-MS. The different arsenic species of interest are extracted using toluene and back-extracted into dilute nitric acid. The detection limit was 0.1 µmol/L and relative CV is 5%.

4.5.1.2 Organochlorine and organobromine analyses in plasma samples

Concentrations of 14 PCB congeners, 13 organochlorine compounds (OCs) and 5 organobromine compounds were determined in individual plasma samples (see Appendix 3). PCBs IUPAC #: 28, 52, 99, 101, 105, 118, 128, 138, 153, 156, 170, 180, 183, 187, aldrin, α-chlordane, γ-chlordane, *cis*-nonachlor, *p,p′*-DDE, *p,p′*-DDT, hexachlorobenzene, mirex, oxychlordane, transnonachlor, β-HCH, and toxaphene (congeners parlar 26 and 52) were measured in plasma by GC-MS (INSPQ Method E-446) according to the following protocol. Blood samples (16 mL) collected in a vial containing EDTA were centrifuged (10 min, 3000 rpm) and the plasma was transferred into pre-cleaned glass vials and frozen until further processing. Samples were thawed, enriched with internal standards and denaturated with formic acid. Organohalogenated compounds are automatically extracted from the aqueous matrix using solid-phase extraction. Extracts are cleaned up on florisil columns and then analyzed by HRGC-MS. The instrumentation consists of an Agilent 6890 GC coupled with an ECD detector (Agilent G2397A) and a mass detector (Agilent 5973 Network). Ions generated are measured after negative chemical ionization. The limits of detection (LODs) are based on a signal-to-noise ratio of 3:1 employing the MS detector for all OCs except PCB-28 and PCB-52, for which they are derived from the ECD detector signal. Percent recovery ranged from 60% to 75%. The LODs were less than 0.05 µg/L for all compounds except for PCB-52 (LOD = 0.3 µg/L; Appendix 3).

4.5.1.3 Perfluoroalkyl compounds analyses in plasma samples

Analyses of perfluorooctane sulfonate (PFOS) were also carried out according to a method recently adapted and further developed by the INSPQ human toxicology laboratory. This method is based on alkaline extraction of PFOS, perfluorooctanoate (PFOA) and perfluorohexanesulfonate (PFHxS) with methyl-tert butyl ether and tetrabutylammonium hydrogen-sulfate, followed by electrospray LC-MS-MS analysis. Quantification is carried-out using isotope-labelled internal standards. This analytical method has a detection LOD of 0.10 µg/L for all analytes. The analytical method has a LOD of 0.10 µg/L for PFOS and 0.30 µg/L for PFOA and PFHxS (see Appendix 3).

4.5.1.4 Determination of dioxin-like activities (DLCs) in plasma by the DR-CALUX assay

Compounds were extracted from plasma using liquid-liquid extraction. Denatured alcohol was added to the plasma sample and the mixture was extracted thrice with hexane. The organic phases were combined and evaporated under vacuum. The resulting extract was purified on an acid-silica column and reconstituted with 5 µL dimethyl sulfoxide (DMSO). The H4IIE-Luc cell line is stably transfected with the dioxin-responsive element promoter ahead of the luciferase enzyme gene. When these cells are exposed to dioxin-like chemicals, they produce the luciferase enzyme, which enables them to produce light in the presence of the substrate luciferin. The cells are plated at a density of

$8x10^4$ cells/well in 24-well plates. After incubating for 5 hours, 2,3,7,8-TCDD dioxin standards and plasma extracts are added to the cells for 24 hours. The cells are washed and lysed in passive lysis buffer (Promega). Luciferase activity (light emission) is determined with a luminometer (LMax, Molecular Devices). Luciferase activity measured in plasma samples is compared to the TCDD standard curve and toxic equivalent concentrations (TEQs) are determined for plasma extracts (Dallaire et al., 2009). We calculated the DLC body burden by multiplying the fat mass (estimated by impedance measurements) by the plasma DLC concentration expressed on a lipid basis and then dividing by the body weight.

4.5.2 Clinical biochemistry

A selection of blood chemistry parameters relevant to cardiovascular health and diabetic status of *Eeyouch* was analyzed in the blood taken from each participant.

4.5.2.1 Blood glucose, insulin

Glucose was measured by a hexokinase enzymatic assay and insulin by a chemiluminescent assay employing the Roche Modular system. Reference concentrations for fasting glucose and insulin are in the range 3.6-5.8 mmol/L and 0-150 pmol/L respectively. Interassay CVs were 1.6% and 1.4% for glucose and 2.9% and 2.3% for insulin at control values of 4.74 and 15.66 mmol/L for glucose and 345.6 and 629.9 pmol/L for insulin.

Threshold values of lipids, glucose and insulin for individuals at high risk of cardiovascular disease and diabetes (Genest et al., 2003) are presented in Table 4.5.1.

TABLE 4.5.1 THRESHOLD VALUES FOR DIFFERENT BIOCHEMICAL PARAMETERS

Parameter	Threshold level
LDL-C (mmol/L) [a]	≥4.5
HDL-C (mmol/L)*l*[a]	<1.00 in men <1.3 in women
Triacylglycerols (mmol/L)[a]	≥1.7
Cholesterol/HDL-C (mmol/L)[a]	≥6.0
Fasting glucose (mmol/L)[b]	≥5.6
Hyperinsulinemia (pmol/L)[b]	≥90

a. Criteria for risk of cardiovascular disease

b. Criteria for clinical identification of metabolic syndrome

4.5.2.2 Blood lipid measurements (cholesterol, HDL cholesterol, triacylglycerols)

Cholesterol and triacylglycerol levels were determined by enzymatic methods, and HDL cholesterol was measured by a direct method using the Roche HDL-C plus 3rd-generation reagent. The LDL-cholesterol concentration was calculated based on the total cholesterol, HDL cholesterol and triacylglycerol measurements (Tremblay et al., 2004). The coefficients of variability were 1.5% and 1.3% for total cholesterol, 2.0% and 1.6% for triglycerides, 1.5% and 2.7% for HDL cholesterol at control values of 2.87 and 6.69 for total cholesterol, 1.07 and 2.32 for triacylglycerols and 0.81 and 1.73 for HDL cholesterol respectively.

4.5.2.3 Fatty acid determination

Blood concentrations of fatty acids (FA) were determined in red blood cell (RBC) membranes by gas-liquid chromatography. RBCs (300 μL) were thawed and lysed in 1 mL water. Membranes were isolated by centrifugation (21,000 g for 15 minutes) and washed twice with a 0.9% NaCl solution. The pellet was spiked with an internal standard of phosphatidylcholine C:15 (Avanti Polar Lipids, Alabaster AL) and lipids were liquid-liquid extracted using chloroform and methanol (2:1 v/v) according to a modified Folch method (Shaikh and Downar, 1981). FAs from membrane phospholipids were methylated in methanol/benzene (4:1 v/v) mixed with acetyl chloride according to previously described methods (Lepage and Roy, 1986). FA profiles were obtained by capillary gas chromatography using a temperature gradient on a HP5890 gas chromatograph (Hewlett Packard, Toronto, ON) equipped with a HP8823 capillary column coupled with a flame ionization detector (FID). Helium was used as an elution gas (split ratio 1:72). FAs were identified according to their retention time on the column, using a standard mixture of 37 FAs as a basis for comparison (FAME 37 mix, Supelco Inc., Bellefonte PA), which contained the FA standard C15:0, as well as the following FAs: C22:5w6, C22:5w3 *cis*-12, a mixture of 31 FAs GLC-411 (NuCheck Prep Inc. Elysian, MN) and a mixture PUFA-3 (Matreya Inc, MJS BioLynx, Brockville, ON). Finally, a mixture of *trans* FA were also used as standards, containing a mixture of C18:2w6 *cis/trans* and a mixture of C18:3w3 *cis/trans* (Supelco Inc., Bellefonte, PA), as well as FA C14:1 *trans*-9, C16:1 *trans*-9, C18:1 *cis*-7, *cis*-13, *trans*-6, *trans*-9, and *trans*-11. Results were expressed as percent of total FAs.

4.5.2.4 CRP, ApoB and AI

High sensitivity C-reactive Protein, Apoproteins A1 and B were measured by nephelometry using a BN ProSpec station (Dade Behring, Mississauga, ON). The analytical sensitivity of the CRP assay was 0.175 mg/L and the interassay coefficient of variation was 4.6% and 3.0% at control levels of 0.95 and 5.03 mg/L respectively. Expected values for healthy individuals are typically <3 mg/L. Control levels of 0.46 and 1.44 g/L for Apo B showed interassay CV of 3.2% and 1.8%, while interassay CV of 4.6% and 3.0% were observed for Apo A1 at control values of 0.80 and 2.15 g/L

respectively. Reference concentrations from healthy adults for Apo B are 0.55-1.40 g/L for men, and 0.55-1.25 g/L for women. Elevated values of Apo B are a risk factor for atherosclerosis. Reference concentrations for Apo A1 are 1.10-2.05 g/L for men and 1.25-2.15 g/L for women. Decreased Apo A1 levels are considered a risk factor for atherosclerotic processes.

4.5.2.5 Inflammatory markers (TNF-a, IL-6, homocysteine)

TNF-α and IL-6 were measured in EDTA-plasma using a human TNF-α ELISA kit (Quantikine HS, R&D System, Minneapolis, MN) and a human IL-6 ELISA kit (Quantikine HS, R&D System, Minneapolis, MN), respectively.

Total plasma homocysteine was quantitatively measured by a chemiluminescent immunoassay with reagents provided by the manufacturer and using the Advia Centaur Analyzer (Bayer Health Care Diagnostic Division, Block Scientific, Bohemia, NY). The analytic sensitivity was 0.50 µmol/L. The functional domain varied from 0.5 to 65 µmol/L. The reference concentration range is 4.0 to 14.0 µmol/L. and CVs for inter- and intra-assays were 2.9% and 3.7%.

4.5.2.6 LDL sizing

Non-denaturing 2 to 16% polyacrylamide gradient gel electrophoresis was performed using a modification of procedures described previously (St-Pierre et al., 2001). LDL particle size was determined using 8 x 8 cm polyacrylamide gradient gels prepared in batches in our laboratory. Aliquots of 3.5 mL of whole plasma samples were mixed 1:1 with a sampling buffer containing 20% sucrose and 0.25% bromophenol blue and loaded onto the gels. A 15-min pre-run at 75V preceded the electrophoresis of plasma samples at 150V for 3 hrs. Gels were stained for 1 hour with Sudan black (0.07%) and stored in a 0.81% acetic acid, 4% methanol solution until analysis using the Imagemaster 1-D Prime computer software (Amersham Pharmacia Biotech, Baie d'Urfé, QC). LDL size was extrapolated from the relative mobility (R_f) of 4 plasma standards of known diameter. The estimated diameter for the major peak in each scan was identified as the LDL peak-particle size. An integrated (or mean) LDL diameter was also computed. This integrated LDL particle size corresponded to the weighed mean size of all LDL subclasses in one individual. It was calculated as a continuous variable and was computed as the sum of the diameter of each LDL subclass multiplied by its relative area. Analysis of pooled plasma standards revealed that measurement of LDL peak and mean particle size was highly reproducible with an interassay coefficient of variation <2% (St-Pierre et al., 2001).

4.5.2.7 Oxidized LDL (OxLDL)

OxLDL was measured in EDTA-plasma using a commercial ELISA kit (Mercodia AB, Uppsala, Sweden) containing a specific antibody (mAb-4E6) that recognizes oxidized LDL and MDA-LDL (malondialdehyde-modified LDL) (Holvoet et al., 2001).

4.5.2.8 Vitamins (Carotenoids, E)

Alpha-tocopherol (vitamin E) was determined using a Waters HPLC system (Lachine, QC) equipped with an autosampler, a reverse phase column (Nucleosil ODS1) and UV detection as previously published (Talwar et al., 1998). This system simultaneously measured vitamin A, α and β-carotenes. The quantitative determination of 25-hydroxyvitamin D in serum was carried out by a procedure including protein extraction and quantitation by competitive radioimmunoassay using the IDS RIA kit (Medicorp Inc., Montréal, QC).

4.5.2.9 Thyroid hormones

TSH, free T4 and total T3 were measured by immunoassays with chemiluminescent detection using the Roche Modular analyzer. The analytical sensitivities for TSH, free T4 and total T3 are 0.005 mIU/L, 5.40 pmol/L and 0.300 nmol/L respectively and the reference concentration ranges are 0.27-4.2 mIU/L for TSH 9-19 pmol/L for free T4 and 1.3-3.1 nmol/L for total T3. Commercial tri-levels controls gave interassay coefficients of variability of 2.0%, 1.8% and 2.1% for TSH, 2.9%, 3.6% and 6% for free T4 and 4.9%, 3.6% and 3.4% for total T3.

4.6 Anthropometric and Clinical Assessments

4.6.1 Cardiovascular diseases

Cardiovascular diseases were classified according to the 10th revision of International Statistical Classification of Diseases and Related Health Problems (ICD-10; WHO, 2007b).Prevalence of CVD was determined by the review of individual medical files. To improve the clinical meaning of this report, we decided to treat hypertensive disease as a separate risk factor of CVD.

Prevalence of hypertension was established by combining information collected from the medical files and parameters obtained during the clinical session. An individual was defined as having hypertension if his/her blood pressure was at least 140 mmHg (systolic) and/or 90 mmHg (diastolic) at the time of the study (Touyz et al., 2006); or had a previous diagnosis of hypertension with or without medication, as mentioned in the medical file

4.6.2 Anthropometric indices.

Height was measured in centimetres using a measuring tape with the patient standing barefoot on a hard surface. Weight was measured on a beam scale. Waist was measured at the end of exhalation with the tape placed horizontally between the last floating rib and the iliac crest. Hip circumference was also obtained with a tape placed on the hips at the pubic symphysis and the most prominent part of the buttocks. Waist and hip circumferences were recorded to the nearest 0.5 centimetres, and height to the nearest centimetre. We transformed weight and height measurements into body mass indices (BMI: kg/m^2), and used the international cut-off point BMI $\geq$ 30 to define obesity in the

population (Bélanger et al., 2004; Kuczmarski and Flegal, 2000; Santé Canada, 2003); BMIs of 25 to 29.9 was considered overweight and 18.5-25.0 normal. Abdominal obesity was defined by the waist circumference (waist ≥102 cm in men, and ≥88 cm in women) (Santé Canada, 2003). Body fat percentage was assessed with a bioelectric impedance analyzer (Tanita TBF-300, GHT Canada, Laval, QC).

4.6.3 Blood pressure

Blood pressure *(BP)* was taken according the WHO clinical guidelines for management of hypertension (Touyz et al., 2006) using mercury sphygmomanometers, 15-inch stethoscopes, and cuffs sized to the subjects' arms. Prior to having their blood pressure taken, subjects must have rested for 5 minutes and not eaten or smoked for at least 30 minutes. Each subject had three blood pressure readings. The mean BP was calculated using the two last measurements (Touyz et al., 2006).

4.6.4 Ultrasound measurement of carotid intimal-to-medial thickness

Measurements of the intimal-to-medial arterial wall thickness (IMT) of the carotid arteries was performed using a high-resolution B-mode ultrasound portable device (Model LogiqBook, GE Medical System, Milwaukee, WI) with and linear 4-10 MHz probe (Model 10LB-Rs, GE Medical System, Milwaukee, WI) by two well experienced sonographers. A transverse scan was performed prior to a longitudinal scan in order to detect any hemodynamically relevant stenosis or the presence of significant plaque. Plaque was defined by either a focal structure that encroaches into the arterial lumen of at least 0.5mm, or 50% of the surrounding IMT value; or a thickness >1.5mm as measured from the media-adventitia interface to the intima-lumen interface defined by a focal echogenic structure protruding into the lumen vessel (Touboul et al., 2007). Well defined segments of both common (left/right) carotids at the near and the far walls (common carotid: 1 cm below the bulb; bulb: 1 cm below the flow divider; internal: 1 cm above the flow divider) were scanned, recorded and the images were digitally stored. Because of their size and superficial location and easy accessibility, segments of 1cm of the near and far walls (1 cm below the flow divider) of both common carotid arteries were used for the evaluation of the IMT. The segments analyzed had to be free of atherosclerotic plaque. Offline measurements were performed by a single reader according to the latest consensus statement on the use of carotid ultrasound to identify subclinical vascular disease (Stein et al., 2008). The 2007 ultrasound images taken in Eastmain and Wemindji were re-analysed in order to comply with the new methodological consensus. Briefly, using a dedicated image-analysis software that allows semiautomated border detection (Carotid Analyzer for Research v.5.5.6, Medical Imaging Application, Coralville, IA), the average of segmental means (1 cm in length) was reported. This approach is reported to be more reproducible, since multiple points (100-150) along the traced segments are averaged (Stein et al., 2008). The edge detection software also allowed the analyser to

edit the tracked borders in cases when the program's algorithm for edge detection was not optimal. The correlation coefficient of the ultrasound measurement assessed by two different readers was 0.97 ($P < 0.001$). These results indicate good reproducibility of the ultrasound analysis. The segmental means of the near/far walls of both common carotids were averaged and designated as the common carotid IMT (mean of the means).

4.6.5 Heart rate variability

Heart rate variability, which provides information about the autonomic cardiac function, was measured in participants aged 15 years and over. Parameters of heart rate variability were derived from a 2-hour Holter monitoring session (Bélanger et al., 2004). These parameters are based on the difference between two consecutive heartbeats (RR) and include the median of all RR intervals (NN), the standard deviation of the RR intervals (SDNN) and the standard deviation of the average RR intervals calculated over 5-min periods (SDANN). We also obtained the square root of the mean squared differences of successive RR intervals (rMSDD) and the proportion of interval differences of successive NN intervals greater than 50 ms (pNN50), which are two indices of cardiac parasympathetic modulation. The analysis of the frequency domain included very low frequency (VLF = 0.0033-0.04 Hz), low frequency (LF = 0.04-0.15 Hz) and high frequency (HF = 0.15-0.40 Hz). The LF/HF ratio represents the sympatho-vagal balance.

4.6.6 Bone density

Women aged 35 to 74 years were recruited among the randomly selected participants and a total of 74 women participated. They were asked to answer a few questions related to their menopausal status, and anthropometric measurements were recorded. The risk of osteoporotic fractures at the right calcaneum was assessed using the Achilles^{TM} ultrasound bone densitometer. This technique is fast (takes approximately 3 minutes), simple, non-invasive, safe (radiation-free), inexpensive and portable (Lunar Corporation, 1995). The ultrasonic pulse propagates through the heel bone. The three ultrasound parameters measured are: first, broadband ultrasound attenuation (BUA, dB/MHz), which reflects bone density as well as architecture; second, speed of sound (SOS, m/sec), which reflects bone density and elasticity; and third, bone stiffness index (SI, %), which reflects the rigidity of bone structure. SI was computed from BUA and SOS measurements using the manufacturer's equation and was expressed as a percentage of young adults' average peak SI (SI = 0.67*BUA + 0.28*SOS –420) (Lunar Corporation, 1995). The densitometer was calibrated daily.

The World Health Organization (WHO, 1994) criteria were used for dual energy X-ray absorptiometry (DEXA) to classify bone mass densitometry (BMD) values: as normal, BMD less than 1 standard deviation (SD) below the mean for young adults, T-score; osteopenia, BMD between

1 and 2.5 SDs below the mean for young adults; or osteoporotic, BMD more than 2.5 SD below the mean for young adults. The quantitative ultrasound (QUS) values were categorized similarly. In the present study, an age-adjusted Z-score of -1 was used as the threshold for risk of fracture.

4.6.7 Medical File Review

During the analysis and interpretation of data collected in the Mistissini study (Bonnier-Viger et al, 2007), we encountered a lack of information concerning the health status of the participants. Medication taken by study participants can impede evaluation of the true prevalence of high blood pressure, diabetes, thyroid problems and other health conditions among the population sampled. Medicines also constitute important confounders in observed associations, such as for effects of contaminants on some clinical chemistry parameters and health outcomes. Furthermore, diagnostic confirmation of self-declared health conditions would have been helpful in validating aspects of the questionnaire data. Therefore, it was decided to supplement the data collected by conducting a medical file review.

The chart-review form used (see Appendix 4) focused on major chronic diseases such as cardiovascular, diabetes, hyper/hypothyroidism, musculoskeletal and metabolic diseases, all of which were addressed in the questionnaires and for which relevant clinical biochemistry data were collected. This review also noted past hospitalization episodes and their related causes, as well as medication taken 12 months before the beginning of the study.

Permission was obtained from the Cree Board of Health (see Appendix 4) to access the archived medical charts of each participant (see Appendix 4).Support was also solicited and received from the head nurse of the Eastmain and Wemindji clinics. The medical chart review involved one research nurse working full-time in the community concurrently with the clinical field work of the study. The research nurse consulted the consent form signed by each randomly selected participant (8 years old and over, or guardian) to make sure that approval had been granted.

A second chart review focused on infections during the past 5-10 years for all participants who had antibodies to one of the following zoonotic agents or zoonoses: California virus, Q fever, leptospirosis, trichinosis, tularemia, toxoplasmosis, toxocariasis and echinococcosis (see Appendix 4). The information gathered was to ascertain whether past episodes of infection may have been transmitted from animals, and was collected by a research nurse a few months after the completion of the clinical field work.

Training was provided for the health professional in each community to ensure adequate follow-up for individuals with positive clinical results.

4.7 Dietary Habits and Nutritional Status

This report covers the nutritional adequacy and dietary quality component of the study and the analysis and interpretation of some of the dietary data. We report on the intake of traditional foods, selected market foods, macronutrients and selected micronutrients. Food-group intake was considered in relation to Canada's Food Guide and recommended goals for dietary intake in relation to the number of individuals having an intake that is below estimated average recommendations (EAR) or adequate intakes (AI) as defined by the Dietary Reference Intakes (DRI) (IOM, 2000a). In addition, the report includes the results of the serum 25(OH) D measurements (a marker of vitamin D status), and explores the relationship between markers of dietary fat quality as they relate to traditional and market food intake. Finally, preliminary analyses of the relation of dietary quality to adiposity are provided.

4.7.1 Dietary assessment

Dietary intake was assessed using two food frequency questionnaires (FFQs) and a 24-hour recall (see Section 4.3.3). The average daily nutrient composition of the diet of study participants was estimated using CANDAT software (Godin Inc, London, ON). This software uses the Canadian Nutrient file (Health Canada, 2007) plus additional food items as necessary (Johnson-Down et al., 2006), including CINE's published data on traditional food nutrient composition data (http://cine.mcgill.ca/nutrients/searchpage.php). Double verification (recall data entry verification by two people) was done.

4.7.2 Assessment of inadequate nutrient intake

To enable public health agencies to formulate nutrition messages for the community, it is important to know the proportion of individuals in a group whose usual daily intake of a nutrient is less than the requirement for that nutrient. To assess inadequate nutrient intake, the Estimated Average Requirement (EAR) cut-point method was used (IOM, 2003). Observed daily intakes were adjusted to estimate the distribution of usual daily intakes using either the National Research Council Method or the Iowa State University method (IOM, 2003). Subsequently, the proportion of individuals in the group with intakes below the daily median requirement or EAR is determined. This method is not appropriate for energy or iron in menstruating women because the requirements are not normally distributed (IOM, 2000b). However the frequency of inadequate iron intake in adult women was estimated using the probability method (IOM, 2000b).

4.8 Physical Activity

4.8.1 Preface

Physical activity is a protective factor against being overweight and obesity (Tremblay and Williams, 2003), and physical inactivity is associated with an increased risk of chronic diseases (Pols et al., 1998). Culturally acceptable and validated instruments for assessing physical activity among Indigenous Peoples are lacking and sorely needed for health behaviour surveillance and for evaluation of the effectiveness of health promotion efforts. Also, in epidemiologic studies, a valid physical activity instrument can facilitate multidisciplinary research regarding health determinants.

The primary objective of the physical activity assessment was to evaluate whether the International Physical Activity Questionnaire (IPAQ) physical activity score correlates with anthropometric indices. If the IPAQ is a valid tool for physical activity assessment among the Cree, then significant correlations between activity level and anthropometric indices should be observed in the study population. Additional validation using accelerometers, heart rate monitors and/or pedometers, as well as exploration of the IPAQ ability to predict biomarkers known to be associated with physical activity in a larger sample, will be explored.

4.8.2 Background on the international physical activity questionnaire (IPAQ)

The IPAQ questionnaire was developed in 1996 by an International Consensus Group in an attempt to address the lack of internationally comparable physical activity measures (IPAQ, 2005a, b). Two versions of the IPAQ were developed, the short and the long versions. The short version was designed for use in surveillance studies; while the long version is more suitable for a more comprehensive assessment of daily activity for use in research. However, given concerns regarding the questionnaire burden of health research on participants, the short version was selected for the Cree study. The IPAQ assesses activity performed in leisure time, domestic activities, work and transportation-related activities, and is designed to be culturally adaptable. The reliability and validity of the IPAQ tests show that its abilities to measure physical activity levels are comparable to other generally accepted self-reported assessment methods. Correlation ranges of 0.34 to 0.89 have been obtained from reliability studies and 0.14 to 0.53 in validation studies (Craig et al, 2003). The IPAQ has been selected for use in various high-profile studies such as the European Physical Activity Surveillance System (EUPASS), the European Health Interview Survey (EUROHIS), the Countrywide Integrated Non-communicable Disease Intervention (CINDI), and the WHO World Health Survey (WHS) (IPAQ, 2005a, b). However, the statistical methods used to determine the reliability and validity of the IPAQ have been criticized (Hallal and Victoro, 2004). Furthermore, a study involving the measurement of physical activity in urban indigenous Australians abandoned the IPAQ when participants had considerable trouble understanding and completing the questionnaire (Marshall,

2004). In the Mistissini study in 2005, percent body fat was found to be correlated to physical activity (Egeland et al., 2008).

While doubly-labelled water testing, involving deuterium and oxygen-18 enriched water, is considered the best, or gold standard for validating a physical activity questionnaire, it is time-consuming, expensive and problematic to execute in remote communities. Accelerometers and heart rate monitors (Tremblay et al., 2002; Bassett, 2000) can be used in field settings to validate questionnaires. Another approach is a self-reported log book and activity diary. As a first phase pilot study evaluation, our objective was to determine whether the IPAQ correlated with anthropometric indices.

4.8.3 IPAQ questionnaire administration

The interview-administered short version of the IPAQ was used in the current study as part of the individual questionnaire (see Appendix 1). It has been recommended that cultural adaptations be made to the physical activities used in the original IPAQ questionnaire in order to increase cultural relevance (IPAQ, 2005 a, b). Bilingual Cree research interviewers reviewed the original IPAQ and suggested culturally appropriate examples of physical activities to replace the original ones provided by IPAQ; they also translated the questionnaire. The comprehensive compendium of physical activity provided by Ainsworth et al. (2000) was used to calculate physical activity as metabolic equivalents (METs), which represent multiples of resting metabolic rates, and a standard body weight of 60 kg to measure the volume of each type of activity and to sum the MET minutes per week. MET values and formulas for the computation of MET minutes/week were based upon the formulas provided by an IPAQ Reliability Study (Craig et al., 2003). Twenty-two adult participants (10 in Eastmain and 12 in Wemindji) were excluded from the analyses due to missing physical activity data. All activities were summed to provide a Total MET score, whereas for Vigorous MET scores only activities listed as vigorous in intensity in the compendium of physical activity were used to calculate the score. The questionnaire covered the past 7 days.

Total MET and Vigorous MET scores were evaluated as continuous data and as ordered categorical groupings approximating quartiles for Total METs and approximating tertiles for Vigorous METs. Due to the distribution of the scores, uneven sample sizes exist in the various groupings.

4.9 Statistical Analysis

Statistical analyses were conducted with a significance threshold of $\alpha = 5\%$ using SAS (SAS Version 8.2 and 9.1, SAS Institute, Cary, NC) except for principal component analysis (PCA) which was performed using SPSS (version 11 and 17, SPSS Inc. Chicago, IL).

4.9.1 Dietary habits and nutritional status

Software for Intake Distribution Estimation (SIDE) (Software for Intake Distribution Estimation, Iowa State University 1996) was used to obtain estimates of the usual nutrient intake distributions using observed intakes on repeated days, adjusting for the interview sequence and the day of the week. When the SIDE software was unable to adjust a nutrient, the NRC method was attempted (National Research Council, 1986).

Principal component analysis (PCA; Gauch, 1982) was used to produce a smaller number of uncorrelated variables (referred to as factors or axes) that contain most of the variance of the raw dietary-consumption data (market plus traditional foods). This technique allows the complete suite of dietary questions, as well as life-style/activities such as smoking and hunting, to be summarized with most of the variations explained by the first and second axes. In this manner, single variables were generated that represent traditional or market food items. PCA analysis of the consumption frequencies of the food items derived from the diet questionnaires was carried out after screening of the diet data to eliminate those variables with zero variance. As described in Section 4.9.3, this data-reduction technique can also be helpful in identifying food sources of contaminants.

4.9.2 Physical activity

Only adults 18 years of age and older were included in the current analyses. Bivariate Spearman correlations between the total metabolic equivalents (METs) and vigorous METs and BMI, % body fat and waist circumference (WC) were examined, which is appropriate for skewed data. Furthermore, mean and standard deviations (SD) for the anthropometric variables were evaluated by the approximate quartile groupings of total METs and the approximate tertile groupings of vigorous METs. Multivariable linear regression analyses were conducted to control for age and gender, and we explored the homogeneity of the results by testing physical activity level by gender, interaction terms, and by separately conducting age-adjusted regressions for men and women. Furthermore, because of the high prevalence of obesity, we further stratified by obesity ($BMI < 30$ vs. $BMI \geq 30$) and re-evaluated physical activity associations with WC and % body fat.

4.9.3 Environmental contaminants exposure

Percent detection was computed for all contaminants according to age group. Non-detects were replaced with a value equal to half the limit of detection. Further statistical analyses were carried-out only when a minimum of 60% of individuals had detectable levels of a given contaminant. Descriptive statistics are presented for contaminant body burdens. Since most contaminants follow a log-normal distribution, geometric means and confidence intervals were computed and compared. The associations between hair and blood concentrations of mercury, and between blood and nail concentrations of selenium were assessed using Pearson's correlation coefficients. The association

between the results of the DR-CALUX assay with PCB-153, as a marker for exposure to the environmental mixture of organochlorine pesticides containing dioxin-like compounds, was assessed in the same manner.

PCA and correspondence analysis (CA; Thioulouse et al., 1997) were employed to generate a smaller number of uncorrelated variables containing most of the variance of the raw data sets of plasma contaminants (Tsuji et al, 2006). In this way, contaminants with similar concentration patterns were grouped. CA, like PCA, constitutes a factor analysis technique that reduces sets of multiple intercorrelated variables to fewer uncorrelated ones. Its application is somewhat more versatile than of PCA. Plasma contaminant concentrations, both PCB congeners and organochlorine pesticides, were log (x + 1) transformed before CA or PCA. Concentrations of contaminants below the detection limit (DL) were imputed as DL/2. The CA was carried out employing only those PCBs and pesticides for which the detection frequency ≥70%. Both the measured contaminant concentrations, and the new CA and PCA summary variables, were analyzed by 2-way ANOVA to examine the effects of age group and gender.

Plasma contaminant summary variables (principal components, correspondence analysis axes, and sums of PCB congeners and pesticides) were investigated to determine if values of these variables were dependent on consumption of the various traditional food items. Partial correlation analyses adjusting for age were used to explore the interdependence of the various traditional food items and those between the organochlorine contaminants and the traditional dietary-consumption frequency data.

Analyses were performed using SPSS version 11 and 17 (SPSS Inc. Chicago, IL) with the exception of CA, which was carried out using the ADE-4 package (Thioulouse et al, 1997).

4.9.4 CVD and diabetes risk factors

The analyses reported here are descriptive according to the categories of the various variables such as socio-demographics, lifestyle habits and anthropometric variables. Variance analysis allowed us to compare means, and the chi-squared test was used to compare proportions When the distribution of a variable was not normally distributed, the median and interquartile range (IQR = Q75-Q25) were presented, and comparisons were carried out with Mann-Whitney U test. For log-transformed variables, the geometric mean was calculated. All data were weighted in order to take into account sampling strategy. Linear regression and/or Pearson product moment correlations were used to evaluate the relationship between mercury and Holter parameters. Because of the small sample size, other multivariate analyses were not carried out. An increased sample size would allow a more extensive examination of chronic diseases and their association with other factors in the framework.

4.9.5 Osteoporosis

For descriptive analysis, weighted frequencies and prevalence for categorical variables and weighted means for continuous variables were calculated to describe osteoporosis and its risk factors in the 74 *Eeyou* women (Wemindji n = 37 and Eastmain n = 37). The osteoporosis risk factor variables that were available were age (years), weight (kg), height (cm), waist circumference (cm), hip circumference (cm), menopausal status (assessed by the question "Do you still have your period?"), current hormonal replacement therapy, physical activity (measured by walking less than one hour per day), and current smoking status. Weighted means and confidence intervals of the ultrasound measurements were also calculated according to certain factors such as current smoking status, menopausal status among peri- and post-menopausal women, and oral contraceptive use among the women who still have their periods. Multivariate analysis was not performed in the present analysis because of the small sample size and the low-level association between osteoporosis and other risk factors. It will be considered when the data from other communities can be included to increase the sample size.

4.10 Participation in Dietary, Environmental Exposure, Clinical Biochemistry and Medical Outcomes in Eastmain

There are a number of reasons why the participation rates varied between the various components of the study. Of these, non-compliance with answering questions on the appropriate questionnaire, exclusion/inclusion of children, and sub-studies that targeted specific participant groups constituted the primary reasons.

4.10.1 Total Population

The core study consisted of a total of 150 participants in Eastmain and 202 in Wemindji, divided into age-specific subgroups as shown in Tables 4.2.1A,B and 4.2.2A,B.

4.10.2 Socio-demographic characteristics

As reported in Table 4.4.1 exclusion of 0 to 7-year-olds reduced the participants in the individual questionnaire. Further, not all participants answered every question, and some questions focused on sub-groups (e.g., hunters).

4.10.3 Dietary habits, nutritional status and lifestyles

Children age 0-8 years were also excluded in the administration of the 3 dietary questionnaires (Table 4.4.1).

4.10.4 Environmental contaminants

As reported in Tables 4.4.1 and 4.4.2, the participant numbers in the contaminant exposure components of the study depended on the specific contaminant measured in plasma or whole blood,

and whether children under 8 years old were included. Hair mercury was assessed for all children and adults who had hair long enough to supply samples.

4.10. 5 Clinical biochemistry and clinical assessments

The clinical biochemistry and clinical assessments did not include the 0-7 year olds. Carotid intima-media thickness and heart variability measurements were limited to individuals aged ≥15 years. Bone density measurements involved women participants aged 35 to 74 years.

4.10.6 Seroprevalence of zoonoses.

All adults (15 years and older) had their blood tested for zoonoses as described in Chapter 6.

5. RESULTS AND DISCUSSION

5.1 Demographics and lifestyle in Wemindji and Eastmain

5.1.1 Socio-demographic profile

Some aspects of the socio-demographic profile of the study participants are summarized in Tables 5.1.1A,B. Female participation was higher than that of males. Cree was the primary language, followed by English. Most individuals completed some secondary education or higher, and the proportion of students was 23.5% (Wemindji) and 30.6% (Eastmain). Respectively 35.9% and 45.5% reported working full-time in Wemindji and Eastmain, while 11.8% (Wemindji) and 14.2% (Eastmain) declared having part-time employment or working occasionally. The remainder of the respondents declared receiving a pension, unemployment insurance, or income security; and also included a small number who did housework.

5.1.2 Bush-related activities

Time spent in the bush was not recorded in 2007 (it will be reintroduced in 2008). Use of lead-containing ammunition appeared to be higher than non-lead shot (Tables 5.1.2A,B).

TABLE 5.1.1A SOCIO-DEMOGRAPHIC CHARACTERISTICS OF WEMINDJI PARTICIPANTS

	Number of replies	Wemindji (%)
Gender	202	
Male		47.0
Female		53.0
Language spoken at home (excluding 0-7 yr. olds)	171	
Cree		94.2
English		51.5
French		1.8
Proportion of households with adults aged 15 to 49 years	170	
0		7.1
1-2		43.5
3-4		31.8
≥5		17.6
Proportion of households with adults aged 50 years or more	170	
0		50.6
1-2		47.1
3-4		2.3
≥5		0.0
Proportion of households with children aged 14 years or less	170	
0		37.6
1-2		39.4
3-4		17.1
≥5		5.9
Highest level of formal education completed	170	
No schooling		1.8
Some, or completed Elementary		23.5
Some, or completed Secondary		55.3
Some, or completed Collegial and beyond		19.4
Working status	170	
Student		23.5
Work full-time		35.9
Work part-time or occasionally		11.8
Unemployed		28.8

TABLE 5.1.1B SOCIO-DEMOGRAPHIC CHARACTERISTICS OF EASTMAIN PARTICIPANTS

	Number of replies	Eastmain (%)
Gender	150	
Male		40.0
Female		60.0
Language spoken at home (excluding 0-7 yr. olds)	134	
Cree		97.0
English		42.5
French		8.2
Proportion of households with adults aged 15 to 49 years	134	
0		3.0
1-2		36.6
3-4		39.6
≥5		20.9
Proportion of households with adults aged 50 years or more	134	
0		64.9
1-2		33.6
3-4		1.5
≥5		0.0
Proportion of households with children aged 14 years or less	134	
0		19.4
1-2		49.3
3-4		26.9
≥5		4.5
Highest level of formal education completed	134	
No schooling		0.7
Some, or completed Elementary		24.6
Some, or completed Secondary		62.7
Some, or completed Collegial and beyond		11.9
Working status	134	
Student		30.6
Work full-time		45.5
Work part-time or occasionally		14.2
Unemployed		9.7

TABLE 5.1.2A USE OF FIREARMS BY WEMINDJI PARTICIPANTS

Question and Reply	Number of replies	Wemindji (%)
Hunting	170	
Yes		54.1
No		45.9
Hunting with a gun	92	
Yes		97.8
No		2.2
Used bullets	90	
Yes		78.9
No		21.1
Used lead shot	87	
Yes		85.1
No		14.9
Used non-lead shot	87	
Yes		12.6
No		87.4

TABLE 5.1.2B USE OF FIREARMS BY EASTMAIN PARTICIPANTS

Question and Reply	Number of replies	Eastmain (%)
Hunting	134	
Yes		38.8
No		61.2
Hunting with a gun	52	
Yes		98.1
No		1.9
Used bullets	50	
Yes		82.0
No		18.0
Used lead shot	46	
Yes		58.7
No		41.3
Used non-lead shot	46	
Yes		26.1
No		73.9

5.1.3 Sources of drinking water

In both communities, bottled water was the primary routine source of drinking water (Wemindji, 71.8%; Eastmain, 61.9%) (see Tables 5.1.3A,B). In Eastmain spring water was the second choice (35.1%), while tap water came in third (22.4%); in Wemindji, spring water (21.8%) and tap water (20.2%) were second choices. Lake/river water and melted ice or snow were rarely used. By contrast, the primary source of drinking water for Wemindji community members when in the bush was spring water (48.2%), melted ice or snow was the second choice (30.9%), followed by lake or river water (24.4%). Consumption of bottled water (18.1%) was more frequent than tap water (4.2%) when in the bush. For Eastmain, the primary source of drinking water in the bush was melted ice or snow (40.3%), water from a spring came in second along with bottled water (24.6% and 20.9%, respectively); use of water from a lake, river or tap was less frequent.

TABLE 5.1.3A SOURCES OF DRINKING WATER USED BY WEMINDJI PARTICIPANTS

	In the community (n = 170)	In the bush (n = 170)
	%	%
Tap water		
All / most time	20.2	4.2
Sometimes	30.4	4.2
Rarely / never	49.4	91.6
Bottled water		
All / most time	71.8	18.1
Sometimes	21.8	15.1
Rarely / never	6.5	66.9
Water from a spring		
All / most time	21.8	48.2
Sometimes	25.3	11.4
Rarely / never	52.9	40.4
Water from a lake/river		
All / most time	2.4	24.4
Sometimes	11.3	13.4
Rarely / never	86.3	62.2
Melted ice or snow		
All / most time	0.6	30.9
Sometimes	9.5	23.0
Rarely / never	89.9	46.1

TABLE 5.1.3B SOURCES OF DRINKING WATER USED BY EASTMAIN PARTICIPANTS

	In the community (n = 134)	In the bush (n = 134)
	%	%
Tap water		
All / most time	22.4	5.2
Sometimes	17.2	4.5
Rarely / never	60.4	90.3
Bottled water		
All / most time	61.9	20.9
Sometimes	33.6	20.9
Rarely / never	4.5	58.2
Water from a spring		
All / most time	35.1	24.6
Sometimes	11.9	5.2
Rarely / never	53.0	70.1
Water from a lake/river		
All / most time	2.3	6.0
Sometimes	3.8	6.8
Rarely / never	94.0	87.2
Melted ice or snow		
All / most time	2.2	40.3
Sometimes	6.7	10.4
Rarely / never	91.0	49.3

5.1.4 Smoking status

Eeyouch in Wemindji and Eastmain for the most part do not smoke in their homes; respectively, only 4.93% and 16.7% did so. Nearly a quarter of the participants (24.6%) in Wemindji, compared to 38% in Eastmain, reported smoking currently. A greater percentage (34.9%) reported being former smokers in Wemindji *versus* 27.3% in Eastmain. Heavy smoking of more than 10 cigarettes per day was reported by 8.9% of smokers in Wemindji and 9.3% in Eastmain.

The results indicate that *Eeyouch* are aware of the damaging effects of second-hand smoke, are actively limiting smoking in their homes, and report that a sizable proportion in both communities has quit smoking.

Exposure to the toxic metal cadmium in relation to cigarette smoking is considered in Section 5.3.1.1.

5.2 Dietary Assessment and Physical Activity

5.2.1 Dietary habits and nutritional status

5.2.1.1 Anthropometry

Adult guidelines for anthropometric parameters are based on cut-off values for individuals over 20 years of age. A BMI of 30 or greater indicates a high risk of health-related complications due to excess body weight for height. In Wemindji, 2.9% of adult women over the age of 20 years and 12.1% of men had a healthy BMI of less than 25 kg/m2, whereas 29.0% of women and 13.8% of men had values indicative of being overweight (25.0-29.9); 68.1% of women and 74.1% of men had a BMI of 30 or greater. By comparison in Eastmain, 3.5% of women and 12.1% of men had a BMI below 25 kg/m2, whereas 17.5% of women and 18.2% of men had a BMI indicative of being overweight (25.0-29.9); 79% of women and 69.7% of men had BMI values of 30 or greater.

Using age and gender-specific cut-off values for percent body fat from a three-country study (Gallagher et al. 1999), indicated elevated health risk for 98.6% of women and 92.9% of men in Wemindji and 98.3% of women and 90.9% of men in Eastmain. Similarly, waist circumference measures indicated that 98.6% of women and 83.1% of men in Wemindji and that 96.5% of women and 75.8% of men in Eastmain are at risk for health-related complications due to central-fat patterning based upon WHO cut-off values of 88 cm for women and 102 cm for men (WHO, 2000).

For children and youth (20 years of age and under) in Wemindji, the mean ± SD waist circumference was 90.7±15.9 cm for girls and 88.9±17.2 cm for boys, whereas percent body fat was 37.0±9.24% for girls and 23.8±10.8% for boys. Similarly in Eastmain, the average waist circumference was 94.6±11.8 cm for girls and 94.1±13.7 cm for boys; and the percent body fat was 39.7±7.35% for girls and 29.1±10.2% for boys. Being overweight (i.e., having a BMI > 85th percentile) was highly prevalent in Wemindji and Eastmain, respectively with 73.3% and 77.2% of girls exceeding this BMI percentile, compared to 65.0% and 77.7% of boys. A less conservative overweight classification, namely BMI > 95th percentile, applied to 66.7% of girls and 30.0% of boys in Wemindji, with comparable levels in Eastmain of 66.6% (girls) and 44.4% (boys).

Overweight during childhood predicts overweight and obesity in adulthood (Guo and Chumlea 1999). Consequently, the data indicate that Wemindji and Eastmain youth are at risk for future obesity and health-related complications due to excess adiposity. For adults, the anthropometric parameters suggest the same for a large proportion of community members. Women in particular showed greater prevalence of obesity than men.

5.2.1.2 Dietary assessment

The age and gender distribution of the project participants, as well as the number of repeat recalls administered, are presented in Table 5.2.1A (Wemindji) and Table 5.2.1B (Eastmain). In Wemindji (Eastmain), a total of 164 (131) individuals participated in the dietary component of the study; repeat recalls were obtained for 42 (37) individuals, or 25.6% (28.2%) of respondents.

Energy intakes (EI) were validated by comparing them to estimated basal metabolic rate (BMR_{est}) calculated from the standard World Health Organization equations (FAO/WHO/UNU, 1985). The ratio of EI to the estimated BMR is used to determine whether the amount consumed is realistic, given the energy requirements of one's height, weight, gender and age. In adults, EI: $BMR_{est} < 1.5$ for a group indicates underreporting (Black, et al. 1991). Because of under-reporting, caution is needed in interpreting the absolute values of micronutrient intakes. In Wemindji, the ratio of the EI to the BMR_{est} was 1.21±0.56 for men 19 years of age or older and 1.45±0.63 for women in the same age group; 1.56±0.90 for boys 18 years of age or younger, and similarly 1.48±0.85 for girls. In Eastmain, the corresponding data were: 1.25±0.47 (men ≥19 years), 1.40±0.61 (women ≥19 years), 1.30±0.43 (boys ≤18 years) and 1.13±0.52 (girls ≤18 years). Further investigation is required to determine the reason for the apparent underreporting in the men. One possible reason is that men may be impatient with dietary questions. Overall, because of the under-reporting caution is needed in interpreting the absolute values of micronutrient intake.

TABLE 5.2.1A TOTAL NUMBER OF 24-HOUR RECALLS COLLECTED IN THE CREE COMMUNITY OF WEMINDJI BY GENDER AND AGE GROUPS (N = 164).

Age (years)	9-13		14-18		>19	
Recall	One	Repeat	One	Repeat	One	Repeat
Men/ Boys	13	5	7	3	58	14
Women/ Girls	8	1	7	2	71	17
Total	21	6	14	5	129	31

TABLE 5.2.1B TOTAL NUMBER OF 24-HOUR RECALLS COLLECTED IN THE CREE COMMUNITY OF EASTMAIN BY GENDER AND AGE GROUPS (N = 131).

Age (years)	9-13		14-18		>19	
Recall	One	Repeat	One	Repeat	One	Repeat
Men/ Boys	9	3	9	3	34	9
Women/ Girls	8	3	10	3	61	16
Total	17	6	19	6	95	25

5.2.1.3 Traditional food intake

Tables 5.2.2A (Wemindji) and 5.2.2B (Eastmain) summarize data on the percentage of the population consuming specific traditional foods corresponding to the questions on food frequency. These tables give average monthly frequency of consumption of these foods in days/month for consumers. Overall in Wemindji, caribou, moose, bear, beaver, rabbit, geese and ptarmigan (or other related birds) were common traditional food items with over 50% of the population reporting that they ever consumed these items in the past year (Table 5.2.2A). The consumption pattern in Eastmain was similar (Table 5.2.2B)

When traditional food consumption was evaluated by gender and age, there were striking differences between the two communities. Relative to children or adults under 40 years, older adults in Wemindji consumed ≥50% game, fish, fowl, and berries, compared to 2-6 times more in Eastmain (Figures 5.2.1A and 5.2.1B). The reports of traditional foods on the 24-hour recalls showed a stronger trend in both Wemindji (Figure 5.2.2A) and Eastmain (Figure 5.2.2B). While food frequencies may tend to overestimate consumption of foods, especially those that are considered desirable, this is unlikely to account for the striking age-dependent differences observed.

TABLE 5.2.2A PERCENTAGE OF THE POPULATION (WEMINDJI) CONSUMING VARIOUS TRADITIONAL FOOD ITEMS IN THE PAST YEAR AND AVERAGE MONTHLY FREQUENCY OF CONSUMPTION (NUMBER OF DAYS/MONTH) *FOR CONSUMERS ONLY* BY AGE AND GENDER[a]

Food	Girls (<19) n = 15 % cons. (days/month)	Boys (<19) n = 20 % cons. (days/month)	Women (≥19) n = 71 % cons. (days/month)	Men (≥19) n = 58 % cons. (days/month)	Total population n = 164 % cons. (days/month)
1. Bear meat dried	0.00 (0.00)	5.00 (0.17)	8.33 (0.12)	22.4 (0.28)	12.05 (0.22)
2. Bear meat cooked	46.7 (0.17)	**65.0** (0.20)	**77.8** (0.42)	**93.1** (0.46)	**78.31** (0.40)
3. Bear liver or kidney	0.00 (0.00)	5.00 (0.17)	20.8 (0.27)	32.8 (0.18)	21.08 (0.22)
4. Moose meat dried	0.00 (0.00)	5.00 (**2.50**)	8.33 (0.33)	17.2 (0.41)	10.84 (0.53)
5. Moose meat cooked	**80.0** (0.76)	**80.0** (1.20)	**94.4** (1.98)	**100** (1.33)	**92.77** (1.56)
6. Moose liver or kidney	0.00 (0.00)	0.00 (0.00)	8.33 (0.08)	17.2 (0.19)	9.64 (0.15)
7. Caribou meat dried	6.67 (0.08)	0.00 (0.00)	4.17 (1.17)	3.45 (0.12)	3.61 (0.64)
8. Caribou meat cooked	46.7 (0.30)	**65.0** (1.55)	**65.3** (1.19)	**67.2** (0.71)	**64.46** (0.99)
9. Caribou liver or kidney	0.00 (0.00)	0.00 (0.00)	1.39 (0.42)	3.45 (0.54)	1.81 (0.50)
10. Beaver meat	33.3 (0.10)	45.0 (0.23)	**68.1** (0.77)	**86.2** (1.42)	**68.07** (0.99)
11. Rabbit Meat	40.0 (0.28)	**65.0** (0.80)	**80.6** (0.93)	**93.1** (1.17)	**79.52** (0.98)
12. Smoked game animal	0.00 (0.00)	5.00 (0.08)	1.39 (0.08)	8.62 (0.27)	4.22 (0.21)
17. Speckled trout	13.3 (2.04)	15.0 (0.64)	27.8 (0.94)	**50.0** (1.16)	32.5 (1.08)
18. Walleye	13.3 (0.37)	30.0 (0.96)	33.3 (0.99)	**63.8** (0.84)	41.6 (0.89)
19. Whitefish	6.67 (**4.00**)	20.0 (0.48)	26.4 (1.40)	39.7 (1.22)	28.3 (1.29)
20. Pike	46.7 (0.38)	35.0 (0.44)	**52.8** (0.79)	**72.4** (0.77)	**56.6** (0.72)
21. Lake trout	13.3 (1.54)	20.0 (0.29)	15.3 (0.47)	25.9 (0.32)	19.3 (0.44)
22. Sturgeon	13.3 (0.21)	10.0 (0.12)	26.4 (0.68)	**51.7** (0.28)	31.9 (0.41)
23. Burbot	0.00 (0.00)	0.00 (0.00)	1.39 (0.08)	3.45 (0.21)	1.81 (0.17)
24. Red or white sucker	13.3 (0.25)	5.00 (0.25)	19.4 (1.11)	20.7 (0.56)	17.5 (0.79)
25. Fish from the ocean	6.67 (0.08)	0.00 (0.00)	6.94 (0.72)	12.1 (1.02)	7.83 (0.83)
26. Fish eggs	13.3 (0.46)	5.00 (0.17)	37.5 (1.40)	39.7 (0.95)	31.9 (1.15)
27. Smoked wild fish	**53.3** (0.72)	20.0 (0.31)	**54.2** (0.98)	**67.2** (1.30)	**54.2** (1.07)
32. Loon or Merganser	0.00 (0.00)	10.0 (0.08)	8.33 (0.25)	15.5 (0.24)	10.2 (0.23)
33. Geese	100 (0.78)	**100.0** (1.27)	**95.8** (1.65)	**100** (1.95)	**98.2** (1.64)
34. Dabblers	13.3 (0.08)	40.0 (0.46)	13.9 (0.56)	**70.7** (0.61)	36.8 (0.57)
35. Sea ducks	0.00 (0.00)	10.0 (0.21)	16.7 (0.40)	22.4 (0.28)	16.3 (0.33)
36. Other ducks	6.67 (0.17)	5.00 (0.08)	12.5 (0.22)	8.62 (1.14)	9.64 (0.50)
37. Ptarmigan, partridge and other birds	**53.3** (0.34)	**80.0** (0.87)	**87.5** (1.40)	**96.6** (1.31)	**86.8** (1.24)
38. Goose gizzard	40.0 (0.54)	15.0 (0.33)	**58.3** (0.81)	44.8 (0.82)	46.4 (0.77)
46. Wild berries	46.7 (1.32)	**55.0** (1.06)	**70.8** (0.96)	**72.4** (0.93)	**67.5** (1.00)
47. Wild berry jam	**60.0** (0.35)	**55.0** (1.43)	**62.5** (1.62)	**51.7** (0.68)	**57.8** (1.19)
48. Bear grease	20.0 (0.42)	10.0 (0.33)	41.7 (0.46)	**56.9** (0.70)	41.0 (0.57)
49. Goose grease	46.7 (0.88)	40.0 (0.67)	45.8 (0.89)	**60.3** (0.95)	**50.6** (0.92)
50. Moose grease	0.00 (0.00)	0.00 (0.00)	4.17 (0.50)	0.00 (0.00)	1.81 (0.50)

a. Characters in bold when percentage of the population is greater than or equal to 50%.

TABLE 5.2.2B PERCENTAGE OF THE POPULATION (EASTMAIN) CONSUMING VARIOUS TRADITIONAL FOOD ITEMS IN THE PAST YEAR AND AVERAGE MONTHLY FREQUENCY OF CONSUMPTION (NUMBER OF DAYS/MONTH) *FOR CONSUMERS ONLY* BY AGE AND GENDER[a]

Food	Girls (<19) n = 18 % cons. (days/month)	Boys (<19) n = 18 % cons. (days/month)	Women (≥19) n = 61 % cons. (days/month)	Men (≥19) n = 34 % cons. (days/month)	Total population n = 131 % cons. (days/month)
1. Bear meat dried	0.00 (0.00)	0.00 (0.00)	14.8 (0.25)	20.6 (0.19)	12.2 (0.22)
2. Bear meat cooked	**55.6** (0.22)	44.4 (0.32)	**77.1** (0.29)	**91.2** (0.39)	**73.3** (0.32)
3. Bear liver or kidney	0.00 (0.00)	0.00 (0.00)	4.92 (0.11)	11.8 (0.16)	5.34 (0.14)
4. Moose meat dried	0.00 (0.00)	5.56 (0.17)	3.28 (0.25)	23.5 (0.79)	8.40 (0.63)
5. Moose meat cooked	**72.2** (2.27)	**72.2** (0.57)	**93.4** (1.77)	**100** (2.63)	**89.3** (1.94)
6. Moose liver or kidney	0.00 (0.00)	16.7 (0.19)	36.1 (0.20)	35.3 (0.24)	28.2 (0.21)
7. Caribou meat dried	0.00 (0.00)	5.56 (0.08)	0.00 (0.00)	0.00 (0.00)	0.76 (0.08)
8. Caribou meat cooked	33.3 (0.36)	27.8 (**2.61**)	31.15 (0.35)	32.5 (0.61)	31.3 (0.69)
9. Caribou liver or kidney	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.94 (0.50)	0.76 (0.50)
10. Beaver meat	38.9 (0.66)	44.4 (0.35)	**65.6** (0.84)	**88.2** (1.75)	**64.9** (1.10)
11. Rabbit Meat	22.2 (1.12)	**66.7** (0.41)	**68.9** (1.04)	**85.3** (1.61)	**66.4** (1.15)
12. Smoked game animal	0.00 (0.00)	0.00 (0.00)	13.1 (0.36)	20.6 (1.72)	11.5 (1.00)
17. Speckled trout	16.7 (0.22)	22.2 (0.15)	41.0 (0.40)	**58.8** (1.23)	39.9 (0.69)
18. Walleye	16.7 (0.11)	22.2 (0.65)	23.0 (0.42)	47.1 (0.69)	28.2 (0.54)
19. Whitefish	11.1 (0.12)	0.00 (0.00)	8.20 (0.48)	11.8 (0.08)	8.40 (0.27)
20. Pike	5.56 (1.25)	11.1 (0.33)	39.3 (0.49)	**55.9** (1.49)	35.1 (0.91)
21. Lake trout	0.00 (0.00)	5.56 (0.08)	8.20 (0.57)	17.7 (1.28)	9.16 (0.88)
22. Sturgeon	11.1 (0.42)	11.1 (0.12)	32.3 (0.29)	**52.9** (0.60)	35.1 (0.41)
23. Burbot	5.56 (0.08)	0.00 (0.00)	0.00 (0.00)	5.88 (2.21)	2.29 (1.50)
24. Red or white sucker	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	5.88 (0.71)	1.53 (0.71)
25. Fish from the ocean	0.00 (0.00)	0.00 (0.00)	1.64 (**2.50**)	11.8 (0.31)	3.82 (0.75)
26. Fish eggs	5.56 (0.17)	0.00 (0.00)	6.56 (0.10)	8.82 (0.22)	6.11 (0.16)
27. Smoked wild fish	5.56 (0.08)	0.00 (0.00)	27.9 (0.19)	32.4 (0.78)	22.1 (0.41)
32. Loon or merganser	0.00 (0.00)	0.00 (0.00)	1.64 (0.08)	14.7 (0.22)	4.58 (0.19)
33. Geese	**83.3** (1.59)	**100** (1.55)	**100** (1.81)	**100** (2.16)	**97.7** (1.84)
34. Dabblers	16.7 (0.33)	22.2 (0.27)	42.6 (0.72)	**55.9** (0.74)	39.7 (0.67)
35. Sea ducks	0.00 (0.00)	5.56 (0.25)	4.92 (0.39)	5.88 (0.83)	4.58 (0.51)
36. Other ducks	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	8.82 (1.17)	2.29 (1.17)
37. Ptarmigan, partridge and other birds	**50.0** (0.72)	44.44 (0.28)	**80.3** (1.19)	**91.18** (0.87)	**74.1** (0.97)
38. Goose gizzard	16.7 (0.72)	5.56 (0.25)	**54.1** (0.48)	29.41 (0.47)	35.9 (0.49)
46. Wild berries	**50.0** (0.53)	38.9 (0.49)	**62.3** (0.79)	**64.71** (1.09)	**58.0** (0.82)
47. Wild berry jam	44.4 (0.68)	27.8 (0.23)	**52.5** (0.45)	47.06 (3.59)	46.6 (1.28)
48. Bear grease	5.56 (0.08)	22.2 (1.18)	39.3 (0.72)	**55.88** (1.14)	36.6 (0.91)
49. Goose grease	38.9 (0.48)	44.4 (0.61)	42.6 (0.99)	**50.00** (1.37)	44.3 (0.99)
50. Moose grease	0.00 (0.00)	11.1 (3.37)	4.92 (0.79)	5.88 (2.25)	5.34 (1.95)

a. Characters in bold when percentage of the population is greater than or equal to 50%.

FIGURE 5.2.1A AVERAGE NUMBER OF TIMES PER WEEK RESPONDENTS REPORTED EATING TRADITIONAL FOODS ON THE TRADITIONAL FOOD FREQUENCY QUESTIONNAIRE (WEMINDJI)

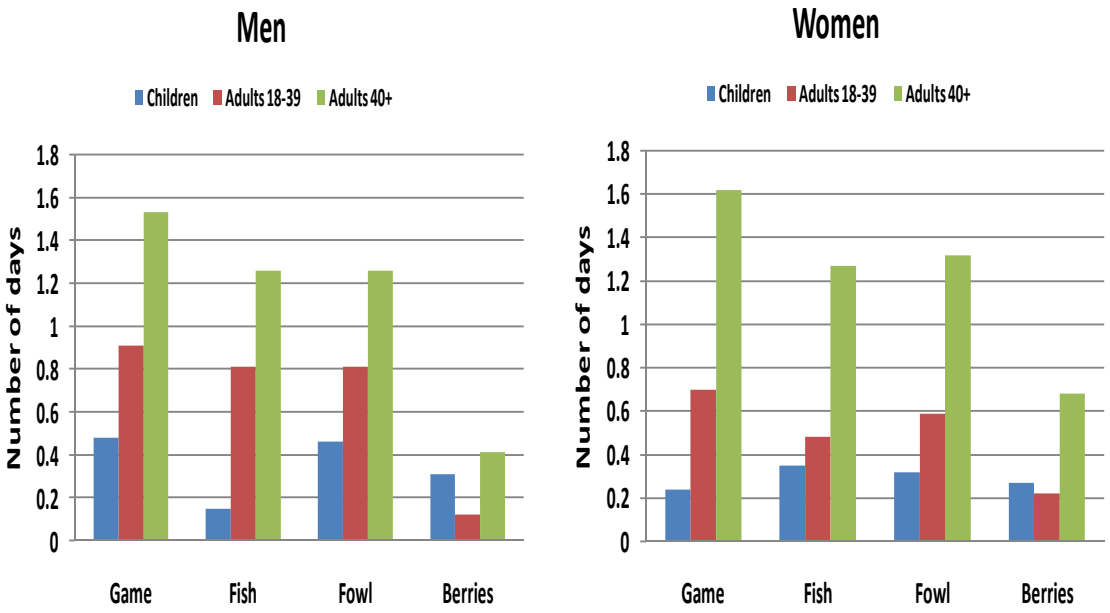


FIGURE 5.2.1B AVERAGE NUMBER OF TIMES PER WEEK RESPONDENTS REPORTED EATING TRADITIONAL FOODS ON THE TRADITIONAL FOOD FREQUENCY QUESTIONNAIRE (EASTMAIN)

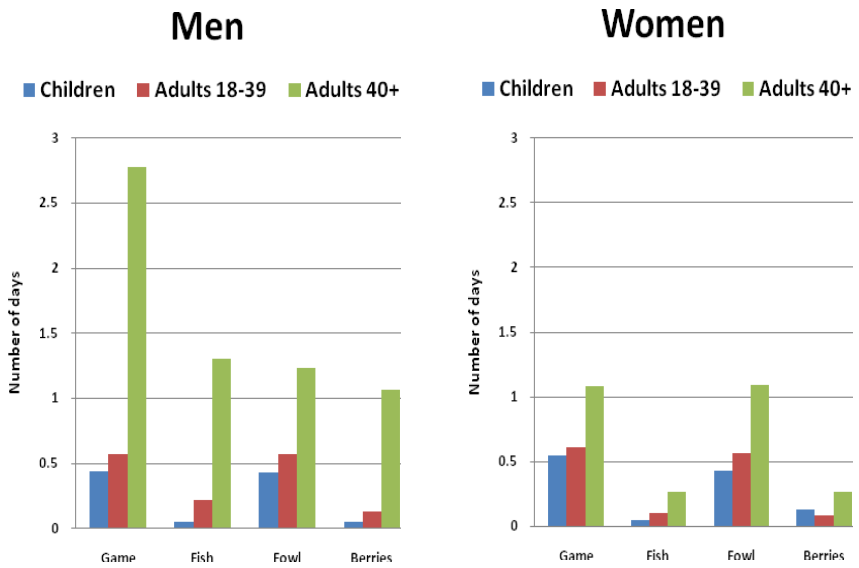


FIGURE 5.2.2A PERCENTAGE OF INDIVIDUALS CONSUMING TRADITIONAL FOODS IN THE PREVIOUS 24 HOURS (WEMINDJI; SPRING 2007)

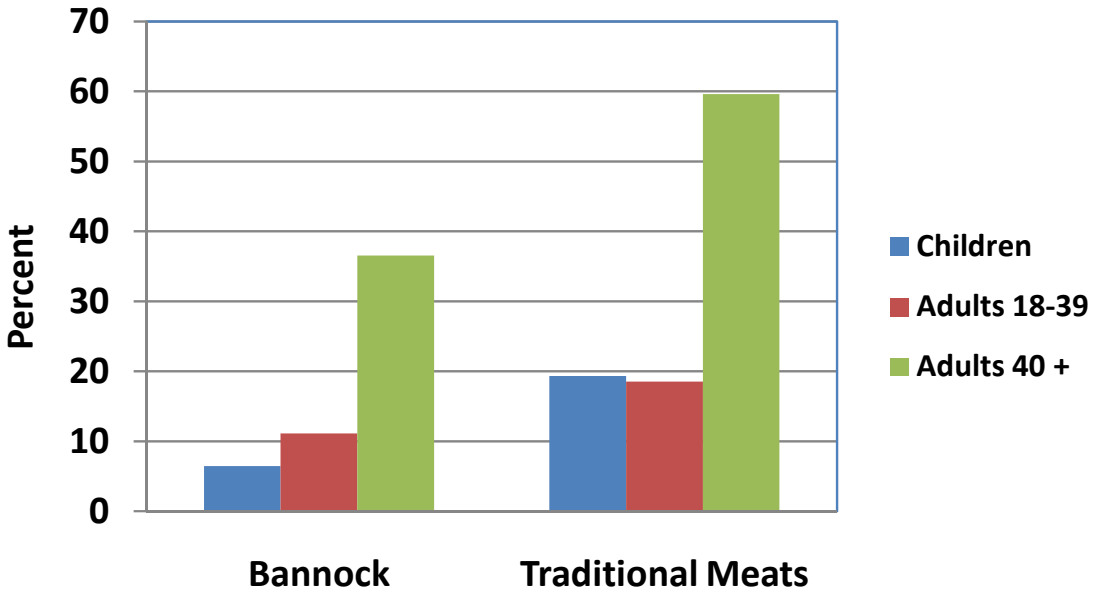
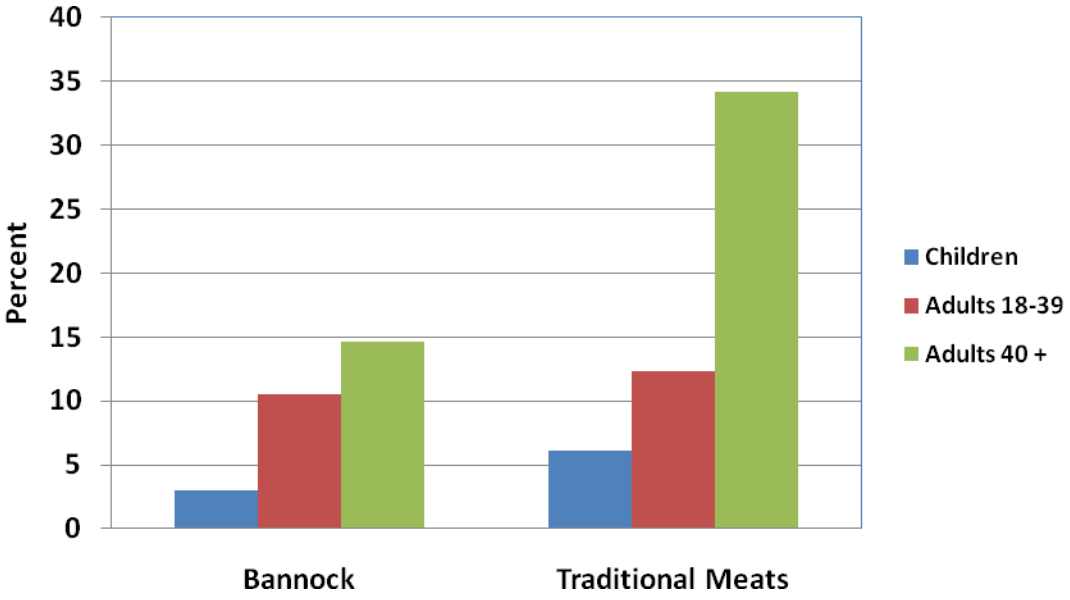


FIGURE 5.2.2B PERCENTAGE OF INDIVIDUALS CONSUMING TRADITIONAL FOODS IN THE PREVIOUS 24 HOURS (EASTMAIN; SUMMER 2007)



Factor Analysis

For the total diet (i.e., market plus traditional food) model, the PCA axes loadings are summarized in Table 5.2.3A for the market variables and in Table 5.2.3B for the traditional food items. PC-1 explains the largest amount of variation (11.8%), and is thus the most prominent of the new uncorrelated dietary variables. A perusal of both tables indicates that PC-1 only has strong positive loadings for traditional food items (highlighted in green). Consequently, it constitutes a traditional diet axis. PC-2 focuses on chips, crisps, poutine, fries and fried snacks and only two traditional food items (burbot fish and other ducks); all are positive loadings. It may therefore be primarily taken as a market food component. The same approximate designation appears relevant for PC-3, but with positive loadings for many market variables and negative for two traditional food items (burbot and red or white sucker). Figure 5.2.3 suggests that the consumption of traditional foods is more frequent in Mistissini than Eastmain and Wemindji, especially in the over-40 group; conversely, the market food items in question are more frequently consumed in the youngest group, and somewhat more so in Eastmain (Figures 5.2.4 and 5.2.5). Referring back to Tables 5.2.3A and 5.2.3B, PC-4 like PC-1 is a traditional food axis: with strong negative loadings (i.e., consumption increases with increased negativity; highlighted in pink) for dried bear meat, moose liver or kidney, lake trout, other wild fish (to those listed), bird and duck gizzards and wild berry jam; and positive loadings for animal fats 2 (other than bear or goose), and ptarmigan, partridge and other birds (i.e., those not listed in Table 5.2.3B). By contrast, PC-5 has positive weightings for vegetables and fruits (strong for tomatoes) and the common alcohol beverages beer and wine (strong loading for the latter). PC-6 is more difficult to interpret. Clearly, principal component analysis constitutes a powerful tool for grouping food items that are consumed.

A comparison of the loadings for inclusion of the market dietary consumption variables (Table 5.2.3B) in the principal component analysis with when they are not (Table 5.2.4 and Figure 5.2.6) indicates little change for the major axes. Again PC-1 constitutes the primary component (strong positive loadings for many of the traditional food variables); PC-2 with strong positive presence of burbot, red and white sucker and other ducks; strong negative loadings for other ducks (PC-3) and for fats other than bear and goose grease (PC-4).

TABLE 5.2.3A PRINCIPAL COMPONENT AXES LOADINGS FOR THE MEAN DAILY CONSUMPTION FREQUENCIES (ANNUAL AVERAGE) FOR THE MARKET (STORE BOUGHT) FOOD VARIABLES OF THE TOTAL DIET (EASTMAIN, MISTISSINI, AND WEMINDJI)

+Mean daily frequency over year (Questionnaire)	PC-1 of Mkt. & Trad. Diet (11.8%)	PC-2 of Mkt. & Trad. Diet (3.7%)	PC-3 of Mkt. & Trad. Diet (3.76%)	PC-4 of Mkt. & Trad. Diet (3.4%)	PC-5 of Mkt. & Trad. Diet (3.0%)	PC-6 of Mkt. & Trad. Diet (2.8%)
Q1: Fresh fruit	-0.012	0.239	0.086	0.087	0.229	0.267
Q2: Canned fruit	0.117	0.234	0.100	0.178	0.125	0.172
Q3: Dried fruit	0.074	-0.026	-0.181	0.026	0.165	0.196
Q4: Potatoes	0.207	0.233	-0.044	-0.085	0.259	0.459
Q5: Carrots, peas or corn	0.027	0.242	-0.153	-0.040	0.306	0.466
Q6: Salad or coleslaw	0.189	0.258	-0.317	0.070	0.250	0.282
Q7: Tomatoes	0.083	0.272	-0.325	-0.152	0.366	0.232
Q21: Cakes, snack cakes, boudin cake, donuts, pies, pastries	0.136	0.348	0.069	0.118	0.138	0.219
Q22: Cookies	0.279	0.300	0.167	0.120	0.114	0.152
Q25-1: Soft drinks- Regular	-0.016	0.242	0.416	0.134	-0.069	-0.172
Q25-2: Soft drinks- Diet	0.009	0.092	-0.140	-0.236	0.286	0.004
Q26-1: Ice tea- Regular	-0.066	0.293	0.506	0.150	-0.078	-0.167
Q26-2: Ice tea- Diet	0.090	0.036	-0.038	0.005	-0.055	-0.071
Q27: Fruit drinks or Sports drinks	0.003	0.140	0.287	0.075	0.010	-0.048
Q28: Real fruit juice	-0.035	0.164	0.167	0.173	0.132	-0.094
Q29-1: Milk- Whole	-0.032	0.056	-0.022	0.002	0.080	0.046
Q29-2: Milk- 2%, Grand Pré	0.039	-0.089	0.091	0.016	0.000	0.111
Q29-3: Milk- 1%	-0.011	0.086	0.071	0.030	0.066	0.076
Q29-4: Milk- Skim	-0.029	-0.025	-0.054	-0.028	-0.004	0.030
Q30: Chocolate milk	-0.017	0.119	0.205	0.100	0.017	0.015
Q32-1: Beer- Regular	-0.031	0.102	-0.092	-0.200	0.230	-0.364
Q32-2: Beer- Light	-0.040	-0.046	-0.095	-0.080	-0.023	0.023
Q33: Wine	0.005	0.122	-0.225	-0.268	0.383	-0.355
Q34-1: Alcohol- Mixed with juice or pop	-0.050	0.083	0.076	0.048	-0.027	-0.139
Q34-2: Alcohol- Shooters or on ice	-0.031	0.012	-0.021	-0.023	0.045	-0.011
Q42: Chips, crisps, cheese puffs	-0.094	0.423	0.508	0.082	0.032	-0.166
Q43: Nacho chips with melted cheese	-0.021	0.290	0.292	0.051	0.101	-0.101
Q44-1: Microwave Popcorn- Regular	-0.013	0.288	0.234	0.117	0.076	0.040
Q44-2: Microwave Popcorn - Light or Low fat	-0.061	0.078	0.031	0.046	0.086	0.124
Q47: Poutine	-0.060	0.416	0.425	0.176	0.040	-0.043
Q48: French fries, fried potatoes or hash browns	-0.101	0.327	0.094	0.104	0.179	0.073
Q49: Deep fried snacks	0.137	0.360	0.156	0.240	0.101	0.145
Q50: Butter	0.035	0.036	0.071	-0.123	0.137	-0.103
Q51: Margarine	0.009	-0.145	-0.041	0.084	0.174	0.084
Q52: Lard or shortening	0.171	-0.108	0.034	-0.018	0.110	0.106
Q53: Vegetable oil	0.097	0.067	-0.060	-0.151	0.302	-0.051

TABLE 5.2.3B PRINCIPAL COMPONENT AXES LOADINGS FOR THE MEAN DAILY CONSUMPTION FREQUENCIES (ANNUAL AVERAGE) FOR THE TRADITIONAL FOOD VARIABLES OF THE TOTAL DIET (EASTMAIN, MISTISSINI, AND WEMINDJI)

Mean daily frequency over year (Questionnaire)	PC-1 of Mkt. & Trad. Diet (11.8%)	PC-2 of Mkt. & Trad. Diet (3.7%)	PC-3 of Mkt. & Trad. Diet (3.76%)	PC-4 of Mkt. & Trad. Diet (3.4%)	PC-5 of Mkt. & Trad. Diet (3.0%)	PC-6 of Mkt. & Trad. Diet (2.8%)
Q1: Bear meat, dried	0.518	-0.046	0.220	-0.385	-0.050	0.141
Q2: Bear meat, cooked	0.443	-0.143	0.145	-0.124	0.053	0.293
Q3: Bear liver or kidney	0.074	-0.120	-0.132	0.001	0.100	-0.025
Q4: Moose meat, dried	0.482	-0.260	0.182	0.092	0.335	0.002
Q5: Moose meat, cooked	0.651	-0.274	0.234	-0.072	0.133	0.156
Q6: Moose liver or kidney	0.518	-0.042	0.206	-0.391	-0.135	0.141
Q7: Caribou meat, dried	0.486	-0.221	0.225	0.056	0.264	-0.031
Q8: Caribou meat, cooked	0.544	-0.161	0.234	-0.099	0.176	0.100
Q9: Caribou liver or kidney	0.078	-0.068	0.045	-0.109	0.007	0.170
Q10: Beaver meat	0.539	-0.247	0.070	0.192	0.040	0.105
Q11: Rabbit meat	0.425	-0.295	-0.002	0.131	0.046	0.096
Q12: Smoked game animal meat	0.507	-0.004	0.097	-0.065	-0.093	0.192
Q13: Other Game Animal 1	0.315	-0.129	-0.143	0.274	0.007	-0.113
Q14: Other Game Animal 2	0.097	-0.089	0.018	0.038	0.168	0.061
Q17: Speckled trout	0.631	-0.023	0.247	-0.247	-0.116	-0.060
Q18: Walleye	0.616	-0.105	0.088	0.213	0.027	-0.095
Q19: Whitefish	0.511	-0.234	-0.046	0.225	0.272	0.017
Q20: Pike	0.749	-0.145	0.076	0.139	-0.007	-0.047
Q21: Lake Trout	0.660	0.024	0.278	-0.343	-0.163	-0.109
Q22: Sturgeon	0.334	-0.075	-0.154	0.210	-0.048	0.029
Q23: Burbot	0.447	0.444	-0.407	0.093	-0.283	0.113
Q24: Red or White Sucker	0.556	0.248	-0.353	0.229	-0.202	0.048
Q25: Fish from the ocean	0.054	-0.035	-0.061	0.036	0.086	0.099
Q26: Fish eggs	0.363	0.015	-0.263	0.281	-0.013	-0.039
Q27: Smoked wild fish	0.498	-0.283	0.129	0.079	0.242	-0.137
Q28: Other Wild Fish 1	-0.001	0.000	-0.054	0.006	0.044	-0.039
Q29: Other Wild Fish 2	0.044	0.172	-0.226	-0.370	0.471	-0.463
Q30: Fish liver 1	0.171	-0.036	-0.259	0.297	0.020	-0.015
Q31: Fish liver 2	0.084	0.036	-0.128	0.146	-0.087	-0.081
Q32: Loon or Merganser	0.465	0.063	0.033	-0.280	-0.239	-0.062
Q33: Geese	0.548	0.065	-0.030	0.214	-0.011	-0.042
Q34: Dappler Ducks	0.636	0.187	-0.068	-0.093	-0.299	0.026
Q35: Sea Ducks	0.679	0.332	-0.163	-0.159	-0.248	0.038
Q36: Other Ducks	0.540	0.452	-0.302	-0.241	-0.355	-0.067
Q37: Ptarmigan, partridge and other birds	0.552	0.066	-0.158	0.335	0.020	-0.312

Q38: Bird and Duck gizzards 1	0.505	-0.004	0.112	0.126	-0.009	-0.097
Q39: Bird and Duck gizzards 2	0.372	-0.050	0.064	-0.354	-0.182	0.033
Q40: Bird and Duck gizzards 3	0.175	-0.170	-0.012	0.020	-0.081	0.143
Q41: Bird and Duck gizzards 4	-0.006	-0.033	-0.012	-0.031	-0.051	0.047
Q42: Bird and Duck livers or kidneys 1	0.056	-0.135	-0.113	0.133	0.051	0.001
Q46: Wild berries	0.580	0.094	0.047	-0.211	0.057	-0.106
Q47: Wild berry jam	0.480	0.222	-0.170	-0.413	0.357	-0.382
Q48: Bear grease	0.500	0.156	-0.311	0.274	-0.118	-0.158
Q49: Goose grease	0.444	0.028	0.069	0.253	0.129	-0.143
Q50: Other Animal Fats 1	0.145	0.044	0.015	0.238	0.057	-0.169
Q51: Other Animal Fats 2	0.235	-0.051	-0.092	0.353	0.056	-0.355

FIGURE 5.2.3 MEAN VALUES OF TOTAL (MARKET AND TRADITIONAL) DIETARY SUMMARY VARIABLE PC-1 (± 95% CONFIDENCE INTERVAL) BY AGE CATEGORY AND COMMUNITY

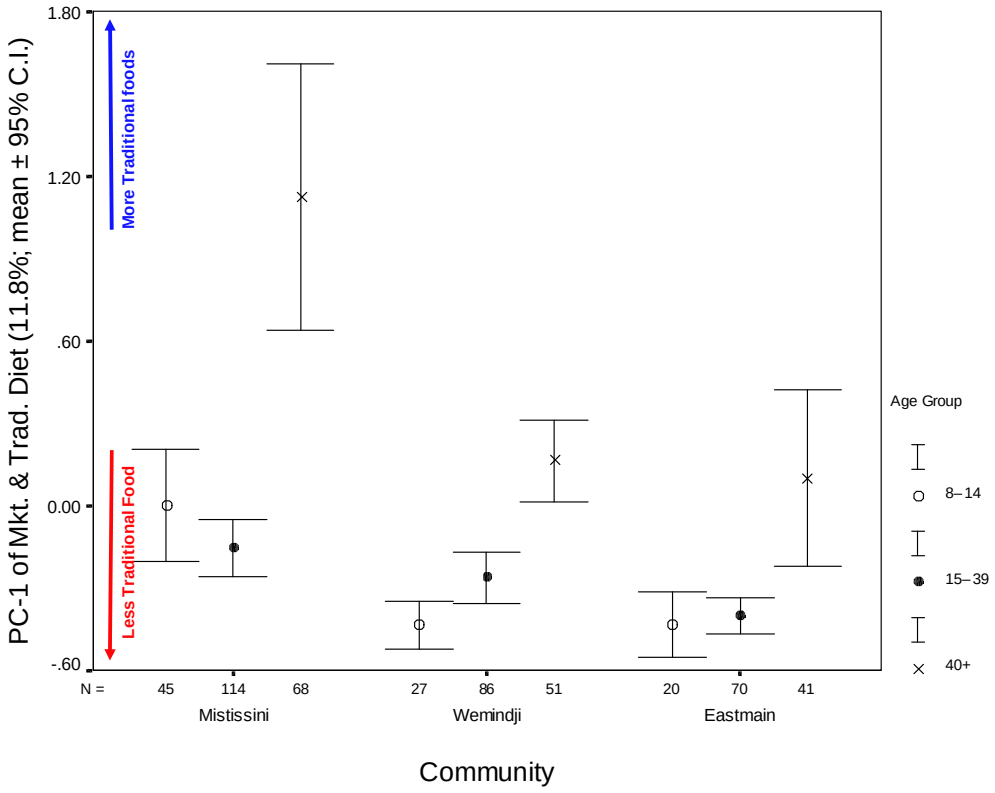


FIGURE 5.2.4 MEAN VALUES OF TOTAL (MARKET AND TRADITIONAL) DIETARY SUMMARY VARIABLE PC-2 (± 95% CONFIDENCE INTERVAL) BY AGE CATEGORY AND COMMUNITY

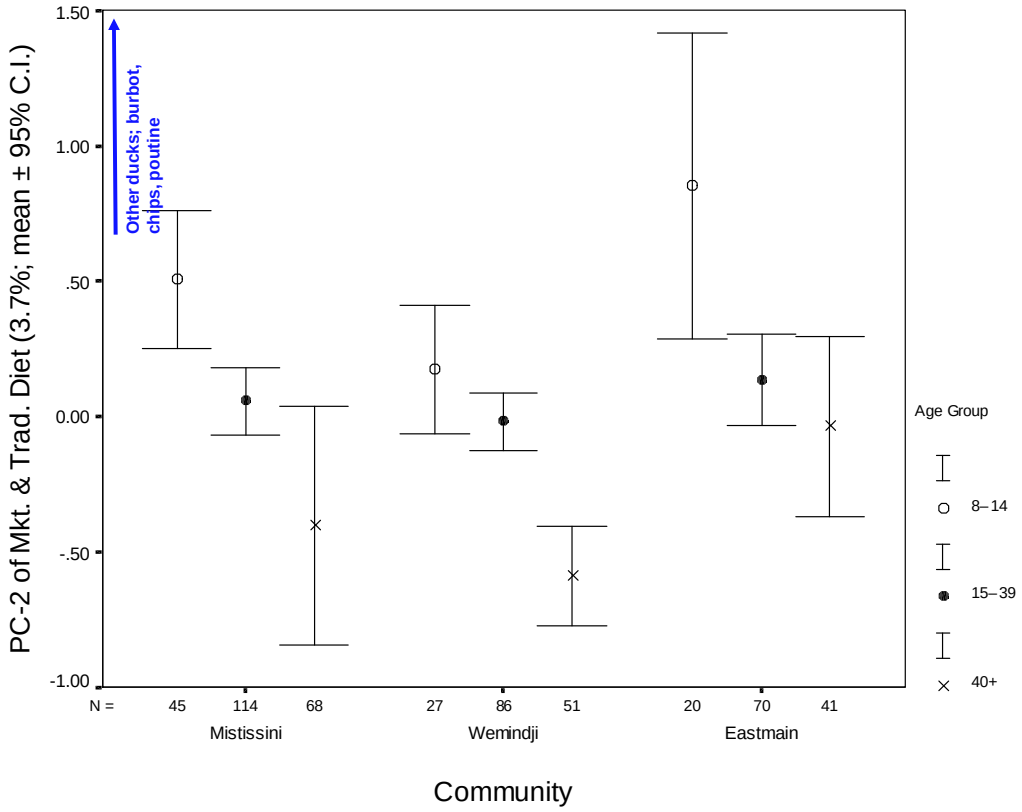


FIGURE 5.2.5 MEAN VALUES OF TOTAL (MARKET AND TRADITIONAL) DIETARY SUMMARY VARIABLE PC-3 (± 95% CONFIDENCE INTERVAL) BY AGE CATEGORY AND COMMUNITY

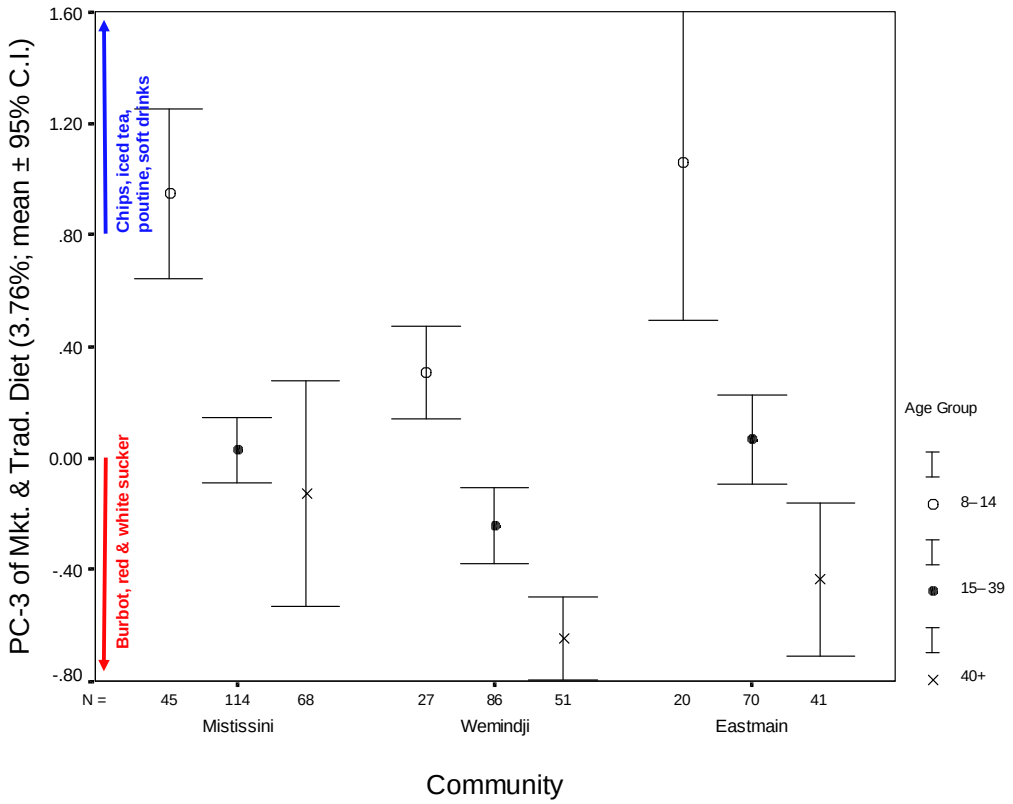
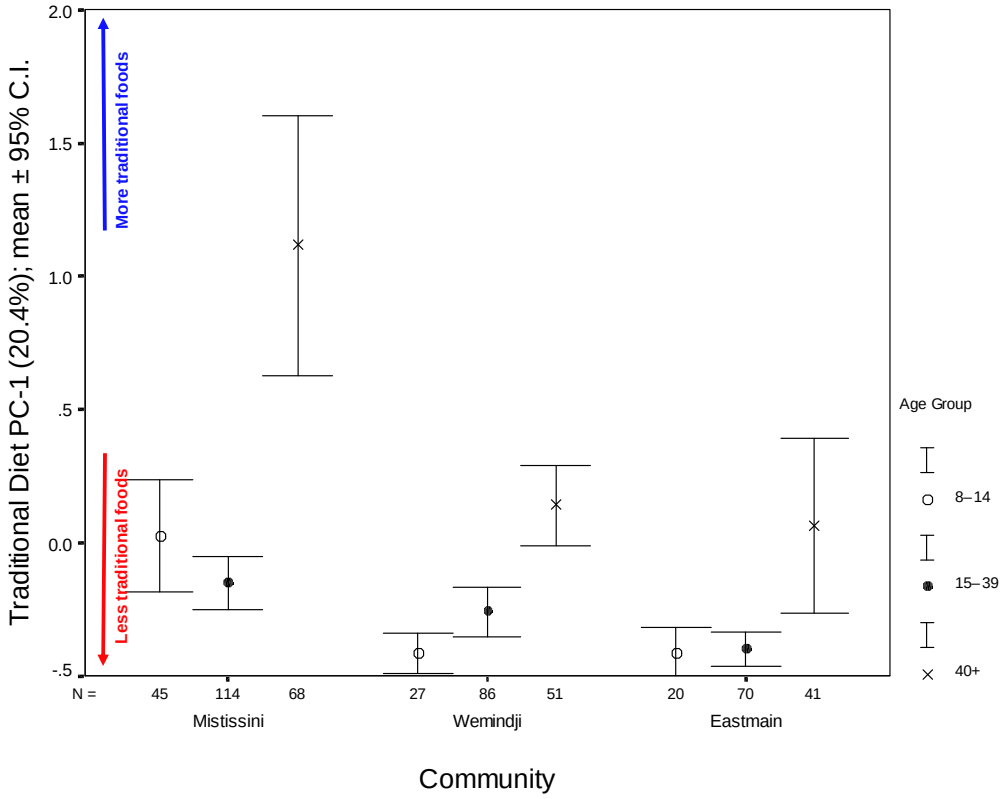


TABLE 5.2.4 PRINCIPAL COMPONENT AXES LOADINGS FOR THE MEAN DAILY CONSUMPTION FREQUENCIES (ANNUAL AVERAGE) FOR THE TRADITIONAL FOOD VARIABLES (MARKET DIETARY VARIABLES ARE NOT CONSIDERED) (EASTMAIN, MISTISSINI, AND WEMINDJI)

Traditional Diet Frequency (Questionnaire)	Traditional Diet PC-1 (20.4%)	Traditional Diet PC-2 (6.0%)	Traditional Diet PC-3 (5.8%)	Traditional Diet PC-4 (4.4%)
Q1: Bear meat, dried	0.521	-0.289	-0.381	-0.095
Q2: Bear meat, cooked	0.440	-0.297	-0.077	0.222
Q3: Bear liver or kidney	0.074	-0.002	0.109	0.113
Q4: Moose meat, dried	0.484	-0.337	0.248	-0.123
Q5: Moose meat, cooked	0.654	-0.400	0.052	0.181
Q6: Moose liver or kidney	0.521	-0.244	-0.408	0.032
Q7: Caribou meat, dried	0.483	-0.340	0.189	-0.214
Q8: Caribou meat, cooked	0.548	-0.340	-0.013	-0.028
Q9: Caribou liver or kidney	0.078	-0.132	-0.091	0.094
Q10: Beaver meat	0.539	-0.180	0.274	0.440
Q11: Rabbit meat	0.426	-0.161	0.247	0.364
Q12: Smoked game animal meat	0.508	-0.110	-0.096	0.287
Q13: Other Game Animal 1	0.316	0.091	0.307	0.047
Q14: Other Game Animal 2	0.098	-0.091	0.078	-0.034
Q17: Speckled trout	0.641	-0.192	-0.263	0.028
Q18: Walleye	0.621	-0.055	0.232	-0.036
Q19: Whitefish	0.508	-0.101	0.363	0.011
Q20: Pike	0.750	-0.104	0.181	0.055
Q21: Lake Trout	0.673	-0.192	-0.390	-0.187
Q22: Sturgeon	0.334	0.116	0.228	0.289
Q23: Burbot	0.436	0.663	-0.124	0.234
Q24: Red or White Sucker	0.549	0.520	0.085	0.138
Q25: Fish from the ocean	0.051	-0.017	0.053	0.047
Q26: Fish eggs	0.362	0.263	0.281	0.036
Q27: Smoked wild fish	0.505	-0.267	0.234	-0.208
Q28: Other Wild Fish 1	0.000	0.030	0.039	0.011
Q29: Other Wild Fish 2	0.042	0.087	-0.140	-0.250
Q30: Fish liver 1	0.169	0.206	0.311	0.155
Q31: Fish liver 2	0.086	0.192	0.101	0.122
Q32: Loon or Merganser	0.473	0.028	-0.347	-0.020
Q33: Geese	0.546	0.146	0.174	0.033
Q34: Dappler Ducks	0.637	0.250	-0.236	0.182
Q35: Sea Ducks	0.675	0.367	-0.335	0.022
Q36: Other Ducks	0.537	0.559	-0.445	0.036
Q37: Ptarmigan, partridge and other birds	0.554	0.279	0.313	-0.430
Q38: Bird and Duck gizzards 1	0.508	-0.028	0.096	-0.144

Q39: Bird and Duck gizzards 2	0.375	-0.132	-0.362	-0.018
Q40: Bird and Duck gizzards 3	0.178	-0.107	0.072	0.446
Q41: Bird and Duck gizzards 4	-0.007	-0.016	-0.023	0.097
Q42: Bird and Duck livers or kidneys 1	0.057	0.018	0.199	0.074
Q46: Wild berries	0.581	-0.017	-0.203	-0.262
Q47: Wild berry jam	0.478	0.117	-0.270	-0.375
Q48: Bear grease	0.500	0.441	0.211	0.003
Q49: Goose grease	0.444	0.002	0.237	-0.281
Q50: Other Animal Fats 1	0.146	0.069	0.215	-0.296
Q51: Other Animal Fats 2	0.244	0.142	0.388	-0.507

FIGURE 5.2.6 MEAN VALUES OF THE TRADITIONAL DIETARY SUMMARY VARIABLE PC-1 (± 95% CONFIDENCE INTERVAL) BY AGE CATEGORY AND COMMUNITY



5.2.1.4 Nutrient intake estimates

Macronutrients, saturated fat and cholesterol

The percent of energy taken in as protein, total fat, and carbohydrates are provided in Figures 5.2.7A-5.2.10B. Acceptable Macronutrient Distribution Range (AMDR) for fat intake as a percent of total energy ranges 20-35% for adults (IOM, 2005). Both men and women exceeded this range. For men and women Wemindji, total fat contributed 37% of energy on average; it was 39% of energy in Eastmain. For children, the recommended AMDR for fat intake as a percent of total energy ranges 25-35%. The averages in the two communities for boys and girls were, respectively, 34% and 39% in Wemindji and 37% and 38% in Eastmain.

For men and women, median daily protein intake was adequate, with only an estimated 5.2% in Wemindji and 1.7% in Eastmain of women, compared to 2.82% of men in Wemindji and none in Eastmain, below the estimated average requirement (IOM 2005). Protein intake was adequate in both girls and boys, and well within recommended guideline of 10-30% of energy as protein (IOM, 2002). In the past, Canadian guidelines suggested that saturated fat intake be less than or equal to 10% of energy consumed to prevent type 2 diabetes and heart disease. Saturated fat intake was greater than this for men, women and children in both Wemindji (where 80% of persons consumed over 10% of their daily energy intake in the form of saturated fat; Figure 5.2.11A) and in Eastmain (>70%; Figure 5.2.11B). It is now recommended that the daily consumption of saturated fat and cholesterol be as low as possible while consuming a nutritionally adequate diet.

Previous guidelines have recommended that daily cholesterol intake be limited to 300 mg/day. The median intake of cholesterol was high for men (530mg/day in Wemindji and 635 mg/day in Eastmain) (Tables 5.2.9A and 5.2.9B). Also, median cholesterol levels were high for women (407 mg/day in Wemindji and 543 mg/day in Eastmain), and boys (373 mg/day vs. 442 mg/day, Wemindji and Eastmain respectively). The median intake by girls was 182 mg/day (Wemindji) *versus* 211 mg/day (Eastmain). The observed cholesterol intake for adults is considered high compared to other North American studies (IOM, 2005; Gray-Donald et al., 2000).

FIGURE 5.2.7A PERCENTAGE OF ENERGY AS MACRONUTRIENTS IN MEN AGED 19 YEARS AND OLDER (WEMINDJI)

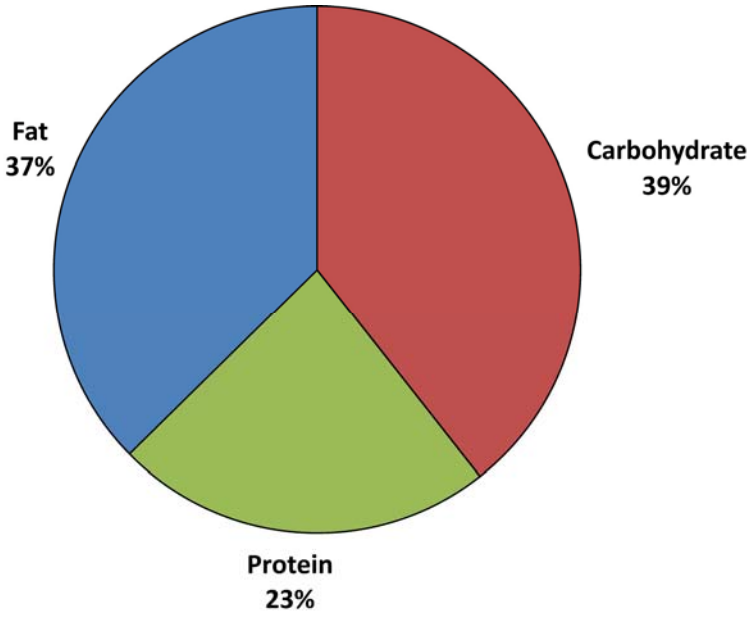


FIGURE 5.2.7B PERCENTAGE OF ENERGY AS MACRONUTRIENTS IN MEN AGED 19 YEARS AND OLDER (EASTMAIN)

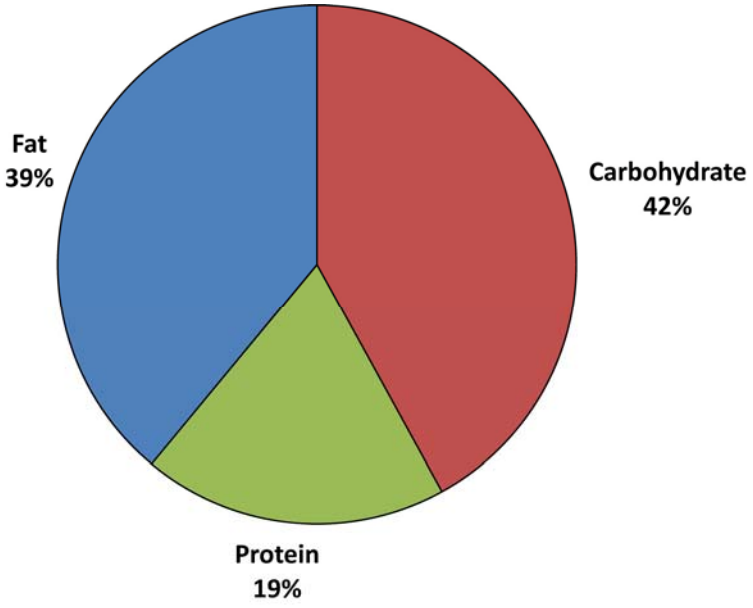


FIGURE 5.2.8A PERCENTAGE OF ENERGY AS MACRONUTRIENTS IN WOMEN AGED 19 YEARS AND OLDER (WEMINDJI)

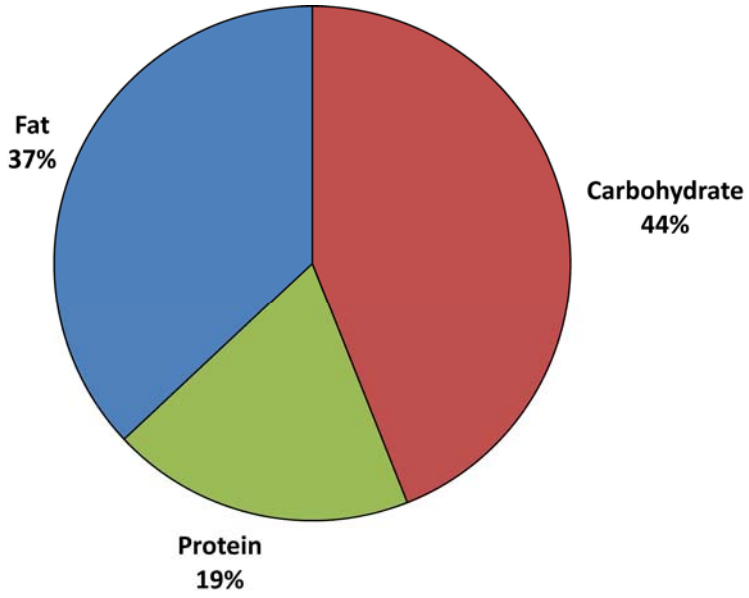


FIGURE 5.2.8B PERCENTAGE OF ENERGY AS MACRONUTRIENTS IN WOMEN AGED 19 YEARS AND OLDER (EASTMAIN)

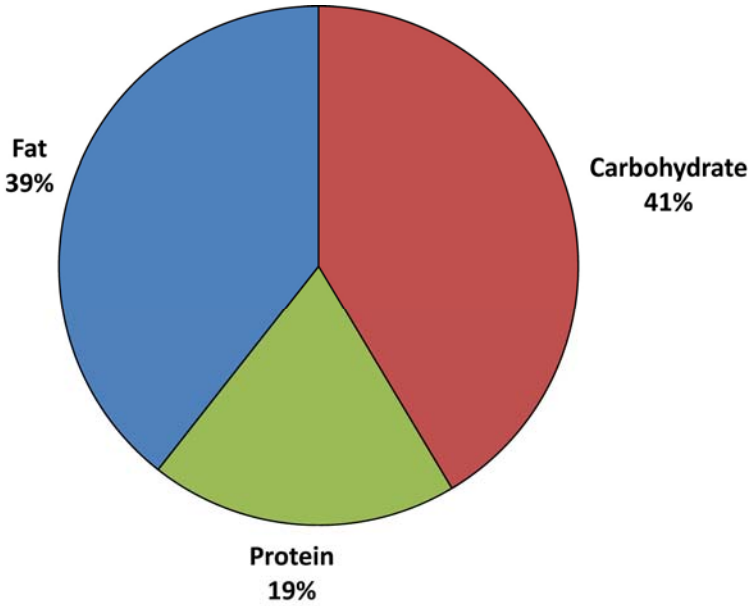


FIGURE 5.2.9A PERCENTAGE OF ENERGY AS MACRONUTRIENTS IN BOYS AGED 9-18 YEARS (WEMINDJI)

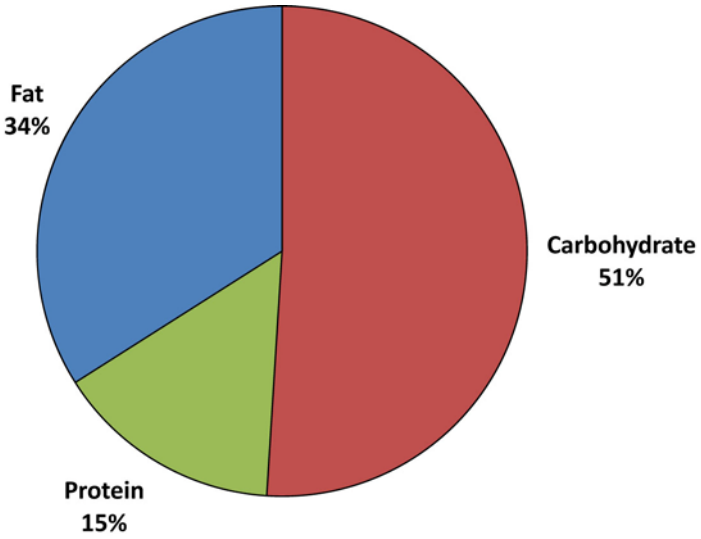


FIGURE 5.2.9B PERCENTAGE OF ENERGY AS MACRONUTRIENTS BOYS AGED 9-18 YEARS (EASTMAIN)

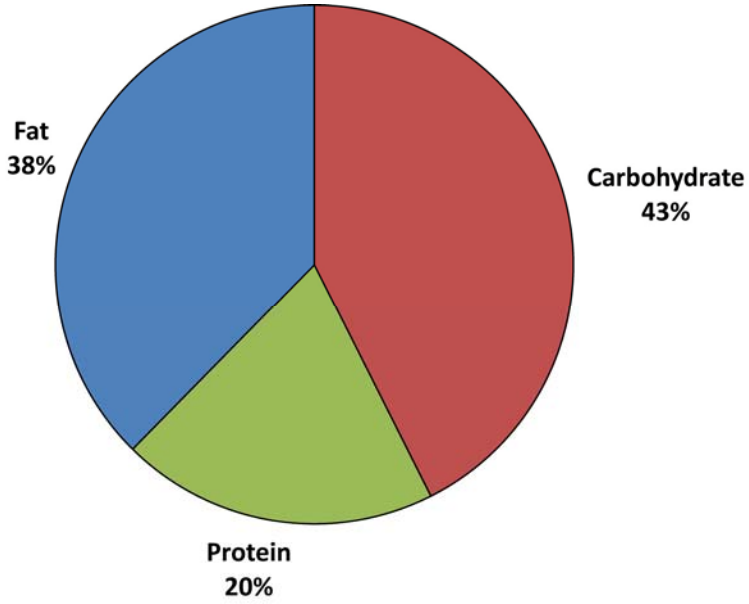


FIGURE 5.2.10A PERCENTAGE OF ENERGY AS MACRONUTRIENTS IN GIRLS AGED 9-18 YEARS (WEMINDJI)

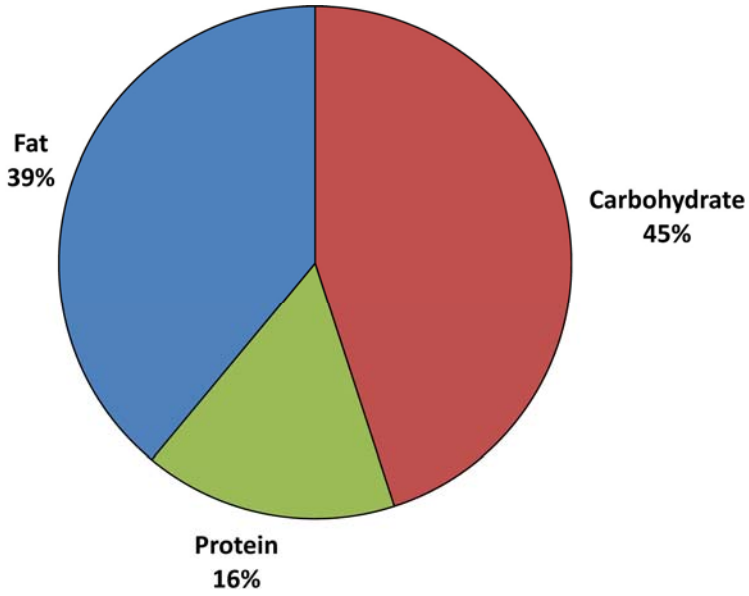


FIGURE 5.2.10B PERCENTAGE OF ENERGY AS MACRONUTRIENTS IN GIRLS AGED 9-18 YEARS (EASTMAIN)

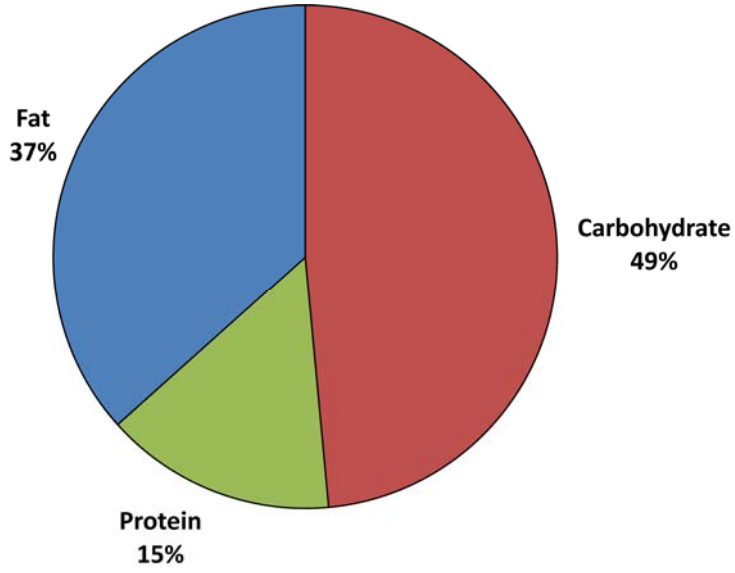


FIGURE 5.2.11A PERCENT OF POPULATION FOR WHOM SATURATED FAT COMPRISED MORE THAN 10% OF ENERGY INTAKE (WEMINDJI)

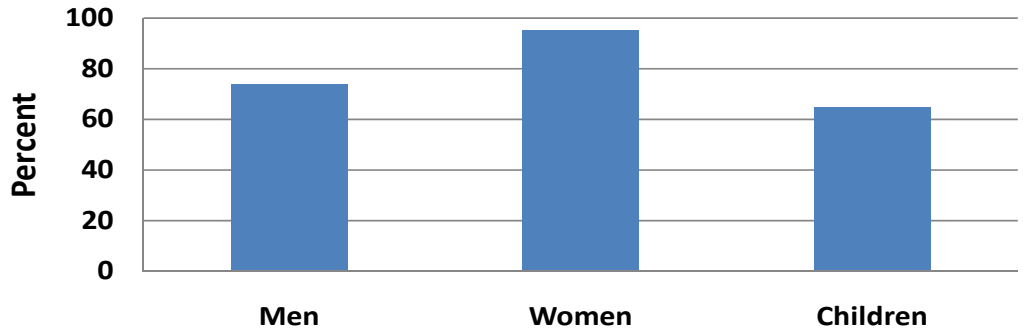
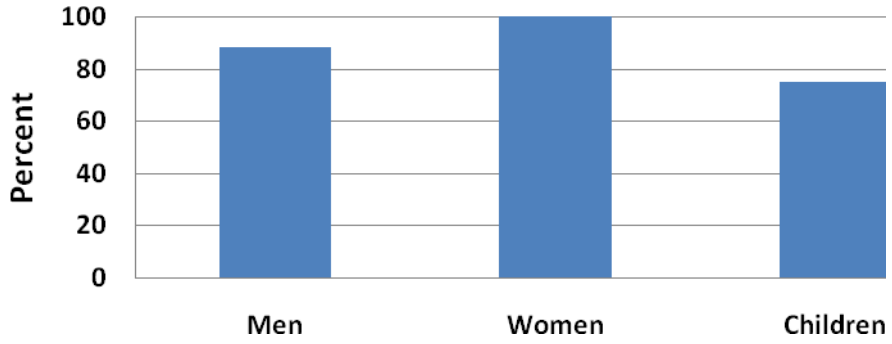


FIGURE 5.2.11B PERCENT OF POPULATION FOR WHOM SATURATED FAT COMPRISED MORE THAN 10% OF TOTAL ENERGY INTAKE (EASTMAIN)



Micronutrient intake in adults

In Wemindji 50 to 60% of men and women had inadequate vitamin A (IOM, 2000b), whereas in Eastmain it was around 30% for both (Tables 5.2.5A,B and 5.2.6A,B). A small percentage of men (5.17%) were below the estimated average requirement (EAR) for daily folate intake (IOM, 1998), but all women met their adequate intake of this vitamin. By comparison, a near equal percentage of men (18.7%) and women (16.7%) were below the EAR in Eastmain (Tables 5.2.5A,B and 5.2.6A,B). In Wemindji, close to a fifth (19.6%) of women did not meet their daily requirements for vitamin C (IOM, 2000c), and close to 60% of men did not; in Eastmain, the proportions were 24% (women) and 35.3% (men). Mean vitamin D intake for both men (10.6 µg) and women (6.16 µg) in Wemindji, and 7.02 µg for men and 7.17 µg for women in Eastmain (Tables 5.2.7A,B and 5.2.8A,B), are difficult to

interpret because the adequate intake levels (AI)) range from 5-15 µg/day depending on age (IOM, 2000c). Please note that some of these figures may be a result of underreporting.

The mean daily calcium intake in Wemindji for men was 675 mg/d and women 690 mg/d, compared to 733 mg/d (men) and 768 mg/d (women) in Eastmain (Tables 5.2.7A,B and 5.2.8A,B); all were considerably below the adequate intake (AI) of 1000 – 1200 mg/day (IOM, 1997). Also noteworthy is the low magnesium intake among men and women. Eighty five percent of men in Wemindji aged 19-30, and 75.3% of men, aged 31 and older, had inadequate magnesium intake (IOM, 1997). In Eastmain the corresponding percentages were 70% and 86.4% (Tables 5.2.5A,B and 5.2.6A,B). Women fared a little better in Wemindji, with 55% (19-30 years) and 40.4% (31 and older) having inadequate magnesium intakes; respectively, they were 58.3% and 30.6% in Eastmain. For zinc (Tables 5.2.5A,B and 5.2.6A,B), virtually all men met their daily EAR (in Wemindji 0.67% did not, and none in Eastmain); 5.63% of women in Wemindji and 4.92% in Eastmain consumed inadequate amounts. Iron intake was adequate in men (IOM 2000b) in both communities (Tables 5.2.5A,B and 5.2.6A,B). Analysis showed that a very small probability of inadequate iron intake in the women of pre-menopausal age (19-50 years old), with 4.30% in Wemindji and 6.1% in Eastmain falling in the inadequate intake range and no probability of inadequacy in older women (>50 years of age) in either community.

TABLE 5.2.5A MEAN, MEDIAN AND PERCENT INDIVIDUALS BELOW EAR (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN EAR IN WOMEN 19 YEARS OF AGE AND OLDER (N = 71)[a] (WEMINDJI)

Nutrient	Mean intake	± SD	Median intake	% Individuals below EAR	EAR	RDA or recommended levels
Energy[b] (kilocalories)	2282	901	2289	NA		
Cholesterol[b] (mg)	403	252	407	NA		As low as possible while consuming a nutritionally adequate diet
Vitamin A[b](RAE)	538	831	492	54.9	500	700
Folate[b] (DFE)	493	440	486	0.00	320	400
Vitamin C[b] (mg)	119	172	103	19.6	60	75
Iron[b](19-50 yrs) (mg) (n = 57)	22.6	25.1	22.9	4.30[d]	8.1	18
Iron[b] (≥51 yrs) (mg) (n = 14)	26.9	13.9	24.4	0.00	5	8
Magnesium[b](19-30 yrs) (mg) (n = 24)	261	98.2	246	55.0	255	310
Magnesium[b] (≥31 yrs) (mg) (n = 47)	283	147	273	40.4	265	320
Zinc[c] (mg)	13.8	10.6	10.8	5.63	6.8	8

a. EAR = estimated average requirements; NA = not applicable; SD = standard deviation; RDA = recommended; daily allowance

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

d. Used probability method rather than percent below EAR.

TABLE 5.2.5B MEAN, MEDIAN AND PERCENT INDIVIDUALS BELOW EAR (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN EAR IN WOMEN 19 YEARS OF AGE AND OLDER (N = 61)[a] (EASTMAIN)

Nutrient	Mean intake	± SD	Median intake	% Individuals below EAR	EAR	RDA or recommended levels
Energy[b] (kilocalories)	2260	944	2322	NA	NA	
Cholesterol[b] (mg)	543	403	469	NA	NA	As low as possible while consuming a nutritionally adequate diet
Vitamin A[b] (RAE)	651	420	665	31.1	500	700
Folate[b] (DFE)	479	353	467	16.7	320	400
Vitamin C[b] (mg)	141	149	111	24.4	60	75
Iron[b] (19-50 yrs) (mg) (n = 54)	28.4	81.1	20.1	6.09[d]	8.1	18
Iron[b] (≥51 yrs) (mg) (n = 7)	15.3	6.91	21.7	0.00	5	8
Magnesium[b] (19-30 yrs) (mg) (n = 12)	276	133	247	58.3	255	310
Magnesium[b] (≥31 yrs) (mg) (n = 49)	299	117	284	30.6	265	320
Zinc[c] (mg)	13.6	8.13	11.4	4.92	6.8	8

a. EAR = estimated average requirements; NA = not applicable; SD = standard deviation; RDA = recommended; daily allowance

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

d. Used probability method rather than percent below EAR.

TABLE 5.2.6A MEAN, MEDIAN AND PERCENT INDIVIDUALS BELOW EAR (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN EAR IN MEN 19 YEARS OF AGE AND OLDER (N = 58)[a] (WEMINDJI)

Nutrient	Mean intake	± SD	Median intake	% Individuals below EAR	EAR	RDA or recommended levels
Energy[c] (kilocalories)	2372	1093	2283	NA		
Cholesterol[c] (mg)	576	372	530	NA		As low as possible while consuming a nutritionally adequate diet
Vitamin A[b](RAE)	543	435	591	60.3	625	900
Folate[c] (DFE)	551	422	510	5.17	320	400
Vitamin C[b] (mg)	99.3	145	58.2	59.6	75	90
Iron[b] (mg)	20.5	12.4	20.6	0.00	6	8
Magnesium[c] (19-30 yrs) (mg) (n = 13)	244	91.0	259	84.6	330	400
Magnesium[b] (≥31 yrs) (mg) (n = 45)	310	167	299	75.3	350	420
Zinc[b] (mg)	18.0	16.6	16.9	0.67	9.4	11

a. EAR = estimated average requirements; NA = not applicable; SD = standard deviation; RDA = recommended daily allowance

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

TABLE 5.2.6B MEAN, MEDIAN AND PERCENT INDIVIDUALS BELOW EAR (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN EAR IN MEN 19 YEARS OF AGE AND OLDER (N = 34)[a] (EASTMAIN)

Nutrient	Mean intake	± SD	Median intake	% Individuals below EAR	EAR	RDA or recommended levels
Energy[b] (kilocalories)	2521	1023	2250	NA	NA	
Cholesterol[c] (mg)	639	544	549	NA	NA	As low as possible while consuming a nutritionally adequate diet
Vitamin A[b] (RAE)	742	575	550	29.6	625	900
Folate[b] (DFE)	562	334	520	18.7	320	400
Vitamin C[b] (mg)	120	133	96.1	35.3	75	90
Iron[c] (mg)	20.2	11.4	19.2	0.00	6	8
Magnesium[c] (19-30 yrs) (mg) (n = 10)	280	117	260	70.0	330	400
Magnesium[b] (≥31 yrs) (mg) (n = 24)	301	184	263	86.4	350	420
Zinc[b] (mg)	17.3	12.1	18.6	0.00	9.4	11

a. EAR = estimated average requirements; NA = not applicable; SD = standard deviation; RDA = recommended daily allowance

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

TABLE 5.2.7A MEAN AND MEDIAN INTAKE (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN AI IN WOMEN 19 YEARS OF AGE AND OLDER (N = 71)[a] (WEMINDJI)

Nutrient	Mean intake	± SD	Median intake	AI
Fiber[b] (g)	13.5	8.11	13.3	21-25
Linoleic acid[b] (g)	13.8	7.51	14.5	11-12
Linolenic acid[b] (g)	1.70	1.22	1.62	1.1
Vitamin D[b] (µg)	6.16	7.41	5.57	5-15
Calcium[b] (mg)	690	515	625	1000-1200

a. AI = adequate intake; SD = standard deviation

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the percent of individuals below the EAR.

TABLE 5.2.7B MEAN AND MEDIAN INTAKE (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN AI IN WOMEN 19 YEARS OF AGE AND OLDER (N = 61)[a] (EASTMAIN)

Nutrient	Mean intake	± SD	Median intake	AI
Fiber[b] (g)	13.7	10.1	13.0	21-25
Linoleic acid[b] (g)	14.9	10.8	14.3	11-12
Linolenic acid[c] (g)	1.98	2.01	1.76	1.1
Vitamin D[b] (µg)	7.17	6.49	6.11	5-15
Calcium[b] (mg)	768	484	704	1000-1200

a. NA = not applicable; SD = standard deviation; AI = adequate intake

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method.

TABLE 5.2.8A MEAN AND MEDIAN INTAKE (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN AI FOR MEN 19 YEARS OF AGE AND OLDER (N = 58)[a] (WEMINDJI)

Nutrient	Mean intake	± SD	Median intake	AI
Fiber[b] (g)	10.8	7.51	10.7	30-38
Linoleic acid[b] (g)	13.3	7.84	12.7	14-17
Linolenic acid[b] (g)	1.87	1.50	1.76	1.6
Vitamin D[b] (µg)	10.6	14.1	5.35	5-15
Calcium[b] (mg)	675	371	665	1 000-1 200

a. AI = adequate intake; SD = standard deviation

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

TABLE 5.2.8B MEAN AND MEDIAN INTAKE (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN AI FOR MEN 19 YEARS OF AGE AND OLDER (N = 34)[a] (EASTMAIN)

Nutrient	Mean intake	± SD	Median intake	AI
Fiber[b] (g)	15.2	12.5	12.6	30-38
Linoleic acid[c] (g)	15.2	7.38	12.8	14-17
Linolenic acid[b] (g)	1.74	1.25	1.62	1.6
Vitamin D[b] (µg)	7.02	6.73	4.97	5-15
Calcium[b] (mg)	733	443	652	1000-1200

a. AI = adequate intake; SD = standard deviation;

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM 2003).

Micronutrient intake in children

The adjusted daily mean nutrient intakes for children are listed in Tables 5.2.9A,B to 5.2.12A,B in relation to Dietary Reference Intakes (DRI) or recommended daily allowance (RDA) for individuals and, when applicable, as the percentage of individuals having intakes below the EAR values (IOM, 1997, 1998, 2000b, 2000c, 2005). Inadequate intake can only be quantified by the EAR cut-point method if the data can be adjusted to estimate usual intake (IOM, 2003). In addition, it is necessary to adjust each nutrient intake by age and gender categories corresponding to the requirements. Using this method on unadjusted intake can overestimate inadequacy by more than 100% (Jahns et al., 2004).

The results presented in this and the next paragraph are presented in Tables 5.2.9A,B to 5.2.12A,B. In Wemindji, 15% of boys 9-13 and 86% of those 14-18 had inadequate vitamin A intake (IOM, 2000b). By comparison, in Eastmain, 22% of boys 9-13 and 56% of the 14-18 group consumed inadequate vitamin A levels. All boys aged 9-13 were above the EAR for folate intake (IOM, 1998), whereas 33% of boys of that age in Eastmain were below it; in the older boys (14-18), 11% of the Eastmain group and none in Wemindji had inadequate folate intake. For Wemindji all boys aged 9-13 and 14-18 and the 9-13 Eastmain group consumed adequate amounts of iron (IOM, 2000b), while 11% of those 14-18 in Eastmain were below the iron EAR. None of the girls aged 9-13 in Wemindji and (Eastmain) consumed inadequate amounts of iron, though 9% of girls 14-18 in Wemindji and 35% in Eastmain had inadequate iron intakes. All boys 14-18 and girls in Wemindji had inadequate magnesium intake (IOM, 1997); in Eastmain, 78% of the boys and 100% of the girls in this age group consumed inadequate amounts. Boys and girls 9-13 fared better, with 38% (Wemindji) and 63% (Eastmain) of the girls below the EAR and respectively 15% and 22% of the boys.

Mean vitamin D intakes for most boys and girls were below the AI of 5 µg/day (IOM, 1997), respectively at 4.47 µg/d and 2.53 µg/d in Wemindji; and 3.23 µg/d (girls) in Eastmain. In Eastmain boys, the mean intake of vitamin D met the AI (5.13 µg/d). In Wemindji, mean calcium intake for boys was 870 mg/d and 1035 mg/d for girls, whereas in Eastmain it was 759 mg/d (boys) and 732 mg/d (girls); all were below the AI of 1300 mg/day (IOM, 1997).

TABLE 5.2.9A MEAN, MEDIAN AND PERCENT INDIVIDUALS BELOW EAR (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN EAR IN BOYS 9-18 YEARS OF AGE (N = 20)[a] (WEMINDJI)

Nutrient	Age	Mean intake	± SD	Median intake	% Individuals below EAR	EAR	RDA or recommended levels
Energy[c] (kilocalories)	9-18	2588	1297	2189	NA		
Cholesterol[c] (mg)	9-18	386	285	373	NA		As low as possible while consuming a nutritionally adequate diet
Vitamin A[b] (RAE) (n = 13)	9-13	680	707	534	15.4	445	600
Vitamin A[b] (RAE) (n = 7)	14-18	654	646	480	85.7	630	900
Folate[b] (DFE) (n = 13)	9-13	467	186	361	0.00	250	300
Folate[c] (DFE) (n = 7)	14-18	654	571	509	0.00	330	400
Vitamin C[b] (mg) (n = 13)	9-13	153	184	106	38.5	39	45
Vitamin C[c] (mg) (n = 7)	14-18	172	203	142	14.3	63	75
Iron[c] (mg) (n = 13)	9-13	19.6	10.6	16.2	0.00	5.9	8
Iron[c] (mg) (n = 7)	14-18	19.2	10.9	17.0	0.00	7.7	11
Magnesium[b](mg) (n = 13)	9-13	240	110	234	15.4	200	240
Magnesium[c] (mg) (n = 7)	14-18	305	314	269	100	340	410
Zinc[c] (mg) (n = 13)	9-13	12.4	9.08	11.0	0.00	7	8
Zinc[c] (mg) (n = 7)	14-18	14.2	7.97	15.2	28.7	8.5	11

a. EAR = estimated average requirement; NA = not applicable; SD = standard deviation; RDA = recommended daily allowance

b. Nutrient adjusted using SIDE software (Iowa State University 1996) with adjustments made for sequence and day of week. Where appropriate, this software also provides the percent individuals below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

TABLE 5.2.9B MEAN, MEDIAN AND PERCENT INDIVIDUALS BELOW EAR (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN EAR IN BOYS 9-18 YEARS OF AGE (N = 18)[a] (EASTMAIN)

Nutrient	Age	Mean intake	± SD	Median intake	% Individuals below EAR	EAR	RDA or recommended levels
Energy[c] (kilocalories)	9-18	2283	1279	2288	NA	NA	
Cholesterol[c] (mg)	9-18	442	358	305	NA	NA	As low as possible while consuming a nutritionally adequate diet
Vitamin A[b] (RAE) (n = 9)	9-13	461	349	563	22.2	445	600
Vitamin A[b] (RAE) (n = 9)	14-18	575	529	491	55.6	630	900
Folate[b] (DFE) (n = 9)	9-13	243	117	319	33.3	250	300
Folate[c] (DFE) (n = 9)	14-18	428	292	497	11.1	330	400
Vitamin C[b] (mg) (n = 9)	9-13	93.7	101	45.5	33.3	39	45
Vitamin C[c] (mg) (n = 9)	14-18	163	151	184	33.3	63	75
Iron[c] (mg) (n = 9)	9-13	12.8	5.69	14.8	0.00	5.9	8
Iron[c] (mg) (n = 9)	14-18	21.7	17.0	18.0	11.1	7.7	11
Magnesium[b] (mg) (n = 9)	9-13	203	81.7	230	22.2	200	240
Magnesium[c] (mg) (n = 9)	14-18	289	154	288	77.8	340	410
Zinc[b] (mg) (n = 9)	9-13	11.6	7.49	10.3	0.00	7	8
Zinc[c] (mg) (n = 9)	14-18	22.5	18.6	16.9	22.2	8.5	11

a. EAR = estimated average requirement; NA = not applicable; SD = standard deviation; RDA = recommended daily allowance.

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

TABLE 5.2.10A MEAN AND MEDIAN INTAKE (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN AI IN BOYS 9-18 YEARS OF AGE (N = 20)[a] (WEMINDJI)

Nutrient	Age	Mean intake	± SD	Median intake	AI
Fiber[c] (g)	9-18	15.8	17.3	11.6	31-38
Linoleic acid[c] (g)	9-18	15.5	12.5	12.0	12-16
Linolenic acid[b] (g)	9-18	1.54	1.14	1.46	1.2-1.6
Vitamin D[c] (mcg)	9-18	4.47	3.62	3.82	5
Calcium[c] (mg)	9-18	870	664	764	1300
Fiber[c] (g)	9-18	15.8	17.3	11.6	31-38

a. AI = adequate intake; SD = standard deviation

b. Nutrient adjusted using SIDE software (Iowa State University 1996) with adjustments made for sequence and day of week. Where appropriate, this software also provides the percent individuals below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

TABLE 5.2.10B MEAN AND MEDIAN INTAKE (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN AI FOR BOYS 9-18 YEARS OF AGE (N = 18)[a] (EASTMAIN)

Nutrient	Age	Mean intake	± SD	Median intake	AI
Fiber[c] (g)	9-18	11.4	6.04	10.2	31-38
Linoleic acid[c] (g)	9-18	16.0	17.2	12.2	12-16
Linolenic acid[b] (g)	9-18	1.31	1.70	1.31	1.2-1.6
Vitamin D[c] (mcg)	9-18	5.13	6.58	3.29	5
Calcium[c] (mg)	9-18	759	602	718	1300

a. AI = adequate intake; SD = standard deviation

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003)

TABLE 5.2.11A MEAN, MEDIAN AND PERCENT INDIVIDUALS BELOW EAR (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN EAR IN GIRLS 9-18 YEARS OF AGE (N = 15)[a] (WEMINDJI)

Nutrient	Age (yrs)	Mean intake	± SD	Median intake	% Individuals below EAR	EAR	RDA or recommended levels
Energy[b] (kilocalories)	9-18	2229	1047	2097	NA		
Cholesterol[c] (mg)	9-18	240	190	182	NA		As low as possible while consuming a nutritionally adequate diet
Vitamin A[b] (RAE) (n = 8)	9-13	487	468	446	37.5	420	600
Vitamin A[b] (RAE) (n = 7)	14-18	472	297	493	42.9	485	700
Folate[c] (DFE)(n = 8)	9-13	369	194	293	12.5	250	300
Folate[c] (DFE)(n = 7)	14-18	242	175	229	100	330	400
Vitamin C[c] (mg) (n = 8)	9-13	149	220	131	0.00	39	45
Vitamin C[c] (mg) (n = 7)	14-18	34.5	48.0	23.3	85.7	56	65
Iron[c] (mg) (n = 8)	9-13	25.3	16.7	18.2	0.00	5.7	8
Iron[c] (mg) (n = 7)	14-18	11.0	6.45	16.7	8.86[d]	7.9	15
Magnesium[3] (mg) (n = 8)	9-13	236	102	220	37.5	200	240
Magnesium[c] (mg) (n = 7)	14-18	125	62.6	190	100	330	360
Zinc[c] (mg) (n = 8)	9-13	22.0	12.7	11.5	0.00	7	8
Zinc[c] (mg) (n = 7)	14-18	6.53	2.67	6.10	57.1	7.3	9

a. EAR = estimated average requirement for groups; NA = not applicable; SD = standard deviation

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

d. Used probability method rather than percent below EAR.

TABLE 5.2.11B ADJUSTED NUTRIENT INTAKE (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN EAR FOR GIRLS 9-18 YEARS OF AGE (N = 18)[a] (EASTMAIN)

Nutrient	Age (yrs)	Mean intake	± SD	Median intake	% Individuals below EAR	EAR	RDA or recommended levels
Energy[b] (kilocalories)	9-18	1742	765	1817	NA	NA	
Cholesterol[b] (mg)	9-18	211	171	181	NA	NA	As low as possible while consuming a nutritionally adequate diet
Vitamin A[b] (RAE) (n = 8)	9-13	484	151	441	37.5	420	600
Vitamin A[b] (RAE) (n = 10)	14-18	258	250	183	80.0	485	700
Folate[c] (DFE) (n = 8)	9-13	322	206	270	25.0	250	300
Folate[c] (DFE) (n = 10)	14-18	246	146	237	100	330	400
Vitamin C[c] (mg) (n = 8)	9-13	89.1	109	120	0.00	39	45
Vitamin C[c] (mg) (n = 10)	14-18	89.6	72.9	51.3	60.0[d]	56	65
Iron[c] (mg) (n = 8)	9-13	11.2	6.00	14.6	0.00	5.7	8
Iron[c] (mg) (n = 10)	14-18	39.2	93.4	11.4	34.9[d]	7.9	15
Magnesium[c] (mg) (n = 8)	9-13	198	87.7	190	62.5	200	240
Magnesium[c] (mg) (n = 10)	14-18	180	88.5	183	100	330	360
Zinc[c] (mg) (n = 8)	9-13	9.94	5.39	8.66	0.00	7	8
Zinc[c] (mg) (n = 10)	14-18	7.73	4.83	7.84	40.0	7.3	9

a. EAR = estimated average requirement for groups; NA = not applicable; SD = standard deviation

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

d. Used probability method rather than percent below EAR.

TABLE 5.2.12A MEAN AND MEDIAN INTAKE (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN AI IN GIRLS 8-18 YEARS OF AGE (N = 15)[a] (WEMINDJI)

Nutrient	Age (yrs)	Mean intake	± SD	Median intake	AI
Fiber[c] (g)	9-18	10.3	6.05	9.50	26
Linoleic acid[c] (g)	9-18	10.4	8.18	9.45	10-11
Linolenic acid[c] (g)	9-18	1.75	1.64	1.12	1.0-1.1
Vitamin D[c] (mcg)	9-18	2.53	1.73	2.49	5
Calcium[c] (mg)	9-18	1035	1292	716	1300

a. AI = Adequate intake: SD = standard deviation

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003).

TABLE 5.2.12B ADJUSTED NUTRIENT INTAKE (INCLUDING SUPPLEMENTS) FOR NUTRIENTS WITH AN AI FOR GIRLS 9-18 YEARS OF AGE (N = 18)[a] (EASTMAIN)

Nutrient	Age (yrs)	Mean intake	± SD	Median intake	AI
Fiber[c] (g)	9-18	9.90	6.07	9.38	26
Linoleic acid[c] (g)	9-18	10.9	9.44	10.1	10-11
Linolenic acid[c] (g)	9-18	0.84	0.63	1.06	1.0-1.1
Vitamin D[c] (mcg)	9-18	3.23	3.30	2.09	5
Calcium[c] (mg)	9-18	732	456	706	1300

a. AI = adequate intake; SD = standard deviation

b. Nutrient adjusted using SIDE software (Iowa State University 1996). Adjustments made for sequence and day of week. Where appropriate, this software also provides the number below the EAR.

c. Nutrient adjusted using NRC method (IOM, 2003)

5.2.1.5 Food Intake Analyses

Dietary habits

We investigated dietary habits compared to those recommended by Canada's Food Guide to Healthy Eating (http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index_e.html) (Tables 5.2.13A,B). Daily servings of vegetables and fruits and milk products were below recommendations. This would further indicate possible inadequacies in vitamin D, calcium and magnesium intakes.

TABLE 5.2.13A PORTIONS OF DAILY SERVINGS FROM CANADA'S FOOD GUIDE TO HEALTHY EATING IN THE CREE COMMUNITY OF WEMINDJI BY GENDER AND AGE GROUP (N = 164)

CFGHE Group	Girls (<19) n = 18	Boys (<19) n = 18	Women (≥19) n = 61	Men (≥19) n = 34	Total population n = 131	Recommended
Vegetables and fruit	1.81±2.25	3.89±5.05	3.24±3.53	2.29±3.07	2.85±3.52	5-10
Grains	5.20±3.30	7.02±4.04	6.60±4.26	6.38±4.46	6.46±4.21	5-12
Milk products	2.54±3.97	1.62±2.34	0.91±1.01	0.88±0.88	1.14±1.71	2-4
Meat and alternates	3.21±2.71	3.51±2.31	4.77±3.65	6.00±5.00	4.90±4.07	2-3

TABLE 5.2.13B PORTIONS OF DAILY SERVINGS FROM CANADA'S FOOD GUIDE TO HEALTHY EATING IN THE CREE COMMUNITY OF EASTMAIN BY GENDER AND AGE GROUP (N = 228)

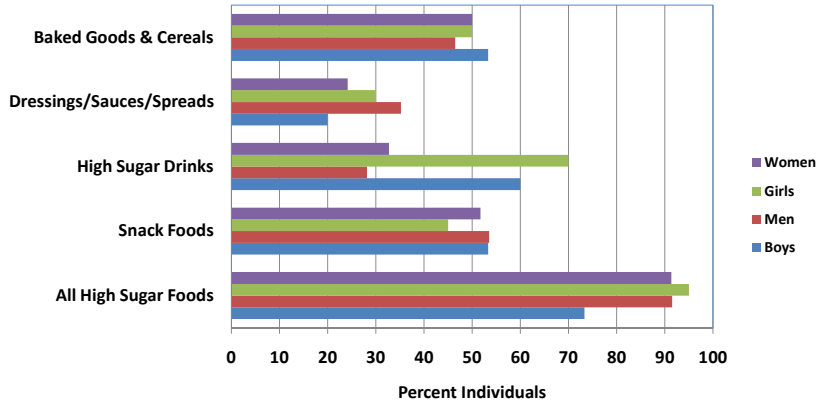
CFGHE Group	Girls (<19) n = 26	Boys (<19) n = 35	Women (≥19) n = 64	Men (≥19) n = 103	Total population n = 228	Recommended
Vegetables and fruit	2.14±2.10	2.87±2.57	3.10±3.24	3.27±3.00	3.05±3.04	5-10
Grains	3.57±2.44	3.87±2.31	5.55±3.74	6.64±3.61	5.38±3.57	5-12
Milk products	1.64±1.40	1.47±1.67	1.06±1.12	1.12±1.22	1.22±1.28	2-4
Meat and alternates	1.89±2.17	4.17±4.16	3.96±2.40	5.05±3.38	4.02±3.07	2-3

We also looked at the proportion of individuals consuming high-sugar foods or foods with greater than 25% energy as sugar (Figures 5.2.12A,B), and the percent of total energy intake that these foods provided in the 24-hour recalls (Figures 5.2.13A,B). (Nutrient-rich foods that naturally contain high levels of sugar were excluded from the list, such as fruits and vegetables). In Wemindji, greater than 85% of the total population consume high sugar foods. More than 30% of the adults and 65% of the children indicated in the 24-hour recall consuming sweet drinks, such as soft drinks and fruit punches/powdered drinks. Such drinks represented 9-12% or more of the daily energy intake in the men, women, and children (Figure 5.2.13A). Adults who consumed them on average drank 1.5

cans/day (SD = 0.9), whereas for youth it was 2.16 cans/day (SD = 1.96); a maximum of 8.4 cans was reported by one individual. By comparison in Eastmain, more than 70% of the total population consumed high-sugar foods; >30% of the adults and >55% of children did so. In this case, these drinks represented 7-14% or more of the daily energy intake in the men, women and children who consumed them (Figure 5.2.13B). The adults, on average, drank 1.3 cans/day (SD = 0.98) and youth 1.9 cans/day (SD = 1.52), with an individual maximum of 6.8 cans.

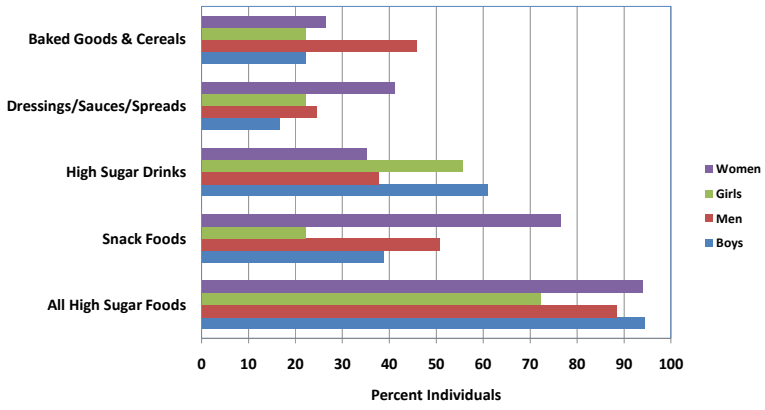
Further we investigated the proportion of individuals consuming high-fat foods, defined as foods with >40% of the energy as total fat (Figures 5.2.14A,B), and the percent of total energy that these foods provided in the 24-hour recalls (Figure 5.2.15A,B). For both communities, >50% of the energy intake for girls who ate them was obtained from snack foods, fast foods and baked goods; for boys it was 40% (Wemindji) and 60% (Eastmain), and for men and women 30% (Wemindji) and 40% (Eastmain).

FIGURE 5.2.12A PROPORTION OF INDIVIDUALS CONSUMING HIGH-SUGAR FOODS[a] IN THE CREE COMMUNITY OF WEMINDJI IN THE PREVIOUS 24 HOURS



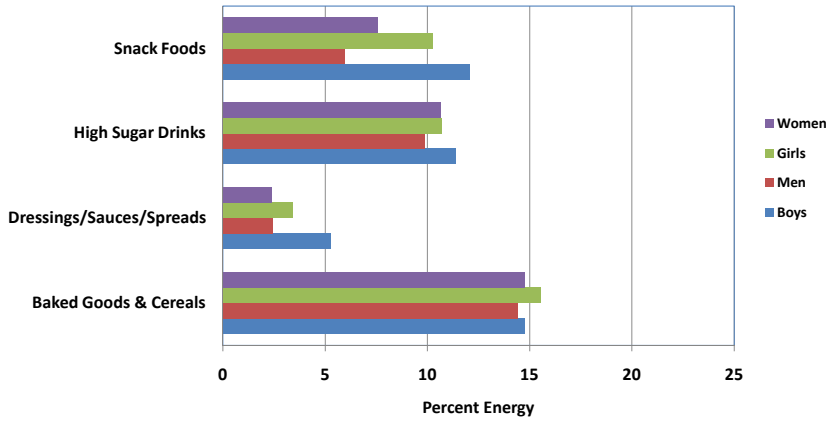
a. High-sugar foods defined as >25% energy as total sugar (excluding fruits, vegetables and their juices, alcoholic beverages, chocolate milk, ice cream, cheese and yogurt); 89.5% of individuals in the sample ate at least one category of high-sugar food.

FIGURE 5.2.12B PROPORTION OF INDIVIDUALS CONSUMING HIGH-SUGAR FOODS[a] IN THE CREE COMMUNITY OF EASTMAIN IN THE PREVIOUS 24 HOURS



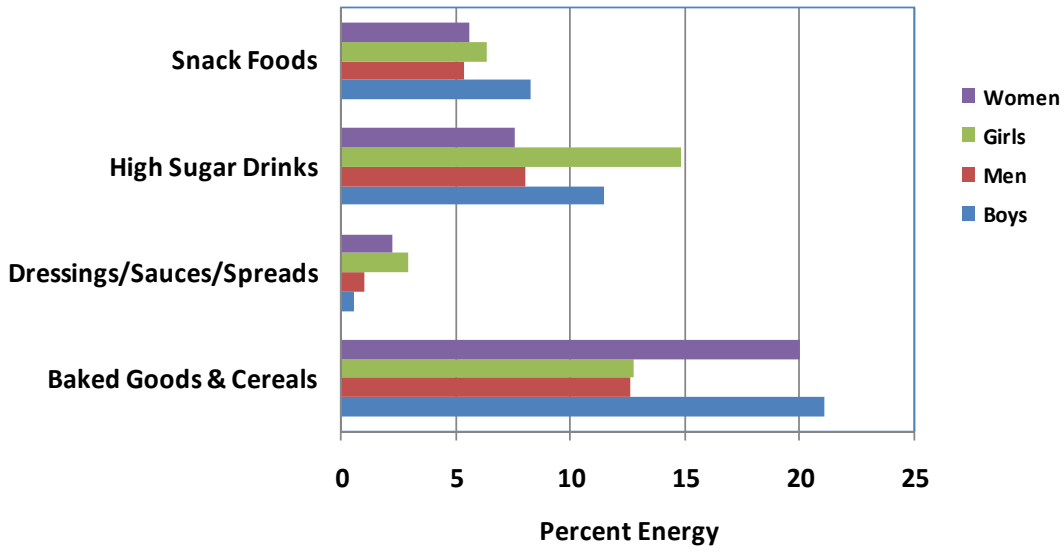
a. High-sugar foods defined as >25% energy as total sugar (excluding fruits, vegetables and their juices, alcoholic beverages, chocolate milk, ice cream, cheese and yogurt); 89.5% of individuals in the sample ate at least one category of high-sugar food.

FIGURE 5.2.13A PERCENT OF ENERGY FROM HIGH-SUGAR FOODS[a] FOR INDIVIDUALS IN THE CREE COMMUNITY OF WEMINDJI CONSUMING THEM IN THE PAST 24 HOURS



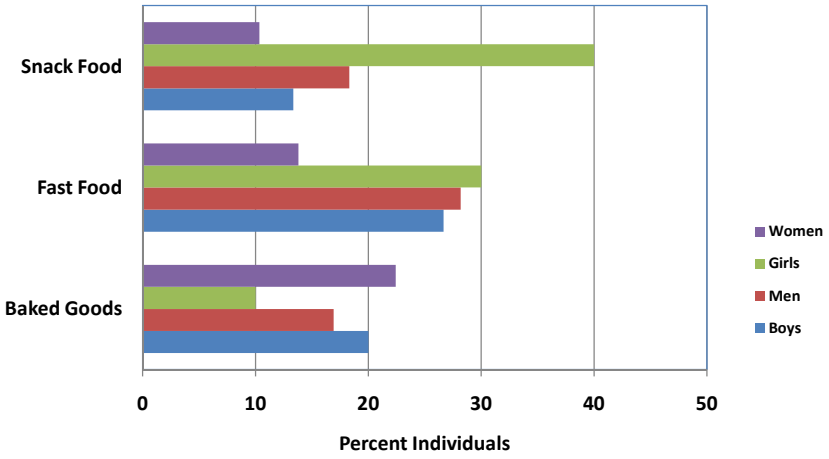
a. High-sugar foods defined as >25% energy as total sugar (excluding fruits, vegetables and their juices, alcoholic beverages, chocolate milk, ice cream, cheese and yogurt); 89.5% of individuals in the sample ate at least one category of high-sugar food.

FIGURE 5.2.13B PERCENT OF ENERGY FROM HIGH-SUGAR FOODS[a] FOR INDIVIDUALS IN THE CREE COMMUNITY OF EASTMAIN CONSUMING THEM IN THE PAST 24 HOURS



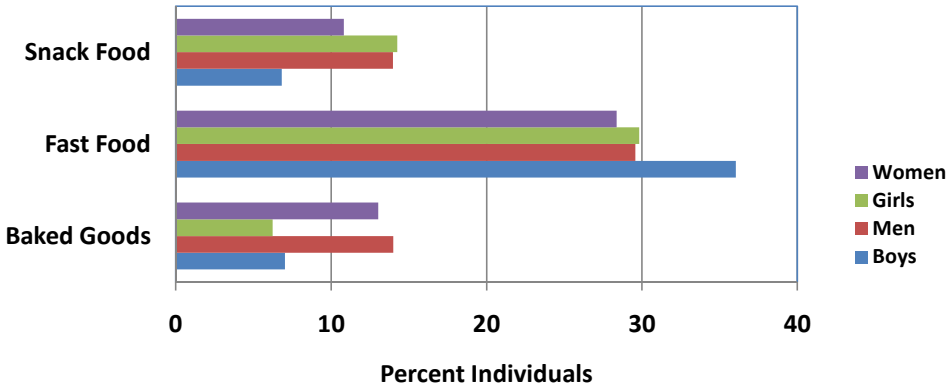
a. High-sugar foods defined as >25% energy as total sugar (excluding fruits, vegetables and their juices, alcoholic beverages, chocolate milk, ice cream, cheese and yogurt); 89.5% of individuals in the sample ate at least one category of high-sugar food.

FIGURE 5.2.14A PROPORTION OF INDIVIDUALS CONSUMING HIGH-FAT FOODS[a] IN THE CREE COMMUNITY OF WEMINDJI IN THE PREVIOUS 24 HOURS



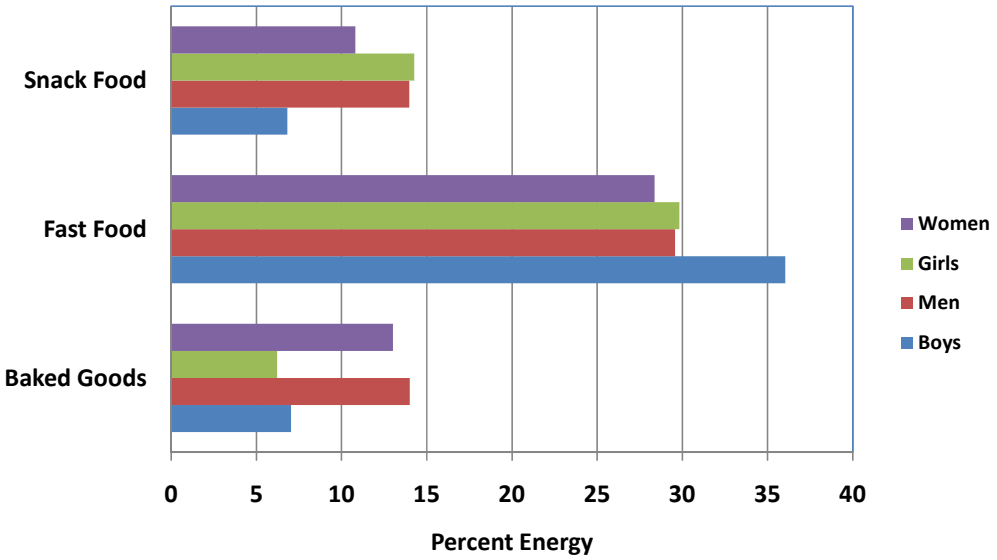
a. High-fat foods defined as >40% energy as total fat.

FIGURE 5.2.14B PROPORTION OF INDIVIDUALS CONSUMING HIGH-FAT FOODS[a] IN THE CREE COMMUNITY OF EASTMAIN IN THE PREVIOUS 24 HOURS



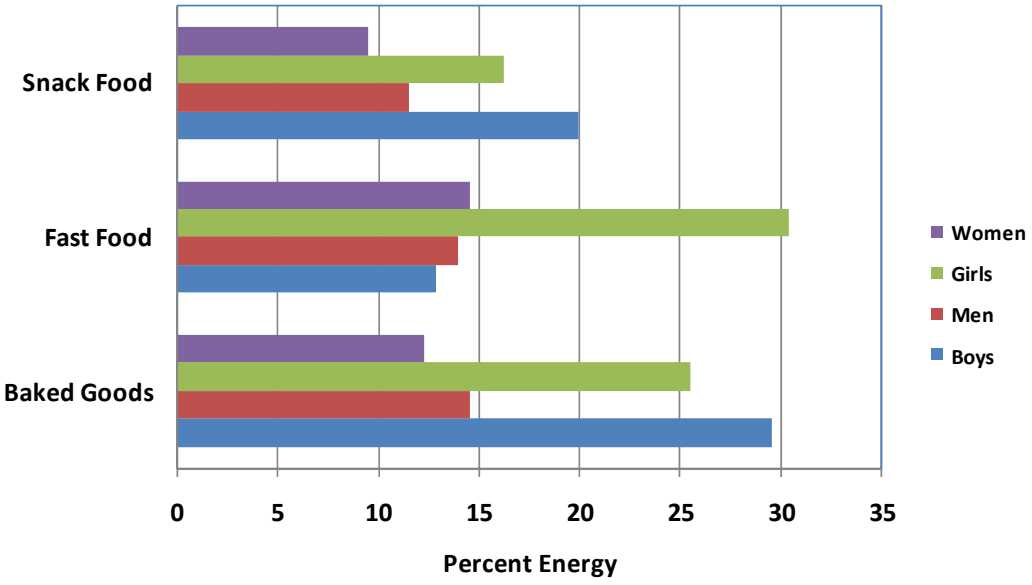
a. High-fat foods defined as >40% energy as total fat.

FIGURE 5.2.15A PERCENT OF ENERGY FROM HIGH-FAT FOODS[a] FOR INDIVIDUALS IN THE CREE COMMUNITY OF WEMINDJI CONSUMING THEM IN THE PAST 24 HOURS



a. High-fat foods defined as >40% energy as total fat.

FIGURE 5.2.15B PERCENT OF ENERGY FROM HIGH-FAT FOODS[a] FOR INDIVIDUALS IN THE CREE COMMUNITY OF EASTMAIN CONSUMING THEM IN THE PAST 24 HOURS



a. High-fat foods defined as >40% energy as total fat.

Vitamin D status assessment

Serum 25 (OH) D (25-Hydroxy vitamin D) is considered the best indicator of vitamin D status; it reflects both cutaneous production and dietary exposure. Results of the laboratory analyses of serum 25 (OH) D indicate that for *Eeyou* summer-time vitamin D status is normal. In Wemindji, the mean concentrations observed were 49.1±13.8 nmol/L (women) and 54.7±11.7 nmol/L (men). Values between 20 and 100 nmol/l are considered normal regardless of age or gender (IOM, 1997). As Wemindji was surveyed in the spring, the low dietary intake of vitamin D identified in the dietary questionnaires would be compensated by cutaneous production of vitamin D with some sunlight exposure. For Eastmain, the values observed were somewhat higher with means of 56.0±16.2 nmol/L (women) and 63.8±18.0 nmol/L (men). Since the Eastmain blood samples were drawn in August a comparable sunlight enhancement of endogenous production of vitamin D as mentioned for Wemindji has likely occurred. During the winter months, fat from traditional food, milk, cheese, and yogurt can provide vitamin D in one's diet. Supplements are also available and may be needed, particularly in winter months, for pregnant and lactating women, children and older adults.

Markers of dietary fat quality as they relate to traditional and market food intake

Among the women in Wemindji, long-chain *n*-3 fatty acids (EPA and DHA) measured as a percent of total fatty acids in erythrocyte (red blood cell) membranes was highly related to the consumption frequency of traditional food and fish averaged over the entire past year and over the past spring season (Table 5.2.14A). For men in Wemindji, significant associations were observed between the frequency of traditional food and fish consumption averaged over the past year, but with somewhat weaker correlations than observed for the past spring season and for women. For Wemindji children, the correlations between *n*-3 fatty acids and the consumption frequency of traditional food and fish were of comparable magnitude for both seasonal categories, and were statistically significant (correlation coefficients r of 0.32-0.36)

A similar pattern was seen in Eastmain. However, it should be noted that the traditional food and fish consumption data in this community pertains to summertime (Table 5.2.14B), compared to springtime in Wemindji (Table 5.2.14A). The correlations for men were the most robust (r = 0.73-0.76, compared to r = 0.48-0.53 for women), with little averaging-time dependence. For Eastmain children, no significant correlations were observed. This is not surprising given the overall low consumption of all traditional food and fish consumption by children.

TABLE 5.2.14A PEARSON CORRELATION COEFFICIENTS BETWEEN TRADITIONAL FOOD CONSUMPTION AND OMEGA-3 (*N*-3 AS EPA AND DHA) FATTY ACIDS AS % OF TOTAL FATTY ACIDS IN ERYTHROCYTE MEMBRANE PHOSPHOLIPIDS[a] (WEMINDJI)

Average Daily Frequency	Past Year Traditional food consumption	Past Year Fish consumption	Spring Traditional food consumption	Spring Fish consumption
Adult Men	0.46***	0.51***	0.28*	0.24*
Adult Women	0.33***	0.31***	0.35***	0.57***
Children	0.36***	0.32**	0.34*	0.32*

a. * p < 0.10; ** p < 0.05; *** p < 0.01

TABLE 5.2.14B PEARSON CORRELATION COEFFICIENTS BETWEEN TRADITIONAL FOOD CONSUMPTION AND OMEGA-3 (N-3 AS EPA AND DHA) FATTY ACIDS AS % OF TOTAL FATTY ACIDS IN ERYTHROCYTE MEMBRANE PHOSPHOLIPIDS[a] (EASTMAIN)

Average Daily Frequency	Past Year Traditional food consumption	Past Year Fish consumption	Summer Traditional food consumption	Summer Fish consumption
Adult Men	0.76***	0.75***	0.74***	0.73***
Adult Women	0.48***	0.53***	0.48***	0.53***
Children	0.18	0.24	0.19	0.23

a. * p < 0.10; ** p < 0.05; *** p < 0.01.

The impact of decreasing the consumption of traditional food relative to market food on the relationship between good *n*-3 (primarily from fish) and *bad trans* fatty acids (from store-bought foods) was also evaluated. As expected, in both communities, there was a negative correlation between *n*-3 and *trans* fatty acids ($r = -0.27$, $p \leq 0.001$ in Wemindji, $r = -0.33$, $p \leq 0.0001$ in Eastmain). In other words, as the heart healthy *n*-3 fat from fish increased in the blood, the heart-dangerous *trans*-fat decreased, indicating the importance of traditional food in maintaining a healthy diet among *Eeyouch*. *Trans*-fat in erythrocyte membranes in Wemindji correlated significantly with the market food frequency questionnaire items on baked and high fat food items (Wemindji, $r = 0.19$, p-value ≤ 0.03; Eastmain, $r = 0.17$, p-value = 0.06). However, past-day consumption of baked goods, fast foods, and snack foods in the 24-hour recall did not correlate as strongly or in the same direction with *trans*-fat in erythrocyte membranes (Wemindji, $r = 0.14$, p-value = 0.07; Eastmain, $r = -0.04$, p-value = 0.65). This suggests that assessment of these dietary habits for one day does not distinguish dietary habits as adequately as a food frequency questionnaire.

In both the 24-hour recall and the market food frequency questionnaire, high sugar drinks were not significantly related to *trans*-fat in erythrocyte membranes for any age group in either community.

5.2.1.6 Discussion

The dietary data provide valuable background information on the dietary habits and nutritional status of the communities and a context from which to evaluate and manage benefits and risks as they pertain to dietary habits and traditional food consumption. The intakes show sufficient intake of animal foods that are good sources of iron and zinc, but low intake of fruits and vegetables leading to low magnesium, folate, calcium and fibre intake. We suspect that the vitamin C intake may result from fortified beverages. Low intake of milk products led to low calcium and vitamin D intakes because these are the main sources of these nutrients. Given the importance of magnesium in protecting against hypertension and its likely role in preventing type-2 diabetes (Champagne, 2008), future community consultations need to emphasize the many aspects of nutrition and health to promote healthier dietary habits.

Analyses of food intake highlight that interventions in targeting the intake of soft drinks and other sugared drinks as well as snack foods, fast foods and baked goods would reduce caloric intake without reducing intake of important nutrients. All of these foods are an optional part of a total diet and represent as much as 40-50% of the energy intake of consumers participating in the health study. If intake of these food items were underestimated, as indicated by the EI/BMR ratios of less than 1.5, there is even more cause for concern. The finding of high-sugar drink consumption is particularly worthy of discussion and communication with community members. Each can of high-sugar drink (carbonated beverage, or sweetened drink) provides approximately 155 kilocalories. Provided that all other dietary intake represents the intake needed to maintain one's weight, the addition of one can of pop drink per day to one's diet would result in a 16-pound weight gain over a one-year period. In the current study, the average intake of sweetened drinks was 1.5 cans/day and 1.3 cans/day for adults in Wemindji and Eastmain respectively and 2.2 cans/day and 1.9 cans/day for children/youth in Wemindji and Eastmain respectively. Simple changes like replacing a can of pop with water over a lifetime could result in remarkable improvements in achieving a healthy body weight and in promoting overall health and well-being.

5.2.1.7 Recommendations for future data collection

- Add the evaluation of PTH to the study protocol to improve the assessment of vitamin D status and consider re-testing a sub-sample of individuals in the winter to evaluate fluctuations in vitamin D status.

5.2.2 Physical activity

A total of 114 adult participants (≥18 years) in Wemindji had valid physical activity measurements, their mean age was 37.6±12.7 years, and 52.6% of the participants were women. Similarly, in

Eastmain there were 89 participants with valid data (mean age was 38.6±13, and 64.8% women). Unfortunately, these numbers do not have the statistical power to identify significant results. Combining the results for Wemindji and Eastmain with the other *Eeyou Istchee* communities will be explored in the final and 3rd technical report in this series. Nevertheless it is encouraging that in Mistissini the results indicated that dedicated walkers enjoyed health benefits of their physical activity and that, in general, it can improve the health status in *Eeyouch* (Egeland et al., 2008). This suggests that the IPAQ has potential as a surveillance and research tool in *Eeyou Istchee* communities.

5.3 Environmental contaminants

5.3.1 Toxic metals in individual samples

5.3.1.1 Cadmium

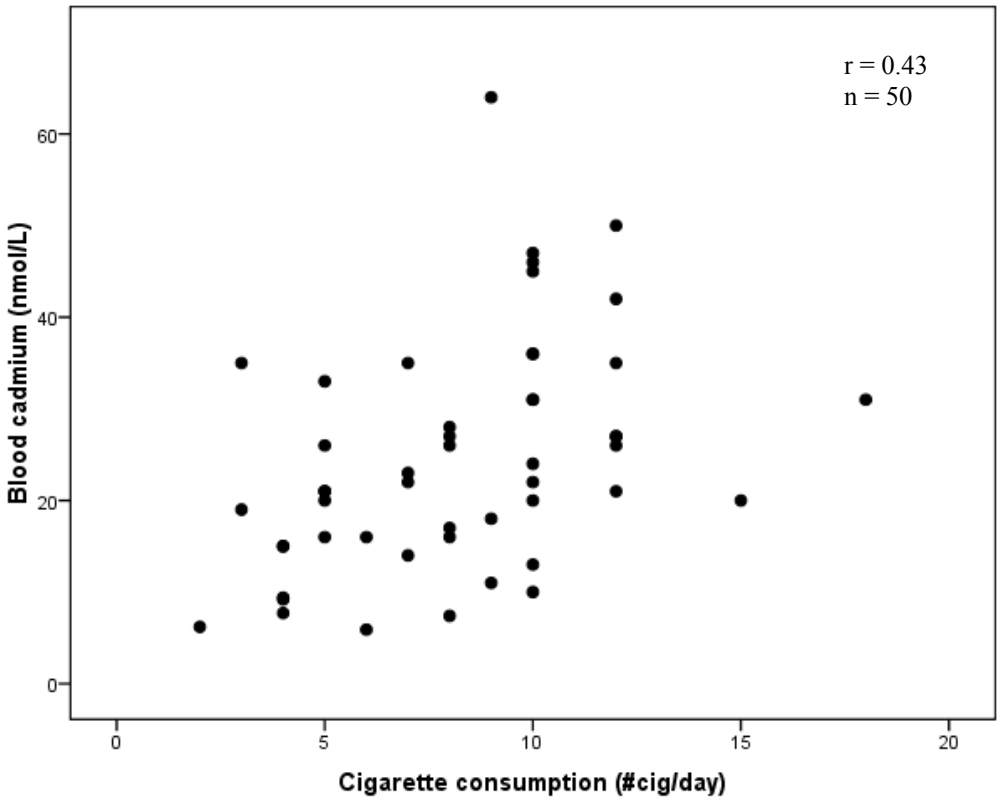
Data in Table 5.3.1A show the observed blood concentrations of cadmium in participants stratified by age group. Mean blood cadmium levels were not different when stratified by gender and did not increase linearly with age in Wemindji and Eastmain. The highest concentrations were noted in the 15-39 years old groups, which could be linked with the high prevalence of smoking in this age stratum. When cadmium exposure data were stratified by smoking status (Table 5.3.1B), blood cadmium concentrations were markedly higher in smokers than in ex-smokers and non (never)-smokers ($p < 0.0001$), while smaller differences were observed between ex-smokers and never-smokers. These concentration patterns are similar to those reported previously in Mistissini (Bonnier-Viger et al, 2007). Interestingly, geomean levels in non-smokers from Wemindji and Eastmain are also similar to the mean concentrations observed in Oujé-Bougoumou (6.21 nmol/L) and Nemaska (4.13 nmol/L) Cree populations (Dewailly and Nieboer, 2005), and for the general Quebec population (4.73 nmol/L) (CTQ, 2003).

As illustrated in Figure 5.3.1, moderate correlations of blood cadmium with self-declared cigarette smoking frequency (cigarettes per day) were observed (Wemindji: Pearson's $r = 0.43$, $p = 0.002$, $n = 50$; Eastmain: Pearson's $r = 0.46$, $p = 0.0004$, $n = 57$). Multivariate analyses revealed that active smoking was the only variable explaining the variance in blood cadmium levels among both Wemindji (R^2 model $= 0.58$, $p < 0.0001$) and Eastmain participants (R^2 model $= 0.65$, $p < 0.0001$). Being an ex-smoker explained 8% of the variance ($p = 0.002$), while age accounted for only a small fraction (partial $r^2 = 0.04$, $p = 0.01$). Dietary sources of exposure to cadmium such as the consumption of offal were not associated with blood cadmium levels in residents from these communities.

Table 5.3.2A lists the number of participants exceeding the concern and action levels in each age group and smoking categories according to thresholds determined in earlier studies. Five individuals in Wemindji and 11 in Eastmain (all of them smokers) exceeded the action level established to prevent kidney damage (44.5 nmol/L). Thirty-two percent of the Wemindji smokers and 44% of Eastmain smokers exceeded the concern level of 25 nmol/L.

FIGURE 5.3.1 CORRELATIONS BETWEEN BLOOD CADMIUM CONCENTRATIONS AND SELF-DECLARED CIGARETTE CONSUMPTION IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS

A) WEMINDJI



B) EASTMAIN

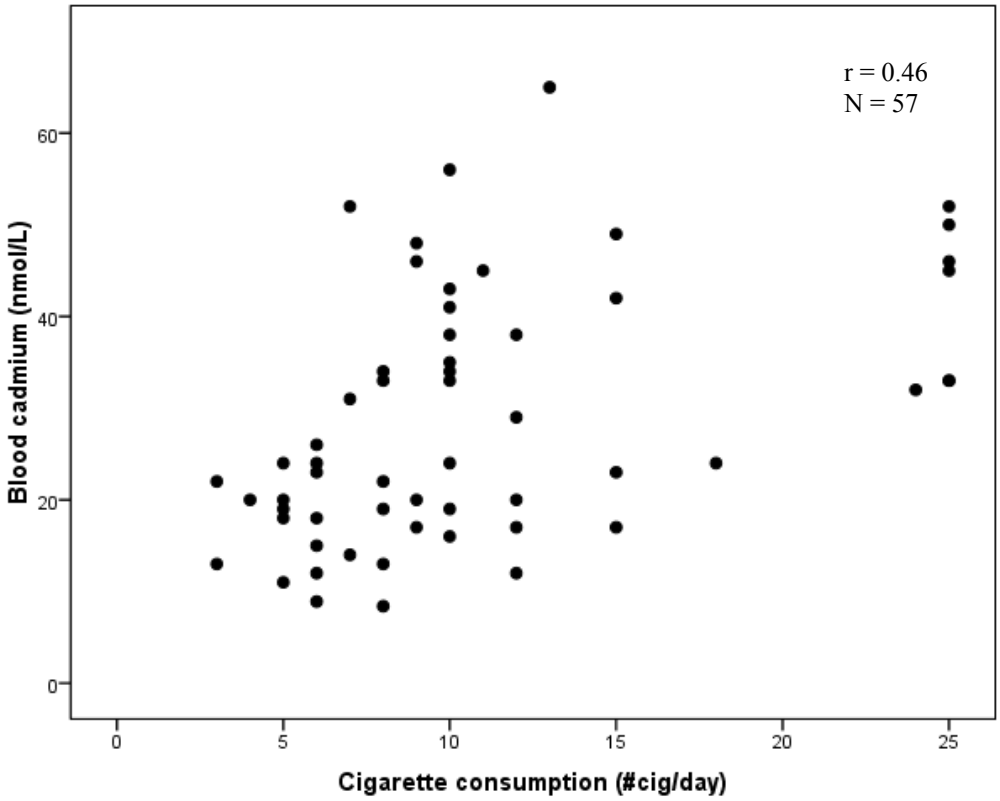

r = 0.46
N = 57
Blood cadmium (nmol/L)
0
20
40
60
0
5
10
15
20
25
Cigarette consumption (#cig/day)

TABLE 5.3.1A WHOLE-BLOOD CONCENTRATIONS OF CADMIUM (NMOL/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE) STRATIFIED BY AGE GROUPS AND GENDER

Age group	n	% det. [1]	Mean (SD) [2]	Geometric mean (95% CI) [3]		Minimum	Maximum
(A) Wemindji							
8-14 years	29	96.6	5.26 (17.39)	2.46	(1.55-3.91)	< DL	27.00
Women	14	92.9	3.93 (14.28)	1.94	(0.98-3.87)	< DL	19.00
Men	15	100	6.87 (19.73)	3.29	(1.67-6.48)	0.66	27.00
15-39 years	86	98.8	15.33 (34.04)	9.14	(7.16-11.67)	< DL	64.00
Women	50	98.0	15.89 (35.17)	9.34	(6.71-12.99)	< DL	64.00
Men	36	100	14.71 (32.81)	8.94	(6.10-13.09)	1.10	50.00
≥40 years	55	98.2	6.66 (15.51)	4.40	(3.40-5.68)	< DL	26.00
Women	27	100	8.13 (17.08)	5.82	(4.15-8.16)	1.10	26.00
Men	28	96.4	5.16 (13.21)	3.31	(2.27-4.82)	< DL	21.00
Total (≥8 years)	170	99.3	10.85 (28.89)	5.79	(4.83-6.95)	< DL	64.00
Women	91	97.8	11.37 (30.40)	6.10	(4.73-8.67)	< DL	64.00
Men	79	98.7	10.28 (27.17)	5.47	(4.19-7.14)	< DL	50.00
(B) Eastmain							
8-14 years	23	95.7	4.26 (16.10)	1.76	(1.05-2.94)	< DL	34.00
Women	11	90.9	4.56 (13.81)	2.11	(0.87-5.09)	< DL	24.00
Men	12	100	3.98 (18.56)	1.48	(0.75-2.94)	0.60	34.00
15-39 years	70	100	19.02 (36.25)	9.12	(6.50-12.79)	0.50	65.00
Women	44	100	15.48 (23.54)	9.27	(6.54-13.15)	1.00	48.00
Men	26	100	22.54 (50.40)	8.96	(4.56-17.60)	0.05	65.00
≥40 years	41	100	13.74 (26.16)	8.75	(6.38-12.01)	1.00	49.00
Women	26	100	12.85 (23.60)	7.90	(5.19-12.02)	1.00	49.00
Men	15	100	14.66 (30.85)	9.73	(5.66-16.74)	1.90	41.00
Total (≥8 years)	134	99.3	14.81 32.30)	6.80	(5.36-8.63)	0.20	65.00
Women	81	98.8	12.80 (23.35)	6.88	(5.22-9.06)	0.20	49.00
Men	53	100	16.82 (42.29)	6.73	(4.40-10.28)	0.50	65.00

1. Percentage of detection; detection limit: 0.04 nmol/L; 2 Standard deviation; 3 95% Confidence interval

TABLE 5.3.1B WHOLE-BLOOD CONCENTRATIONS OF CADMIUM (NMOL/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE) STRATIFIED BY SMOKING CATEGORIES IN EACH AGE GROUP

Group	n	% det. [1]	Mean (SD) [2]	Geometric mean (95% CI) [3]		Minimum	Maximum
(A) Wemindji							
8-14 years	29	96.6	5.26 (17.39)	2.46	(1.55-3.91)	< DL	27.00
Smoker	5	100	13.48 (27.41)	8.51	(1.92-37.67)	2.20	27.00
Ex-smoker	7	85.7	6.00 (16.57)	2.48	(0.54-11.48)	< DL	18.00
Non-smoker	17	100	2.47 (7.81)	1.69	(1.15-2.48)	0.66	14.00
15-39 years	86	98.8	15.33 (34.04)	9.14	(7.16-11.68)	< DL	64.00
Smoker	58	100	21.25 (32.67)	17.00	(14.07-20.53)	3.00	64.00
Ex-smoker	24	96.8	3.15 (4.45)	2.62	(1.94-3.54)	< DL	10.00
Non-smoker	4	100	2.08 (1.88)	1.98	(1.11-3.51)	1.40	2.80
≥40 years	55	98.2	6.66 (15.51)	4.40	(3.40-5.68)	< DL	26.00
Smoker	12	100	15.92 (15.72)	14.69	(11.21-19.25)	7.20	26.00
Ex-smoker	39	97.4	4.09(8.15)	3.13	(2.44-4.03)	< DL	19.00
Non-smoker	3	100	4.38 (6.87)	3.69	(0.56-24.41)	1.60	7.30
(B) Eastmain							
8-14 years	23	95.5	4.26 (16.10)	1.76	(1.06-2.94)	< DL	34.00
Smoker	4	100	17.15 (28.39)	11.36	(1.72-75.18)	2.40	34.00
Ex-smoker	1	100	4.80 (NA)	4.80	NA	NA	NA
Non-smoker	17	94.1	1.29 (1.75)	1.06	(0.75-1.49)	< DL	3.50
15-39 years	70	100	19.02 (36.25)	9.12	(6.50-12.79)	0.50	65.00
Smoker	44	100	29.32 (32.1)	23.67	(18.73-29.91)	1.00	65.00
Ex-smoker	17	100	2.55 (2.58)	2.22	(1.66-2.99)	0.70	5.30
Non-smoker	9	100	2.00 (3.96)	1.49	(0.82-2.69)	0.50	7.80
≥40 years	41	100	13.74 (26.16)	8.75	(6.38-12.01)	1.00	49.00
Smoker	17	100	25.06 (24.54)	22.35	(17.19-29.07)	8.00	49.00
Ex-smoker	23	100	4.87 (5.50)	4.16	(3.21-5.37)	1.00	10.00
Non-smoker	1	100	6.10 (NA)	6.1		6.10	6.10

1. Percentage of detection; detection limit: 0.04 nmol/L
2. Standard deviation
3. 95% Confidence interval

TABLE 5.3.2A EXCEEDANCES OF THE CONCERN AND ACTION LEVELS FOR WHOLE-BLOOD CADMIUM IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE) BASED ON THRESHOLDS DETERMINED IN EARLIER STUDIES AND STRATIFIED BY AGE AND SMOKING STATUS

Age group	Smoking category[2]	> Concern level [1]		> Action level [1]	
		Concern level (nmol/L)	n (%)	Action level (nmol/L)	n (%)
(A) Wemindji					
8-14 years	Non-smoker	5	5 (20.5)	44.5	0
	Smoker	25	1 (17.0)	44.5	0
15-39 years	Non-smoker	5	2 (6.5)	44.5	0
	Smoker	25	21 (36.2)	44.5	5 (8.2)
≥40 years	Non-smoker	5	10 (24.3)	44.5	0
	Smoker	25	2 (17.1)	44.5	0
(B) Eastmain					
8-14 years	Non-smoker	5	0	44.5	0
	Smoker	25	1 (24.2)	44.5	0
15-39 years	Non-smoker	5	2 (5.9)	44.5	0
	Smoker	25	18 (45.9)	44.5	10 (27.4)
≥40 years	Non-smoker	5	9 (36.0)	44.5	0
	Smoker	25	8 (44.8)	44.5	1 (4.5)

1. Source: CTQ, 2003; or Järup et al., 1988; Elinder and Järup (1996). Levels of concern are from the Oujé-Bougoumou / Nemaska report (Dewailly and Nieboer 2005)

2. Non-smokers were merged with ex-smokers

The thresholds for the determination of exceedances of concern and action levels used in the current study to orient follow-up are based on a review of medical evidence for the effects of cadmium exposure. Based on these thresholds, 6 children/teens from Wemindji and 2 from Eastmain showed concentrations above the concern level of 10 nmol/L; 5 of them were smokers and one was an ex-smoker (Table 5.3.2**B**). In the younger adult group, 37 participants of Wemindji and 29 from Eastmain showed concentrations above the concern level (65 smokers and one ex-smoker); 5 individuals from Wemindji and 10 from Eastmain exceeded the action level (all smokers). In older adults, 12 Wemindji participants (10 smokers and 2 ex-smokers) had levels above the concern level, whereas 16 Eastmain participants (15 smokers and one ex-smoker) exceeded this level. One Eastmain participant in the older age group (a smoker) was above the action level.

TABLE 5.3.2B EXCEEDANCES OF THE CONCERN AND ACTION LEVELS FOR WHOLE-BLOOD CADMIUM IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE), BASED ON THRESHOLDS USED IN THE CURRENT FOLLOW-UP PROTOCOL

Age group	Level (nmol/L)		n (%)
(A) Wemindji			
8-14 years	Acceptable level	<10.0	23 (80.1)
	Concern level	10.0-44.9	6 (19.9)
	Action level	≥45.0	0
15-39 years	Acceptable level	<10.0	44 (51.3)
	Concern level	10.0-44.9	37 (43.2)
	Action level	≥45.0	5 (5.5)
≥40 years	Acceptable level	<10.0	43 (78.0)
	Concern level	10.0-44.9	12 (22.0)
	Action level	≥45.0	0
(B) Eastmain			
8-14 years	Acceptable level	<10.0	21 (91.3)
	Concern level	10.0-44.9	2 (8.7)
	Action level	≥45.0	0
15-39 years	Acceptable level	<10.0	31 (43.9)
	Concern level	10.0-44.9	29 (39.2)
	Action level	≥45.0	10 (16.9)
≥40 years	Acceptable level	<10.0	24 (57.5)
	Concern level	10.0-44.9	16 (40.5)
	Action level	≥45.0	1 (2.0)

5.3.1.2 Lead

Table 5.3.3A lists the observed blood lead concentrations for Wemindji and Eastmain participants stratified by age group and gender. Mean blood lead levels were significantly higher in men than women ($p < 0.001$) and increased with age ($p < 0.0001$) in Wemindji participants. They also increased with age in Eastmain participants ($p < 0.0001$), but no difference was observed between men and women ($p = 0.88$). In both communities, the geomean lead concentrations in the older age group (≥40 years) were about 4-fold higher than those of individuals in the 8-14 years category. Mean levels in Wemindji and Eastmain participants were similar to those previously reported in Mistissini (Bonnier-Viger et al, 2007) and for the Oujé-Bougoumou and Nemaska communities (Dewailly and Nieboer, 2005). These observed blood lead concentrations in children are all within the reference range proposed by the INSPQ (0.04 to 0.32 µmol/L); indeed, the geomean concentrations observed

for all the participants in Wemindji and Eastmain are comparable to those observed in the general population of Quebec (i.e., 0.10 μmol/L) (CTQ, 2003).

In both Wemindji and Eastmain, mean lead levels were significantly different between smokers and never-smokers ($p = 0.01$), but not between smokers and ex-smokers ($p > 0.10$) (Table 5.3.3B).

In the individual questionnaire, a question was asked to document the use of lead shot during hunting activities. In Wemindji, among the 89 people who answered the question, 82.6% declared using lead shot, while 14.1% declared not using any lead shot. Mean blood lead concentrations in these categories are shown in Table 5.3.3C; no significant difference was found between lead shot users and non-users (Wemindji: $p = 0.08$; Eastmain: $p = 0.4$). However, the use of plastic-coated lead shot by the 'non-users' cannot be ruled out.

When multivariate regression modeling was used to assess the relation between blood lead concentrations and selected dietary sources (mainly terrestrial game and bird consumption) in Wemindji participants, the main variable explaining lead levels in blood was the age of participants (partial $r^2 = 0.29$, $p < 0.0001$), followed by gender (partial $r^2 = 0.12$, $p < 0.0001$). Among dietary sources, only bird gizzards (partial $r^2 = 0.08$, $p = 0.0002$) explained a small percentage of the variance of blood lead concentrations (R^2 model = 0.46, $p < 0.0001$). In Eastmain participants, the main variable explaining lead levels in blood was again the age of participants (partial $r^2 = 0.26$, $p < 0.0001$). The consumption of ducks (partial $r^2 = 0.11$, $p = 0.0001$) also explained a percentage of the variance of blood lead concentrations (R^2 model = 0.43, $p < 0.0001$). Lead pellets may be ingested by humans directly when consuming ducks killed using lead shot, or when consuming gizzards from birds that have ingested lead pellets (Tsuji et al 2008a, b).

TABLE 5.3.3A WHOLE-BLOOD CONCENTRATIONS OF LEAD (µMOL/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS STRATIFIED BY AGE GROUPS AND GENDER

Age group	n	% det. [1]	Mean (SD) [2]	Geometric mean (95% CI) [3]		Minimum	Maximum
(A) Wemindji							
0-7 years	30	100	0.07 (0.11)	0.06	(0.05-0.08)	0.02	0.20
Women	16	100	0.06 (0.05)	0.05	(0.04-0.07)	0.02	0.10
Men	14	100	0.09 (0.14)	0.07	(0.05-0.11)	0.03	0.20
8-14 years	29	100	0.08 (0.18)	0.06	(0.05-0.08)	0.02	0.30
Women	14	100	0.06 (0.13)	0.05	(0.03-0.07)	0.02	0.22
Men	15	100	0.11 (0.21)	0.08	(0.06-0.13)	0.03	0.30
15-39 years	86	100	0.16 (0.40)	0.10	(0.08-0.12)	0.02	0.76
Women	50	100	0.11 (0.26)	0.07	(0.05-0.09)	0.02	0.53
Men	36	100	0.22 (0.50)	0.15	(0.11-0.21)	0.03	0.76
≥40 years	55	100	0.36 (0.76)	0.27	(0.22-0.33)	0.05	1.80
Women	27	100	0.38 (0.92)	0.27	(0.20-0.38)	0.05	1.80
Men	28	100	0.34 (0.58)	0.27	(0.20-0.36)	0.08	1.20
Total	200	100	0.19 (0.55)	0.11	(0.10-0.13)	0.02	1.80
Women	107	100	0.16 (0.58)	0.09	(0.07-0.11)	0.02	1.80
Men	93	100	0.22 (0.50)	0.15	(0.12-0.18)	0.03	1.20
(B) Eastmain							
0-7 years	16	100	0.06 (0.04)	0.05	(0.0-0.06)	0.03	0.11
Women	9	100	0.05 (0.03)	0.05	(0.04-0.06)	0.03	0.09
Men	7	100	0.06 (0.05)	0.06	(0.05-0.08)	0.05	0.11
8-14 years	23	100	0.07 (0.10)	0.05	(0.04-0.07)	0.02	0.22
Women	11	100	0.05 (0.03)	0.05	(0.04-0.06)	0.02	0.07
Men	12	100	0.08 (0.13)	0.06	(0.04-0.10)	0.03	0.22
15-39 years	70	100	0.10 (0.13)	0.08	(0.07-0.09)	0.02	0.33
Women	44	100	0.10 (0.15)	0.07	(0.06-0.09)	0.02	0.33
Men	26	100	0.09 (0.10)	0.08	(0.07-0.10)	0.03	0.24
≥40 years	41	100	0.27 (0.43)	0.20	(0.15-0.26)	0.03	0.99
Women	26	100	0.24 (0.28)	0.18	(0.13-0.26)	0.03	0.56
Men	15	100	0.30 (0.62)	0.22	(0.15-0.34)	0.08	0.99
Total	150	100	0.14 (0.30)	0.09	(0.08-0.11)	0.02	0.99
Women	90	100	0.13 (0.23)	0.09	(0.07-0.10)	0.02	0.56
Men	60	100	0.15 (0.38)	0.10	(0.08-0.12)	0.03	0.99

1. Percentage of detection; detection limit: 0.001 µmol/L

2. Standard deviation

3. 95% Confidence interval

TABLE 5.3.3B WHOLE-BLOOD CONCENTRATIONS OF LEAD (µMOL/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥ 8 YEARS OF AGE) STRATIFIED BY SMOKING CATEGORY IN EACH AGE GROUP

Age group	Smoking category	n	Mean (SD) [1]	Geometric mean (95% CI) [2]		Minimum	Maximum
(A) Wemindji							
8-14 yrs	Smoker	5	0.10 (0.25)	0.08	(0.03-0.24)	0.04	0.27
	Ex-smoker	7	0.06 (0.07)	0.05	(0.03-0.07)	0.04	0.11
	Non-smokers	17	0.09 (0.20)	0.06	(0.04-0.09)	0.02	0.30
15-39 yrs	Smoker	58	0.17 (0.39)	0.11	(0.08-0.14)	0.02	0.75
	Ex-smoker	24	0.16 (0.44)	0.10	(0.06-0.15)	0.02	0.76
	Non-smoker	4	0.06 (0.08)	0.05	(0.02-0.12)	0.03	0.10
40+ yrs	Smoker	12	0.32 (0.48)	0.26	(0.17-0.41)	0.08	0.76
	Ex-smoker	39	0.37 (0.79)	0.27	(0.21-0.35)	0.05	1.80
	Non-smoker	3	0.23 (0.34)	0.20	(0.04-1.02)	0.10	0.38
(B) Eastmain							
8-14 yrs	Smoker	4	0.05 (0.02)	0.05	(0.03-0.07)	0.04	0.07
	Ex-smoker	1	0.02 (NA)	0.02	NA	NA	NA
	Non-smoker	17	0.07 (0.11)	0.06	(0.04-0.08)	0.03	0.22
15-39 yrs	Smoker	44	0.10 (0.12)	0.08	(0.07-0.10)	0.02	0.28
	Ex-smoker	17	0.10 (0.16)	0.08	(0.06-0.11)	0.03	0.33
	Non-smoker	9	0.09 (0.15)	0.07	(0.04-0.11)	0.03	0.31
40+ yrs	Smoker	17	0.34 (0.57)	0.25	(0.16-0.38)	0.05	0.99
	Ex-smoker	23	0.21 (0.25)	0.17	(0.12-0.23)	0.03	0.51
	Non-smoker	1	0.45 (NA)	0.45		0.45	0.45

1. Standard deviation

2. 95% Confidence interval

TABLE 5.3.3C WHOLE-BLOOD CONCENTRATIONS OF LEAD (µMOL/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS STRATIFIED ACCORDING TO THE USE OF LEAD SHOT FOR HUNTING

Lead shot use	n	Mean (SD) [1]	Geometric mean (95% CI) [2]		Minimum	Maximum
(A) Wemindji						
Yes	73	0.27 (0.70)	0.18	(0.14-0.22)	0.02	1.80
No	13	0.24 (0.36)	0.19	(0.12-0.31)	0.05	0.46
Don't know	3	0.18 (0.36)	0.14	(0.02-0.93)	0.09	0.36
(B) Eastmain						
Yes	27	0.20 (0.52)	0.13	(0.09-0.19)	0.03	0.99
No	19	0.13 (0.20)	0.11	(0.08-0.14)	0.03	0.51
Don't know	5	0.13 (0.21)	0.10	(0.03-0.28)	0.04	0.27

1. Standard deviation

2. 95% Confidence interval

Table 5.3.4 shows the percent of the population exceeding the concern and action levels determined for blood lead concentration. In Wemindji, three adults aged over 40 years-old showed levels above the action level of 1 µmol/L, suggesting the need for an appropriate follow-up. Ten adults showed concentrations above the concern level of 0.5 µmol/L. In Eastmain, none of the participants showed levels above the action levels and four adults aged over 40 years showed concentrations above the concern level of 0.5 µmol/L.

TABLE 5.3.4 EXCEEDANCES OF THE CONCERN AND ACTION LEVELS OF WHOLE-BLOOD LEAD IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS ACCORDING TO THRESHOLDS USED IN THE CURRENT STUDY

Group	Level (nmol/L)		n (%)
(A) Wemindji			
0-7 years	Acceptable level	≤0.48	30 (100)
	Action level	>0.48	0
8-14 years	Acceptable level	≤0.48	29 (100)
	Action level	>0.48	0
15-39 years	Acceptable level	<0.5	82 (95.0)
	Concern level	0.5- 0.9	4 (5.0)
	Action level	≥1.0	0
≥40 years	Acceptable level	<0.5	46 (83.7)
	Concern level	0.5-0.9	6 (10.8)
	Action level	≥1.0	3 (5.5)
(B) Eastmain			
0-7 years	Acceptable level	≤0.48	16 (100)
	Action level	>0.48	0
8-14 years	Acceptable level	≤0.48	23 (100)
	Action level	>0.48	0
15-39 years	Acceptable level	<0.5	70 (100)
	Concern level	0.5-0.9	0
	Action level	≥1.0	0
≥40 years	Acceptable level	<0.5	37 (89.5)
	Concern level	0.5-0.9	4 (10.5)
	Action level	≥1.0	0

5.3.1.3 Mercury

Concentrations of the observed mercury (total) in blood samples are presented in Table 5.3.5. Mean levels strongly increased with age ($p < 0.001$), but no significant gender-related differences were noted ($p > 0.3$). The mean blood concentration in the older age group was about 13 times (Wemindji) and 7 times (Eastmain) higher than in the youngest age groups. Mean blood mercury levels were similar in Wemindji and Eastmain participants, but concentrations in those communities were 2-fold lower than those previously reported in Mistissini (Bonnier-Viger et al, 2007) and were also lower than those observed in Oujé-Bougoumou and Nemaska Cree populations (Dewailly and Nieboer, 2005). However, geomean concentrations in Wemindji and Eastmain are higher than in the general population of Quebec (3.7 nmol/L) (CTQ, 2003).

When sources of exposure to mercury were investigated using multivariate regression analysis, the contribution of fish (piscivorous *vs.* non-piscivorous species) and duck consumption was tested. The final regression model for Wemindji data (R^2 model = 0.58, $p < 0.0001$) showed that piscivorous fish (partial $r^2 = 0.05$, $p = 0.005$), herbivorous fish (partial $r^2 = 0.07$, $p = 0.0004$) and ducks (partial $r^2 = 0.04$, $p = 0.007$) were dietary sources of mercury. The final regression model for Eastmain data (R^2 model = 0.56, $p < 0.0001$) included the consumption of piscivorous fish (partial $r^2 = 0.21$, $p < 0.0001$) as the most important predictor of mercury concentrations, followed by age (partial $r^2 = 0.17$, $p < 0.0001$) and herbivorous ducks consumption (partial $r^2 = 0.04$, $p = 0.02$).

TABLE 5.3.5 WHOLE-BLOOD CONCENTRATIONS OF TOTAL MERCURY (NMOL/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE)

Group	n	% det. [1]	Mean (SD) [2]	Geometric mean (95% CI) [3]		Minimum	Maximum
(A) Wemindji							
8-14 years	29	89.7	5.94 (18.33)	2,89	(1.75-4.75)	< DL	29.00
Women	14	92.9	5.48 (16.20)	3.31	(1.74-6.30)	< DL	25.00
Men	15	86.7	6.51 (20.63)	2.45	(1.04-5.74)	< DL	29.00
15-39 years	86	97.7	6.38 (2048)	6.70	(4.96-9.07)	< DL	170.00
Women	50	98.0	18.03 (80.89)	5.88	(3.86-8.98)	< DL	170.00
Men	36	97.2	15.73 (49.07)	7.75	(4.95-12.12)	< DL	77.00
≥40 years	55	100	69.53 (189.86)	38.15	(27.73-52.48)	2.30	410.00
Women	27	100	53.78 (127.69)	32.90	(21.34-50.73)	2.30	210.00
Men	28	100	85.58 (231.14)	44.37	(27.19-72.39)	2.40	410.00
Total (≥8 years)	170	97.1	31.81 (134.09)	10.10	(7.89-12.92)	< DL	410.00
Women	91	97.8	26.77 (101.50)	9.01	(6.49-12.51)	< DL	210.00
Men	79	96.2	37.35 (163.44)	11.44	(7.85-16.69)	< DL	410.00
(B) Eastmain							
8-14 years	23	91.3	6.38 (20.48)	2.88	(1.65-5.05)	< DL	48.00
Women	11	90.9	5.00 (11.69)	2.96	(1.37-6.41)	< DL	21.00
Men	12	91.7	7.71 (26.45)	2.81	(1.10-7.15)	< DL	48.00
15-39 years	70	95.7	12.93 (38.08)	4.54	(3.14-6.58)	< DL	85.00
Women	44	97.7	10.06 (23.75)	4.87	(3.30-7.19)	< DL	61.00
Men	26	92.3	15.78 (54.26)	4.24	(2.04-8.78)	< DL	85.00
≥40 years	41	100	37.97 (96.91)	20.30	(13.93-29.58)	0.60	200.00
Women	26	100	39.45 (87.16)	19.47	(11.36-33.39)	0.60	190.00
Men	15	100	36.44 (115.07)	21.20	(11.80-38.09)	2.80	200.00
Total (≥8 years)	134	96.3	19.90 (65.49)	6.82	(5.19-8.95)	< DL	200.00
Women	81	97.5	18.87 (58.23)	7.07	(5.12-9.76)	< DL	190.00
Men	53	94.3	20.93 (75.77)	6.57	(4.08-10.58)	< DL	200.00

1. Percentage of detection; detection limit: 0.5 nmol/L

2. Standard deviation

3. 95% Confidence interval

Table 5.3.6 presents the percentage of participants exceeding the concern and action levels for mercury. In Wemindji, two young adults (2%) and 20% of adults aged 40 years and over showed concentrations above the 100-nmol/L concern level. In Eastmain, five adults (12%) aged 40 years and over showed concentrations above 100 nmol/L. None of the participants from either community showed concentrations above the action level.

TABLE 5.3.6 EXCEEDANCES OF THE CONCERN AND ACTION LEVELS FOR WHOLE-BLOOD TOTAL MERCURY IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE) ACCORDING TO THRESHOLDS USED IN THE CURRENT STUDY

Group	Level (nmol/L)		n (%)
(A) Wemindji			
8-14 years	Acceptable level	<60.0	29 (100)
	Concern level	60.0-99.9	0
	Action level	≥100.0	0
15-39 years	Acceptable level	<100.0	84 (97.9)
	Concern level	100.0-499.9	2 (2.1)
	Action level	≥500.0	0
≥40 years	Acceptable level	<100.0	44 (80.1)
	Concern level	100.0-499.9	11 (19.9)
	Action level	≥500.0	0
(B) Eastmain			
8-14 years	Acceptable level	<60.0	23 (100)
	Concern level	60.0-99.9	0
	Action level	≥100.0	0
15-39 years	Acceptable level	<100.0	70 (100)
	Concern level	100.0-499.9	0
	Action level	≥500.0	0
≥40 years	Acceptable level	<100.0	36 (88.9)
	Concern level	100.0-499.9	5 (11.1)
	Action level	≥500.0	0

The concentration of mercury in hair samples (0-2 cm segment) was also determined. In both communities, they increased with age ($p < 0.0001$) and no difference was noted between men and women ($p > 0.5$) (Tables 5.3.7). As shown in Figure 5.3.2A, the concentrations of hair and blood mercury were strongly associated in children (Pearson's $r = 0.68$; $p < 0.001$), young adults (Pearson's $r = 0.86$; $p < 0.001$) and adults aged 40 years and older (Pearson's $r = 0.78$; $p < 0.001$) from Wemindji. Mercury measurements for Eastmain were also strongly correlated in young adults (Pearson's $r = 0.74$; $p < 0.001$) and adults aged 40 years and over (Pearson's $r = 0.80$; $p < 0.001$) (see Figure 5.3.2B). Some adults from both communities showed markedly higher levels of hair mercury than those expected based on this correlation, suggesting that average exposure during the last two months was greater than the current exposure (reflected by blood levels).

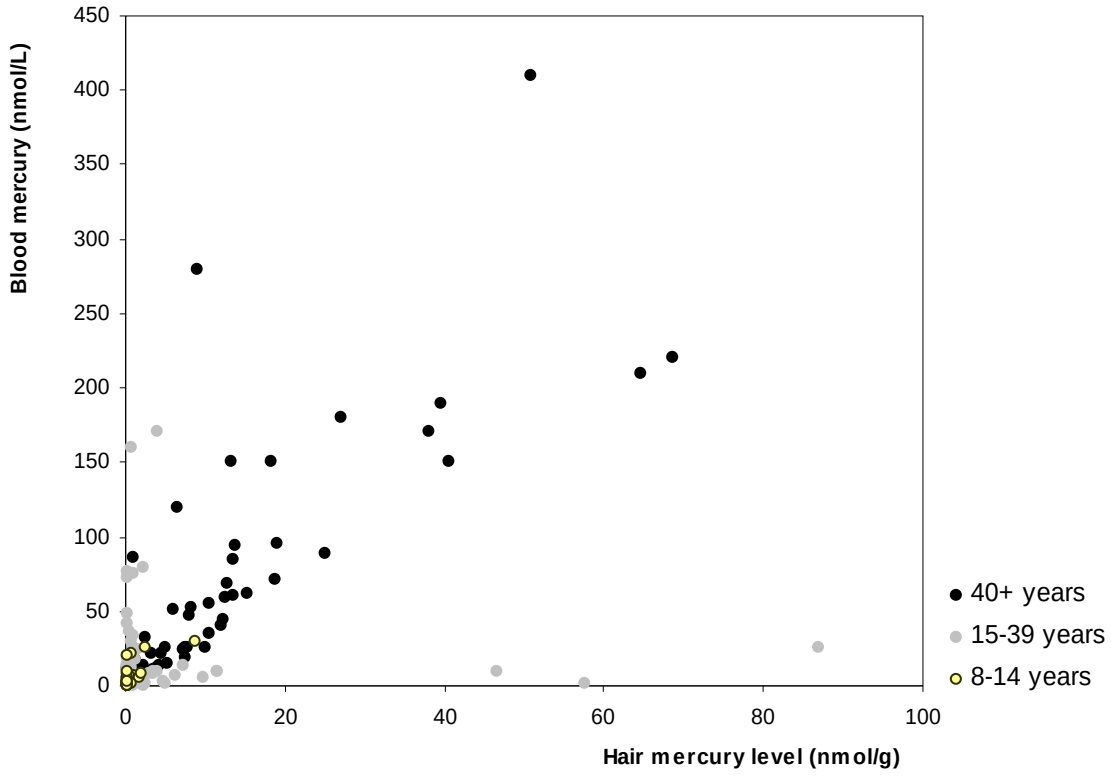
TABLE 5.3.7 HAIR (0-2 CM) CONCENTRATIONS OF TOTAL MERCURY (µG/G) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS

A (nmol/g)		%	Mean	Geometric mean		Minimum	Maximum
Group	n	det.[1]	(SD) [2]	(95% CI) [3]			
(A) Wemindji							
0-7 years	30	56.7				< DL	1.36
Women	16	68.8	0.27 (0.77)	0.16	(0.10-0.27)	< DL	1.36
Men	14	42.9				< DL	0.45
8-14 years	29	31.0				< DL	1.75
Women	14	28.6				< DL	0.48
Men	15	33.3				< DL	1.75
15-39 years	78	64.1	0.58 (3.94)	0.18	(0.14-0.24)	< DL	11.58
Women	50	56.0				< DL	1.58
Men	28	78.6	0.47 (1.74)	0.23	(0.14-0.36)	< DL	2.31
≥40 years	51	94.1	2.63 (7.51)	1.30	(0.88-1.91)	< DL	13.75
Women	26	96.2	2.03 (6.06)	0.16	(0.11-0.23)	< DL	12.95
Men	25	92.0	3.28 (8.63)	0.23	(0.14-0.36)	< DL	13.75
Total	188	66.0	1.01 (5.24)	0.23	(0.21-0.32)	< DL	13.76
Women	106	64.2	0.86 (4.73)	0.24	(0.18-0.32)	< DL	12.95
Men	82	68.3	1.18 (5.84)	0.28	(0.20-0.41)	< DL	13.76
(B) Eastmain							
0-7 years	15	20.0				< DL	1.88
Women	9	22.2				< DL	1.88
Men	6	16.7				< DL	0.19
8-14 years	20	35.0				< DL	0.31
Women	11	45.5				< DL	0.27
Men	9	22.2				< DL	0.31
15-39 years	61	52.5				< DL	5.03
Women	44	52.3				< DL	5.03
Men	17	52.9				< DL	2.48
≥40 years	40	90.0	1.61 (3.88)	0.82	(0.54-1.25)	< DL	7.42
Women	26	88.5	1.67 (3.66)	0.76	(0.43-1.37)	< DL	7.42
Men	14	92.9	1.54 (4.38)	0.89	(0.45-1.77)	< DL	7.21
Total	136	57.4				< DL	7.42
Women	90	58.9				< DL	7.42
Men	46	54.4				< DL	7.21

1. Percentage of detection; detection limit: 0.082 µg/g; means were only calculated and reported when the percentage of detection frequency was ≥60%
2. Standard deviation
3. 95% Confidence interval

FIGURE 5.3.2 CORRELATIONS BETWEEN BLOOD MERCURY CONCENTRATIONS AND HAIR MERCURY CONCENTRATIONS LABELLED BY AGE GROUPS IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS

A) WEMINDJI



B) EASTMAIN

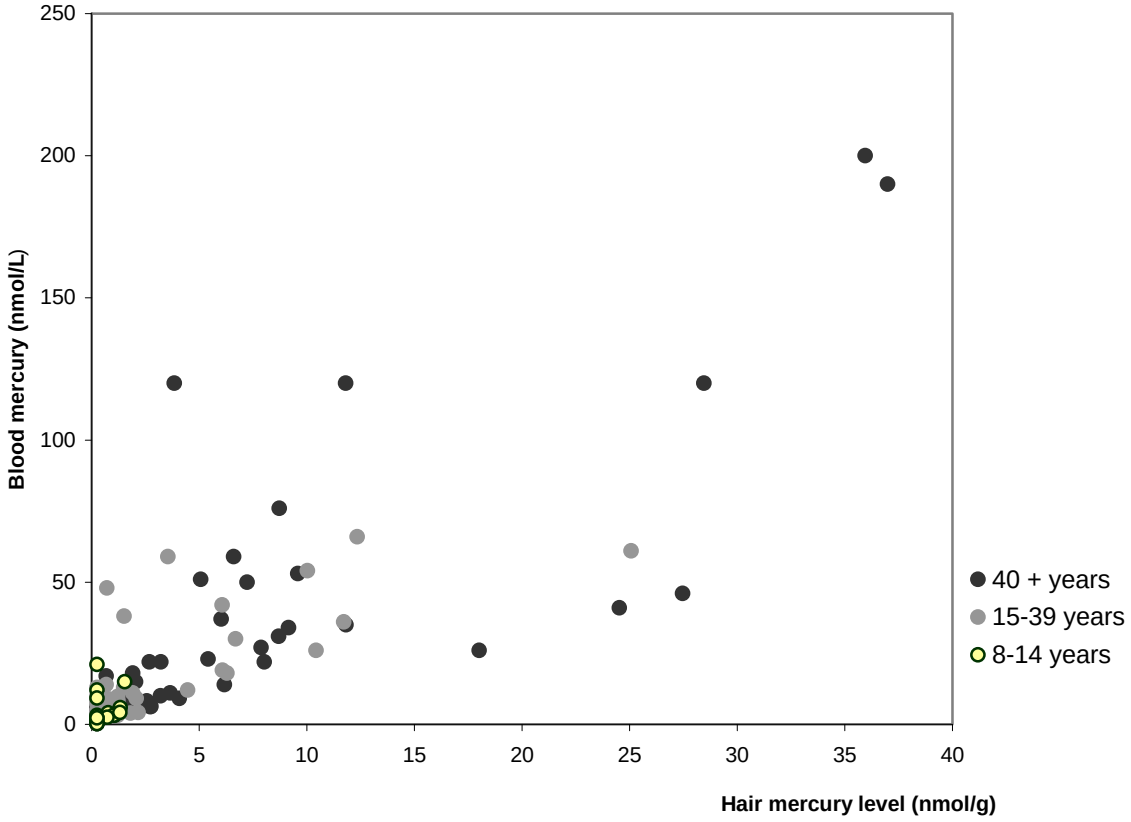


Table 5.3.8 lists the proportion of the population in each age stratum that exceeded concern and action levels for hair mercury concentrations. Twelve percent (n = 6) of Wemindji participants over 40 years and 2 participants younger than 40 exhibited hair levels above the concern level of 6 µg/g. Only 2 participants from Eastmain (both 40 years and older) exhibited hair levels above the concern level. None of the participants from either community exhibited levels above the action level.

TABLE 5.3.8 EXCEEDANCES OF THE CONCERN AND ACTION LEVELS OF HAIR MERCURY (0-2 CM) AMONG WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS ACCORDING TO THRESHOLDS USED IN THE CURRENT STUDY

Group		Level (µg/g)	n (%)
(A) Wemindji			
0-7 years	Acceptable level	< 4.0	30 (100)
	Concern level	4-5.9	0
	Action level	≥6.0	0
8-14 years	Acceptable level	<4.0	29 (100)
	Concern level	4-5.9	0
	Action level	≥6.0	0
15-39 years	Acceptable level	<6.0	76 (97.4)
	Concern level	6.0-29.9	2 (2.6)
	Action level	≥30.0	0
≥40 years	Acceptable level	<6.0	45 (88.2)
	Concern level	6.0-29.9	6 (11.8)
	Action level	≥30.0	0
(B) Eastmain			
0-7 years	Acceptable level	<4.0	15 (100)
	Concern level	4-5.9	0
	Action level	≥6.0	0
8-14 years	Acceptable level	<4.0	20 (100)
	Concern level	4-5.9	0
	Action level	≥6.0	0
15-39 years	Acceptable level	<6.0	61 (100)
	Concern level	6.0-29.9	0
	Action level	≥30.0	0
≥40 years	Acceptable level	<6.0	38 (95.0)
	Concern level	6.0-29.9	2 (5.0)
	Action level	≥30.0	0

5.3.1.4 Selenium

Similarly to mercury levels, blood selenium concentrations increased with age ($p < 0.0001$) in both communities (Table 5.3.9). In the 40 years-and-older groups, mean (geometric) concentrations were about 9% higher than those in the 8-14 years age groups ($p < 0.05$). Concentrations seemed slightly higher in men than in women but differences were not statistically significant (Wemindji: $p = 0.07$; Eastmain: $p = 0.05$). Table 5.3.10 contains the percentage of the population sample above the upper limit of selenium concentration observed in the southern Quebec population (4 µmol/L), and another determined in the framework of a childhood poisoning with the chemical selenious acid (3 µmol/L). In general, selenium levels were higher than those observed in the southern Quebec population, but only 2 older adults from Wemindji and one from Eastmain had levels above the 4 µmol/L level of potential concern determined by the US EPA (see footnote 2 to Table 5.3.10). It is important to note that selenium is an essential component of certain enzymes which are necessary for the normal functioning of several physiological and biochemical functions. Fish are a good source of dietary selenium. Selenium poisoning is not frequent and concentrations up to levels reaching 8.5 µmol/L were not associated with any clinical symptoms in a previous study conducted in people living in seleniferous areas (Longnecker et al, 1991). In the current study all participants had blood selenium levels below 8.5 µmol/L, suggesting that selenium exposure is not an issue of concern in Wemindji and Eastmain.

TABLE 5.3.9 WHOLE-BLOOD CONCENTRATIONS OF SELENIUM (µMOL/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE)[1]

Group	n	Mean (SD)[2]	Geometric mean (95% CI)		Minimum	Maximum
(A) Wemindji						
8-14 years	29	2.08 (0.59)	2.07	(1.98-2.15)	1.70	2.90
Women	14	2.14 (0.79)	2.12	(1.96-2.30)	1.70	2.90
Men	15	2.00 (0.23)	2.00	(1.94-2.05)	1.90	2.20
15-39 years	86	2.19 (0.52)	2.18	(2.14-2.23)	1.70	2.80
Women	50	2.16 (0.52)	2.15	(2.09-2.21)	1.70	2.80
Men	36	2.22 (0.50)	2.21	(2.15-2.28)	1.80	2.70
≥40 years	55	2.27 (0.86)	2.25	(2.16-2.34)	1.70	3.70
Women	27	2.17 (0.65)	2.16	(2.06-2.26)	1.80	2.90
Men	28	2.38 (0.98)	2.34	(2.20-2.50)	1.70	3.70
Total (≥8 years)	170	2.20 (0.67)	2.18	(2.14-2.22)	1.70	3.70
Women	91	2.16 (0.60)	2.15	(2.10-2.20)	1.70	2.90
Men	79	2.24 (0.74)	2.22	(2.16-2.28)	1.70	3.70
(B) Eastmain						
8-14 years	23	2.04 (0.34)	2.03	(1.96-2.10)	1.70	2.40
Women	11	2.05 (0.36)	2.04	(1.92-2.16)	1.80	2.40
Men	12	2.03 (0.32)	2.02	(1.92-2.13)	1.70	2.30
15-39 years	70	2.13 (0.47)	2.11	(2.06-2.17)	1.70	2.80
Women	44	2.07 (0.47)	2.06	(1.98-2.14)	1.70	2.80
Men	26	2.18 (0.44)	2.17	(2.10-2.25)	1.80	2.60
≥40 years	41	2.23 (0.58)	2.21	(2.13-2.30)	1.80	3.10
Women	26	2.18 (0.42)	2.17	(2.09-2.26)	1.80	2.70
Men	15	2.28 (0.80)	2.26	(2.09-2.44)	1.80	3.10
Total (≥8 years)	134	2.15 (0.50)	2.13	(2.09-2.17)	1.70	3.10
Women	81	2.10 (0.44)	2.09	(2.04-2.14)	1.70	2.80
Men	53	2.19 (0.57)	2.17	(2.11-2.24)	1.70	3.10

1. Selenium was detected in all samples

2. Standard deviation

3. 95% Confidence interval

TABLE 5.3.10 EXCEEDANCES OF THE CONCERN AND ACTION LEVELS OF WHOLE-BLOOD SELENIUM IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE)

	(A) Wemindji	
	Concern level of 3.0 µmol/L (for children only) [1]	**Concern level (of 4.0 µmol/L) [2]**
Group	**n (%)**	**n (%)**
8-14 years	0	0
15-39 years	NA	0
≥40 years	NA	2 (3.6)
	(B) Eastmain	
8-14 years	0	0
15-39 years	NA	0
≥40 years	NA	1 (2.4)

1. Nantel et al (1985), based on follow-up of acute poisoning by inorganic selenious acid in a child

2. Source: upper end of the laboratory reference range (CTQ, 2003); Longnecker et al 1991; US EPA, http://www.epa.gov/iris/subst/0472.htm

Selenium was also analysed in nail samples of the participants. Concentrations in nails were significantly different between gender ($p = 0.001$), but in contrast to whole blood selenium, concentrations in nails did not vary between age groups ($p > 0.5$) (Table 5.3.11). The correlation between nail selenium levels and blood selenium concentrations was weak and not statistically significant (data not shown).

TABLE 5.3.11 CONCENTRATIONS OF SELENIUM IN NAILS (NMOL/G) OF WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE) [1]

Group	n	Mean (SD) [2]	Geometric mean (95% CI) [3]		Minimum	Maximum
A) Wemindji						
8-14 years	25	10.05 (3.43)	9.95	(9.39-10.54)	7.73	13.93
Women	13	10.38 (2.44)	10.33	(9.77-10.94)	8.61	11.65
Men	12	9.58 (4.13)	9.44	(8.43-10.57)	7.73	13.93
15-39 years	80	9.68 (4.02)	9.55	(9.19-9.91)	6.33	13.93
Women	45	10.39 (3.65)	10.28	(9.81-10.76)	6.97	13.93
Men	35	8.94 (3.61)	8.85	(8.40-9.31)	6.33	13.93
≥40 years	53	9.34 (3.70)	9.22	(8.82-9.64)	6.08	13.93
Women	25	10.11 (3.91)	9.99	(9.36-10.66)	7.47	13.93
Men	28	8.62 (2.55)	8.55	(8.13-8.99)	6.08	10.89
Total	158	9.63 (3.85)	9.50	(9.26-9.75)	6.08	13.93
Women	83	10.30 (3.55)	10.20	(9.88-10.53)	6.97	13.93
Men	75	8.92 (3.38)	8.82	(8.52-9.13)	6.08	13.93
B) Eastmain						
8-14 years	20	10.09 (3.14)	9.97	(9.27-10.72)	7.73	12.66
Women	9	9.98 (3.35)	9.85	(8.66-11.21)	7.73	12.66
Men	11	10.18 (3.11)	10.07	(9.09-11.16)	8.36	12.66
15-39 years	63	9.88 (3.51)	9.74	(9.34-10.16)	6.84	19.00
Women	40	10.27 (3.49)	10.11	(9.57-10.69)	7.73	19.00
Men	23	9.49 (3.38)	9.38	(8.76-10.04)	6.84	12.54
≥40 years	39	10.13 (3.56)	9.99	(9.46-10.54)	7.35	16.46
Women	26	10.98 (3.05)	10.87	(10.26-11.52)	8.36	16.46
Men	13	9.10 (3.02)	9.02	(8.31-9.79)	7.35	11.65
Total	122	10.00 (3.45)	9.86	(9.57-10.16)	6.84	19.00
Women	75	10.48 (3.36)	10.34	(9.95-10.74)	7.73	19.00
Men	47	9.49 (3.26)	9.38	(8.98-9.81)	6.84	12.66

1. Selenium was detected in all samples

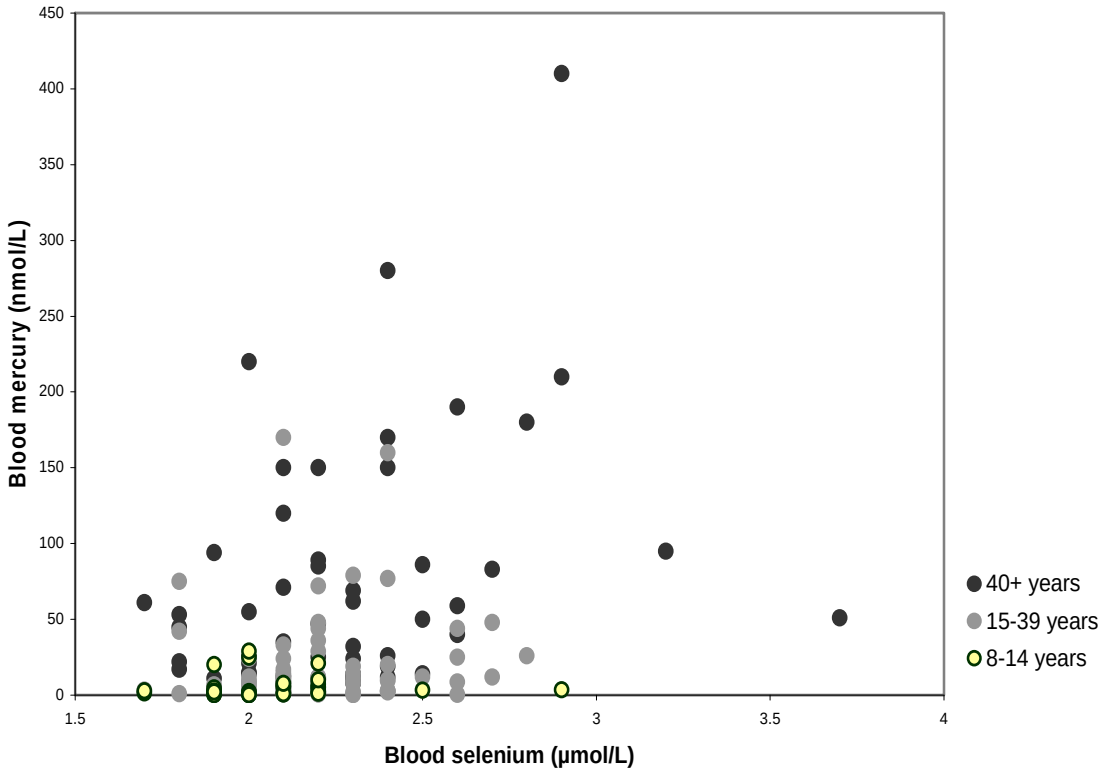
2. Standard deviation

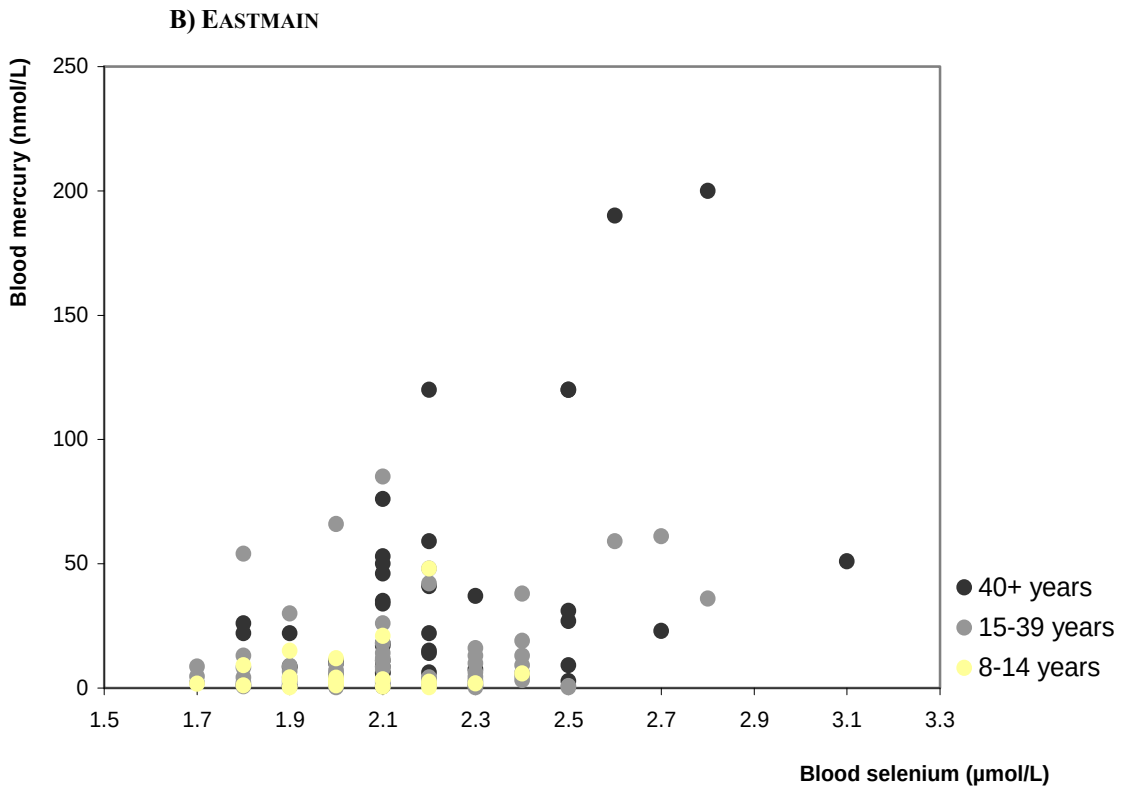
3. 95% Confidence interval

Blood selenium was correlated with blood mercury concentrations in both Wemindji (Figure 5.3.3A: Pearson's $r = 0.33$; $p < 0.001$; $n = 170$) and Eastmain participants (Figure 5.3.3B: Pearson's $r = 0.41$; $p < 0.001$; $n = 134$). These moderate correlations suggest that the source of exposure for mercury and selenium is the same (at least partially), and most probably related to fish consumption.

FIGURE 5.3.4 CORRELATIONS BETWEEN BLOOD SELENIUM CONCENTRATIONS AND BLOOD MERCURY CONCENTRATIONS, LABELLED BY AGE GROUPS IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS

A) WEMINDJI





5.3.1.5 Miscellaneous inorganic elements

As indicated in Table 4.4.1 of the methods section, inorganic arsenic concentrations in urine were measured for all participants ≥8 years old, as was total arsenic in hair (Table 4.4.2). The pertinent results are not reported in the current document; neither are the whole blood concentrations of the following metals: cobalt, copper, molybdenum, nickel and zinc (see Table 4.2.2). Although in the *Nituuchischaayihtitaau Aschii* database, the corresponding data have not as yet been statistically analyzed, but will be. Humans require proper intake of copper and zinc, and thus the measured blood levels are of dietary research interest. By contrast, the other inorganic elements mentioned are considered toxic environmental contaminants. Exposure to them above background usually reflects the presence of some kind of industrial activity. Thus the measured levels in the present study of cobalt, molybdenum and nickel in blood, and of arsenic in hair and inorganic arsenic in urine, provide an estimate of background exposure in the event resource development (such as mining) occurs in *Eeyou Istchee* in the future.

5.3.2 Persistent organic pollutants

5.3.2.1 Observed concentrations in plasma

The observed detection frequencies for PCBs, PBB-153, PPDEs, and the OCPs are summarized in Table 5.3.12 for Eastmain, Mistissini and Wemindji combined. Pertinent information about the detection limits and the analytical performance measures of reproducibility and recovery are provided in Appendix 2, Table 2A. Of the listed compounds, the number detected in 60% (or 70%) of the samples were: 8(7) of 15 PCBs; 4(2) of 13 OCPs; and 1(0) of the PBDEs.

Tables 5.3.13 and 5.3.14 provide the summary statistics for the concentrations of the organic contaminants and their detection frequencies (i.e., % of values above the detection limit) by age category for Eastmain, Mistissini and Wemindji. The concentrations are reported in units of μg/L of blood plasma and μg/kg plasma lipid. The plot of the sum of OCPs versus the sum of PCBs for the three communities is depicted in Figure 5.3.5, while the distribution is by age category in Fig 5.3.6. The latter clearly shows that age is a strong predictor of the body burden of these compounds with plasma concentrations taken as its measure. The community dependence in Figure 5.3.5 is not as obvious, but is depicted more clearly in Figures 5.3.7 and 5.3.8. For the 40- and-over age group, it is clear that exposure to PCBs and OCPs has the sequence: Mistissini > Wemindji > Eastmain.

A perusal of Table 5.3.15 illustrates the extent the concern levels for PCBs were exceeded in the communities. Not surprisingly, these exceedances reflect the concentration trends summarized in Table 5.3.13. Clearly, Eastmain exhibited lower proportions, relatively speaking, of study subjects with concentrations in the concern ranges of 20-99 μg/L (children and women 15-39 years) and ≥100 μg/L (other adults).

The correlation matrix for all organic contaminants measured in more than 70% of samples is provided in Table 5.3.16. All compounds are highly correlated with each other (Pearson's coefficient ranging from 0.45 to 1.000; all significant with $p < 0.001$). The strongest associations were noted among PCB congeners, while pesticides showed slightly lower correlations. The 70% detection frequency selection criteria constitute a compromise between optimizing the data available for statistical analyses and minimizing bias (Anda et al, 2007; Sandanger et al, 2009).

5.3.2.2 Contaminant correspondence analysis

Because of the 70% detection frequency eligibility criteria, the correspondence analysis was limited to PCB congeners 118, 138, 170, 180 and 187, and *p,p'*-DDE and HCB. PCB-163 could not be included as the data was not available for Mistissini. The summary in Table 5.3.17 indicates that the four new variables, namely CA-1, CA-2, CA-3 and CA-4, explain 97.4% of the variability, with CA-1 accounting for 67.4%. As illustrated in Figure 5.3.9, the CA-1 summary variable, like the actual

concentrations for the PCBs in Tables 5.3.13 and 5.3.14, decrease across the communities in the order: Mistissini > Wemindji > Eastmain and show a strong age dependence. This is further illustrated in Figure 5.3.10. Note that in these two figures as CA-1 assumes more negative values, the concentrations of *p,p'*-DDE and HCB increase relative to the PCBs. Consequently, PCBs are less prominent relative to the organochlorine pesticides in the order Mistissini > Wemindji > Eastmain. A focus on the linear regression lines in Figure 5.3.10 might be helpful.

The concentrations of PCB-153 and PCB-180 are generally higher than the other PCB congeners listed in Table 5.3.17 (see Table 5.3.13), and both have positive loadings on CA-2 with PC-180 being strong. This suggests that, in the first instance, CA-2 constitutes a concentration axes. With reference to Figure 5.3.11, the age dependence of CA-2 appears weakest for Mistissini across the age groups. Since the concentrations of PCB-118 (see Table 5.3.13) and HCB (see Table 5.3.14) are higher in females than males and the negative loadings on CA-2 for PC-118 and HCB are strong, CA-2 also appears to have some gender dependence. For the same reason, gender may also contribute to CA-3, although positive loadings favour HCB and negative values PCB-118 (see Figure 5.3.12). The plots in Figures 5.3.11 and 5.3.12 suggest, relatively speaking, that children have more HCB than PCB-118.

The results of ANOVA analysis (see Table 5.3.18) reinforce the illustrated (in this and the previous subsections) community and age dependences of contaminant concentrations and their summary variables, as well as of summary dietary consumption variables. CA-2 is confirmed as a gender axis, while this designation for CA-3 did not reach significance suggesting that other contributions are important. Statistical (category) interaction appears evident between community and age, for the sum concentration variables (PCBs, OCPs, Aroclor), contaminant axis CA-2 and CA-4, and PC-1 of both the total and traditional diet consumption rates. This indicates that the age category is dependent on community. It is well established that accumulation of OCs with age reflects the generally long residence times of these substances in the human body (Ogura, 2004) and the quantity of fish and other traditional food items consumed (see Section 5.3.2.3).

5.3.2.3 Potential sources

Age-adjusted partial correlations between organo-chlorine contaminant and dietary consumption summary variables are summarized in Table 5.3.19. It is clear that PC-1 of both the total (market and traditional) and traditional diets correlate positively with the sum of organochlorine concentrations ($p = 0.000$), as well as the related CA-1 ($p = 0.024$) and CA-2 ($p = 0.0015$) summary variables. This constitutes good evidence that traditional foods are the major source of the organochlorine contaminants. Further since PC-2 of the total diet is essentially a market food axis, the absence of any association confirms that this food source is not linked to the body burden of the OC contaminants

considered. By contrast, PC-2 of the traditional diet suggest that burbot, red and white sucker and other ducks stand out as more probable sources of OCPs than of PCBs.

The strong associations exhibited in Figures 5.3.5 (by community) and 5.3.6 (by age) between the sums of OCPs and PCBs are not observed for the sum of PBDEs versus the sum of PCBs (see Figures 5.3.13 and 5.3.14) nor with OCPs (data not shown). Interestingly, PC-3 of the traditional diet is negatively correlated ($p \leq 0.05$) with each of the sum concentrations of PCBs, OCPs and Aroclor (see Table5.3.19), but exhibits a positive slope for the sum of PBDEs ($p = 0.027$). These two observations suggest different sources of PBDEs compared to PCBs and OCPs. In fact known sources of PBDEs are fire retardants that are present in many consumer products such as in thermoplastics of computers, building and insulation materials, furniture foams, and household textiles (AMAP, 2003). With references to loadings of the traditional diet PC-3 axis in Table 5.2.5, consumption of food items with considerable positive loadings such as whitefish, fish liver, birds (ptarmigan, partridge and others) and fats other that bear and goose grease may contribute to PDBE exposures. Because of the ubiquitous presence of PBDEs in the home environment, contamination during food preparation cannot be discounted. In Section 5.3.4, some age dependence of blood plasma levels is reported for one of the most persistent and ubiquitous PBDEs, namely congener PBDE 153. A moderate correlation with PCB 153 is also reported. It would appear therefore that PBDEs are entering the traditional food chain. And finally, the significant positive associations observed between PC-3 of the total diet and the sum of PCBs ($p = 0.0001$) and Aroclor ($p = 0.0003$) in Table 5.3.19 suggest that some market foods such as high-fat snack foods and deep fried foods may also be sources of PCBs. This observation needs further investigation, since association between the consumption of these items and of traditional foods may occur in some individuals.

FIGURE 5.3.5 COMPARISON OF THE SUM OF ORGANOCHLORINE PESTICIDES WITH THE SUM OF PCB CONGENERS BY COMMUNITY

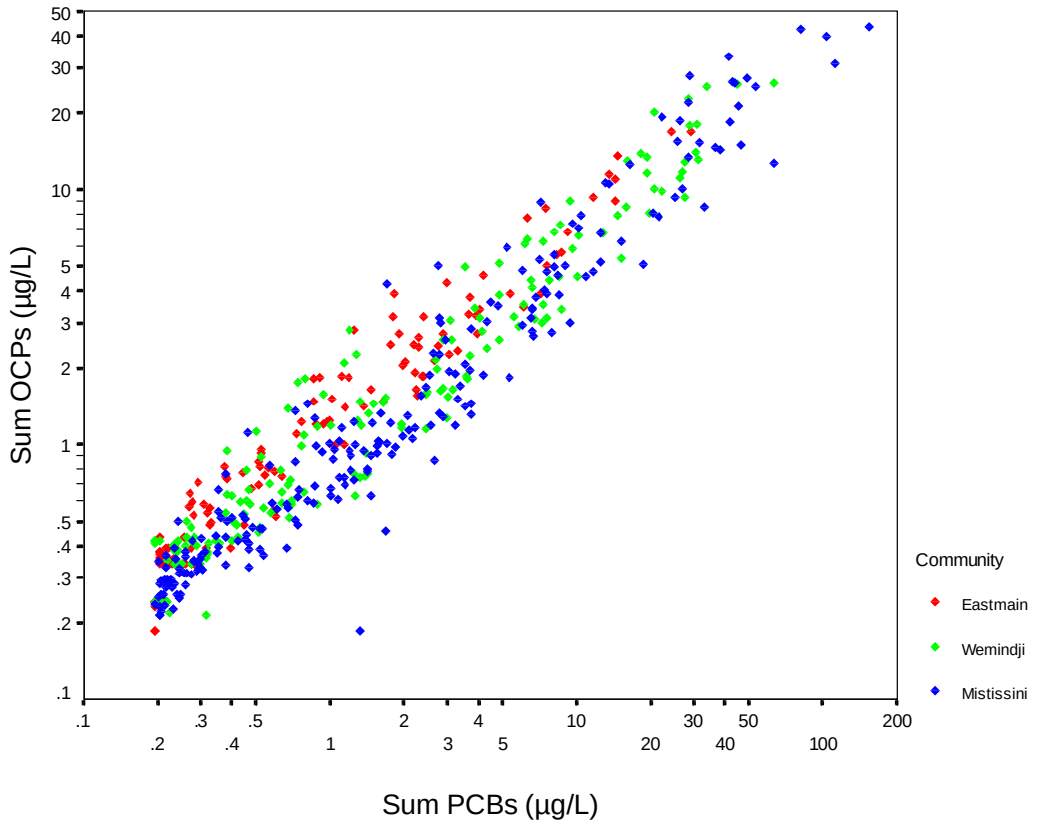


FIGURE 5.3.6 COMPARISON OF THE SUM OF ORGANOCHLORINE PESTICIDES WITH THE SUM OF PCB CONGENERS BY AGE CATEGORY

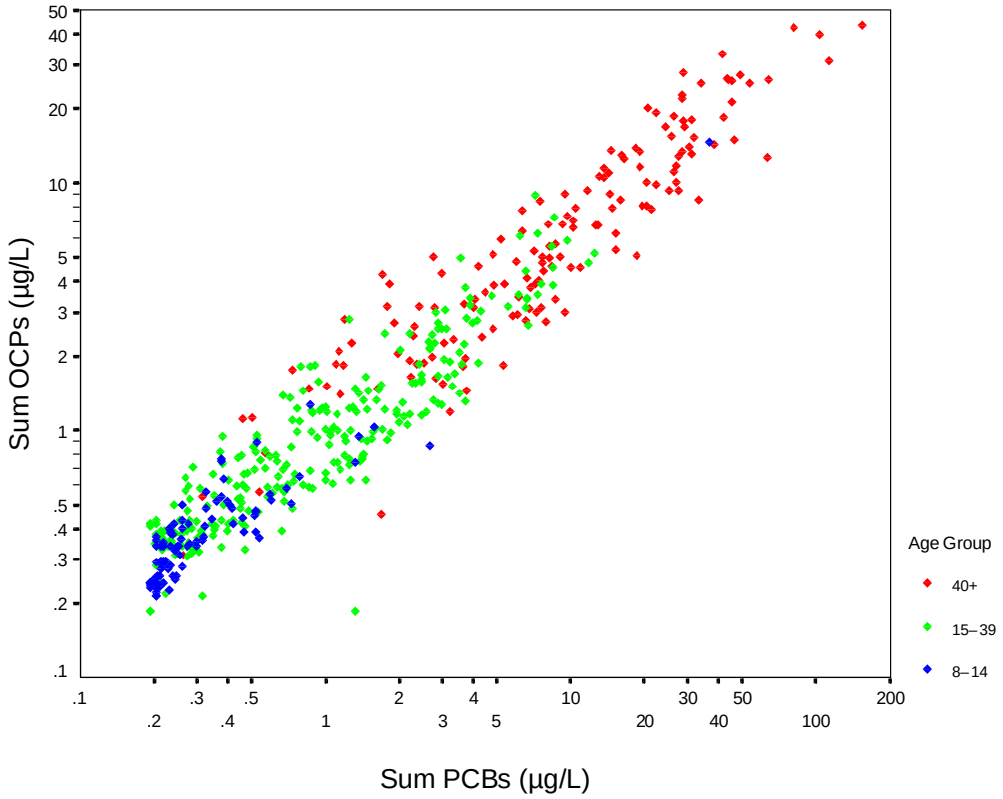


FIGURE 5.3.7 MEAN VALUES OF THE SUM OF PCBS IN PLASMA (± 95% CONFIDENCE INTERVAL) BY AGE CATEGORY AND COMMUNITY

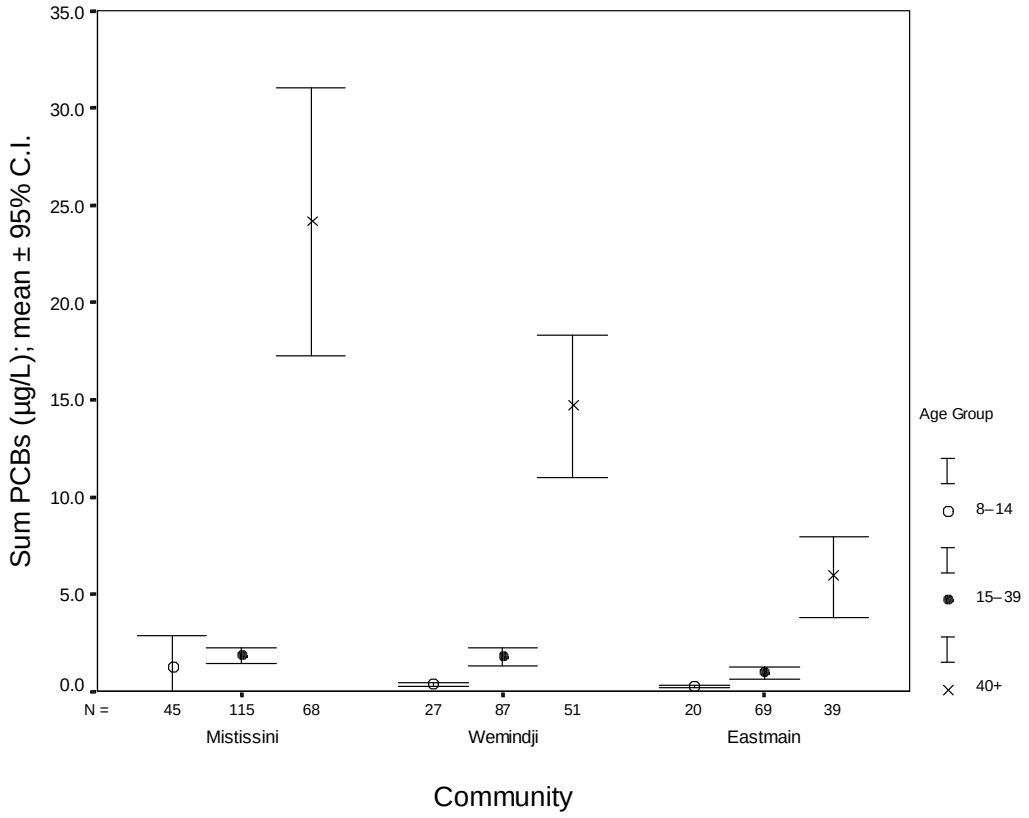


FIGURE 5.3.8 MEAN VALUES OF THE SUM OF ORGANOCHLORINE PESTICIDES IN PLASMA (± 95% CONFIDENCE INTERVAL) BY AGE CATEGORY AND COMMUNITY

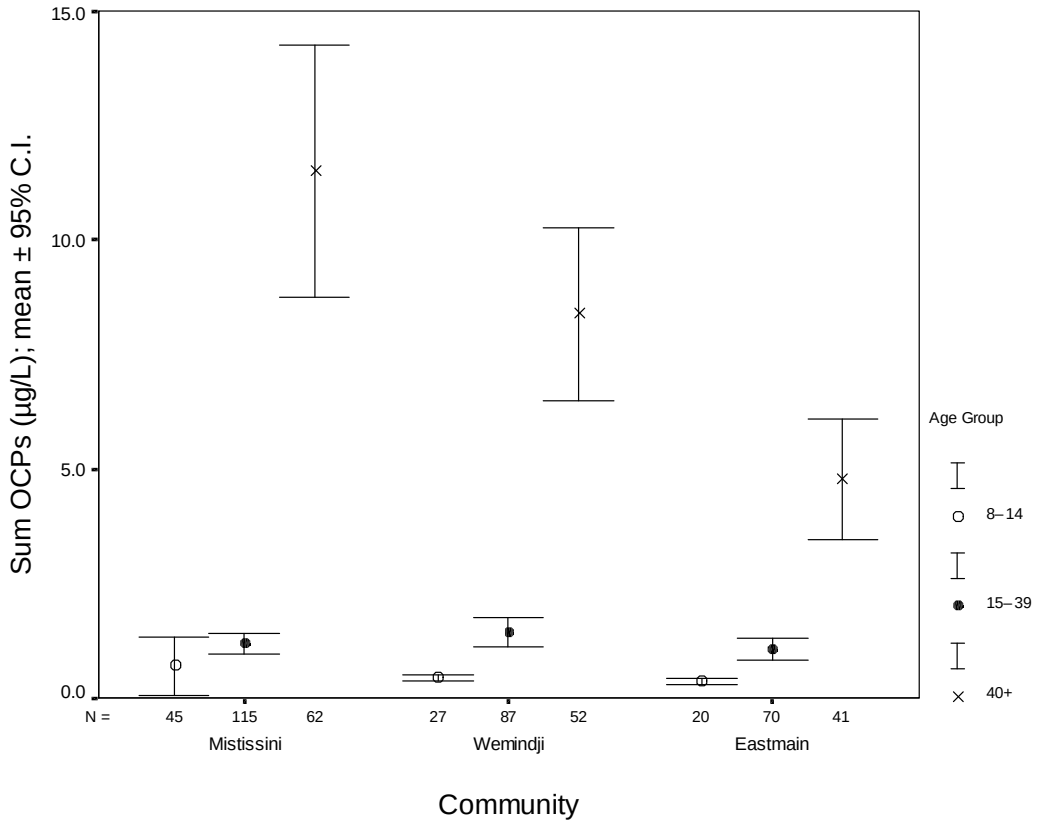


FIGURE 5.3.9 MEAN VALUES OF THE CONTAMINANT SUMMARY VARIABLE CA-1 (± 95% CONFIDENCE INTERVAL) BY AGE CATEGORY AND COMMUNITY

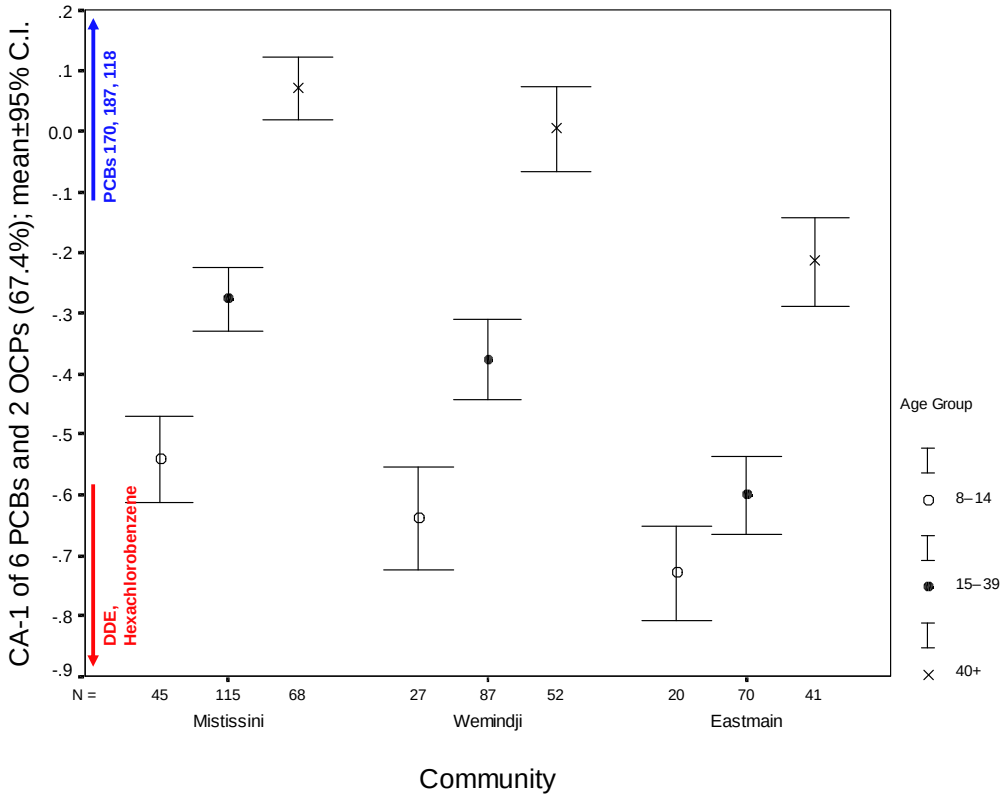


FIGURE 5.3.10 THE DEPENDENCE OF THE CONTAMINANT SUMMARY VARIABLE CA-1 ON AGE AND COMMUNITY

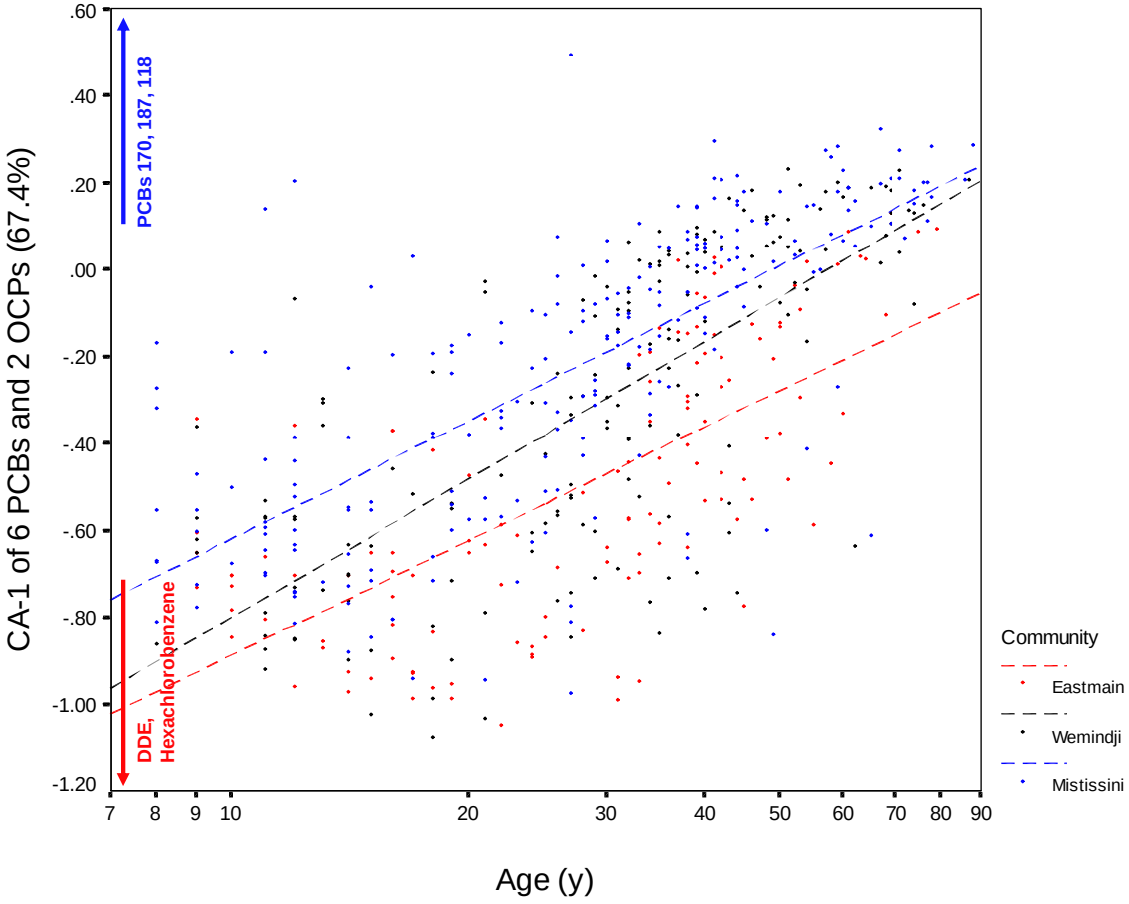


FIGURE 5.3.11 MEAN VALUES OF THE CONTAMINANT SUMMARY VARIABLE CA-2 (± 95% CONFIDENCE INTERVAL) BY AGE CATEGORY AND COMMUNITY

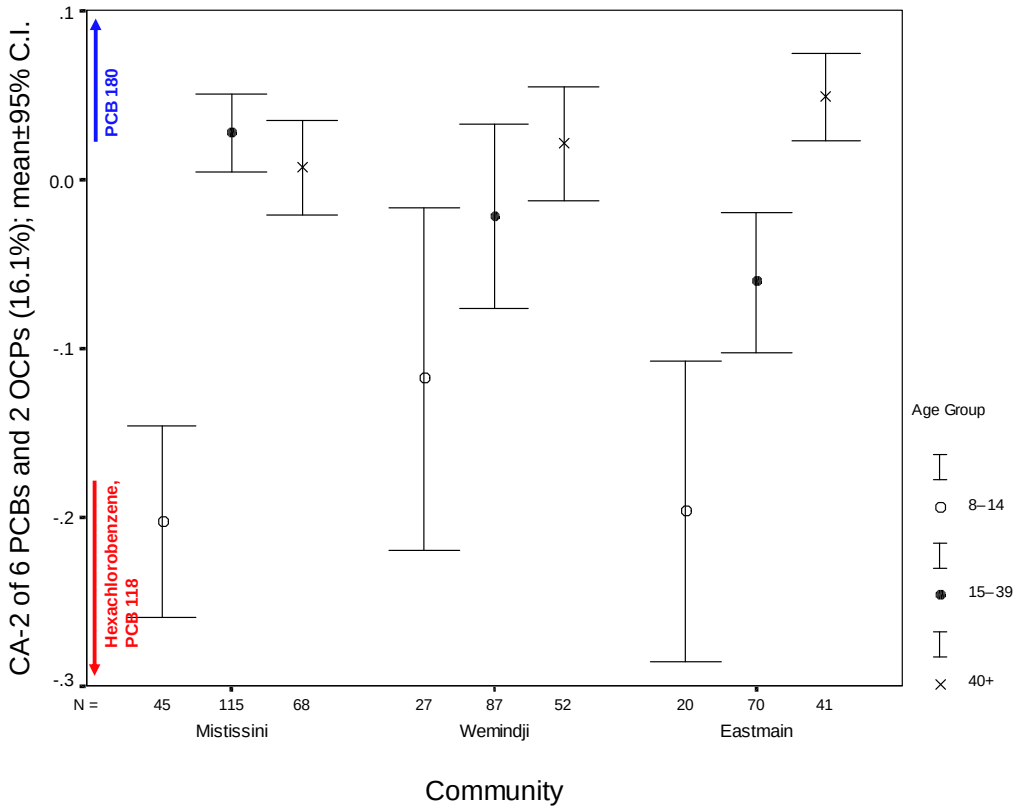


FIGURE 5.3.12 MEAN VALUES OF THE CONTAMINANT SUMMARY VARIABLE CA-3 (± 95% CONFIDENCE INTERVAL) BY AGE CATEGORY AND COMMUNITY

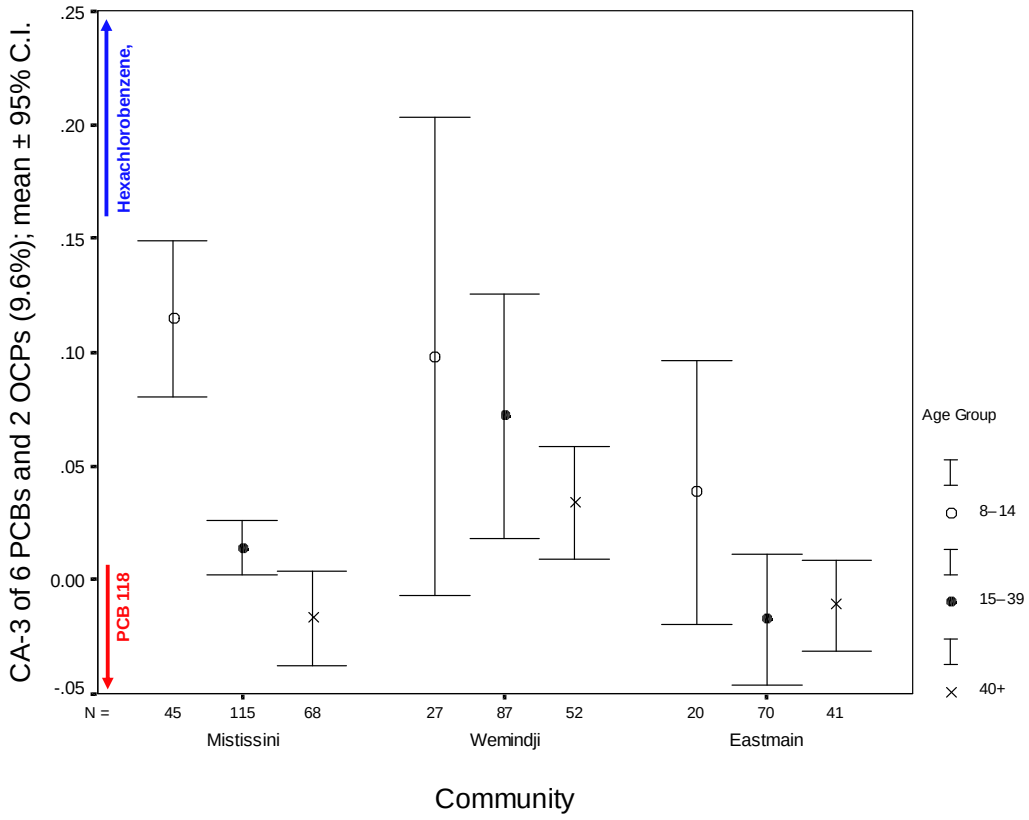


FIGURE 5.3.13 COMPARISON OF THE SUM OF PBDES WITH THE SUM OF PCBS BY COMMUNITY

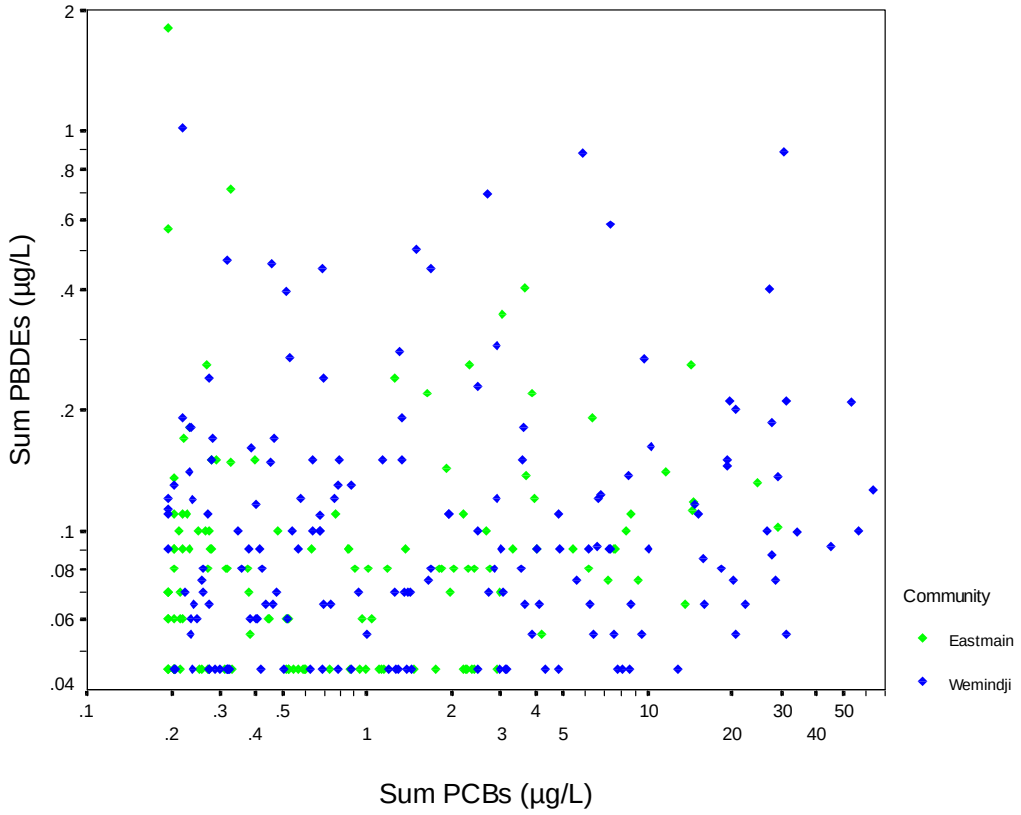


FIGURE 5.3.14 COMPARISON OF THE SUM OF PBDES WITH THE SUM OF PCBS BY AGE

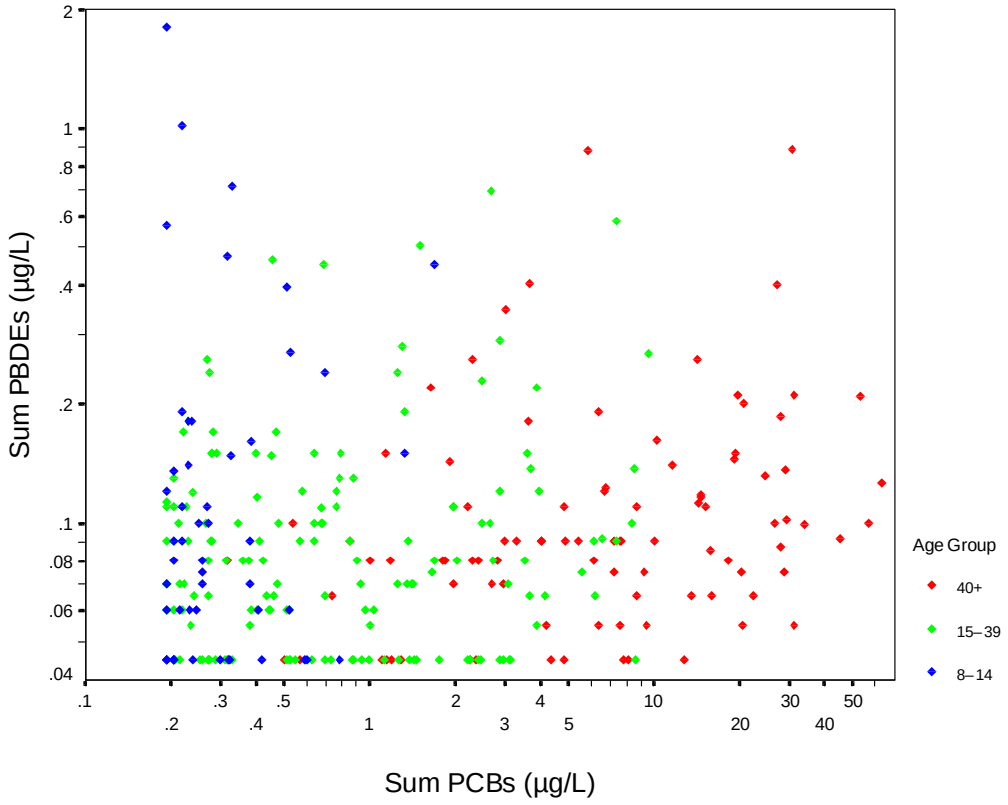


TABLE 5.3.12 PERCENT DETECTION OF PCB CONGENERS AND CHLORINATED PESTICIDES IN PLASMA (EASTMAIN, MISTISSINI AND WEMINDJI)

Contaminant	Detection (% of residents >7 years)
PCB 28 (µg/L)	1.0
PCB 99 (µg/L)	54.7
PCB 101 (µg/L)	3.8
PCB 105 (µg/L)	39.0
PCB 118 (µg/L)	73.7
PCB 128 (µg/L)	12.8
PCB 138 (µg/L)	89.7
PCB 153 (µg/L)	97.3
PCB 156 (µg/L)	63.8
PCB 170 (µg/L)	74.5
PCB 180 (µg/L)	90.9
PCB 183 (µg/L)	58.7
PCB 187 (µg/L)	77.1
Aldrin (µg/L)	0.0
beta-HCH (µg/L)	17.3
alpha-Chlordane (µg/L)	0.2
gamma-Chlordane (µg/L)	0.2
cis-Nonachlor (µg/L)	40.4
p,p′-DDE (µg/L)	99.0
p,p′-DDT (µg/L)	9.3
Hexachlorobenzene (µg/L)	71.4
Mirex (µg/L)	63.6
Oxychlordane (µg/L)	58.6
trans-Nonachlor (µg/L)	68.4
PCB 52 (µg/L)	0.0
PCB 163 (µg/L)	76.4
PBB 153 (µg/L)	18.5
PBDE 47 (µg/L)	62.0
PBDE 99 (µg/L)	13.5
PBDE 100 (µg/L)	16.2
PBDE 153 (µg/L)	49.8
Toxaphene 26 (µg/L)	37.4
Toxaphene 50 (µg/L)	38.0
60< % <70	
>70%	

TABLE 5.3.13 PLASMA CONCENTRATIONS OF INDIVIDUAL PCB CONGENERS AND SUM OF PCBS (IN µG/L AND µG/KG LIPDS) DETECTED IN MORE THAN 60% OF THE MISTISSINI, WEMINDJI AND EASTMAIN PARTICIPANTS

						Concentration of Contaminants in Plasma (µg/L)						Lipid Concentration of Contaminants (µg/kg lipid)			
PCB congener (or PCB sum)	Community	Gender	Age Group (y range)	n	% of values above detection limit	Arithmetic Mean	Standard Deviation of Mean	Minimum[a]	Maximum	Geometric Mean	95% Confidence Interval for Geometric Mean	Arithmetic Mean	Standard Deviation of Mean	Geometric Mean	95% Confidence Interval for Geometric Mean
PCB 118 (µg/L)	Mistissini	Female	8-14	29	44.8	0.058	0.204	0.010	1.109	0.018	(0.012-0.025)	10.562	32.871	3.839	(2.643-5.577)
			15-39	69	87.0	0.079	0.090	0.010	0.457	0.047	(0.036-0.060)	15.065	15.793	9.348	(7.344-11.89)
			40+	40	100.0	1.650	1.837	0.033	8.349	0.833	(0.544-1.275)	287.453	298.787	147.380	(96.10-226.0)
			Total	138	81.9	0.530	1.220	0.010	8.349	0.088	(0.064-0.120)	93.072	203.214	17.245	(12.75-23.32)
		Male	8-14	16	37.5	0.016	0.010	0.010	0.037	0.014	(0.010-0.018)	3.547	2.213	3.068	(2.318-4.059)
			15-39	46	84.8	0.087	0.143	0.010	0.786	0.043	(0.031-0.059)	15.630	25.420	8.020	(5.878-10.94)
			40+	28	100.0	0.751	0.899	0.018	3.682	0.402	(0.249-0.647)	121.219	124.396	67.065	(41.49-108.3)
			Total	90	81.1	0.281	0.598	0.010	3.682	0.071	(0.050-0.099)	46.332	87.193	13.089	(9.457-18.11)
	Wemindji	Female	8-14	12	25.0	0.014	0.007	0.010	0.028	0.013	(0.009-0.016)	2.733	1.685	2.381	(1.714-3.307)
			15-39	50	64.0	0.070	0.114	0.010	0.570	0.031	(0.022-0.043)	11.901	18.565	5.673	(4.098-7.851)
			40+	26	100.0	0.756	1.008	0.018	4.400	0.370	(0.218-0.626)	126.598	175.560	61.909	(36.72-104.3)
			Total	88	69.3	0.265	0.634	0.010	4.400	0.057	(0.040-0.082)	44.539	109.164	10.211	(7.203-14.47)
		Male	8-14	15	6.7	0.010	0.002	0.010	0.017	0.010	(0.009-0.011)	2.481	0.615	2.418	(2.127-2.748)
			15-39	37	81.1	0.088	0.117	0.010	0.500	0.044	(0.029-0.064)	13.936	18.369	7.635	(5.333-10.92)
			40+	26	100.0	0.635	0.743	0.020	3.300	0.328	(0.195-0.550)	123.232	164.669	57.114	(33.03-98.75)
			Total	78	73.1	0.255	0.509	0.010	3.300	0.065	(0.044-0.094)	48.165	108.784	11.970	(8.340-17.17)
	Eastmain	Female	8-14	9	11.1	0.011	0.003	0.010	0.020	0.011	(0.009-0.012)	2.364	0.831	2.264	(1.806-2.838)
			15-39	44	65.9	0.069	0.097	0.010	0.450	0.033	(0.022-0.047)	12.669	16.704	6.582	(4.712-9.192)
			40+	26	92.3	0.381	0.461	0.010	1.400	0.178	(0.102-0.309)	68.082	82.972	31.373	(18.11-54.33)
			Total	79	68.4	0.165	0.311	0.010	1.400	0.050	(0.036-0.070)	29.732	55.690	9.745	(7.068-13.43)
		Male	8-14	11	27.3	0.013	0.006	0.010	0.028	0.012	(0.009-0.015)	2.618	1.195	2.429	(1.875-3.144)
			15-39	26	42.3	0.025	0.029	0.010	0.120	0.017	(0.012-0.023)	4.745	5.216	3.418	(2.547-4.586)
			40+	15	100.0	0.151	0.147	0.026	0.470	0.097	(0.056-0.166)	27.060	26.719	17.223	(10.03-29.55)
			Total	52	55.8	0.059	0.100	0.010	0.470	0.026	(0.019-0.036)	10.732	17.902	5.070	(3.744-6.864)
PCB 138 (µg/L)	Mistissini	Female	8-14	29	72.4	0.179	0.690	0.010	3.744	0.032	(0.019-0.053)	32.155	111.553	6.994	(4.209-11.62)
			15-39	69	97.1	0.224	0.259	0.010	1.085	0.122	(0.092-0.161)	43.009	47.561	24.161	(18.36-31.78)
			40+	40	100.0	2.990	2.953	0.066	12.091	1.716	(1.162-2.531)	521.323	480.980	303.468	(205.4-448.2)
			Total	138	92.8	1.016	2.053	0.010	12.091	0.198	(0.143-0.273)	179.370	342.951	38.773	(28.42-52.89)
		Male	8-14	16	68.8	0.035	0.034	0.010	0.126	0.024	(0.015-0.037)	7.645	7.872	5.206	(3.276-8.271)
			15-39	46	95.7	0.247	0.338	0.010	1.810	0.130	(0.091-0.183)	44.166	59.631	24.239	(17.40-33.74)
			40+	28	100.0	2.530	3.380	0.022	15.251	1.303	(0.792-2.140)	382.373	386.388	217.329	(133.1-354.7)
			Total	90	92.2	0.919	2.171	0.010	15.251	0.197	(0.134-0.288)	142.893	271.052	36.485	(25.36-52.47)
	Wemindji	Female	8-14	12	91.7	0.041	0.039	0.010	0.150	0.030	(0.018-0.048)	8.144	8.769	5.687	(3.367-9.604)
			15-39	50	88.0	0.185	0.257	0.010	1.100	0.079	(0.053-0.115)	31.445	40.990	14.243	(9.778-20.74)
			40+	26	100.0	1.735	1.972	0.057	9.600	1.017	(0.642-1.610)	286.645	334.081	170.096	(108.1-267.4)
			Total	88	92.0	0.623	1.297	0.010	9.600	0.147	(0.100-0.214)	103.668	217.462	26.150	(18.10-37.77)
		Male	8-14	15	80.0	0.035	0.031	0.010	0.110	0.026	(0.017-0.039)	8.193	7.337	6.082	(3.980-9.293)
			15-39	37	97.3	0.303	0.375	0.010	1.400	0.152	(0.099-0.230)	47.954	56.567	26.283	(17.77-38.86)
			40+	26	100.0	1.751	1.381	0.051	4.900	1.088	(0.668-1.768)	325.513	293.684	189.203	(114.0-313.7)
			Total	78	94.9	0.734	1.104	0.010	4.900	0.209	(0.139-0.310)	132.827	220.303	38.300	(26.17-56.03)
	Eastmain	Female	8-14	9	66.7	0.022	0.014	0.010	0.046	0.019	(0.011-0.030)	4.730	3.077	3.987	(2.507-6.338)
			15-39	44	77.3	0.166	0.261	0.010	1.500	0.067	(0.043-0.102)	29.727	41.121	13.365	(8.964-19.92)
			40+	26	100.0	0.886	1.057	0.020	4.200	0.466	(0.281-0.772)	154.873	178.826	81.962	(49.58-135.4)
			Total	79	83.5	0.387	0.722	0.010	4.200	0.110	(0.075-0.159)	68.066	122.420	21.152	(14.80-30.21)
		Male	8-14	11	27.3	0.023	0.025	0.010	0.075	0.016	(0.009-0.027)	4.590	5.013	3.127	(1.796-5.443)
			15-39	26	80.8	0.086	0.161	0.010	0.770	0.038	(0.023-0.060)	15.720	27.899	7.466	(4.821-11.56)
			40+	15	100.0	0.537	0.509	0.082	1.700	0.355	(0.208-0.604)	93.013	81.632	62.952	(37.36-106.0)
			Total	52	75.0	0.203	0.362	0.010	1.700	0.060	(0.038-0.092)	35.662	59.951	11.488	(7.557-17.46)

Table 5.3.13 continued

PCB congener (or PCB sum)	Community	Gender	Age Group (y range)	n	% of values above detection limit	Concentration of Contaminants in Plasma (µg/L)						Lipid Concentration of Contaminants (µg/kg lipid)			
						Arithmetic Mean	Standard Deviation of Mean	Minimum[a]	Maximum	Geometric Mean	95% Confidence Interval for Geometric Mean	Arithmetic Mean	Standard Deviation of Mean	Geometric Mean	95% Confidence Interval for Geometric Mean
PCB 153 (µg/L)	Mistissini	Female	8-14	29	96.6	0.509	2.109	0.010	11.426	0.069	(0.039-0.119)	89.959	340.463	14.997	(8.703-25.84)
			15-39	69	100.0	0.538	0.624	0.019	2.841	0.280	(0.207-0.376)	103.701	116.122	55.492	(41.41-74.36)
			40+	40	100.0	7.645	8.192	0.104	36.288	4.215	(2.818-6.302)	1323.054	1287.999	745.485	(498.5-1114.)
			Total	138	99.3	2.592	5.541	0.010	36.288	0.458	(0.327-0.639)	454.249	901.668	89.503	(64.72-123.7)
		Male	8-14	16	93.8	0.078	0.080	0.010	0.287	0.050	(0.030-0.083)	17.202	18.386	10.929	(6.484-18.42)
			15-39	46	100.0	0.632	0.849	0.018	3.998	0.318	(0.220-0.459)	112.202	146.262	59.498	(41.94-84.40)
			40+	28	100.0	7.574	10.328	0.045	49.149	3.834	(2.297-6.399)	1136.796	1108.731	639.742	(386.1-1059.)
			Total	90	98.9	2.693	6.607	0.010	49.149	0.497	(0.330-0.748)	414.076	789.649	92.168	(62.37-136.1)
	Wemindji	Female	8-14	12	91.7	0.101	0.124	0.010	0.470	0.062	(0.033-0.117)	20.553	27.980	11.859	(6.107-23.02)
			15-39	50	96.0	0.437	0.620	0.010	2.900	0.173	(0.114-0.260)	73.966	99.194	31.265	(20.92-46.70)
			40+	26	100.0	4.162	4.331	0.130	20.000	2.428	(1.504-3.918)	685.938	732.124	406.067	(253.7-649.8)
			Total	88	96.6	1.492	2.941	0.010	20.000	0.328	(0.220-0.488)	247.492	491.451	58.431	(39.64-86.11)
		Male	8-14	15	100.0	0.084	0.075	0.020	0.260	0.061	(0.038-0.095)	19.785	18.017	14.223	(9.051-22.35)
			15-39	37	97.3	0.712	0.835	0.010	3.300	0.362	(0.234-0.557)	114.655	130.984	62.673	(41.81-93.93)
			40+	26	100.0	4.794	3.680	0.120	13.000	2.929	(1.764-4.864)	881.845	756.544	509.598	(301.6-860.9)
			Total	78	98.7	1.952	2.978	0.010	13.000	0.516	(0.340-0.781)	352.141	580.753	94.755	(63.72-140.8)
	Eastmain	Female	8-14	9	88.9	0.040	0.029	0.010	0.089	0.032	(0.018-0.056)	8.538	6.439	6.741	(3.873-11.73)
			15-39	44	93.2	0.315	0.458	0.010	2.500	0.126	(0.080-0.196)	57.070	75.087	25.184	(16.55-38.31)
			40+	26	100.0	1.888	2.232	0.052	8.700	1.000	(0.608-1.643)	330.574	381.648	175.813	(107.4-287.6)
			Total	79	94.9	0.801	1.519	0.010	8.700	0.213	(0.143-0.315)	141.555	260.334	41.083	(28.24-59.74)
		Male	8-14	11	63.6	0.051	0.067	0.010	0.190	0.026	(0.012-0.055)	9.955	13.295	5.150	(2.422-10.94)
			15-39	26	100.0	0.168	0.266	0.020	1.200	0.082	(0.052-0.129)	31.092	46.636	16.300	(10.60-25.06)
			40+	15	100.0	1.375	1.296	0.230	4.100	0.913	(0.541-1.540)	240.694	220.516	161.951	(96.77-271.0)
			Total	52	92.3	0.491	0.907	0.010	4.100	0.129	(0.080-0.207)	87.082	155.791	24.773	(15.68-39.13)
PCB 156 (µg/L)	Mistissini	Female	8-14	29	13.8	0.068	0.284	0.010	1.544	0.014	(0.009-0.021)	11.923	45.789	3.074	(2.080-4.543)
			15-39	69	69.6	0.054	0.065	0.010	0.325	0.032	(0.024-0.040)	10.524	12.202	6.264	(4.914-7.985)
			40+	40	97.5	0.825	0.972	0.010	4.881	0.446	(0.299-0.664)	141.618	150.450	78.886	(53.05-117.2)
			Total	138	65.9	0.281	0.640	0.010	4.881	0.057	(0.042-0.076)	48.817	102.407	11.241	(8.482-14.89)
		Male	8-14	16	18.8	0.012	0.006	0.010	0.030	0.012	(0.009-0.013)	2.727	1.351	2.513	(2.045-3.087)
			15-39	46	69.6	0.064	0.092	0.010	0.471	0.034	(0.024-0.046)	11.366	15.619	6.343	(4.680-8.596)
			40+	28	96.4	1.001	1.435	0.010	6.975	0.490	(0.297-0.807)	149.011	150.263	81.738	(50.15-133.2)
			Total	90	68.9	0.347	0.908	0.010	6.975	0.064	(0.044-0.093)	52.653	105.942	11.918	(8.371-16.96)
	Wemindji	Female	8-14	12	25.0	0.015	0.012	0.010	0.051	0.013	(0.009-0.017)	3.032	2.775	2.441	(1.664-3.580)
			15-39	50	48.0	0.049	0.066	0.010	0.310	0.024	(0.017-0.033)	8.252	10.532	4.409	(3.247-5.985)
			40+	26	100.0	0.517	0.508	0.016	2.200	0.291	(0.176-0.481)	83.934	83.313	48.737	(29.90-79.43)
			Total	88	60.2	0.182	0.352	0.010	2.200	0.046	(0.032-0.065)	29.901	57.441	8.273	(5.921-11.55)
		Male	8-14	15	20.0	0.012	0.005	0.010	0.028	0.012	(0.009-0.013)	2.927	1.323	2.713	(2.193-3.355)
			15-39	37	83.8	0.072	0.071	0.010	0.270	0.045	(0.031-0.062)	11.677	11.036	7.713	(5.648-10.53)
			40+	26	96.2	0.589	0.452	0.010	1.500	0.355	(0.209-0.600)	108.264	92.101	61.721	(35.87-106.1)
			Total	78	75.6	0.233	0.365	0.010	1.500	0.069	(0.047-0.099)	42.190	70.945	12.619	(8.867-17.95)
	Eastmain	Female	8-14	9	0.0	0.010	0.000	0.010	0.010	0.010	(0.01-0.01)	2.117	0.289	2.097	(1.865-2.355)
			15-39	44	45.5	0.031	0.038	0.010	0.230	0.020	(0.015-0.025)	5.639	5.931	3.990	(3.151-5.051)
			40+	26	96.2	0.194	0.231	0.010	0.970	0.110	(0.070-0.172)	34.053	39.677	19.368	(12.39-30.25)
			Total	79	57.0	0.082	0.155	0.010	0.970	0.032	(0.024-0.042)	14.589	26.710	6.236	(4.783-8.131)
		Male	8-14	11	18.2	0.012	0.004	0.010	0.020	0.011	(0.009-0.013)	2.315	0.800	2.212	(1.802-2.713)
			15-39	26	30.8	0.020	0.021	0.010	0.093	0.015	(0.011-0.019)	3.762	3.783	2.884	(2.219-3.746)
			40+	15	100.0	0.156	0.147	0.029	0.530	0.108	(0.066-0.175)	27.862	26.539	19.130	(11.71-31.23)
			Total	52	48.1	0.057	0.101	0.010	0.530	0.025	(0.017-0.033)	10.408	18.076	4.706	(3.441-6.434)

Table 5.3.13 continued

PCB congener (or PCB sum)	Community	Gender	Age Group (y range)	n	% of values above detection limit	Concentration of Contaminants in Plasma (µg/L)						Lipid Concentration of Contaminants (µg/kg lipid)			
						Arithmetic Mean	Standard Deviation of Mean	Minimum[a]	Maximum	Geometric Mean	95% Confidence Interval for Geometric Mean	Arithmetic Mean	Standard Deviation of Mean	Geometric Mean	95% Confidence Interval for Geometric Mean
PCB 170 (µg/L)	Mistissini	Female	8-14	29	34.5	0.123	0.537	0.010	2.910	0.018	(0.011-0.028)	21.407	86.617	3.864	(2.435-6.130)
			15-39	69	76.8	0.104	0.126	0.010	0.622	0.053	(0.039-0.071)	19.977	23.640	10.573	(7.931-14.09)
			40+	40	100.0	1.528	1.736	0.022	7.954	0.834	(0.561-1.239)	261.462	265.722	147.576	(99.48-218.9)
			Total	138	74.6	0.520	1.158	0.010	7.954	0.094	(0.068-0.129)	90.273	184.282	18.372	(13.48-25.03)
		Male	8-14	16	31.3	0.016	0.012	0.010	0.048	0.014	(0.010-0.018)	3.584	2.736	2.981	(2.200-4.037)
			15-39	46	84.8	0.129	0.177	0.010	0.845	0.065	(0.045-0.093)	22.849	30.239	12.228	(8.725-17.13)
			40+	28	96.4	1.920	2.682	0.010	12.871	0.937	(0.553-1.586)	286.075	282.140	156.419	(93.47-261.7)
			Total	90	78.9	0.666	1.708	0.010	12.871	0.113	(0.075-0.169)	101.316	200.628	21.026	(14.33-30.84)
	Wemindji	Female	8-14	12	41.7	0.021	0.022	0.010	0.088	0.016	(0.010-0.024)	4.332	5.047	3.042	(1.849-5.002)
			15-39	50	70.0	0.089	0.122	0.010	0.520	0.039	(0.027-0.056)	14.835	19.127	7.112	(5.031-10.05)
			40+	26	100.0	0.941	0.898	0.033	3.900	0.555	(0.343-0.896)	153.416	147.035	92.823	(58.14-148.1)
			Total	88	75.0	0.331	0.631	0.010	3.900	0.076	(0.052-0.110)	54.347	102.942	13.530	(9.402-19.47)
		Male	8-14	15	40.0	0.018	0.012	0.010	0.045	0.015	(0.011-0.021)	4.352	2.986	3.580	(2.531-5.062)
			15-39	37	89.2	0.145	0.154	0.010	0.600	0.082	(0.055-0.120)	23.339	23.939	14.188	(9.953-20.22)
			40+	26	100.0	1.113	0.801	0.030	2.600	0.706	(0.431-1.157)	202.269	156.901	122.856	(73.84-204.4)
			Total	78	83.3	0.443	0.670	0.010	2.600	0.122	(0.081-0.181)	79.331	126.362	22.357	(15.28-32.70)
	Eastmain	Female	8-14	9	11.1	0.011	0.003	0.010	0.020	0.011	(0.009-0.012)	2.364	0.831	2.264	(1.806-2.838)
			15-39	44	59.1	0.062	0.091	0.010	0.540	0.031	(0.022-0.044)	11.191	14.192	6.269	(4.544-8.646)
			40+	26	100.0	0.404	0.482	0.020	2.000	0.230	(0.147-0.359)	70.696	82.524	40.418	(25.94-62.97)
			Total	79	67.1	0.169	0.327	0.010	2.000	0.053	(0.038-0.074)	29.769	55.978	10.308	(7.486-14.19)
		Male	8-14	11	18.2	0.014	0.009	0.010	0.032	0.012	(0.009-0.016)	2.752	1.734	2.418	(1.742-3.355)
			15-39	26	61.5	0.040	0.054	0.010	0.230	0.024	(0.016-0.034)	7.458	9.477	4.684	(3.269-6.711)
			40+	15	100.0	0.339	0.309	0.057	1.100	0.231	(0.139-0.384)	60.438	56.233	41.037	(24.64-68.32)
			Total	52	63.5	0.120	0.218	0.010	1.100	0.040	(0.026-0.059)	21.745	39.177	7.617	(5.185-11.18)
PCB 180 (µg/L)	Mistissini	Female	8-14	29	65.5	0.450	2.062	0.010	11.154	0.035	(0.019-0.064)	77.163	332.595	7.608	(4.175-13.86)
			15-39	69	95.7	0.380	0.458	0.010	2.250	0.181	(0.130-0.250)	73.369	86.478	35.940	(26.11-49.46)
			40+	40	100.0	5.872	6.785	0.073	32.368	3.168	(2.120-4.731)	1008.736	1050.494	560.333	(375.9-835.1)
			Total	138	90.6	1.987	4.504	0.010	32.368	0.294	(0.204-0.421)	345.287	722.107	57.496	(40.52-81.58)
		Male	8-14	16	68.8	0.042	0.043	0.010	0.149	0.028	(0.016-0.045)	9.390	9.954	5.988	(3.583-10.00)
			15-39	46	95.7	0.500	0.718	0.010	3.771	0.228	(0.151-0.342)	88.119	121.548	42.542	(28.84-62.73)
			40+	28	100.0	7.223	9.319	0.022	44.446	3.635	(2.105-6.274)	1112.180	1066.437	606.482	(353.5-1040.)
			Total	90	92.2	2.510	6.064	0.010	44.446	0.370	(0.235-0.582)	392.720	767.936	68.621	(44.46-105.8)
	Wemindji	Female	8-14	12	91.7	0.064	0.074	0.010	0.280	0.041	(0.023-0.074)	13.142	16.737	7.874	(4.165-14.88)
			15-39	50	92.0	0.312	0.438	0.010	1.900	0.125	(0.083-0.187)	52.200	68.739	22.624	(15.26-33.52)
			40+	26	100.0	3.487	3.145	0.120	13.000	2.066	(1.269-3.359)	569.414	516.044	345.420	(214.8-555.3)
			Total	88	94.3	1.216	2.268	0.010	13.000	0.246	(0.163-0.370)	199.687	370.639	43.835	(29.43-65.28)
		Male	8-14	15	93.3	0.053	0.043	0.010	0.150	0.040	(0.025-0.061)	12.417	10.378	9.255	(6.012-14.24)
			15-39	37	97.3	0.526	0.555	0.010	2.200	0.289	(0.190-0.437)	85.348	87.163	49.973	(33.91-73.64)
			40+	26	100.0	4.538	3.626	0.110	14.000	2.761	(1.659-4.593)	833.568	745.785	480.318	(283.8-812.6)
			Total	78	97.4	1.772	2.884	0.010	14.000	0.418	(0.270-0.645)	320.729	564.005	76.824	(50.72-116.3)
	Eastmain	Female	8-14	9	55.6	0.022	0.015	0.010	0.050	0.018	(0.011-0.029)	4.625	3.268	3.834	(2.378-6.181)
			15-39	44	84.1	0.203	0.286	0.010	1.600	0.084	(0.053-0.130)	36.742	46.134	16.814	(11.13-25.38)
			40+	26	100.0	1.493	1.807	0.064	7.500	0.833	(0.527-1.314)	262.228	312.498	146.332	(92.93-230.4)
			Total	79	86.1	0.607	1.219	0.010	7.500	0.150	(0.099-0.225)	107.293	210.950	28.960	(19.68-42.60)
		Male	8-14	11	36.4	0.031	0.038	0.010	0.110	0.018	(0.009-0.035)	6.083	7.538	3.638	(1.903-6.949)
			15-39	26	88.5	0.130	0.184	0.010	0.770	0.064	(0.039-0.103)	24.271	32.718	12.603	(7.903-20.09)
			40+	15	100.0	1.309	1.276	0.200	4.600	0.862	(0.508-1.460)	235.736	238.528	152.858	(89.70-260.4)
			Total	52	80.8	0.449	0.878	0.010	4.600	0.104	(0.062-0.171)	81.423	161.392	19.905	(12.24-32.34)

Table 5.3.13 continued

PCB congener (or PCB sum)	Community	Gender	Age Group (y range)	n	% of values above detection limit	Concentration of Contaminants in Plasma (µg/L) Arithmetic Mean	Standard Deviation of Mean	Minimum[a]	Maximum	Geometric Mean	95% Confidence Interval for Geometric Mean	Lipid Concentration of Contaminants (µg/kg lipid) Arithmetic Mean	Standard Deviation of Mean	Geometric Mean	95% Confidence Interval for Geometric Mean
PCB 187 (µg/L)	Mistissini	Female	8-14	29	44.8	0.142	0.619	0.010	3.353	0.020	(0.012-0.033)	24.719	99.732	4.452	(2.772-7.150)
			15-39	69	84.1	0.142	0.167	0.010	0.726	0.071	(0.052-0.096)	27.195	30.775	14.132	(10.47-19.06)
			40+	40	100.0	2.084	2.321	0.023	10.456	1.144	(0.765-1.710)	359.319	360.584	202.402	(135.6-302.0)
			Total	138	80.4	0.705	1.552	0.010	10.456	0.123	(0.088-0.170)	122.943	249.978	23.981	(17.42-33.00)
		Male	8-14	16	31.3	0.019	0.016	0.010	0.061	0.015	(0.010-0.020)	4.131	3.654	3.215	(2.255-4.580)
			15-39	46	87.0	0.180	0.244	0.010	1.089	0.088	(0.060-0.128)	31.638	41.868	16.407	(11.49-23.42)
			40+	28	96.4	2.321	3.149	0.010	15.153	1.168	(0.688-1.980)	347.868	336.833	194.830	(116.1-326.7)
			Total	90	80.0	0.817	2.019	0.010	15.153	0.143	(0.094-0.216)	125.131	240.969	26.516	(17.90-39.26)
	Wemindji	Female	8-14	12	50.0	0.025	0.028	0.010	0.110	0.018	(0.011-0.029)	5.135	6.388	3.439	(2.024-5.843)
			15-39	50	74.0	0.121	0.178	0.010	0.800	0.048	(0.032-0.071)	20.212	28.032	8.741	(6.005-12.72)
			40+	26	100.0	1.274	1.276	0.039	5.800	0.741	(0.454-1.207)	209.504	214.363	123.913	(76.73-200.0)
			Total	88	78.4	0.448	0.881	0.010	5.800	0.095	(0.063-0.140)	74.083	146.480	16.848	(11.49-24.70)
		Male	8-14	15	53.3	0.021	0.015	0.010	0.054	0.017	(0.012-0.023)	4.866	3.572	3.969	(2.804-5.618)
			15-39	37	89.2	0.217	0.254	0.010	0.980	0.109	(0.071-0.167)	34.783	39.690	18.926	(12.71-28.16)
			40+	26	100.0	1.570	1.203	0.036	4.100	0.959	(0.575-1.598)	287.153	241.569	166.879	(98.48-282.7)
			Total	78	85.9	0.630	0.976	0.010	4.100	0.158	(0.103-0.240)	113.153	187.468	28.955	(19.36-43.29)
	Eastmain	Female	8-14	9	11.1	0.011	0.003	0.010	0.019	0.011	(0.009-0.012)	2.339	0.762	2.252	(1.816-2.791)
			15-39	44	61.4	0.090	0.138	0.010	0.770	0.039	(0.026-0.057)	16.248	22.066	7.788	(5.379-11.27)
			40+	26	100.0	0.541	0.612	0.018	2.300	0.300	(0.186-0.482)	94.432	104.743	52.727	(32.93-84.41)
			Total	79	68.4	0.229	0.424	0.010	2.300	0.066	(0.045-0.094)	40.395	72.486	12.688	(8.958-17.97)
		Male	8-14	11	27.3	0.016	0.012	0.010	0.040	0.014	(0.009-0.019)	3.168	2.333	2.659	(1.819-3.887)
			15-39	26	53.8	0.050	0.082	0.010	0.360	0.025	(0.015-0.038)	9.325	14.384	4.892	(3.223-7.424)
			40+	15	100.0	0.455	0.424	0.072	1.400	0.300	(0.176-0.510)	80.863	77.036	53.238	(31.33-90.44)
			Total	52	61.5	0.160	0.298	0.010	1.400	0.045	(0.028-0.069)	28.659	53.515	8.562	(5.626-13.02)
Sum of all PCBs (µg/L)	Mistissini	Female	8-14	29		1.703	6.749	0.202	36.684	0.388	(0.255-0.589)	304.020	1087.426	84.382	(56.02-127.0)
			15-39	69		1.722	1.877	0.202	8.473	1.040	(0.813-1.328)	332.453	346.942	206.215	(162.0-262.4)
			40+	40		24.025	25.616	0.459	112.176	13.517	(9.168-19.92)	4154.598	4022.227	2390.859	(1622.-3523.)
			Total	138		8.183	17.350	0.202	112.176	1.778	(1.326-2.381)	1434.346	2819.469	347.730	(262.3-460.9)
		Male	8-14	16		0.342	0.200	0.193	0.858	0.303	(0.234-0.389)	75.519	47.144	65.788	(50.10-86.37)
			15-39	46		2.045	2.652	0.201	12.398	1.170	(0.858-1.593)	364.153	456.805	218.628	(163.3-292.5)
			40+	28		24.336	32.265	0.260	153.893	12.860	(7.959-20.77)	3685.620	3519.981	2145.753	(1338.-3439.)
			Total	90		8.677	20.778	0.193	153.893	1.939	(1.355-2.775)	1346.185	2524.929	359.390	(255.8-504.7)
	Wemindji	Female	8-14	12		0.405	0.311	0.193	1.328	0.343	(0.243-0.483)	81.211	72.144	65.155	(43.78-96.96)
			15-39	50		1.436	1.861	0.193	8.569	0.756	(0.553-1.031)	243.743	294.584	136.947	(101.5-184.7)
			40+	25		13.571	14.020	0.536	63.158	7.984	(4.949-12.87)	2244.159	2355.596	1342.734	(839.2-2148.)
			Total	87		4.780	9.406	0.193	63.158	1.335	(0.954-1.865)	796.157	1567.441	238.206	(172.1-329.6)
		Male	8-14	15		0.356	0.177	0.203	0.780	0.324	(0.256-0.409)	83.990	43.806	75.685	(58.97-97.13)
			15-39	37		2.282	2.484	0.193	9.594	1.361	(0.960-1.927)	368.513	385.978	235.700	(171.2-324.3)
			40+	26		15.727	12.060	0.500	45.086	9.886	(6.098-16.02)	2898.352	2510.891	1719.846	(1041.-2840.)
			Total	78		6.393	9.734	0.193	45.086	2.000	(1.392-2.874)	1157.077	1914.124	367.447	(260.0-519.2)
	Eastmain	Female	8-14	9		0.251	0.063	0.193	0.377	0.244	(0.204-0.292)	53.004	15.549	51.221	(41.61-63.04)
			15-39	44		1.118	1.478	0.193	8.328	0.633	(0.462-0.865)	204.975	237.324	126.871	(95.23-169.0)
			40+	26		6.297	7.309	0.317	29.005	3.553	(2.255-5.597)	1104.106	1252.697	624.482	(397.4-981.1)
			Total	79		2.724	4.975	0.193	29.005	1.002	(0.736-1.361)	483.578	852.976	193.324	(144.8-258.0)
		Male	8-14	11		0.282	0.158	0.193	0.596	0.253	(0.187-0.341)	55.835	31.888	49.892	(36.54-68.11)
			15-39	25		0.670	0.862	0.203	3.938	0.443	(0.317-0.617)	126.853	150.289	88.237	(64.50-120.7)
			40+	13		5.078	4.423	0.853	14.360	3.517	(2.030-6.091)	901.501	775.638	634.875	(373.0-1080.)
			Total	49		1.752	3.061	0.193	14.360	0.677	(0.469-0.975)	316.429	537.493	131.051	(92.23-186.2)

[a] represents the minimum observed value, or value imputed at [detection limit / 2] if % of values above detection limit < 100.

* not sampled

TABLE 5.3.14 PLASMA CONCENTRATIONS OF ORGANOCHLORINE PESTICIDES AND POLYBROMINATED DIPHENYL ETHERS (IN µG/L AND µG /KG LIPIDS) DETECTED IN MORE THAN 60% OF MISTISSINI, WEMINDJI AND EASTMAIN PARTICIPANTS

						Concentration of Contaminants in Plasma (µg/L)						Lipid Concentration of Contaminants (µg/kg lipid)			
Pesticide, or sum of OCPs, or PBDEs	Community	Gender	Age Group (y range)	n	% of values above detection limit	Arithmetic Mean	Standard Deviation of Mean	Minimum[a]	Maximum	Geometric Mean	95% Confidence Interval for Geometric Mean	Arithmetic Mean	Standard Deviation of Mean	Geometric Mean	95% Confidence Interval for Geometric Mean
p,p'-DDE (µg/L)	Mistissini	Female	8-14	29	100.0	0.592	1.956	0.069	10.713	0.209	(0.143-0.304)	109.510	314.563	45.490	(31.53-65.62)
			15-39	69	100.0	0.873	0.824	0.143	3.131	0.594	(0.480-0.733)	169.133	157.255	117.833	(96.13-144.4)
			40+	40	100.0	10.549	8.798	0.189	31.296	6.899	(4.893-9.726)	1867.264	1577.716	1220.255	(865.9-1719.)
			Total	138	100.0	3.619	6.551	0.069	31.296	0.971	(0.738-1.277)	648.816	1162.763	189.959	(146.1-246.9)
		Male	8-14	16	100.0	0.268	0.249	0.084	1.063	0.202	(0.136-0.298)	58.649	55.461	43.901	(29.46-65.41)
			15-39	46	97.8	1.006	1.322	0.045	7.863	0.638	(0.484-0.840)	182.035	239.865	119.266	(91.58-155.3)
			40+	28	100.0	7.331	8.433	0.163	35.023	4.193	(2.663-6.599)	1217.708	1358.145	699.580	(443.8-1102.)
			Total	90	98.9	2.842	5.634	0.045	35.023	0.934	(0.687-1.269)	482.309	915.536	173.136	(129.3-231.7)
	Wemindji	Female	8-14	12	100.0	0.278	0.105	0.100	0.520	0.260	(0.200-0.336)	54.022	25.060	49.290	(37.12-65.44)
			15-39	50	96.0	0.964	1.260	0.045	6.200	0.541	(0.400-0.731)	164.203	199.718	98.009	(73.40-130.8)
			40+	26	100.0	6.869	5.888	0.390	20.000	4.409	(2.880-6.750)	1134.161	984.860	737.387	(485.6-1119.)
			Total	88	97.7	2.615	4.311	0.045	20.000	0.910	(0.669-1.236)	435.757	713.803	161.996	(120.5-217.6)
		Male	8-14	15	100.0	0.297	0.160	0.100	0.700	0.261	(0.193-0.351)	70.357	41.634	60.883	(44.82-82.69)
			15-39	37	100.0	1.228	1.124	0.200	4.900	0.873	(0.660-1.154)	196.467	156.283	151.203	(118.1-193.4)
			40+	26	100.0	5.812	4.742	0.900	21.000	4.285	(3.081-5.956)	1072.990	1023.294	745.350	(522.4-1063.)
			Total	78	100.0	2.577	3.649	0.100	21.000	1.176	(0.880-1.570)	464.390	735.879	216.033	(164.6-283.5)
	Eastmain	Female	8-14	9	100.0	0.233	0.149	0.090	0.580	0.200	(0.128-0.312)	49.768	34.164	41.924	(26.39-66.59)
			15-39	44	95.5	0.915	0.891	0.045	3.800	0.541	(0.382-0.763)	169.934	155.380	108.405	(79.08-148.5)
			40+	26	100.0	4.197	3.761	0.390	13.000	2.904	(2.017-4.178)	740.810	662.888	510.355	(354.9-733.7)
			Total	79	97.5	1.918	2.757	0.045	13.000	0.839	(0.617-1.140)	344.128	483.566	161.987	(121.6-215.6)
		Male	8-14	11	100.0	0.211	0.126	0.100	0.410	0.179	(0.119-0.268)	41.946	24.767	35.205	(22.99-53.90)
			15-39	26	100.0	0.629	0.474	0.200	1.900	0.495	(0.374-0.654)	119.688	84.865	98.133	(76.42-126.0)
			40+	15	100.0	3.187	2.312	1.100	7.500	2.512	(1.700-3.712)	563.003	398.190	445.434	(300.8-659.4)
			Total	52	100.0	1.278	1.764	0.100	7.500	0.638	(0.460-0.884)	231.122	305.975	122.221	(89.47-166.9)
Hexachlorobenzene (µg/L)	Mistissini	Female	8-14	29	82.8	0.039	0.063	0.020	0.364	0.030	(0.024-0.036)	7.996	9.926	6.419	(5.281-7.801)
			15-39	69	94.2	0.045	0.024	0.020	0.123	0.040	(0.035-0.044)	8.621	3.909	7.864	(7.098-8.712)
			40+	40	100.0	0.275	0.210	0.041	0.909	0.208	(0.162-0.266)	48.795	35.978	36.772	(28.56-47.34)
			Total	138	93.5	0.110	0.157	0.020	0.909	0.060	(0.050-0.071)	20.134	27.092	11.784	(10.08-13.77)
		Male	8-14	16	68.8	0.028	0.009	0.020	0.048	0.027	(0.022-0.030)	6.040	1.897	5.765	(4.867-6.828)
			15-39	46	95.7	0.050	0.031	0.020	0.186	0.044	(0.037-0.050)	9.167	5.488	8.137	(7.093-9.334)
			40+	28	100.0	0.198	0.221	0.029	1.135	0.138	(0.100-0.188)	30.195	23.204	23.001	(17.16-30.82)
			Total	90	92.2	0.092	0.143	0.020	1.135	0.057	(0.047-0.068)	15.153	16.847	10.575	(9.003-12.41)
	Wemindji	Female	8-14	12	16.7	0.035	0.046	0.020	0.180	0.026	(0.016-0.038)	7.019	10.138	4.880	(3.171-7.508)
			15-39	50	42.0	0.062	0.125	0.020	0.890	0.037	(0.029-0.046)	10.302	18.622	6.684	(5.387-8.293)
			40+	26	96.2	0.280	0.267	0.020	0.970	0.193	(0.134-0.277)	45.863	42.478	32.231	(22.60-45.95)
			Total	88	54.5	0.123	0.200	0.020	0.970	0.057	(0.044-0.073)	20.361	31.684	10.193	(8.099-12.82)
		Male	8-14	15	20.0	0.031	0.024	0.020	0.098	0.026	(0.019-0.035)	7.459	6.030	6.067	(4.350-8.460)
			15-39	37	62.2	0.113	0.155	0.020	0.770	0.059	(0.041-0.085)	18.539	26.661	10.274	(7.324-14.41)
			40+	26	100.0	0.199	0.137	0.044	0.560	0.161	(0.122-0.210)	35.145	23.281	27.930	(20.94-37.23)
			Total	78	66.7	0.126	0.145	0.020	0.770	0.071	(0.055-0.090)	21.943	24.904	12.957	(10.28-16.32)
	Eastmain	Female	8-14	9	0.0	0.020	0.000	0.020	0.020	0.020	(0.020-0.020)	4.233	0.578	4.193	(3.731-4.711)
			15-39	44	40.9	0.055	0.062	0.020	0.320	0.037	(0.028-0.047)	10.121	9.417	7.354	(5.839-9.262)
			40+	26	92.3	0.152	0.137	0.020	0.550	0.108	(0.077-0.152)	26.117	22.393	19.028	(13.68-26.45)
			Total	79	53.2	0.083	0.103	0.020	0.550	0.049	(0.039-0.060)	14.715	16.660	9.433	(7.712-11.53)
		Male	8-14	11	0.0	0.020	0.000	0.020	0.020	0.020	(0.020-0.020)	3.976	0.609	3.937	(3.570-4.340)
			15-39	26	26.9	0.037	0.030	0.020	0.110	0.029	(0.022-0.037)	7.090	5.275	5.785	(4.527-7.390)
			40+	15	93.3	0.113	0.064	0.020	0.230	0.096	(0.067-0.136)	20.491	13.643	16.969	(11.84-24.30)
			Total	52	40.4	0.055	0.055	0.020	0.230	0.038	(0.030-0.047)	10.297	10.451	7.274	(5.842-9.054)

Table 5.3.14 continued

Pesticide, or sum of OCPs, or PBDEs	Community	Gender	Age Group (y range)	n	% of values above detection limit	Concentration of Contaminants in Plasma (µg/L)						Lipid Concentration of Contaminants (µg/kg lipid)			
						Arithmetic Mean	Standard Deviation of Mean	Minimum[a]	Maximum	Geometric Mean	95% Confidence Interval for Geometric Mean	Arithmetic Mean	Standard Deviation of Mean	Geometric Mean	95% Confidence Interval for Geometric Mean
Mirex (µg/L)	Mistissini	Female	8-14	29	13.8	0.065	0.287	0.010	1.558	0.013	(0.009-0.019)	11.318	46.190	2.873	(2.000-4.126)
			15-39	69	65.2	0.048	0.054	0.010	0.236	0.028	(0.022-0.035)	9.222	10.046	5.599	(4.417-7.094)
			40+	40	97.5	0.741	0.809	0.010	3.505	0.388	(0.252-0.596)	128.323	126.809	68.611	(44.50-105.7)
			Total	138	63.8	0.253	0.550	0.010	3.505	0.051	(0.038-0.068)	44.184	89.303	10.061	(7.602-13.31)
		Male	8-14	16	0.0	0.010	0.000	0.010	0.010	0.010	(0.01-0.01)	2.201	0.347	2.174	(1.989-2.374)
			15-39	46	67.4	0.063	0.086	0.010	0.389	0.032	(0.022-0.044)	10.950	14.405	5.979	(4.366-8.187)
			40+	28	96.4	1.043	1.302	0.010	5.907	0.568	(0.352-0.915)	159.072	148.807	94.794	(59.47-151.0)
			Total	90	64.4	0.358	0.856	0.010	5.907	0.064	(0.043-0.094)	55.477	108.323	11.800	(8.147-17.09)
	Wemindji	Female	8-14	12	16.7	0.013	0.009	0.010	0.039	0.012	(0.009-0.015)	2.646	2.048	2.253	(1.618-3.137)
			15-39	50	54.0	0.069	0.101	0.010	0.410	0.029	(0.020-0.042)	11.452	15.686	5.341	(3.795-7.515)
			40+	26	100.0	0.856	0.929	0.028	4.100	0.472	(0.284-0.783)	140.437	155.799	78.943	(48.01-129.7)
			Total	88	62.5	0.294	0.623	0.010	4.100	0.059	(0.040-0.086)	48.360	103.533	10.522	(7.250-15.26)
		Male	8-14	15	13.3	0.011	0.004	0.010	0.020	0.011	(0.009-0.012)	2.683	0.931	2.560	(2.162-3.031)
			15-39	37	83.8	0.115	0.126	0.010	0.470	0.060	(0.039-0.090)	18.761	20.255	10.381	(7.080-15.22)
			40+	26	100.0	1.089	0.833	0.020	2.500	0.618	(0.347-1.099)	197.879	159.951	107.495	(59.53-194.0)
			Total	78	75.6	0.420	0.679	0.010	2.500	0.094	(0.061-0.144)	75.375	127.025	17.287	(11.48-26.02)
	Eastmain	Female	8-14	9	0.0	0.010	0.000	0.010	0.010	0.010	(0.01-0.01)	2.117	0.289	2.097	(1.865-2.355)
			15-39	44	56.8	0.033	0.037	0.010	0.210	0.022	(0.017-0.028)	6.154	5.717	4.457	(3.519-5.644)
			40+	26	100.0	0.266	0.345	0.020	1.500	0.151	(0.097-0.232)	46.754	58.853	26.501	(17.23-40.74)
			Total	79	64.6	0.107	0.227	0.010	1.500	0.038	(0.028-0.051)	19.056	38.870	7.355	(5.555-9.737)
		Male	8-14	11	9.1	0.011	0.003	0.010	0.020	0.011	(0.009-0.012)	2.170	0.679	2.097	(1.761-2.494)
			15-39	26	26.9	0.031	0.057	0.010	0.280	0.016	(0.011-0.023)	5.740	9.864	3.172	(2.209-4.553)
			40+	15	100.0	0.278	0.307	0.026	0.980	0.145	(0.073-0.287)	50.470	58.859	25.788	(12.99-51.18)
			Total	52	44.2	0.098	0.202	0.010	0.980	0.028	(0.018-0.041)	17.888	37.941	5.318	(3.629-7.792)
trans-Nonachlor (µg/L)	Mistissini	Female	8-14	29	17.2	0.047	0.187	0.010	1.020	0.013	(0.009-0.018)	8.422	30.078	2.917	(2.082-4.087)
			15-39	69	66.7	0.042	0.048	0.010	0.274	0.027	(0.021-0.033)	7.972	8.248	5.404	(4.391-6.649)
			40+	40	100.0	0.554	0.577	0.021	2.497	0.330	(0.231-0.469)	96.289	91.975	58.288	(40.96-82.93)
			Total	138	65.9	0.192	0.396	0.010	2.497	0.048	(0.037-0.063)	33.666	65.109	9.459	(7.330-12.20)
		Male	8-14	16	18.8	0.012	0.005	0.010	0.030	0.012	(0.009-0.013)	2.678	1.230	2.506	(2.082-3.014)
			15-39	46	76.1	0.056	0.070	0.010	0.294	0.033	(0.024-0.044)	9.838	12.179	6.144	(4.685-8.056)
			40+	28	96.4	0.654	0.983	0.010	4.911	0.326	(0.201-0.527)	94.408	93.955	54.359	(34.24-86.27)
			Total	90	72.2	0.234	0.613	0.010	4.911	0.056	(0.039-0.077)	34.876	66.171	10.322	(7.544-14.12)
	Wemindji	Female	8-14	12	8.3	0.012	0.008	0.010	0.038	0.011	(0.008-0.014)	2.447	1.916	2.122	(1.572-2.863)
			15-39	50	64.0	0.044	0.055	0.010	0.270	0.026	(0.019-0.034)	7.498	8.783	4.760	(3.676-6.163)
			40+	26	100.0	0.395	0.444	0.024	2.100	0.246	(0.162-0.370)	65.724	76.288	41.056	(27.34-61.64)
			Total	88	67.0	0.143	0.292	0.010	2.100	0.045	(0.033-0.061)	24.012	49.569	8.058	(5.980-10.85)
		Male	8-14	15	13.3	0.011	0.004	0.010	0.020	0.011	(0.009-0.012)	2.683	0.931	2.560	(2.162-3.031)
			15-39	37	83.8	0.075	0.092	0.010	0.380	0.044	(0.030-0.061)	11.741	13.411	7.544	(5.568-10.21)
			40+	26	100.0	0.472	0.353	0.031	1.100	0.327	(0.220-0.484)	85.634	67.919	56.899	(37.54-86.23)
			Total	78	75.6	0.195	0.289	0.010	1.100	0.065	(0.046-0.092)	34.630	53.953	12.018	(8.645-16.70)
	Eastmain	Female	8-14	9	11.1	0.012	0.005	0.010	0.024	0.011	(0.008-0.013)	2.462	1.114	2.311	(1.768-3.018)
			15-39	44	61.4	0.054	0.089	0.010	0.550	0.028	(0.020-0.038)	9.727	13.674	5.652	(4.215-7.578)
			40+	26	96.2	0.254	0.280	0.010	0.970	0.148	(0.094-0.230)	44.710	49.577	26.014	(16.71-40.47)
			Total	79	67.1	0.115	0.198	0.010	0.970	0.044	(0.032-0.059)	20.412	34.487	8.437	(6.346-11.21)
		Male	8-14	11	27.3	0.013	0.005	0.010	0.020	0.012	(0.009-0.014)	2.490	0.869	2.367	(1.900-2.948)
			15-39	26	53.8	0.034	0.041	0.010	0.180	0.021	(0.014-0.030)	6.287	7.235	4.216	(3.031-5.865)
			40+	15	100.0	0.218	0.178	0.038	0.590	0.157	(0.098-0.252)	38.393	31.127	27.889	(17.49-44.44)
			Total	52	61.5	0.082	0.131	0.010	0.590	0.034	(0.023-0.048)	14.745	22.915	6.436	(4.585-9.031)

Table 5.3.14 continued

Pesticide, or sum of OCPs, or PBDEs	Community	Gender	Age Group (y range)	n	% of values above detection limit	Concentration of Contaminants in Plasma (µg/L) Arithmetic Mean	Standard Deviation of Mean	Minimum[a]	Maximum	Geometric Mean	95% Confidence Interval for Geometric Mean	Lipid Concentration of Contaminants (µg/kg lipid) Arithmetic Mean	Standard Deviation of Mean	Geometric Mean	95% Confidence Interval for Geometric Mean
Sum OCPs (µg/L)	Mistissini	Female	8-14	29		0.870	2.625	0.213	14.475	0.394	(0.289-0.535)	163.655	420.713	85.598	(63.51-115.3)
			15-39	69		1.129	0.959	0.283	3.878	0.840	(0.700-1.006)	218.980	179.913	166.542	(139.9-198.2)
			40+	35		12.695	10.423	0.457	39.827	8.363	(5.844-11.96)	2262.705	1865.316	1487.486	(1038.-2130.)
			Total	133		4.116	7.511	0.213	39.827	1.303	(1.019-1.665)	744.739	1334.194	256.295	(202.7-323.9)
		Male	8-14	16		0.418	0.264	0.224	1.257	0.369	(0.286-0.475)	91.773	59.148	80.168	(61.29-104.8)
			15-39	46		1.303	1.530	0.185	8.868	0.908	(0.719-1.146)	236.072	275.326	169.713	(136.0-211.6)
			40+	27		9.995	11.401	0.312	43.199	5.881	(3.803-9.093)	1623.136	1660.680	990.229	(642.3-1526.)
			Total	89		3.781	7.531	0.185	43.199	1.361	(1.028-1.800)	630.925	1136.041	253.249	(194.4-329.8)
	Wemindji	Female	8-14	12		0.441	0.124	0.240	0.734	0.426	(0.356-0.507)	85.731	32.418	80.798	(64.55-101.1)
			15-39	50		1.264	1.508	0.212	7.255	0.812	(0.634-1.039)	215.787	236.529	147.133	(116.5-185.7)
			40+	26		8.798	7.532	0.563	25.844	5.831	(3.893-8.732)	1452.375	1262.362	975.070	(656.5-1448.)
			Total	88		3.378	5.489	0.212	25.844	1.331	(1.010-1.754)	563.408	909.205	237.071	(181.9-308.8)
		Male	8-14	15		0.452	0.173	0.240	0.887	0.425	(0.348-0.518)	106.982	46.500	99.132	(79.67-123.3)
			15-39	37		1.671	1.466	0.380	6.184	1.238	(0.958-1.598)	269.402	207.883	214.375	(171.6-267.7)
			40+	26		7.985	6.112	1.116	25.689	5.923	(4.245-8.263)	1466.248	1289.621	1030.351	(720.2-1473.)
			Total	78		3.541	4.832	0.240	25.689	1.698	(1.292-2.231)	637.116	955.208	311.910	(241.2-403.2)
	Eastmain	Female	8-14	9		0.376	0.156	0.230	0.744	0.353	(0.268-0.465)	79.993	36.950	74.080	(54.59-100.5)
			15-39	44		1.195	1.131	0.185	5.531	0.810	(0.616-1.064)	222.876	189.618	162.392	(127.2-207.2)
			40+	26		5.189	4.745	0.540	16.827	3.605	(2.523-5.149)	914.504	830.658	633.597	(444.0-904.1)
			Total	79		2.416	3.436	0.185	16.827	1.204	(0.926-1.565)	434.223	598.062	232.445	(182.2-296.4)
		Male	8-14	11		0.354	0.132	0.240	0.560	0.334	(0.262-0.424)	70.463	27.031	65.742	(50.45-85.66)
			15-39	26		0.845	0.610	0.340	2.698	0.695	(0.543-0.887)	161.558	107.539	137.593	(110.4-171.3)
			40+	15		4.061	2.930	1.472	9.298	3.215	(2.184-4.731)	718.757	512.580	569.995	(386.6-840.3)
			Total	52		1.669	2.224	0.240	9.298	0.926	(0.694-1.233)	303.018	388.121	177.339	(135.0-232.8)
Sum PBDEs (µg/L)	Mistissini	Female	8-14	*		*	*	*	*	*	(*-*)	*	*	*	(*-*)
			15-39	*		*	*	*	*	*	(*-*)	*	*	*	(*-*)
			40+	*		*	*	*	*	*	(*-*)	*	*	*	(*-*)
			Total	*		*	*	*	*	*	(*-*)	*	*	*	(*-*)
		Male	8-14	*		*	*	*	*	*	(*-*)	*	*	*	(*-*)
			15-39	*		*	*	*	*	*	(*-*)	*	*	*	(*-*)
			40+	*		*	*	*	*	*	(*-*)	*	*	*	(*-*)
			Total	*		*	*	*	*	*	(*-*)	*	*	*	(*-*)
	Wemindji	Female	8-14	12		0.119	0.097	0.045	0.394	0.095	(0.063-0.143)	22.887	19.214	18.100	(11.73-27.91)
			15-39	50		0.120	0.130	0.045	0.692	0.089	(0.073-0.108)	21.966	24.985	16.211	(13.39-19.61)
			40+	26		0.091	0.045	0.045	0.200	0.082	(0.067-0.098)	15.187	7.481	13.677	(11.37-16.44)
			Total	88		0.111	0.107	0.045	0.692	0.088	(0.077-0.100)	20.089	20.607	15.650	(13.72-17.83)
		Male	8-14	15		0.197	0.256	0.045	1.014	0.117	(0.067-0.202)	46.905	60.475	27.198	(15.41-47.97)
			15-39	37		0.124	0.102	0.045	0.582	0.100	(0.081-0.123)	19.990	11.280	17.360	(14.54-20.72)
			40+	26		0.173	0.221	0.045	0.885	0.115	(0.083-0.159)	28.636	34.788	20.075	(14.88-27.07)
			Total	78		0.154	0.183	0.045	1.014	0.108	(0.091-0.128)	28.048	34.899	19.864	(16.85-23.40)
	Eastmain	Female	8-14	9		0.084	0.035	0.045	0.148	0.077	(0.054-0.108)	17.409	7.465	16.112	(11.71-22.16)
			15-39	44		0.079	0.053	0.045	0.260	0.068	(0.058-0.079)	15.723	9.914	13.659	(11.73-15.89)
			40+	26		0.115	0.090	0.045	0.404	0.095	(0.074-0.119)	21.226	19.539	16.625	(12.83-21.53)
			Total	79		0.091	0.068	0.045	0.404	0.077	(0.068-0.086)	17.727	13.734	14.848	(13.14-16.77)
		Male	8-14	11		0.174	0.234	0.045	0.713	0.099	(0.051-0.191)	32.603	42.046	19.499	(10.38-36.62)
			15-39	26		0.085	0.037	0.045	0.180	0.078	(0.065-0.092)	17.570	9.146	15.441	(12.49-19.07)
			40+	15		0.105	0.060	0.045	0.260	0.093	(0.070-0.122)	18.828	11.008	16.502	(12.37-22.00)
			Total	52		0.110	0.117	0.045	0.713	0.086	(0.073-0.101)	21.113	21.385	16.536	(13.89-19.67)

[a] represents the minimum observed value, or value imputed at [detection limit / 2] if % of values above detection limit < 100.

* not sampled

TABLE 5.3.15 EXCEEDANCES OF THE CONCERN LEVELS FOR TOTAL PCBS (MEASURED AS AROCLOR 1260 IN µG/L) IN EASTMAIN AND WEMINDJI PARTICIPANTS

Community	Age Group (Y)		Aroclor in blood plasma[a] <20 µg/L	20-99 µg/L	≥100 µg/L
Mistissini	8–14	Count	44	1	0
		% within Age Group	97.80%	2.20%	0%
	15–39	Count	112	3	0
		% within Age Group	97.40%	2.60%	0%
	40+	Count	23	33	12
		% within Age Group	33.80%	48.50%	18%
Wemindji	8–14	Count	27	0	0
		% within Age Group	100.00%	0.00%	0%
	15–39	Count	84	3	0
		% within Age Group	96.60%	3.40%	0%
	40+	Count	23	28	1
		% within Age Group	44.20%	53.80%	2%
Eastmain	8–14	Count	20	0	0
		% within Age Group	100.00%	0.00%	0%
	15–39	Count	69	1	0
		% within Age Group	98.60%	1.40%	0%
	40+	Count	33	8	0
		% within Age Group	80.50%	19.50%	0%

a. The level of concern for children and women 15-39 years old is 20 µg/L, while it is 100 µg/L for other adults (see Appendix 4).

TABLE 5.3.16 PEARSON'S CORRELATION COEFFICIENTS BETWEEN ORGANOCHLORINE COMPOUNDS DETECTED IN MORE THAN 70% OF SAMPLES IN PARTICIPANTS (EASTMAIN, MISTISSINI AND WEMINDJI)

A) 8-14 Y	PCB 118 (µg/L)	PCB 138 (µg/L)	PCB 153 (µg/L)	PCB 170 (µg/L)	PCB 180 (µg/L)	PCB 187 (µg/L)	*p,p′*-DDE (µg/L)
PCB 138 (µg/L)	0.998						
PCB 153 (µg/L)	0.998	1.000					
PCB 170 (µg/L)	0.998	0.998	0.999				
PCB 180 (µg/L)	0.997	0.998	0.999	1.000			
PCB 187 (µg/L)	0.998	0.998	0.999	1.000	1.000		
p,p′-DDE (µg/L)	0.990	0.994	0.994	0.992	0.992	0.993	
Hexachlorobenzene (µg/L)	0.869	0.870	0.871	0.871	0.873	0.871	0.876

B) 15-39 Y	PCB 118 (µg/L)	PCB 138 (µg/L)	PCB 153 (µg/L)	PCB 170 (µg/L)	PCB 180 (µg/L)	PCB 187 (µg/L)	*p,p′*-DDE (µg/L)
PCB 138 (µg/L)	0.928						
PCB 153 (µg/L)	0.899	0.976					
PCB 170 (µg/L)	0.848	0.945	0.985				
PCB 180 (µg/L)	0.820	0.916	0.973	0.993			
PCB 187 (µg/L)	0.884	0.965	0.992	0.988	0.979		
p,p′-DDE (µg/L)	0.848	0.857	0.860	0.831	0.820	0.859	
Hexachlorobenzene (µg/L)	0.590	0.590	0.524	0.485	0.452	0.529	0.533

C) ≥40 Y	PCB 118 (µg/L)	PCB 138 (µg/L)	PCB 153 (µg/L)	PCB 170 (µg/L)	PCB 180 (µg/L)	PCB 187 (µg/L)	*p,p′*-DDE (µg/L)
PCB 138 (µg/L)	0.890						
PCB 153 (µg/L)	0.848	0.980					
PCB 170 (µg/L)	0.750	0.932	0.980				
PCB 180 (µg/L)	0.771	0.929	0.980	0.993			
PCB 187 (µg/L)	0.816	0.961	0.995	0.989	0.990		
p,p′-DDE (µg/L)	0.883	0.860	0.828	0.751	0.775	0.809	
Hexachlorobenzene (µg/L)	0.784	0.841	0.815	0.780	0.777	0.807	0.808

TABLE 5.3.17 CORRESPONDENCE ANALYSIS: SCORES OF 6 PCBS AND 2 ORGANOCHLORINE PESTICIDES IN PLASMA OF EASTMAIN, MISTISSINI AND WEMINDJI PARTICIPANTS

Organic Contaminant	CA-1 of 6 PCBs and 2 OCPs (67.4%)	CA-2 of 6 PCBs and 2 OCPs (16.1%)	CA-3 of 6 PCBs and 2 OCPs (9.6%)	CA-4 of 6 PCBs and 2 OCPs (4.3%)
log10 (1+PCB 118 (µg/L))	0.227	-0.317	-0.219	0.021
log10 (1+PCB 138 (µg/L))	0.141	-0.039	-0.043	-0.086
log10 (1+PCB 153 (µg/L))	0.071	0.072	0.005	-0.081
log10 (1+PCB 170 (µg/L))	0.273	-0.011	0.055	0.122
log10 (1+PCB 180 (µg/L))	0.145	0.103	0.058	0.025
log10 (1+PCB 187 (µg/L))	0.241	-0.013	0.018	0.056
log10 (1 + *p,p'*-DDE (µg/L))	-0.372	0.020	-0.038	0.026
log10 (1 + Hexachlorobenzene (µg/L))	-0.300	-0.447	0.400	-0.057

TABLE 5.3.18 ANOVA OF THE EFFECTS OF GENDER, AGE AND COMMUNITY ON CONTAMINANT AND DIET VARIABLES

Tests of Between-Subjects Effects

Source	Dependent Variable	df	Mean Square	F-ratio	p-value	Observed Power
Community (Mistissini, Wemindji, Eastmain)	Sum PCBs (µg/L)	2	1474.619	11.614	0.000012	0.994
	Sum OCPs (µg/L)	2	177.762	8.197	0.000315	0.960
	Aroclor 1260 (µg/L)	2	7474.407	11.764	0.000010	0.994
	CA-1 of 6 PCBs and 2 OCPs (67.4%)	2	2.129	31.142	0.000000	1.000
	CA-2 of 6 PCBs and 2 OCPs (16.1%)	2	0.016	0.531	0.588282	0.138
	CA-3 of 6 PCBs and 2 OCPs (9.6%)	2	0.108	5.150	0.006113	0.825
	CA-4 of 6 PCBs and 2 OCPs (4.3%)	2	0.204	34.278	0.000000	1.000
	Traditional Diet PC-1 (20.4%)	2	14.124	17.927	0.000000	1.000
	Traditional Diet PC-2 (6.0%)	2	2.016	2.041	0.130959	0.421
	Traditional Diet PC-3 (5.8%)	2	1.039	1.036	0.355586	0.231
	Traditional Diet PC-4 (4.4%)	2	1.692	1.690	0.185621	0.356
	PC-1 of Mkt. & Trad. Diet (11.8%)	2	13.676	17.446	0.000000	1.000
	PC-2 of Mkt. & Trad. Diet (3.7%)	2	6.132	6.858	0.001154	0.921
	PC-3 of Mkt. & Trad. Diet (3.76%)	2	9.524	11.686	0.000011	0.994
	PC-4 of Mkt. & Trad. Diet (3.4%)	2	0.259	0.264	0.768357	0.092
Gender (female, male)	Sum PCBs (µg/L)	1	2.126	0.017	0.897091	0.052
	Sum OCPs (µg/L)	1	26.197	1.208	0.272269	0.195
	Aroclor 1260 (µg/L)	1	10.180	0.016	0.899325	0.052
	CA-1 of 6 PCBs and 2 OCPs (67.4%)	1	0.015	0.222	0.637925	0.076
	CA-2 of 6 PCBs and 2 OCPs (16.1%)	1	0.180	6.016	0.014518	0.687
	CA-3 of 6 PCBs and 2 OCPs (9.6%)	1	0.057	2.696	0.101246	0.374
	CA-4 of 6 PCBs and 2 OCPs (4.3%)	1	0.076	12.810	0.000379	0.947
	Traditional Diet PC-1 (20.4%)	1	2.006	2.547	0.111177	0.357
	Traditional Diet PC-2 (6.0%)	1	1.487	1.506	0.220392	0.232
	Traditional Diet PC-3 (5.8%)	1	0.353	0.352	0.553083	0.091
	Traditional Diet PC-4 (4.4%)	1	2.426	2.422	0.120246	0.342
	PC-1 of Mkt. & Trad. Diet (11.8%)	1	1.455	1.857	0.173649	0.275
	PC-2 of Mkt. & Trad. Diet (3.7%)	1	0.939	1.050	0.305983	0.176
	PC-3 of Mkt. & Trad. Diet (3.76%)	1	1.873	2.298	0.130171	0.328
	PC-4 of Mkt. & Trad. Diet (3.4%)	1	0.019	0.019	0.889213	0.052
Age Group (8-14, 15-39, ≥40 Y)	Sum PCBs (µg/L)	2	8926.159	70.299	0.000000	1.000
	Sum OCPs (µg/L)	2	2438.623	112.447	0.000000	1.000
	Aroclor 1260 (µg/L)	2	43405.917	68.314	0.000000	1.000
	CA-1 of 6 PCBs and 2 OCPs (67.4%)	2	10.648	155.771	0.000000	1.000
	CA-2 of 6 PCBs and 2 OCPs (16.1%)	2	1.106	37.015	0.000000	1.000
	CA-3 of 6 PCBs and 2 OCPs (9.6%)	2	0.145	6.881	0.001128	0.922

	CA-4 of 6 PCBs and 2 OCPs (4.3%)	2	0.044	7.409	0.000675	0.940
	Traditional Diet PC-1 (20.4%)	2	25.539	32.415	0.000000	1.000
	Traditional Diet PC-2 (6.0%)	2	0.264	0.267	0.765522	0.092
	Traditional Diet PC-3 (5.8%)	2	2.753	2.745	0.065230	0.541
	Traditional Diet PC-4 (4.4%)	2	3.299	3.294	0.037922	0.624
	PC-1 of Mkt. & Trad. Diet (11.8%)	2	27.472	35.046	0.000000	1.000
	PC-2 of Mkt. & Trad. Diet (3.7%)	2	20.391	22.803	0.000000	1.000
	PC-3 of Mkt. & Trad. Diet (3.76%)	2	36.685	45.014	0.000000	1.000
	PC-4 of Mkt. & Trad. Diet (3.4%)	2	3.159	3.215	0.041001	0.613

Table 5.3.18 continued

Source	Dependent Variable	df	Mean Square	F-ratio	p-value	Observed Power
Community x Gender interaction	Sum PCBs (µg/L)	2	17.659	0.139	0.870195	0.071
	Sum OCPs (µg/L)	2	7.497	0.346	0.707913	0.105
	Aroclor 1260 (µg/L)	2	112.000	0.176	0.838443	0.077
	CA-1 of 6 PCBs and 2 OCPs (67.4%)	2	0.041	0.593	0.552857	0.149
	CA-2 of 6 PCBs and 2 OCPs (16.1%)	2	0.002	0.078	0.924724	0.062
	CA-3 of 6 PCBs and 2 OCPs (9.6%)	2	0.008	0.380	0.684357	0.111
	CA-4 of 6 PCBs and 2 OCPs (4.3%)	2	0.007	1.200	0.302072	0.262
	Traditional Diet PC-1 (20.4%)	2	0.298	0.379	0.684936	0.111
	Traditional Diet PC-2 (6.0%)	2	2.100	2.126	0.120394	0.436
	Traditional Diet PC-3 (5.8%)	2	0.472	0.470	0.624991	0.127
	Traditional Diet PC-4 (4.4%)	2	0.088	0.088	0.916222	0.063
	PC-1 of Mkt. & Trad. Diet (11.8%)	2	0.188	0.240	0.786674	0.088
	PC-2 of Mkt. & Trad. Diet (3.7%)	2	0.073	0.081	0.922075	0.062
	PC-3 of Mkt. & Trad. Diet (3.76%)	2	1.534	1.883	0.153260	0.392
	PC-4 of Mkt. & Trad. Diet (3.4%)	2	1.088	1.107	0.331255	0.245
Community x Age Group interaction	Sum PCBs (µg/L)	4	1270.383	10.005	0.000000	1.000
	Sum OCPs (µg/L)	4	167.255	7.712	0.000005	0.998
	Aroclor 1260 (µg/L)	4	6379.139	10.040	0.000000	1.000
	CA-1 of 6 PCBs and 2 OCPs (67.4%)	4	0.082	1.204	0.308181	0.379
	CA-2 of 6 PCBs and 2 OCPs (16.1%)	4	0.101	3.396	0.009362	0.851
	CA-3 of 6 PCBs and 2 OCPs (9.6%)	4	0.031	1.455	0.214920	0.453
	CA-4 of 6 PCBs and 2 OCPs (4.3%)	4	0.038	6.314	0.000058	0.989
	Traditional Diet PC-1 (20.4%)	4	3.218	4.085	0.002878	0.915
	Traditional Diet PC-2 (6.0%)	4	0.088	0.089	0.985879	0.068
	Traditional Diet PC-3 (5.8%)	4	0.720	0.718	0.580032	0.233
	Traditional Diet PC-4 (4.4%)	4	0.641	0.641	0.633790	0.210
	PC-1 of Mkt. & Trad. Diet (11.8%)	4	3.035	3.872	0.004156	0.899

	PC-2 of Mkt. & Trad. Diet (3.7%)	4	1.012	1.131	0.340977	0.357
	PC-3 of Mkt. & Trad. Diet (3.76%)	4	1.344	1.650	0.160520	0.508
	PC-4 of Mkt. & Trad. Diet (3.4%)	4	2.101	2.138	0.075028	0.633
Gender x Age Group interaction	Sum PCBs (µg/L)	2	7.915	0.062	0.939571	0.059
	Sum OCPs (µg/L)	2	28.586	1.318	0.268581	0.285
	Aroclor 1260 (µg/L)	2	21.567	0.034	0.966629	0.055
	CA-1 of 6 PCBs and 2 OCPs (67.4%)	2	0.058	0.849	0.428417	0.196
	CA-2 of 6 PCBs and 2 OCPs (16.1%)	2	0.054	1.803	0.165888	0.377
	CA-3 of 6 PCBs and 2 OCPs (9.6%)	2	0.030	1.420	0.242797	0.304
	CA-4 of 6 PCBs and 2 OCPs (4.3%)	2	0.000	0.001	0.999057	0.050
	Traditional Diet PC-1 (20.4%)	2	0.029	0.037	0.963778	0.056
	Traditional Diet PC-2 (6.0%)	2	1.527	1.547	0.214020	0.329
	Traditional Diet PC-3 (5.8%)	2	0.063	0.063	0.939090	0.060
	Traditional Diet PC-4 (4.4%)	2	0.484	0.484	0.616884	0.129
	PC-1 of Mkt. & Trad. Diet (11.8%)	2	0.055	0.070	0.932321	0.061
	PC-2 of Mkt. & Trad. Diet (3.7%)	2	0.672	0.752	0.472159	0.178
	PC-3 of Mkt. & Trad. Diet (3.76%)	2	0.013	0.016	0.984230	0.052
	PC-4 of Mkt. & Trad. Diet (3.4%)	2	1.771	1.802	0.165991	0.377
Community x Gender x Age Group interaction	Sum PCBs (µg/L)	4	8.660	0.068	0.991472	0.064
	Sum OCPs (µg/L)	4	5.512	0.254	0.907096	0.106
	Aroclor 1260 (µg/L)	4	36.503	0.057	0.993862	0.062
	CA-1 of 6 PCBs and 2 OCPs (67.4%)	4	0.141	2.064	0.084407	0.616
	CA-2 of 6 PCBs and 2 OCPs (16.1%)	4	0.011	0.381	0.822022	0.138
	CA-3 of 6 PCBs and 2 OCPs (9.6%)	4	0.023	1.091	0.360482	0.345
	CA-4 of 6 PCBs and 2 OCPs (4.3%)	4	0.008	1.343	0.252709	0.420
	Traditional Diet PC-1 (20.4%)	4	1.508	1.914	0.106765	0.579
	Traditional Diet PC-2 (6.0%)	4	0.937	0.949	0.435324	0.302
	Traditional Diet PC-3 (5.8%)	4	0.168	0.167	0.955041	0.085
	Traditional Diet PC-4 (4.4%)	4	0.864	0.863	0.486173	0.276
	PC-1 of Mkt. & Trad. Diet (11.8%)	4	1.593	2.032	0.088809	0.608
	PC-2 of Mkt. & Trad. Diet (3.7%)	4	0.776	0.867	0.483335	0.277
	PC-3 of Mkt. & Trad. Diet (3.76%)	4	1.512	1.855	0.117180	0.563
	PC-4 of Mkt. & Trad. Diet (3.4%)	4	0.538	0.547	0.701109	0.183

TABLE 5.3.19 PARTIAL CORRELATIONS (ADJUSTED FOR AGE) BETWEEN ORGANIC CONTAMINANTS IN BLOOD PLASMA AND DIETARY PRINCIPAL COMPONENT SUMMARY VARIABLES

		Blood Plasma Organic Contaminant Variables							
Diet Frequency Variables	**Controlling for: Age (Y)**	Sum PCBs (µg/L)	Sum OCPs (µg/L)	Sum PBDEs (µg/L)	Aroclor 1260 (µg/L)	CA-1 of 6 PCBs and 2 OCPs (67.4%)	CA-2 of 6 PCBs and 2 OCPs (16.1%)	CA-3 of 6 PCBs and 2 OCPs (9.6%)	CA-4 of 6 PCBs and 2 OCPs (4.3%)
Traditional Diet PC-1 (20.4%)	Correlation	0.345	0.338	0.085	0.350	0.099	-0.138	0.023	-0.037
	p-value (2-tailed)	0.000000	0.000000	0.147898	0.000000	0.024164	0.001533	0.594690	0.403659
	df	515	513	292	519	519	519	519	519
Traditional Diet PC-2 (6.0%)	Correlation	-0.036	0.094	-0.031	-0.024	0.004	-0.027	-0.041	-0.027
	p-value (2-tailed)	0.408198	0.032280	0.598388	0.582729	0.924197	0.545310	0.355544	0.540117
	df	515	513	292	519	519	519	519	519
Traditional Diet PC-3 (5.8%)	Correlation	-0.094	-0.087	0.129	-0.095	0.018	-0.015	0.048	0.004
	p-value (2-tailed)	0.033416	0.049726	0.026829	0.030138	0.681268	0.734952	0.272660	0.931776
	df	515	513	292	519	519	519	519	519
Traditional Diet PC-4 (4.4%)	Correlation	-0.095	-0.044	0.048	-0.106	-0.026	-0.018	0.034	0.021
	p-value (2-tailed)	0.031252	0.323995	0.409323	0.015804	0.557192	0.674424	0.441033	0.624872
	df	515	513	292	519	519	519	519	519
PC-1 of Mkt. & Trad. Diet (11.8%)	Correlation	0.335	0.330	0.086	0.340	0.099	-0.139	0.025	-0.040
	p-value (2-tailed)	0.000000	0.000000	0.139128	0.000000	0.024485	0.001461	0.570294	0.363222
	df	515	513	292	519	519	519	519	519
PC-2 of Mkt. & Trad. Diet (3.7%)	Correlation	0.002	0.069	-0.025	0.012	0.000	-0.020	-0.055	-0.019
	p-value (2-tailed)	0.969446	0.116682	0.665496	0.783463	0.993584	0.654181	0.209399	0.668476
	df	515	513	292	519	519	519	519	519
PC-3 of Mkt. & Trad. Diet (3.76%)	Correlation	0.169	0.069	0.044	0.157	0.030	-0.047	0.004	0.048
	p-value (2-tailed)	0.000111	0.119795	0.455607	0.000316	0.492544	0.281257	0.936227	0.276455
	df	515	513	292	519	519	519	519	519
PC-4 of Mkt. & Trad. Diet (3.4%)	Correlation	-0.045	-0.011	0.099	-0.045	0.020	-0.062	0.032	0.005
	p-value (2-tailed)	0.310371	0.797659	0.091352	0.309436	0.648767	0.157373	0.462475	0.909559
	df	515	513	292	519	519	519	519	519

5.3.2.4 Analysis of plasma samples for DLCs using the DR-CALUX assay

Data in Table 5.3.20 show the mean plasma concentrations of dioxin-like compounds (DLCs) for the participants tested, stratified by age group and gender. DLCs were detected in the vast majority (≥90%) of Wemindji and Eastmain participants aged 40 years and older. These compounds were detected in less than 50% of participants in the younger age groups. Mean plasma concentrations were not different according to gender in Wemindji but were higher in females than males in Eastmain participants ($p = 0.008$). Plasma DLC levels increased with age in participants from Wemindji and Eastmain ($p < 0.0001$). The highest concentrations were noted in the oldest age group (≥40 years). This could be linked to the higher consumption of fish in this age stratum and to the tendency of persistent organic pollutants (POPs) to accumulate in the body with age. When the sum of omega-3 fatty acids concentration in red blood cell membranes, a biomarker of fish consumption, was entered as a covariate in the multivariate models, it was significantly associated with plasma DLC concentrations ($p < 0.0001$). In these models, differences were still significant between age groups, indicating that accumulation of DLCs with age was indeed responsible for part of the age-related increase in plasma DLC concentrations.

The mean (geometric) plasma DLC concentrations in Wemindji participants aged 40 years and older (193 pg TEQ/L) is about two-fold higher than that for the Eastmain participants belonging to the same age-group (99 pg TEQ/L); in magnitude the former value approaches that reported previously for Mistissini residents (237 pg TEQ/L; Bonnier-Viger et al, 2007). For comparative purposes, the mean (geometric) plasma DLC concentration in Inuit of Nunavik from the same age group was 91 pg TEQ/L (95%-CI: 83.0–100.6) (Medehouenou et *al*, unpublished data).

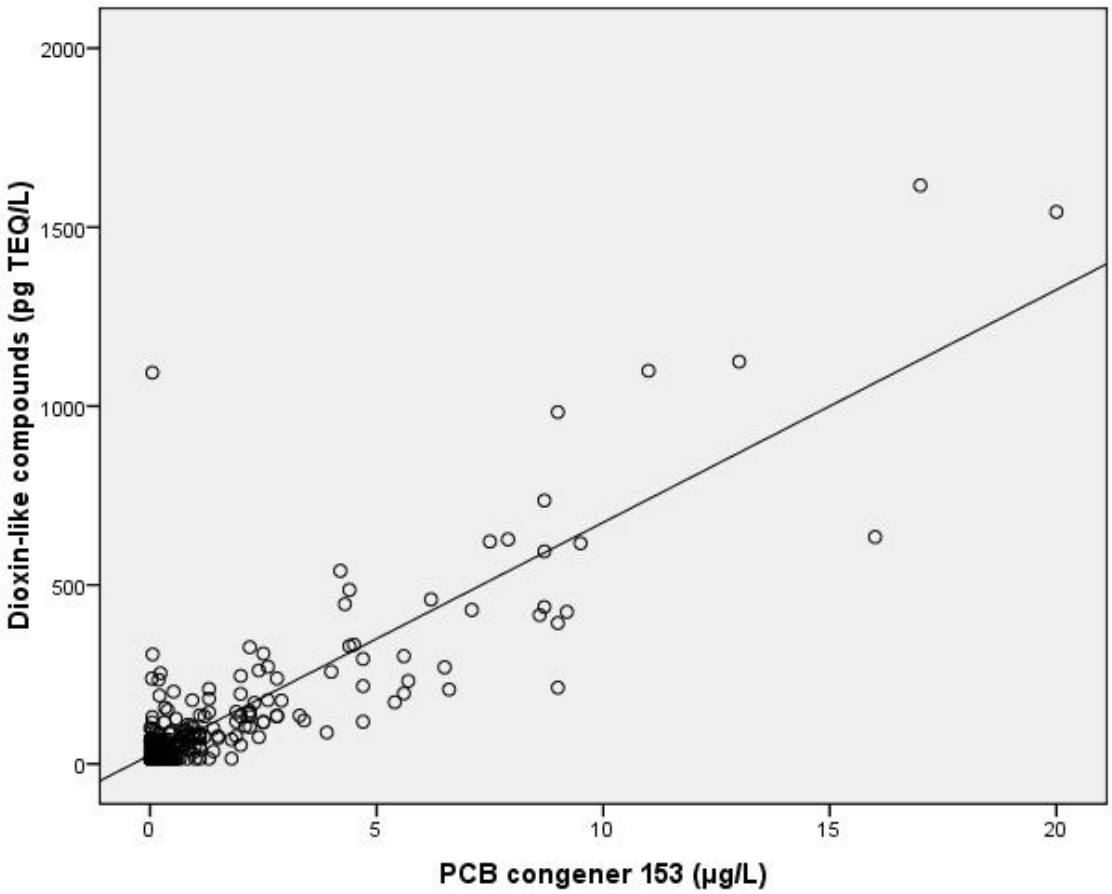
TABLE 5.3.20 PLASMA CONCENTRATIONS OF DIOXIN-LIKE COMPOUNDS (PG TEQ/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE) STRATIFIED BY AGE GROUPS AND GENDER

Age groups		n	% det.[1]	Mean	(SD)[2]	Min	Max	Geo. mean (95%-CI)[3]	
(A) Wemindji									
8-14 years	Female	14	43	41.5	(18.6)	< LOD	92.3	38.7	(31.9-46.8)
	Male	15	47	45.5	(24.4)	< LOD	94.7	40.8	(32.2-51.5)
	Total	29	45	43.6	(21.5)	< LOD	94.7	39.7	(34.2-46.2)
15-39 years	Female	50	40	57.9	(58.2)	< LOD	306.3	44.4	(37.2-52.9)
	Male	37	54	71.1	(72.4)	< LOD	326.1	51.9	(41.2-65.4)
	Total	87	46	63.5	(64.5)	< LOD	326.1	47.4	(41.2-54.6)
≥40 years	Female	27	96	326.2	(431.2)	< LOD	1616.5	173.4	(114.0-263.8)
	Male	28	96	310.8	(281.3)	< LOD	1124.2	214.1	(153.4-298.8)
	Total	55	96	318.4	(359.4)	< LOD	1616.5	193.0	(148.0-251.8)
(B) Eastmain									
8-14 years	Female	11	18	36.3	(14.8)	< LOD	74.7	34.4	(28.6-41.5)
	Male	12	8	31.0	(3.6)	< LOD	42.4	30.9	(29.2-32.7)
	Total	23	13	33.6	(10.6)	< LOD	74.7	32.5	(29.6-35.8)
15-39 years	Female	44	57	90.8	(166.0)	< LOD	1093.4	55.5	(43.7-70.5)
	Male	26	39	41.5	(18.7)	< LOD	94.9	38.4	(33.2-44.4)
	Total	70	50	72.5	(133.7)	< LOD	1093.4	48.4	(41.1-57.1)
≥40 years	Female	26	96	180.2	(174.4)	< LOD	621.6	122.4	(87.6-171.0)
	Male	15	79	85.4	(64.8)	< LOD	253.6	68.1	(47.6-97.3)
	Total	41	90	147.0	(151.6)	< LOD	621.6	99.7	(76.6-129.7)

1. Percentage of detection; limit of detection (LOD): 30 pg TEQ/L; 2 Standard deviation; 3 95% Confidence interval

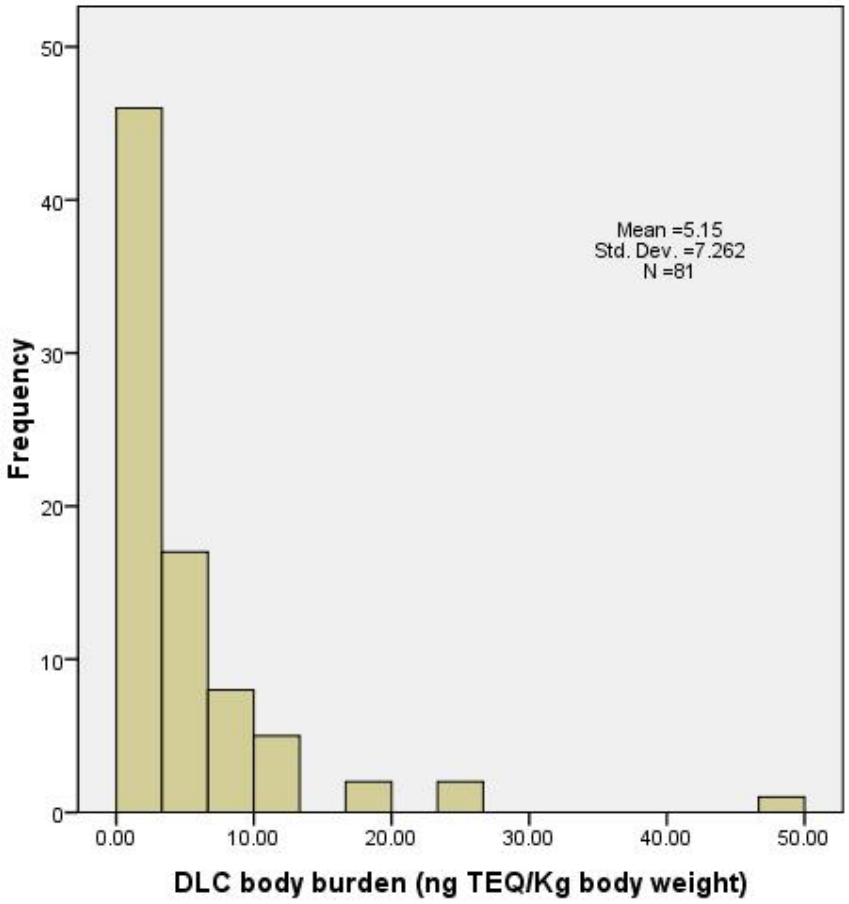
The strong correlation between TEQ concentrations determined using the DR-CALUX assay and PCB-153 plasma concentrations is shown in Figure 5.3.15 (Spearman's $r = 0.70$; $p < 0.0001$). As shown earlier (Table 5.3.16), PCB-153 is correlated to many other organochlorine compounds, including the mono-ortho PCBs, which show dioxin-like activities. Therefore, PCB-153 can be used as an indicator of exposure to the environmental mixture of POPs comprising DLCs.

FIGURE 5.3.15 RELATIONSHIP BETWEEN CONCENTRATIONS OF DIOXIN-LIKE COMPOUNDS MEASURED BY THE DR-CALUX ASSAY AND CONCENTRATIONS OF PCB-153 IN PLASMA SAMPLES FROM 304 *EEYOUCH* (WEMINDJI AND EASTMAIN 2007)



In laboratory animals exposed to TCDD, adverse effects (hormonal, reproductive and developmental) have been observed at body burdens in the range of 28-73 ng TCDD/kg body weight (BW) (van Leeuwen et al. 2000). The fat mass had been estimated by impedance measurements for 297 of the 304 *Eeyouch* participants (Eastmain and Wemindji) for whom we measured the plasma DLC concentration. The mean DLC body burden observed was 7.4 ng TEQ/kg BW (SD = 13.9), with a median of 2.8 ng TEQ/kg BW and range <1 to 120.9 ng TEQ/kg BW. Since the most sensitive adverse health effects listed above concern women of reproductive age, we focused our attention on this subgroup. The distribution of DLC body burdens in women of reproductive age is shown in Figure 5.3.16. Only one woman had a DLC body burden exceeding the body burden associated with the most sensitive adverse health effect in laboratory animals i.e. decreased sperm count in offspring at a body burden of 28 ng TEQ/kg BW.

FIGURE 5.3.16 FREQUENCY DISTRIBUTION OF DIOXIN-LIKE COMPOUND BODY BURDENS IN 81 WOMEN OF REPRODUCTIVE AGE (WEMINDJI AND EASTMAIN 2007)



5.3.3 Analysis of emergent environmental contaminants

Concentrations of perfluorooctane sulfonate (PFOS) in plasma samples from Wemindji and Eastmain participants are presented in Table 5.3.21 PFOS was detected in all samples from both communities. In both communities, except in the youngest age groups, men exhibited higher plasma PFOS concentrations than women. There was a clear increase in PFOS concentrations with age ($p < 0.0001$); the largest differences were noted between individuals in the older age groups compared to those in the other age categories. In the multivariate models, the sum of omega-3 fatty acids concentration in red blood cell membranes entered as a covariate was significantly associated with plasma PFOS concentrations ($p < 0.005$). Hence fish consumption is a likely source of exposure to PFOS in this population. In these models, differences between age groups remained statistically significant, suggesting that PFOS accumulates with age in residents from these communities. Plasma PFOS concentrations in Wemindji and Eastmain residents were similar, except for the older residents (≥40 years) of Wemindji who displayed somewhat higher concentrations than their Eastmain counterparts (18.7 vs. 12.4 µg/L), although the

difference was not statistically significant. Because PFOS analysis was conducted on pooled plasmas samples for Mistissini residents, comparisons cannot be made with levels in residents from this community (Bonnier-Viger et al, 2007). By comparison, the mean (geometric) concentration noted in plasma samples obtained in 2004 from Inuit of Nunavik belonging to the 40-years-and-over age category was 25.5 µg/L (95%-CI: 23.4–27.9) (Dallaire et *al*, 2009).

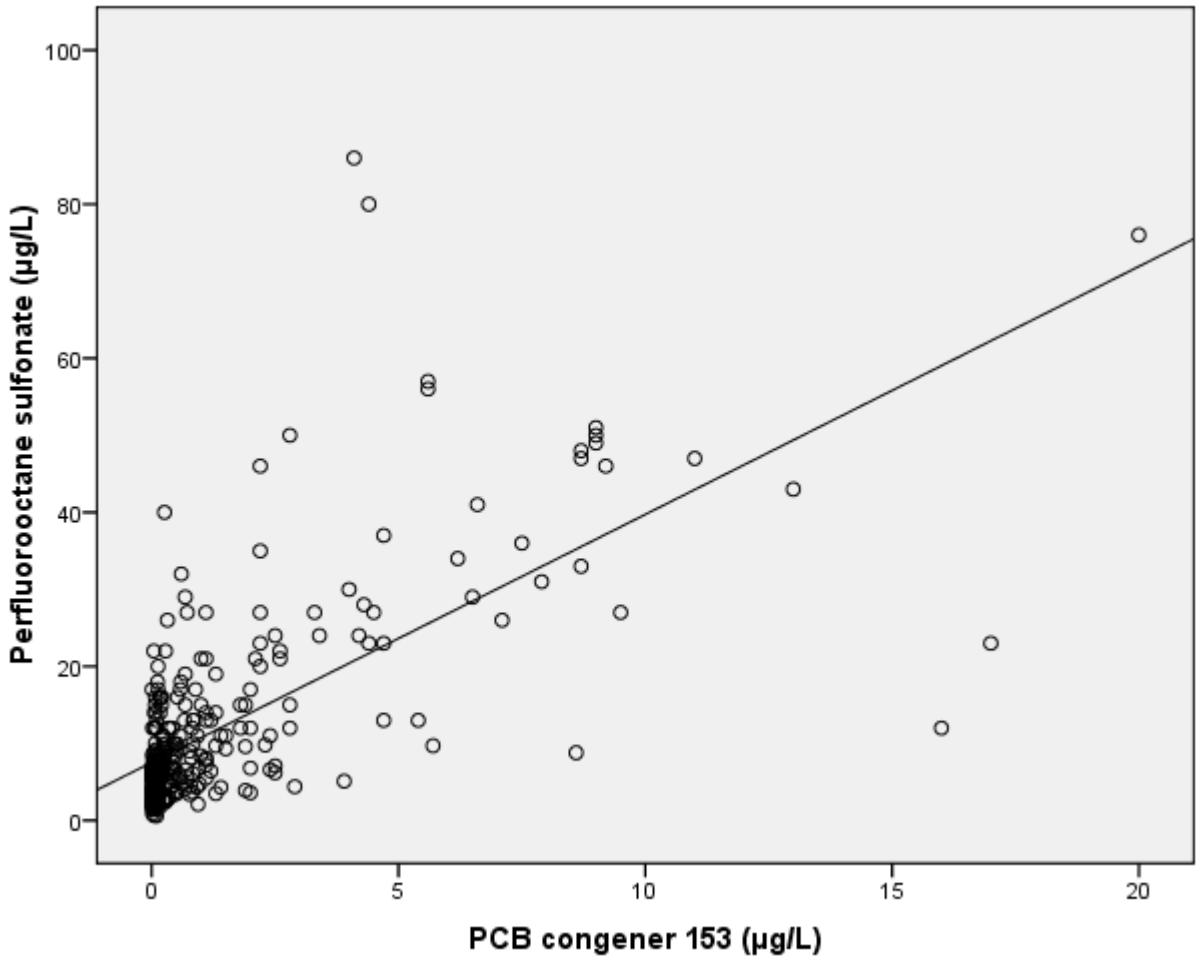
TABLE 5.3.21 PLASMA CONCENTRATIONS OF PERFLUOROOCTANE SULFONATE (µG/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE) STRATIFIED BY AGE GROUPS AND GENDER

Age groups		n	% det.[1]	Mean	(SD)[2]	Min	Max	Geo. mean (95%-CI)[3]	
(A) Wemindji									
8-14 years	Female	14	100	4.4	(1.6)	2.5	7.2	4.2	(3.5-5.0)
	Male	15	100	5.1	(2.7)	1.7	10.0	4.4	(3.4-5.9)
	Total	29	100	4.8	(2.2)	1. 0	10.0	4.3	(3.6-5.1)
15-39 years	Female	50	100	5.3	(3.5)	0.6	16.0	4.3	(3.6-5.2)
	Male	37	100	14.1	(11.6)	3.4	50.0	11.0	(8.8-13.7)
	Total	87	100	9.1	(9.1)	0.6	50.0	6.4	(5.4-7.7)
≥40 years	Female	27	100	21.0	(18.5)	2.4	76.0	14.1	(9.4-20.2)
	Male	28	100	29.3	(17.9)	6.10	80.0	24.3	(19.2-30.8)
	Total	55	100	25.2	(18.5)	2.40	80.0	18.7	(14.9-23.3)
(B) Eastmain									
8-14 years	Female	11	100	4.6	(2.1)	1.8	9.2	4.1	(3.1-5.5)
	Male	12	100	5.3	(2.9)	1.4	12.0	4.5	(3.2-6.4)
	Total	23	100	4.9	(2.5)	1.4	12.0	4.3	(3.5-5.4)
15-39 years	Female	44	100	6.4	(4.7)	1.4	22.0	5.2	(4.3-6.2)
	Male	26	100	9.5	(5.0)	0.6	22.0	8.0	(6.1-10.5)
	Total	70	100	7.5	(5.0)	0.6	22.0	6.1	(5.2-7.1)
≥40 years	Female	26	100	13.6	(9.2)	2.3	36.0	10.8	(8.2-14.2)
	Male	15	100	21.5	(20.0)	2.7	86.0	15.8	(10.5-24.0)
	Total	41	100	16.5	(14.4)	2.3	86.0	12.4	(9.8-15.7)

1. Percentage of detection; limit of detection (LOD): 0.1 µg/L
2. Standard deviation
3. 95% Confidence interval

Figure 5.3.17 shows the correlation between plasma PFOS concentrations and PCB 153 concentrations in Wemindji and Eastmain participants. The correlation coefficient (Spearman r) was 0.63 ($p < 0.0001$), which indicates that both compounds are moderately correlated. Hence PFOS appears to have common features with the PCB 153, a compound often used as an indicator of all POPs present in the food chain.

FIGURE 5.3.17 CORRELATION BETWEEN PFOS AND PCB-153 CONCENTRATIONS IN PLASMA SAMPLES FROM *EEYOUCH* (WEMINDJI AND EASTMAIN, 2007)



A totally different picture emerges when examining data for PBDE 47, which is usually the major PBDE congener detected in plasma samples from North American populations (Dallaire et al., 2009). This compound was detected in 66% of Wemindji and 66% Eastmain residents, but there is no tendency towards higher concentrations of this brominated organic compound with age (Table 5.3.22). There was also no difference between genders, and fish consumption was not linked to the plasma levels of this compound. PBDE 47 plasma concentrations were not correlated to those of PCB 153 (Spearman $r = -0.10$; $p > 0.05$). Hence in contrast to PFOS and DLCs, this compound is not persistent and does not

originate from the food chain. The mean (geometric) concentrations plasma samples from Wemindji residents was 37.9 ng/L (95-% CI: 32.1-42.5), whereas it was 37.3 ng/L (95-% CI: 32.4-42.9) in Eastmain residents. In Nunavik, PBDE 47 was detected in 55% of the 838 samples collected in 2004 (LOD = 15 ng/L) and the mean concentration was 35 ng/L (95-% CI: 33-38). In the Inuit population, PBDE 47 concentrations were linked to the adoption of a westernized lifestyle, although the precise source of exposure could not be determined (Dallaire et al., 2009). Levels in these aboriginal populations from Quebec are low compared to those measured in other North American populations.

TABLE 5.3.22 PLASMA CONCENTRATIONS OF PBDE CONGENER NO. 47 (NG/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE) STRATIFIED BY AGE GROUPS AND GENDER

Age groups		n	% det.[1]	Mean	(SD)[2]	Min	Max	Geo. mean (95%-CI)[3]	
(A) Wemindji									
8-14 years	Female	14	86	72	(60)	< LOD	250	57	(40-81)
	Male	15	60	120	(160)	< LOD	630	66	(40-109)
	Total	29	72	95	(120)	< LOD	630	61	(45-83)
15-39 years	Female	50	58	67	(80)	< LOD	330	49	(40-59)
	Male	37	68	64	(60)	< LOD	380	51	(41-62)
	Total	87	62	66	(70)	< LOD	380	49	(43-57)
≥40 years	Female	27	41	41	(20)	< LOD	110	38	(33-43)
	Male	28	57	73	(110)	< LOD	520	47	(35-62)
	Total	55	49	57	(80)	< LOD	520	42	(36-49)
(B) Eastmain									
8-14 years	Female	11	73	134	(27)	< LOD	940	64	(36-115)
	Male	12	67	84	(11)	< LOD	400	54	(33-88)
	Total	23	70	108	(198)	< LOD	940	59	(41-85)
15-39 years	Female	44	57	47	(30)	< LOD	180	41	(36-48)
	Male	26	69	52	(20)	< LOD	120	47	(40-56)
	Total	70	61	49	(30)	< LOD	180	43	(39-49)
≥40 years	Female	26	73	60	(50)	< LOD	240	49	(40-62)
	Male	15	67	53	(40)	< LOD	170	46	(40-62)
	Total	41	71	58	(40)	< LOD	240	48	(41-57)

1. Percentage of detection; limit of detection (LOD): 27 ng/L

2. Standard deviation

3. 95% Confidence interval

PBDE 153 was detected in 67% of plasma samples from Wemindji participants and 30% of samples from Eastmain participants. The mean (geometric) concentration was 25.9 ng/L (95-%CI: 22.8-29.4) in Wemindji participants and 15.3 ng/L (95-%CI: 13.5-17.4) in Eastmain (Table 5.3.23). In both Cree communities, plasma levels of PBDE 153 did not differ between genders but increased with age ($p < 0.005$); concentrations were higher in the older age group compared to the 18-39 years group. Entering omega-3 fatty acids content in red blood cell membranes as a covariate increased the r-square values of multivariate models; this biomarker of fish consumption was associated with PBDE levels ($p < 0.001$). A moderate correlation was noted between PBDE 153 and PCB 153 plasma levels (Speerman $r = 0.44$; $p < 0.001$). In Nunavik, PBDE 153 was detected in 76% of the 838 plasma samples collected in 2004 (LOD = 5 ng/L); the mean concentration was 17 ng/L (95-% CI: 16-18), a value similar to that of Eastmain participants but 35% lower than that of Wemindji residents. As for Cree residents, levels in Nunavik residents were positively associated with age and correlated to PCB 153 plasma levels. PBDE 153 is a ubiquitous and persistent PBDE congener that shares common properties and/or routes of exposure with PCBs and PFOS (Dallaire et al., 2009).

TABLE 5.3.23 PLASMA CONCENTRATIONS OF PBDE CONGENER NO. 153 (NG/L) IN WEMINDJI (A) AND EASTMAIN (B) PARTICIPANTS (≥8 YEARS OF AGE) STRATIFIED BY AGE GROUPS AND GENDER

Age groups		n	% det.[1]	Mean (SD)[2]		Min	Max	Geo. mean (95%-CI)[3]	
(A) Wemindji									
8-14 years	Female	14	57	44	(71)	< LOD	290	28	(19-41)
	Male	15	47	39	(29)	< LOD	120	31	(23-42)
	Total	29	52	41	(52)	< LOD	290	30	(24-38)
15-39 years	Female	50	62	31	(27)	< LOD	200	27	(24-30)
	Male	37	65	38	(24)	< LOD	130	33	(28-39)
	Total	87	63	34	(26)	< LOD	200	29	(26-32)
≥40 years	Female	27	74	39	(27)	< LOD	110	32	(26-41)
	Male	28	86	68	(65)	< LOD	330	50	(38-67)
	Total	55	80	54	(52)	< LOD	520	41	(34-49)
(B) Eastmain									
8-14 years	Female	11	9	35	(51)	< LOD	190	24	(26-36)
	Male	12	17	42	(52)	< LOD	170	28	(18-44)
	Total	23	13	39	(51)	< LOD	190	26	(19-35)
15-39 years	Female	44	16	23	(12)	< LOD	100	21	(20-24)
	Male	26	27	22	(5)	< LOD	40	22	(21-24)
	Total	70	20	23	(10)	< LOD	100	21	(21-23)
≥40 years	Female	26	50	34	(24)	< LOD	120	29	(24-36)
	Male	15	67	35	(20)	< LOD	100	32	(25-39)
	Total	41	56	34	(22)	< LOD	120	30	(26-35)

1. Percentage of detection; limit of detection (LOD): 14 ng/L

2. Standard deviation

3. 95% Confidence interval

5.4 Chronic Diseases: Cardiovascular Disease, Diabetes, Thyroid Disorders and Bone Density

5.4.1 Clinical biochemistry, cardiovascular risk factors and medical outcomes

Preamble

In the following section, information was retrieved from the individual medical file of each participant in order to increase the accuracy of the interpretations rendered.

5.4.1.1 Estimated Prevalence of Hypertension

Among adults

Information on hypertension was obtained from two sources, namely the medical files and onsite measurements. Tables 5.4.1A,B show the comparison between both assessments. In Wemindji the percentage of stabilized hypertension (i.e., people with diagnosed hypertension, but with normal blood pressure during the onsite clinical session), was high in both men and women (65% and 85%, respectively); only for women was it high in Eastmain (83.3%), compared to around 50% for men (Table 5.4.1B).

TABLE 5.4.1A CRUDE COMPARISON BY GENDER BETWEEN ONSITE MEASURED BLOOD PRESSURE AND PREVIOUS (RECORDED) DIAGNOSIS IN WEMINDJI FOR ADULTS (≥18 YEARS)

	Men (n = 58)		Women (n = 68)	
	Hypertension diagnosed (n = 23)	No mention of hypertension (n = 35)	Hypertension diagnosed (n = 13)	No mention of hypertension (n = 55)
Elevated BP measured[a] (n)	35.5%(8)	11.9%(4)	15%(2)	9.4%(5)
Normal value(n)	64.5%(15)	88.1%(31)	85%(11)	90.6%(50)

a. Elevated Blood Pressure: ≥140 (systolic) and/or ≥90 (diastolic) mmHg

TABLE 5.4.1B CRUDE COMPARISON BY GENDER BETWEEN ONSITE MEASURED BLOOD PRESSURE AND PREVIOUS (RECORDED) DIAGNOSIS IN EASTMAIN FOR ADULTS (≥18 YEARS)

	Men (n = 35)		Women (n = 60)	
	Hypertension diagnosed (n = 12)	No mention of hypertension (n = 23)	Hypertension diagnosed (n = 18)	No mention of hypertension (n = 42)
Elevated BP measured[a](n)	50.3%(6)	13.7(3)	16.7%(3)	7.4%(3)
Normal value(n)	49.7%(6)	86.3%(20)	83.3%(15)	92.6%(39)

a. Elevated Blood Pressure: ≥140 (systolic) and/or ≥90 (diastolic) mmHg

As indicated in Section 4.6.1, we defined adult hypertension (HTN) as having blood pressure at least 140 (systolic) or 90 (diastolic) mmHg*)* at the time of the study *(Touyz et al., 2006),* or a previous diagnosis of HTN with or without medication as mentioned in the medical file.

The *estimated weighted prevalence* of HTN was comparable in both communities: 35.9% (Wemindji) and 39.5% (Eastmain). In Wemindji, HTN was more prevalent among men (45.0%) than women (27.2%) ($p < 0.0001$); no gender difference was evident in Eastmain (43.3% *versus* 35.8%, $p = 0.13$). Most of people with hypertension had other major risk factors of CVD such as obesity, abdominal obesity, dyslipidaemia and tobacco consumption.

Among children and adolescents

Among children and adolescents (8-17 years), the estimated prevalence of HTN was also defined according to information gathered from the medical files and onsite measurements. In this case, hypertension was defined as having an average systolic (SBP) and/or diastolic BP (DBP) above the 95th percentile for gender, age, and height (Falkner *et al*., 2004). Of youths (14-17 years old) in Wemindji and Eastmain, 16.1% ($n = 2$) and 25.7($n = 4$) respectively exceeded their HTN values. All youths with HTN had an elevated BMI (BMI > 95th percentile for age and gender). Interestingly, HTN had also been noted in the medical files of these young participants.

5.4.1.2 Association between blood mercury and blood pressure among adults (≥18 years)

Details are provided in the inserted panel below.

Mercury and blood pressure

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) means were compared across tertiles of blood mercury concentration (Figures A & B). After controlling for confounders (see figure for list of confounders), SBP was significantly higher in the 3rd tertile compared to the 2nd (129 vs. 125 mmHg, p = 0.04). In addition, DBP was higher in the 3rd compared to the 1st tertile (78 vs. 74 mmHg, p = 0.03).

These results agree with previous studies conducted elsewhere (Pedersen *et al.,* 2005; Fillion *et al.,* 2006; Choi *et al.,* 2009,Valera *et al.,* 2009). This effect of mercury on BP overlaps the range of mercury levels (≥40 nmol/L) considered "at risk" by Health Canada for women ≤49 years and males ≤18 years (Legrand et al., 2010).

FIGURE A: SBP BY TERTILES OF BLOOD MERCURY CONCENTRATIONS

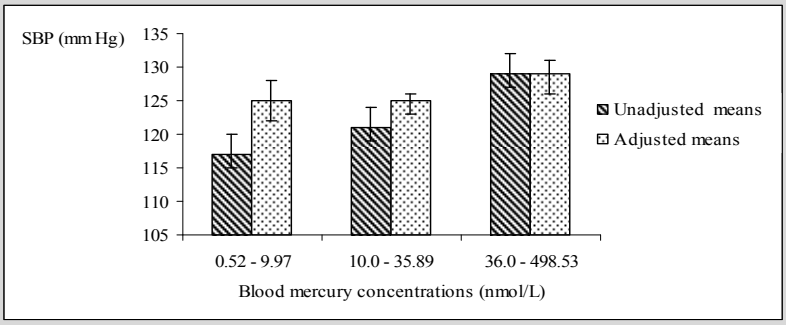
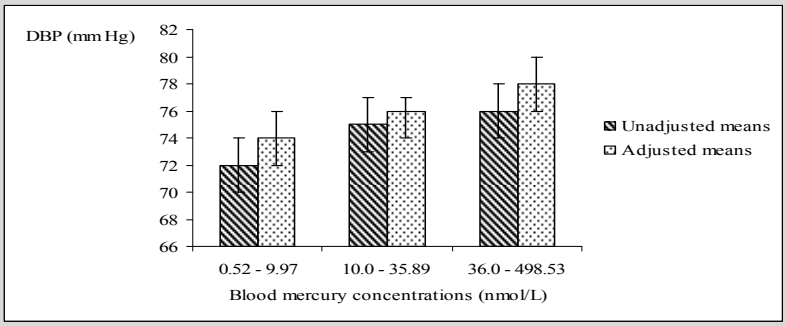


FIGURE B: DBP BY TERTILES OF BLOOD MERCURY CONCENTRATIONS



All means were adjusted for age, gender, total cholesterol, triglycerides, obesity, diabetes, smoking, anti-hypertensive treatment, physical activity, n-3 fatty acids and selenium.

5.4.1.3 Blood lipid profile and fatty acids

Blood lipid profile

Among adults (≥18 years) from Wemindji (see Table 5.4.2 A), elevated total cholesterol (≥5.2 mmol/L) was found in 35.5% of participants, low HDL-C (<1.03 mmol/L in men and <1.29 in women) in 34.7%, elevated total cholesterol/HDL (≥5.0) in 12.8%, elevated LDL-C (>3.4 mmol/L) in 21.0% and elevated blood triglycerides (>1.7 mmol/L) in approximately 27%. In Eastmain, among adults elevated total cholesterol was found in 20.1%, low HDL-C in 48.2%, elevated total cholesterol/HDL in 22.2%, elevated LDL-C in 13.9% and elevated blood triacylglycerol (triglycerides) in approximately 45%. In both communities, the blood lipid profile is markedly related to the obesity status (Table 5.4.2A,B). Gender and age influence is less consistent among lipids and communities (Table 5.4.3A, B).

Among children (8 to 17 years old), we used the modified Cook criteria (Cook *et al.,* 2003) to provide an adequate evaluation of risk factors in this paediatric population. The prevalence of elevated triacylglycerol (>1.2 mmol/L) was 0% and 12% in Wemindji and Eastmain respectively. In Eastmain, elevated triacylglycerol affects only girls, and all of them had elevated BMIs that exceeded the 95th percentile when adjusted for age and gender. For low HDL-C, the prevalence was 22.9% in Wemindji and pertains only to boys. In Eastmain, low HDL-C was evident for 32.1% of adolescents and no gender difference was detected; most (66.3%) had a BMI that exceeded the 95th percentile after taking age and gender into account. (The results have not been adjusted for lipids medication.)

TABLE 5.4.2A PREVALENCE OF ABNORMAL BLOOD LIPID CONCENTRATIONS AMONG ADULTS (≥18 YEARS) ACCORDING TO GENDER AND OBESITY STATUS (BMI ≥ 30 KG/M^2) IN WEMINDJI

	Men (%)			Women (%)			p-value[a]
	Total[b] n = 62	Obese[c]	Not obese	Total[b] n = 74	Obese[c]	Not obese	
Elevated Total Cholesterol (≥5.2 mmol/L) %	39.7	80.3	19.8	31.6	52.1	48.0	0.015
Elevated total cholesterol/HDL (≥5.0) %	18.0	82.6	27.4	8.0	81.9	18.1	<0.0001
Low HDL-C (<1.03 mmol/L in men and <1.29 in women) %	20.6	62.0	38.1	48.0	74.7	25.3	<0.0001
Elevated LDL-C (>3.4 mmol/L) %	29.3	79.2	20.9	12.6	31.8	68.2	<0.0001
Elevated Triacylglycerol (>1.7 mmol/L) %[b]	33.9	76.9	23.1	20.1	100	-	<0.0001

a. Comparison between genders adjusted by age and obesity status

b. Prevalence (%) of abnormal lipid value in the sample

c. Distribution of obesity among people with abnormal value

TABLE 5.4.2B PREVALENCE OF ABNORMAL BLOOD LIPID CONCENTRATIONS AMONG ADULTS (≥18 YEARS) ACCORDING TO GENDER AND DISTRIBUTED OBESITY STATUS IN EASTMAIN

	Men (%)			Women (%)			p-value[a]
	Total[b] n = 37	Obese[c]	Not obese	Total[b] n = 61	Obese[c]	Not obese	
Elevated Total Cholesterol (≥5.2 mmol/L)%	21.8	100	-	18.4	64.1	35.9	0.256
Elevated total cholesterol/HDL (≥5.0)%	32.5	91.9	8.0	11.6	56.8	43.2	<0.0001
Low HDL-C (<1.03 mmol/L in men & <1.29 in women)%	37.7	78.6	21.2	59.0	82.9	17.1	<0.001
Elevated LDL-C (>3.4 mmol/L)%	14.1	80.9	19.1	13.8	62.4	37.7	0.913
Elevated Triacylglycerol (>1.7 mmol/L) %[b]	42.7	87.79	12.3	46.2	85.4	14.6	0.918

a. Comparison between genders adjusted by age and obesity status

b. Prevalence (%) of abnormal lipid value in the sample

c. Distribution of obesity among people with abnormal value

TABLE 5.4.3A BLOOD LIPIDS CONCENTRATIONS ACCORDING TO AGE AND GENDER IN WEMINDJI

	Overall				Male				Female			
	15-39 years n = 87		≥40 years n = 55		15-39 years n = 37		≥40 years n = 28		15-39 years n = 50		≥40 years n = 27	
Total Cholesterol (mmol/L)[a]	4.7	(2.2)	4.9	(2.2)	5.0	(2.5)	4.7	(2.5)	4.5	(1.8)	5.0	(1.8)
Cholesterol/HDL[a]	3.9	(3.1)	3.6	(1.9)	4.1	(3.4)	4.0	(1.9)	3.3	(2.8)	3.4	(1.6)
HDL-C (mmol/L)[a]	1.3	(0.3)	1.3	(0.3)	1.3	(0.3)	1.2	(0.2)	1.3	(0.3)	1.4	(0.2)
LDL-C (mmol/L)[a]	2.2	(0.7)	2.6	(0. 9)	2.5	(0.7)	2.7	(1.0)	2.1	(0.6)	2.6	(0.8)
Triacylglycerol (mmol/L)[b]	1.4	[1.2-1.5]	1.4	[1.2-1.5]	1.3	[1.1-1.5]	1.4	[1.2-1.7]	1.4	[1.3-1.6]	1.3	[1.2-1.5]

a. Arithmetic mean (SD)

b. Geometric mean [95% CI]

TABLE 5.4.3B BLOOD LIPIDS CONCENTRATIONS ACCORDING TO AGE AND GENDER IN EASTMAIN

	Overall				Male				Female			
	15-39 years n = 70		≥40 years n = 41		15-39 years n = 26		≥40 years n = 15		15-39 years n = 44		≥40 years n = 26	
Total Cholesterol (mmol/L)[a]	4.4	(1.5)	4.8	(1.6)	4.5	(1.4)	4.8	(2.2)	4.2	(1.5)	4.7	(1.3)
Cholesterol/HDL[a]	3.8	(2.3)	4.2	(2.3)	3.9	(2.4)	4.4	(3.0)	3.7	(2.3)	4.0	(1.9)
HDL-C (mmol/L)[a]	1.2	(0.6)	1.2	(0.5)	1.2	(0.6)	1.1	(0.6)	1.2	(0.5)	1.2	(0.5)
LDL-C (mmol/L)[a]	2.4	(1.2)	2.7	(1.4)	2.5	(1.4)	2.8	(1.8)	2.3	(1.1)	1.2	(0.5)
Triacylglycerol (mmol/L)[b]	1.4	[1.2-1.6]	1.6	[1.4-1.9]	1.5	[1.2-1.8]	1.6	[1.2-2.0]	1.3	[1.1-1.6]	1.7	[1.4-2.0]

a. Arithmetic mean (SD)

b. Geometric mean [95% CI]

Fatty acid profile in red blood cells

Total polyunsaturated fatty acid (PUFA) concentrations measured in Eastmain and Wemindji participants were similar to those found in Mistissini in 2005 (Bonnier-Viger et al., 2007) for the age categories indicated (Tables 5.4.4A,B).

EPA + DHA and total omega-3 fatty acids concentrations were similar among Eastmain and Wemindji individuals. Concentrations of omega-3 fatty acids (including EPA and DHA) are representative of fish and game consumption, and increase with age as shown in Tables 5.4.4 A, B.

In both communities, *trans*-fatty acids (which mostly reflect market and junk food consumption) and omega-3(n-3) fatty acid concentrations showed opposite trends. Levels of n-3 were higher (approx. 1.3 times), and those of *trans*-fatty acids lower (approx. 1.4 times), among participants 45 years and older, compared to young teenagers (8-14). Additional details are provided in the panel below.

TABLE 5.4.4A RELATIVE CONCENTRATIONS OF FATTY ACIDS (% BY WET WEIGHT OF TOTAL FATTY ACIDS) IN ERYTHROCYTE MEMBRANES STRATIFIED BY AGE IN WEMINDJI

	8-14 years (n = 29)	15-39 years (n = 87)	≥40 years (n = 55)
Fatty acids	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
EPA[b]	0.37 (0.30-0.40)[a]	0.43 (0.40-0.50)	0.69 (0.60-0.80)
DHA[b]	2.7 (2.6-2.9)	3.0 (2.8-3.1)	4.1 (3.8-4.3)
EPA +DHA	3.1 (2.9-3.3)	3.4 (3.2-3.6)	4.8 (4.5-5.1)
PUFA, n-3 series[b,c]	5.2 (5.0-5.5)	5.5 (5.3-5.7)	6.7 (6.6-7.34)
PUFA, n-6 series[b,c]	32.1 (31.8-32.4)	31.7 (31.4-32.0)	29.7 (29.1-30.3)
Total PUFA	37.3 (37.0-37.6)	37.2 (36.8-37.6)	36.7 (36.2-37.2)
n-3/n-6 ratio	0.17 (0.16-0.18)	0.18 (0.2-0.18)	0.24 (0.23-0.30)
MUFA[b,e]	19.7 (19.3-20.1)	19.6 (19.3-19.8)	19.7 (19.3-20.0)
SFA[b,f]	42.9 (42.6-43.1)	43.1 (42.8-43.4)	43.5 (43.2-43.8)
Total trans	*0.74 (0.70-0.80)*	*0.55 (0.50-0.60)*	*0.49 (0.48-0.60)*

a. Arithmetic mean (95% CI) of the percentage by weight of total fatty acids

b. EPA, eicosapentanoic acid; DHA, docosahexanoic acid; PUFA, polyunsaturated fatty acids; MUFA, monounsaturated fatty acids; SFA, saturated fatty acids

c. PUFA, n-3 series: (C18:3 + C18:4 + C20:3 + C20:4 + C20:5 + C22:5 + C22:6)

d. PUFA, n-6 series: (C18:2 +C18:3 + C20:2 + C20:3 + C20:4 + C22:2 +C22:4 + C22:5)

e. MUFA: (C14:1 + C16:1 + C18:1 + C20:1 + C22:1 + C24:1)

f. SFA: (C14:0 +C16:0 + C17:0 + C18:0 + C20:0 + C22:0 +C24:0)

TABLE 5.4.4B RELATIVE CONCENTRATIONS OF FATTY ACIDS (% BY WET WEIGHT OF TOTAL FATTY ACIDS) IN ERYTHROCYTE MEMBRANES STRATIFIED BY AGE IN EASTMAIN

	8-14 years (n = 23)	15-39 years (n = 70)	≥40 years (n = 41)
Fatty acids	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
EPA[b]	0.39 (0.36-0.43)	0.39 (0.36-0.41)	0.57 (0.47-0.66)
DHA[b]	2.8 (2.6-3.0)	3.1 (2.9-3.2)	4.0 (3.7-4.3)
EPA +DHA	3.2 (3.0-3.5)	3.4 (3.3-3.6)	4.6 (4.2-5.0)
PUFA, n-3 series[b,c]	5.5 (5.3-5.8)	5.5 (5.3-5.7)	6.9 (6.4-7.4)
PUFA, n-6 series[b,c]	31.9 (31.4-32.3)	31.7 (31.5-32.0)	30.4 (29.9-31.0)
Total PUFA	37.4 (37.0-37.8	37.2 (37.1-37.4)	37.3 (37.0-37.6)
n-3/n-6 ratio	0.18 (0.17-0.19)	0.18 (0.17-0.19)	0.24 (0.21-0.26)
MUFA[b,e]	20.0 (19.5-20.5)	20.2 (19.9-20.4)	20.1 (19.8-20.4
SFA[b,f]	42.4 (42.1-42.6)	42.4 (42.3-42.5)	42.4 (42.3-42.6)
Total trans	0.72 (0.62-0.83)	0.59 (0.54-0.66)	0.56 (0.48-0.65)

a. Arithmetic mean (95% CI) of the percentage by weight of total fatty acids

b. EPA, eicosapentanoic acid; DHA, docosahexanoic acid; PUFA, polyunsaturated fatty acids; MUFA, monounsaturated fatty acids; SFA, saturated fatty acids

c. PUFA, n-3 series: (C18:3 + C18:4 + C20:3 + C20:4 + C20:5 + C22:5 + C22:6)

d. PUFA, n-6 series: (C18:2 +C18:3 + C20:2 + C20:3 + C20:4 + C22:2 +C22:4 + C22:5)

e. MUFA: (C14:1 + C16:1 + C18:1 + C20:1 + C22:1 + C24:1)

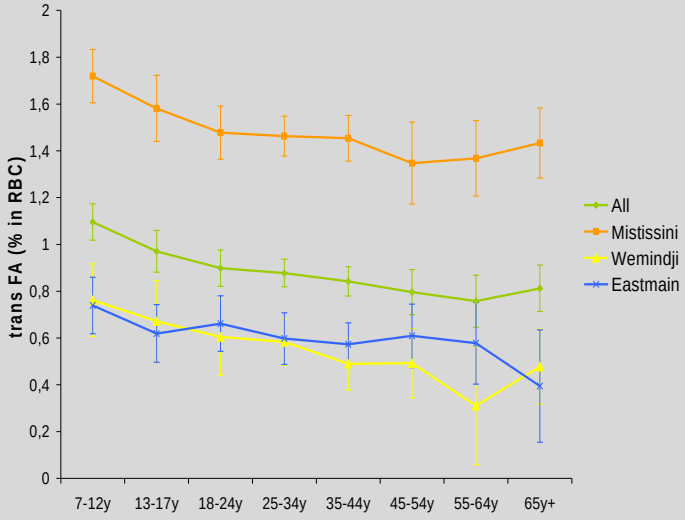
f. SFA: (C14:0 +C16:0 + C17:0 + C18:0 + C20:0 + C22:0 +C24:0)

Health implications of *trans*-fatty acids

The Cree diet is changing, a process bound to have great health implications; it is referred to as the "dietary transition". While omega-3 fatty acids (n3-FA) are indicative of the traditional consumption of country food, industrially produced *trans*-fatty acids (IP-TFA) are likely to be found in store-bought food of low nutritional quality. While conferring practical qualities that are valuable to the food supply of remote communities (e.g. a longer shelf life); their deleterious cardio-vascular effects are well recognised. Hence the importance of assessing the extent to which *Eeyouch* are exposed.

If we consider the three communities, the proportion of TFA in RBC reached an average of 1.04% [0.98;1.10] in children and teenagers aged 8-17 years (n = 123), 0.88% [0.83;0.92] in adults aged 18-39 years (n = 248), and 0.80% [0.75;0.85] in older adults (n = 165, test for trends across age groups: $p < 0.0001$). This is lower than previously reported among Nunavik Inuit communities (1.31% [1.27;1.36] in adults aged 18-39 years, n = 533; and 1.00% [0.95;1.06] in older adults aged 40 or more, n = 348) (Counil et al., 2009). These global averages mask large differences between Cree communities. Mean TFA levels were actually much higher in *Eeyouch* from Mistissini (age and gender-adjusted means: 1.49% [1.46;1.53], n = 233) than in Wemindji (0.57% [0.52;0.62], n = 169) and Eastmain (0.61% [0.54;0.68], n = 134), and the difference between Mistissini and the two other communities is highly significant ($p<0.0001$). Moreover, within each community, TFA decreased with age, the youngest being most exposed, as we previously observed in Nunavik. The highest levels were reached in children aged 8 to 12 living in Mistissini who had on average 1.72% [1.61;1.83] of TFA in RBC membranes (see Figure).

FIGURE: RELATIVE PROPORTIONS OF TRANS FATTY ACIDS IN ERYTHROCYTE MEMBRANES EXPRESSED BY AGE GROUP AND COMMUNITY AMONG THE PARTICIPANTS



5.4.1.4 Atherosclerosis

We evaluated the carotid intimal-to-medial thickness (CIMT) of both the left and right carotid arteries using vascular ultrasonography in individuals aged 40 and older. The mean CIMT of the near and far walls of both common carotids is reported in millimetres (mm) and is considered as a surrogate maker of atherosclerosis. As of now, the CIMT analyses have been completed for the Mistissini, Eastmain and Wemindji communities for a total of 143 individuals. The global average CIMT of all communities is

0.78 ± 0.01 mm [95%CI: 0.75-0.80] which falls below the 1mm limit that was reported to be closely associated with cardiovascular diseases (myocardial infarction and stroke) (Bots *et al.,* 2002) (Table 5.4.5). Among all participants, 27 individuals had CIMT equal to or above the 1mm limit. When categorized in quartiles of age and gender, the CIMT range 0.65 ± 0.02 mm to 0.92 ± 0.02 which is generally higher to what is being observed in other studies of general Caucasians (all $p < 0.0001$) (Demircan *et al.*, 2005; Chambless *et al.*, 1997; Rosvall *et al.*, 2005; O'Leary et al. 1999; Lonn *et al.*, 2001). The CIMT differed between gender ($p < 0.01$) and increased with each quartile of age ($p < 0.0001$), as reported in other studies of Caucasians subjects (Lorenz *et al.,* 2007).

TABLE 5.4.5 COMPARISON OF THE COMMON CAROTID INTIMAL TO MEDIAL THICKNESS IN MILLIMETRES (EXCLUDING SEGMENT WITH PLAQUE)

	All communities	**Individual communities**		
		Mistissini	Eastmain	Wemindji
Men	**0.82 ± 0.02** [a] (n = 61)	0.78 ± 0.04 (n = 20)	0.84 ± 0.04 (n = 15)	0.84 ± 0.03 (n = 26)
Women	**0.74 ± 0.02** (n = 82)	0.78 ± 0.03 (n = 33)	0.70 ± 0.03 (n = 23)	0.74 ± 0.02 (n = 26)
All (men and women)	**0.78 ± 0.01** (n = 143) (43% male)	0.78 ± 0.02 [b] (n = 53) (38% male)	0.75 ± 0.03 [b] (n = 38) (39% male)	0.79 ± 0.02 [b] (n = 52) (50% male)

a. Difference between genders ($p < 0.01$, adjusted for age)

b. Difference between communities ($p = 0.78$)

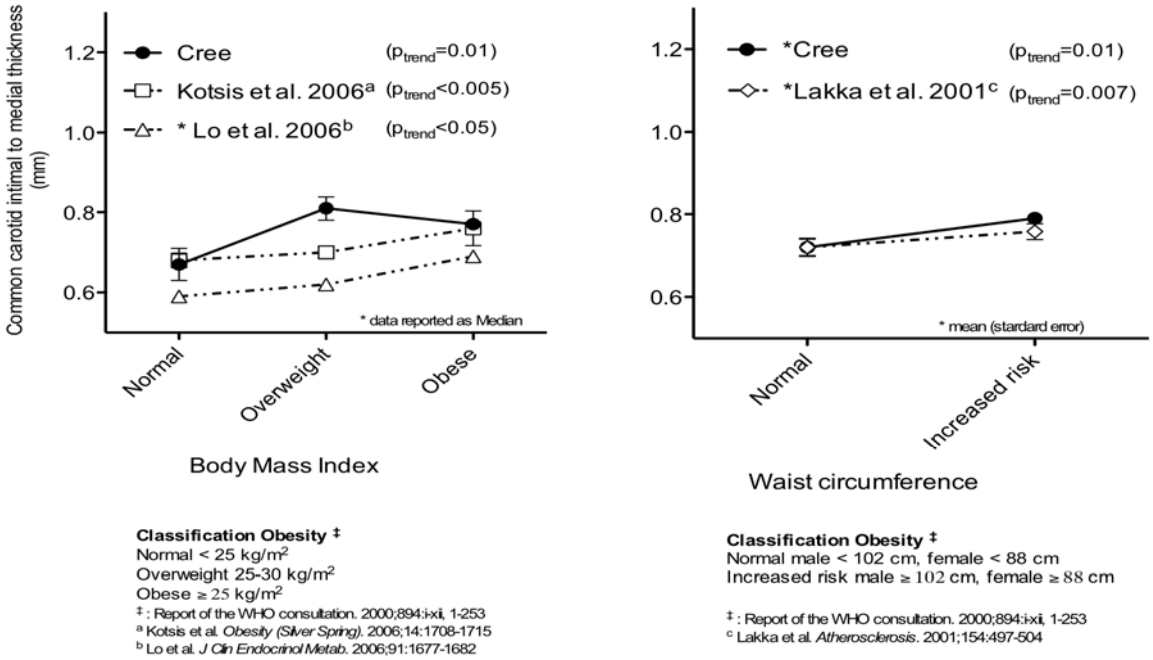
There was a significant difference between hypertensive *versus* non-hypertensive (0.82 ± 0.02mm *versus* 0.75 ± 0.01mm respectively; $p < 0.01$) and dyslipidemic *versus* non-dyslipidemic as recorded in the medical file (0.86 ± 0.03mm *versus* 0.75 ± 0.01mm respectively; $p < 0.01$). There was a non-statistically significant difference in CIMT when individuals were stratified according to the presence or absence of diabetes (0.82 ± 0.02mm vs. 0.74 ± 0.02mm respectively; $p = 0.07$). These results echo those from previous studies (Kannel *et al.* 1996). In a review of 21 studies, Brohall and colleagues (2006) reported that type II diabetes is associated with a 13% increased CIMT.

The CIMT differed between weight status defined as normal (BMI < 25kg/m^2), overweight (BMI = 25-29 kg/m^2) and obese (BMI ≥ 30kg/m^2) (0.67 ± 0.04mm, 0.81 ± 0.03mm, 0.77 ± 0.01mm respectively; $p = 0.01$) (Figure 5.4.1). This significant association is in line with what has been published for Caucasians using comparable ultrasonographic protocols (Kotsis *et al.,* 2006; Lo *et al.,* 2006) (Figure 5.4.1). Similarly, when abdominal adiposity was classified according to risk of cardiovascular disease (Despres & Lemieux, 2006), the common carotid CIMT differed in the group with elevated waist

(0.79 ± 0.01 mm) compared with the normal group (0.72 ± 0.02mm) (p = 0.01, adjusted for age) (Figure 5.4.1). Again, our observations corroborate what has been reported elsewhere (Lakka *et al.,* 2001).

Smoking has been well documented to lead to many detrimental health consequences including cardiovascular disease and also thickening of the carotid (Bhuiyan *et al.,* 2006). Unexpectedly, we were unable to detect any relationship of CIMT with tobacco use.

FIGURE 5.4.1 COMPARATIVE VALUES OF THE CIMT STRATIFIED ACCORDING TO BODY MASS INDEX (A) AND WAIST CIRCUMFERENCE (B)



Classification Obesity ‡
Normal < 25 kg/m²
Overweight 25-30 kg/m²
Obese ≥ 25 kg/m²
‡ : Report of the WHO consultation. 2000;894:i-xii, 1-253
[a] Kotsis et al. *Obesity (Silver Spring).* 2006;14:1708-1715
[b] Lo et al. *J Clin Endocrinol Metab.* 2006;91:1677-1682

Classification Obesity ‡
Normal male < 102 cm, female < 88 cm
Increased risk male ≥ 102 cm, female ≥ 88 cm
‡ : Report of the WHO consultation. 2000;894:i-xii, 1-253
[c] Lakka et al. *Atherosclerosis.* 2001;154:497-504

Mercury and CIMT

It has been reported that mercury exposure can increase the risk of cardiovascular disease through various mechanisms including lipid peroxidation (Salonen et al. 1995). Findings have suggested that in Finish men, mercury accumulation in the hair was associated with accelerated progression of carotid atherosclerosis (Salonen et al. 2000). In the Cree population, we did not observe any correlation between blood concentrations of mercury and CIMT (p = 0.88, adjusted for age and gender).

5.4.1.5 Heart rate variability (HRV)

Heart rate variability (HRV) parameters represent the sympathetic and parasympathetic activity of the autonomic nervous system. Sympathetic activity is responsible for the acceleration of the heartbeat, while parasympathetic activity slows the heartbeat down. In the general population, attenuated HRV, meaning a low vagal activity and a sympathetic predominance, increases the risk of arrhythmias (Fei *et al.,* 1994; Bikkina *et al.,* 1998) and sudden death (Molgaard *et al.*, 1991). Time-domain parameters are indices of cardiac parasympathetic modulation. In terms of frequency domains, low frequency (LF of 0.04-0.15 Hz) represents both sympathetic and parasympathetic activity, while high frequency (HF of 0.15 to 0.40 Hz) is solely an index of parasympathetic activity. The LF/HF ratio represents the sympatho-vagal balance.

HRV in Eastmain are presented in Table 5.4.6A. Women had lower LF/HF ratio than men. Age was negatively correlated with LF (r = -0.56, p < 0.0001), HF (r = -0.55, p < 0.0001), SDNN (r = -0.40, p = 0.0002). Adults 40 years and older had lower LF, HF, SDNN than younger adults (Table 5.4.6.b). HRV parameters measured in Wemindji are presented in Table 5.4.6B. Age was negatively correlated with all parameters (p < 0.001). Adults 40 years and older had lower HRV parameters than younger adults (Table 5.4.6B).

TABLE 5.4.6 A HRV PARAMETERS STRATIFIED BY GENDER (A) AND AGE (B) CATEGORY (EASTMAIN)

GENDER

HRV parameters	All (n = 109)	Men (n = 40)	Women (n = 69)	p-value[a]
	Geomean (95% CI)	Geomean (95% CI)	Geomean (95% CI)	
LF (ms^2)	387 (319-419)	461 (349-610)	341 (263-444)	0.11
HF (ms^2)	138 (111-172)	137 (95-196)	139 (105-185)	0.93
LF/HF	2.8 (2.5-3.0)	3.4 (2.8-4.0)	2.5 (2.2-2.7)	0.002
SDNN (ms)	78 (73-84)	85 (77-94)	74 (68-82)	0.06

a. Geomeans of the HRV parameters were compared by gender using the student T-test

AGE

HRV parameters	15-17 years	18-39 years	≥40 years	p-value[a]
	Geomean (95% CI)	Geomean (95% CI)	Geomean (95% CI)	
LF (ms^2)	891 (531-1496)	467 (367-595)	249 (188-330)	<0.0001
HF (ms^2)	379 (209-687)	166 (126-219)	79 (57-109)	<0.0001
LF/HF	2.3 (1.7-3.2)	2.8 (2.4-3.2)	3.2 (2.7-3.7)	0.22
SDNN (ms)	95 (78-116)	82 (75-90)	71 (64-80)	0.03

a. Geomeans of the HRV parameters were compared by age category using analysis of variance

TABLE 5.4.6B PARAMETERS STRATIFIED BY GENDER (A) AND AGE (B) CATEGORY (WEMINDJI)

GENDER

HRV parameters	All (n = 133)	Men (n = 61)	Women (n = 72)	p-value[a]
	Geomean (95% CI)	Geomean (95% CI)	Geomean (95% CI)	
LF (ms^2)	455 (384-538)	487 (372-636)	426 (343-529)	0.44
HF (ms^2)	164 (135-198)	173 (128-232)	156 (121-200)	0.59
LF/HF	2.8 (2.5-3.0)	2.8 (2.4-3.2)	2.7 (2.4-3.1)	0.76
SDNN (ms)	84 (80-89)	86 (79-92)	83 (77-91)	0.55

a. Geomeans of the HRV parameters were compared by age category using analysis of variance

AGE

HRV parameters	15-17 years	18-39 years	≥40 years	p-value[a]
	Geomean (95% CI)	Geomean (95% CI)	Geomean (95% CI)	
LF (ms^2)	1014 (464-2217)	604 (497-734)	256 (199-331)	<0.0001
HF (ms^2)	518 (203-1323)	193 (153-244)	109 (80-148)	0.0009
LF/HF	1.9 (1.3-3.1)	3.1 (2.8-3.5)	2.4 (2.0-2.7)	0.003
SDNN (ms)	120 (91-159)	88 (82-94)	76 (69-83)	0.002

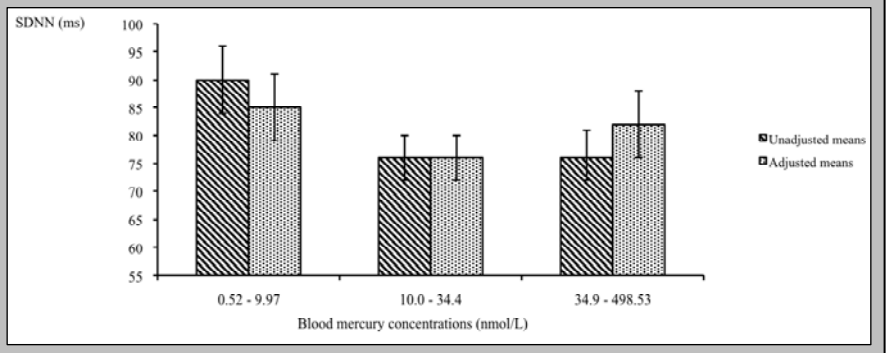
a. Geomeans of the HRV parameters were compared by age category using analysis of variance

Mercury and HRV

The effect of mercury on HRV was studied by pooling the data collected in Mistissini, Eastmain and Wemindji. Comparing HRV means across tertiles of mercury concentrations, we observed significant differences in SDNN. After adjusting for confounders, SDNN values were significantly lower among individuals with blood mercury concentration higher than 10 nmol/L (2 µg/L).

This suggests a negative impact on the parasympathetic activity and supports results on Nunavik Inuit adults (Valera *et al.* 2008).

FIGURE: SDNN BY TERTILES OF BLOOD MERCURY CONCENTRATIONS



SDNN means were adjusted for age, gender, total cholesterol, triglycerides, obesity, diabetes, smoking, physical activity, and n-3 fatty acids. **a** Significantly different from tertile 2 ($p < 0.05$); **b** Significantly different from tertile 3 ($p < 0.05$); **c** Significantly different from tertile 2 ($p = 0.01$)

5.4.1.6 New cardiovascular risk factors

Inflammation

C-reactive protein (CRP) is considered a non-specific marker of systemic inflammation. According to the American Heart current guidelines, concentrations below 1 mg/L are considered low-risk, 1 to 2 mg/L moderate-risk and levels greater than 3 mg/L have been associated with a doubled risk of coronary events and are therefore considered high risk (Pepys and Hirschfield, 2003). Because CRP may increase by 50 000-fold with acute inflammatory conditions such as infections, values above 10 mg/L were discarded as per recommendations of established guidelines (Pepys and Hirschfield, 2003). The generally high levels of CRP presented in Table 5.4.7 provide evidence of increased systemic inflammation, especially among women ($p < 0.0001$).

TABLE 5.4.7 COMPARISON OF CIRCULATING CONCENTRATION OF C REACTIVE PROTEIN (MG/L) BETWEEN GENDERS AND COMMUNITIES EXCLUDING VALUES ABOVE 10 MG/L

	All communities	**Individual communities**		
		Mistissini	Eastmain	Wemindji
Men	**2.8 ± 0.2** [a] (n = 177)	2.7 ± 0.3 (n = 74)	2.7 ± 0.3 (n = 62)	3.2 ± 0.4 (n = 41)
Women	**4.0 ± 0.2** [a] (n = 211)	4.3 ± 0.3 (n = 95)	3.5 ± 0.3 (n = 62)	4.3 ± 0.4 (n = 54)
All (men and women)	**3.5± 0.1** (n = 388) (46% male)	3.6 ± 0.2 [b] (n = 169) (44% male)	3.1 ± 0.2 [b] (n = 124) (50% male)	3.8 ± 0.3 [b] (n = 95) (43% male)

a. Difference between genders ($p < 0.001$, adjusted for age and community of residence)

b. Difference between communities ($p = 0.15$)

Inflammatory markers have also been demonstrated to be involved in the pathogenesis of insulin resistance (Popa *et al.,* 2007). More specifically, CRP and Il-6 are likely predictors of the development of type II diabetes (Pradhan *et al.,* 2001). This is corroborated in the Cree population by the association of circulating concentrations of insulin with those of both Il-6 and CRP (Figure 5.4.2). Furthermore impaired fasting plasma glucose levels also correlated not only with two inflammatory markers, but also with TNF-α and oxidized LDL (Figure 5.4.3).

Recent work in obesity confirms that this condition is considered low-grade chronic inflammation (Balletshofer *et al.*, 2005). Several markers of inflammation including TNF-α, Il-6 and CRP have been identified in high plasmatic concentrations of the obese (Gimeno and Klaman 2005; Yudkin *et al.,* 1999). Such evidence sheds light on the possible mechanisms involving the interaction of circulating

inflammation markers, insulin insensitivity, obesity and dyslipidaemia in cardiovascular disease (Chudek and Wiecek, 2006; Grimble, 2002; Popa *et al.,* 2007). Therefore, in our study it was not surprising to observe an association of increased concentration of circulating inflammatory makers with various indicators of obesity and dyslipidaemia.

Both obesity and insulin resistance are considered chronic inflammatory states (Chudek and Wiecek, 2006; Plomgaard *et al.*, 2007). Also, both obesity and insulin resistance are major determinants of subclinical atherosclerosis (Lorenz *et al.,* 2007) and are considered risk factors for cardiovascular disease. Our observations suggest that the Cree population shows high inflammatory states that coincide with glucose intolerance and excessive adiposity; both are well known to be pro-atherosclerotic. (Lorenz *et al.,* 2007)

FIGURE 5.4.2 COMPARATIVE VALUES OF CIRCULATING PLASMATIC CONCENTRATION OF INSULIN WITH QUARTILES OF CIRCULATING CONCENTRATION OF INTERLEUKIN 6 AND TERTILE OF C-REACTIVE PROTEIN

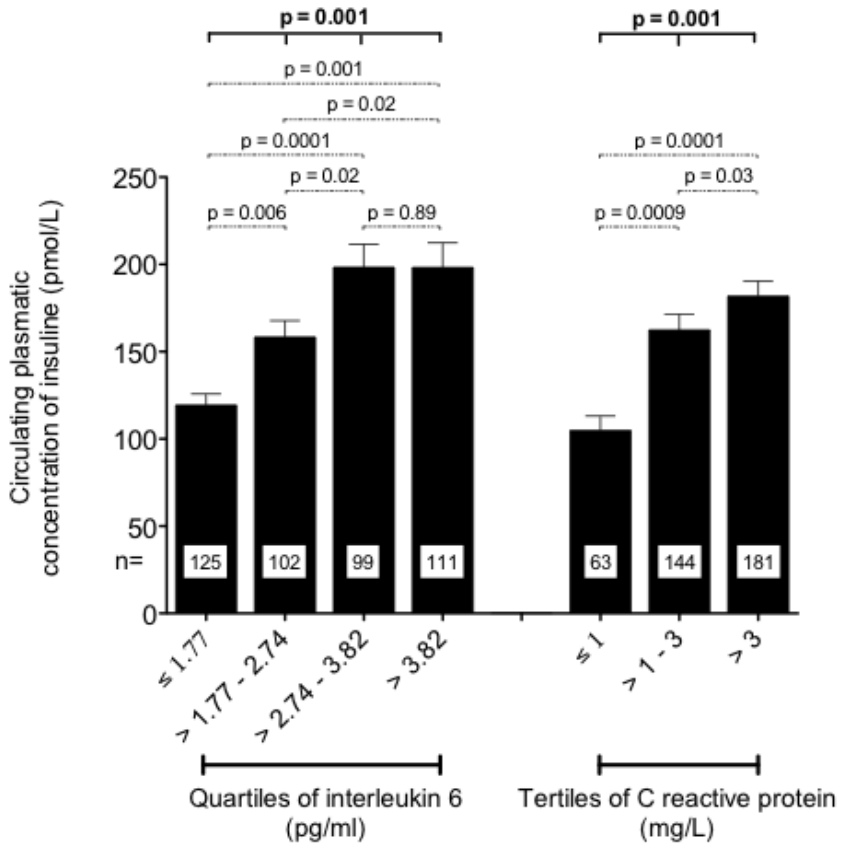
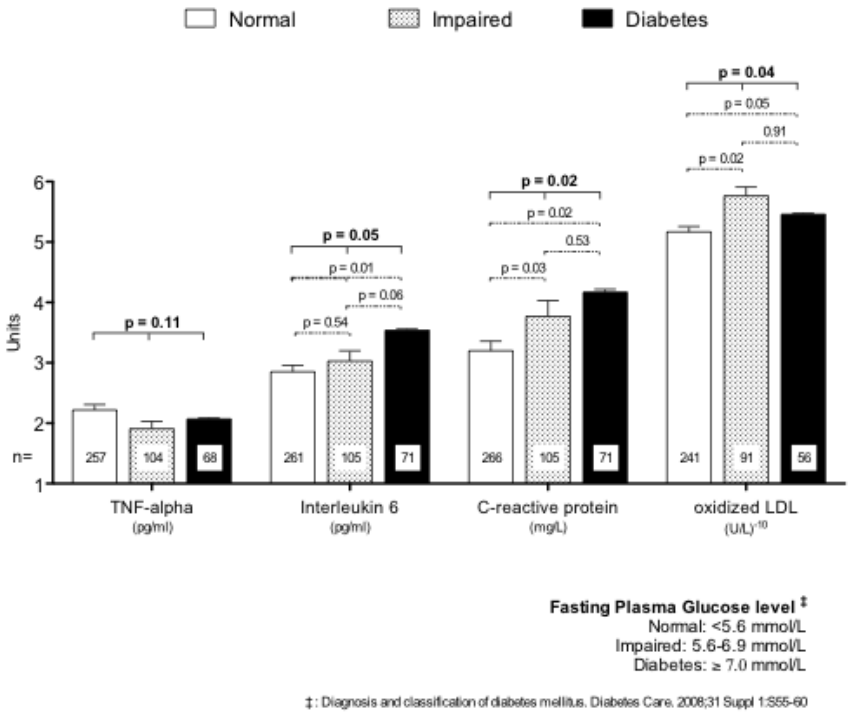


FIGURE 5.4.3 COMPARATIVE VALUES OF CIRCULATING PLASMATIC CONCENTRATION OF INFLAMMATORY MARKERS STRATIFIED ACCORDING TO FASTING PLASMA GLUCOSE CONCENTRATION



Low Density Lipoprotein size

An interesting new marker of CVD is LDL particle size. Smaller, denser LDL particles are considered to be one component of atherogenic dyslipidaemia. They are formed, in part, as a response to elevations of triglycerides. It is considered that LDL peak particle size of less than 255 Å (angströms) are associated with an increased risk for CVD. In Québec City, an average of 257 Å was found in healthy men, and 255 Å in patients with heart disease (Lamarche *et al.,* 2001). In Eastmain participants, LDL average particle size was 255.0 Å, and was significantly associated with age (Table 5.4.8) and a deterioration of the glucose profile (increasing risk) (Table 5.4.9) and tended to be associated with BMI (Table 5.4.10). In Wemindji participants, LDL average particle size was 254.9 Å.

TABLE 5.4.8 LDL PEAK PARTICLE SIZE (Å) AND CVD PARAMETERS IN THE CREE COMMUNITIES OF EASTMAIN, WEMINDJI AND MISTISSINI[a]

	18-39 years			≥40 years		
	n	Mean	95% CI	n	Mean	95% CI
All communities	277	255.2	254.9-255.5	165	254.4	254.4-255.1
Mistissini	120	255.4	[255.0-255.8]	68	254.4	[253.8-255.0]
Eastmain	70	255.2	[254.5-255.8]	41	254.6	[253.7-255.5]
Wemindji	87	254.9	[254.5-255.5]	55	255.3	[254.8-255.8]

a. Subjects younger than 18 years old were excluded from analysis

TABLE 5.4.9 LDL PEAK PARTICLE SIZE (Å) STRATIFIED BY BMI (KG/M^2) IN THE CREE COMMUNITIES OF EASTMAIN, WEMINDJI AND MISTISSINI[A]

BMI	n	Mean	95% CI
≤24.9 kg/m^2	29	256.8	256.2-257.4
25.0-29.9 kg/m^2	87	254.9	254.3-255.4
30.0-30.9 kg/m^2	206	254.8	254.4-255.1
≥40.0 kg/m^2	65	254.9	254.4-255.5

a. Subjects younger than 18 years old were excluded from analysis

TABLE 5.4.10 LDL PEAK PARTICLE SIZE (Å) STRATIFIED BY FASTING GLUCOSE (MMOL/L) IN THE CREE COMMUNITIES OF EASTMAIN, WEMINDJI AND MISTISSINI[A]

Fasting glucose	n	Mean	95% CI
≤5.6 mmol/L	204	255.5	255.2-255.8
5.6-6.9 mmol/L	125	254.7	254.3-255.2
≥7.0 mmol/L	70	253.9	253.3-254.5

a. Subjects younger than 18 years old were excluded from analysis

5.4.1.7 Discussion of risk factors for CVD

In both communities, we observed a similar pattern for the risks factors of CVD. We found a relatively high prevalence (30%) of hypertension, low HDL-C and elevated triglyceride which were detected in more than 1/3 of the sample. However, we also noticed relatively low prevalences of elevated LDL-C, total cholesterol and of total cholesterol/HDL-C ratio. All these risk factors were associated positively with general obesity and also with abdominal obesity. The influence of gender varies from one risk factor to another. Consequently, at this stage of the study, it could be premature to draw a conclusion on gender implication. The increase of sample size anticipated when the remaining communities are included will probably clarify this point. Interestingly, the observed lipid profile is rather similar to that obtained in the 1991 survey (Dewailly *et al.,* 2002). Based on intervention studies, the observed lipid pattern (low HDL-

C and high TG) associated with diabetes could increase the risk of cardiovascular complications (Leiter *et al.,* 2006). However, lifestyle interventions are known to improve lipid profiles (Leiter *et al.,* 2006). Furthermore, EPA+DHA concentrations were approximately half the values found among Inuit of Nunavik (Dewailly *et al.*2001), but remain about 2-3 times those of the general population of Québec.

Concerning TFA levels, we observed geographical differences across the Bay James Cree Territory; the community of Mistissini seems to be particularly exposed compared to the two other communities visited to date. This may indicate a larger access to store-bought foods and restaurants in Mistissini. Geographical differences observed across the Bay James Cree Territory might be also related to the time elapsed between community visits (2005- 2007). In recent years, the food industry has been strongly encouraged to reduce TFA and, a gradual decrease of TFA in processed products and in Canadians is expected. Nevertheless, this result point to the importance of following the example of Denmark and Greenland, which in 2003 imposed a maximum content of 2g trans-fat/100g fat. Research results are currently being translated into actions directed to the improvement of the food supply in Nunavik. Similar approaches should be encouraged in James Bay Cree communities.

Although preliminary, our observations suggest increased subclinical atherosclerosis in the Cree compared to healthy Caucasians. Nonetheless, absolute comparison with other studies should be interpreted with caution as the protocol for assessment of ultrasonographic imaging greatly differs between studies. Methods of analysis have been reported to contribute to measurement variation (Stein *et al.* 2008; Touboul *et al.* 2007). Thus, until an international methodological consensus has been reached, CIMT should be used in etiologic analyses and not as an indicator of disease prevalence. In the *Nituuchischaayihtitaau Aschii*, CIMT was used because it has served as a marker of atherosclerosis onset. However this may not be entirely the case for the Cree, since in our study CIMT did not correlate well with all traditional risk factors of cardiovascular disease. Furthermore the high inflammation states among participants, as evaluated by the relatively high circulating levels of biomarkers of inflammation, on the surface may imply (but see comments below) a premature risk of manifestation of acute CVD such as infarction and/or stroke.

In the general population, attenuated HRV (i.e., meaning low vagal activity and a sympathetic predominance), increases the risk of arrhythmias (Fei *et al.,* 1994; Bikkina *et al.,* 1998) and sudden death (Molgaard *et al.*, 1991). Compared with HRV parameters obtained in a general U.S. population (Tsuji *et al.*, 1996), the observed HRV parameters in Wemindji and Eastmain seem to be within the normal range. In both communities, HRV decreased with age which is in accordance with the literature (Kuch *et al.,* 2001*;* Antelmi *et al.,* 2004).

Generally speaking, the associations observed of blood mercury concentrations with CVD parameters are in accordance with results obtained by others. Nevertheless, more studies are needed in order to establish levels of concern for mercury that identify risk of cardiovascular diseases

For new CVD risk markers such as LDL particle size, data observed in the Cree community of Eastmain and Wemindji were in the expected range. This CVD risk factor tended to be associated with obesity and high fasting glucose.

The use of inflammatory markers as part of a risk stratification strategy is highly debatable (Hackam and Anand 2003). Based on the current evidence, the association between inflammation markers, atherosclerosis and risk factors of CVD might best be used to assess the underlying degree of inflammation along with subclinical atherosclerosis, rather than to predict the future risk of cardiovascular disease. The high prevalence of obesity observed may explain the inflammation states of the Cree population, as excess weight was shown to be a trigger for the inflammatory mechanism (Balletshofer *et al.*, 2005) Hypothetically, such chronic inflammatory states could lead to rapidly increased CIMT and the development of cardiovascular events. Therefore, a plan of action should be quickly devised and initiated in order to protect the Cree population from the westernized cardiovascular disease "pandemic".

5.4.2 Obesity a significant risk factors for type 2 diabetes (T2D)

5.4.2.1 Estimated prevalence of obesity, insulin levels and other risk for T2D

In this study, obesity was defined according to BMI (BMI $\geq$ 30kg/m^2) and waist circumference (WC: waist $\geq$102 cm in men and $\geq$88 cm in women). In Wemindji, the prevalence of obesity defined by BMI was 66.1% and 88.1% when WC-based (abdominal obesity; women 97.1% and men 78.6%). Whilst fat mass was higher in women (40.8 kg *versus* 34.9 kg), we also noted that fat-free mass (kg) was higher in men ($p < 0.0001$). Moreover, we did not observe an association between BMI and age ($p = 0.28$), independent of gender. In Eastmain the prevalence of BMI-based obesity was 71.4%, compared to 83.7% when WC-based (women, 96.7%; men, 71.0%). Moreover, for both genders, we did not observe an association between BMI and age ($p = 0.11$).

Obesity is recognized as a key role in the development of T2D. Thus, we examined its distribution in participants already diagnosed with T2D. In both communities visited, the great majority of participants with diabetes were obese (BMI $\geq$ 30 kg/m^2); 78.1% in Wemindji and 86.2% in Eastmain. Similarly in both communities, all (100%) participants who had blood glucose levels in the diabetes range ($\geq$7.0 mmol/L) and without previous mention of diabetes in their medical files were obese (BMI $\geq$ 30 kg/m^2).

Hyperinsulinemia is a known precursor to pre-diabetes and diabetes. We measured insulin concentration and analysed it based on BMI categories, gender and age (Table 5.4.11). In order to increase precision of this analysis, we merged the data from the three Cree communities visited to date (Mistissini, Eastmain and Wemindji). As observed in this table, higher insulin levels were observed in women across all BMI categories. Globally, insulin levels were positively associated with BMI in both adults and children ($p < 0.0001$).

Fasting insulin concentration was analysed according to glycaemia status, age and gender (Table 5.4.12). Generally, a positive gradient was observed between glycaemia and insulinemia. However, even those participants classified to have normal glycemia still have high levels of insulin (even children), and are at increased risk of developing diabetes.

Finally, information gathered in this study allowed us to estimate the prevalence of T2D in this sample of the population of both communities (Eastmain and Wemindji). T2D was evaluated in the following ways: 1) analysis of blood samples collected during the onsite research study clinical session; and 2), information collected in the medical files of participants. Participants were advised to fast for at least eight hours prior to blood sampling. Both blood glucose and insulin were evaluated. The Canadian Diabetes Association's cut-off levels were used to classify the study population according to blood glucose levels (see Tables 5.4.13A,B) (Canadian Diabetes Association Clinical Guidelines Expert Committee, 2008).

Through blood sampling, we found that 13.4% of adults in the sample population of Wemindji had a blood glucose level in the diabetes range (≥7.0 mmol/L) (Table 5.4.13A) of which 74.1% had already been diagnosed (recorded in the medical file). In Eastmain (Table 5.4.13B) 20.2% of the sample of adult population had a blood glucose level in the diabetes range (≥7.0 mmol/L), of which 84.5% had already been diagnosed.

TABLE 5.4.11 INSULIN CONCENTRATIONS (PMOL/L) BY GENDER AND AGE ACCORDING TO BMI IN ALL 3 CREE COMMUNITIES VISITED

BMI (kg/m^2)	Female 8-18 years Median[b] [IQR] n = 38		Female 18-39 years Median[b] [IQR] n = 147		Female ≥40 years Median[b] [IQR] n = 92		Male 8-18 years Median[b] [IQR] n = 34		Male 18-39 years Median[b] [IQR] n = 101		Male ≥40 years Median[b] [IQR] n = 72	
<24.9 kg/m^2	[a]98.0	[16.0] (n = 13)	93.0	[52.5] (n = 12)	78.0	[55.0](n = 5)	77.0	[51.0] (n = 15	54.5	[18.0](n = 22)	66.5	[49.0](n = 10)
25-29.9	[a]121.0	[49.0] (n = 3)	105.0	[196] (n = 28)	116.5	[70.5](n = 24)	106.5	[126.0] (n = 8)	68.5	[46.0](n = 26)	130.0	[141.0](n = 13)
≥30 kg/m^2	[a]237.0	[229.0] (n = 22)	174.5	[109] (n = 106)	176.0	[167.0](63)	185.0	[193.0] (n = 10)	133.0	[107.0](n = 53)	155.0	[89.0](n = 49)

a. BMI categories were age- and gender-adjusted according to CDC growth charts. The CDC Expert committees' recommendations are to classify BMI-for-age between the 85th and 95th percentile as at risk of overweight (second BMI category in the table), and at or above the 95th percentile as overweight (last BMI category in the table).

b Due to the large distribution of the variable we decided to present the median and their IQR interquartile range (difference between the 25 and the 75th percentile)

NA = not applicable

TABLE 5.4.12 INSULIN CONCENTRATIONS (PMOL/L) BY GENDER AND AGE ACCORDING TO BLOOD GLUCOSE CATEGORIES IN ALL 3 CREE COMMUNITIES VISITED

Blood fasting glucose	Female 8-18 years Mean[a] [95% CI] n = 72		Female 18-39 years Mean[a] [95% CI] n = 147		Female ≥40 years Mean[a] [95% CI] n = 88		Male 8-18 years Mean[a] [95% CI] n = 54		Male 18-39 years Mean[a] [95% CI] n = 101		Male ≥40 years Mean[a] [95% CI] n = 72	
Normal (<6.1 mmol/L)	121.0	[141.0] (n = 61)	146.5	[101.5](n = 120)	114.5	[76.0](n = 42)	98.0	[105.0](n = 47)	99.5	[75.0](n = 90)	125.0	[100.0](n = 41)
suspected IFG (6.1-6.9 mmol/L)		-	209.0	[147.5](n = 12)	172.0	[99.0](n = 21)	77	(n = 1)	212.0	[259.0](n = 8)	148.0	[207.5](n = 8)
suspected DM (≥7.0 mmol/L)	576.0	[682.0](n = 2)	205.5	[145] (n = 14)	197.0	[100.0](n = 29)	-	-	154.0	[187.0](n = 3)	184.0	[89.0](n = 23)

a. Due to large distribution of the variable, we decided to present the median and their IQR interquartile range (difference between the 25 and the 75th percentile).

TABLE 5.4.13A PREVALENCE (%) OF CHART DIAGNOSIS OF T2D AND FASTING GLUCOSE AND INSULIN LEVELS AMONG ADULTS (18 YEARS AND OVER) IN OUR SAMPLE FROM WEMINDJI

Variables	Total (n = 137)[a]	Male (n = 63)[a]	Female (n = 74)[a]
T2D recorded in medical file only % (n)[b]	17.3 (33)	18.6 (12)	16.0 (11)
Fasting glucose			
(<6.1 mmol/L) %	77.8	77.7	77.9
(6.1-6.9 mmol/L) %	8.8	7.7	9.8
(≥7.0 mmol/L) %	13.4	14.6	12.3
Hyperinsulinemia: %			
>90 pmol/L	71.8	62.1	81.1

a. Numbers are presented for information only, as all analyses are weighted.

b. Estimated prevalence is the sum of T2D diagnosis in the medical file plus people with fasting glucose (≥7.0 mmol/L) without any mention of T2D in their medical file; DM: diabetes mellitus; Impaired fasting glucose (IFG); Impaired glucose tolerance (IGT)

TABLE 5.4.13B PREVALENCE (%) OF CHART DIAGNOSIS OF T2D AND FASTING GLUCOSE AND INSULIN LEVELS AMONG ADULTS (18 YEARS AND OVER) IN OUR SAMPLE FROM EASTMAIN

Variables	Total (n = 98)[a]	Male (n = 37)[a]	Female (n = 61)[a]
T2D recorded in medical file only% (n)[b]	17.3 (29)	23.0(8)	35.6(21)
Fasting glucose (n = 183) Normal (<6.1 mmol/L)	66.5	70.0	62.9
suspected IFG (6.1-6.9 mmol/L) %	13.3	13.3	13.4
suspected DM (≥7.0 mmol/L) %	20.2	16.8	23.7
Hyperinsulinemia: % >90 pmol/L	78.2	68.2	88.1

a. Numbers are presented for information only as all analyses are weighted.

b. Estimated prevalence is the sum of T2D diagnosis in the medical file plus people with fasting glucose (≥7.0 mmol/L) without any mention of T2D in their medical file; DM: diabetes mellitus; Impaired fasting glucose (IFG); Impaired glucose tolerance (IGT)

5.4.2.2 Discussion on main determinants of T2D

We observed that 66% and 71% of participants were obese in Wemindji and Eastmain, respectively. Rates of abdominal obesity defined by waist circumference were also alarmingly high. These obesity proportions are higher than in the Inuit (22%) (Dewailly *et al.,* 2007) and in the general Canadian population (14%) (Mongeau *et al.,* 2005). In our study, we also observed elevated plasma insulin concentrations, particularly in women and young girls. Similar levels of fasting insulin have been reported

in girls from an Oji-Cree community in north-western Ontario (median of 101.0 pmol/L and an IQR of 88 pmol/L) (Retnakaran *et al.,* 2006). This observation in children from both communities is of particular concern since hyperinsulinemia and obesity in children can predict CVD and diabetes in adulthood (Retnakaran *et al.*, 2006). In light of these results, we recommend that community-based intervention programs be intensified in order to address the high prevalence of these metabolic risk factors in Cree children.

The small sample size of this study limits our ability to do extensive statistical analyses that would allow a better understanding of observations obtained here. Moreover, it is important to keep in mind that conclusions drawn here are only applicable to the communities visited namely Wemindji and Eastmain. Nevertheless, these findings are consistent with diabetes screenings in these Cree Communities (Kuzmina *et al.*, 2008), specifically 17% *versus* 16.3% (Wemindji) in our *Nituuchischaayihtitaau Aschii* study, and 21.4% *versus* 28.3% (Eastmain). The relatively low response rate in our study has likely introduced selection bias, and may explain the small discrepancy between these two assessments.

As observed in other studies (Brassard *et al.* 1993; Harris *et al.,* 1997), including a previous study in the same Cree Communities (Dannenbaum *et al.* 2008), women have a higher prevalence of T2D than men. Our results show that Cree women also have a higher prevalence of diabetes risk factors, such as obesity and hyperinsulinemia. Tentative explanations include a higher rate of obesity among women and possibly genetic susceptibility (Pollex et *al.*, 2006). Nevertheless, these results imply that a particular effort should be made to focus prevention programs to young women and girls.

In conclusion, the alarmingly high rates of hyperinsulinemia, even in the presence of normal glucose, highlight the significant morbidity associated with the high rates of obesity documented in this study. An intensification of programs already implemented is needed to reduce obesity in Cree adults and children in Wemindji and Eastmain. Considering the influence of obesity as a risk for developing T2D and the associated macrovascular complications, we can anticipate that CVD is likely to increase in the future.

5.4.3 Endocrine parameters and bone ultrasound measurements

5.4.3.1 Prevalence of thyroid disorders

Among participants 15 years old and over, the prevalence of diagnosed hypothyroidism as recorded in the medical file was 1.8% in Wemindji and 2.9% in Eastmain. The prevalence by gender of hypothyroidism is presented in Table 5.4.14. Undiagnosed cases of hypothyroidism (TSH > 4.5 mIU/L, free T4 < 8 pmol/L) were not revealed in the course of the present study.

The prevalence of previously diagnosed hyperthyroidism as recorded in the medical file was 0.6% in Wemindji and 0.7% in Eastmain. No men have been diagnosed with hyperthyroidism in these communities (Table 5.4.15). Only one undiagnosed case of clinical hyperthyroidism was revealed from the study (TSH < 0.1 mIU/L, free T4 > 22 pmol/L).

TABLE 5.4.14 PREVALENCE OF DIAGNOSED[A] HYPOTHYROIDISM IN PARTICIPANTS FROM WEMINDJI AND EASTMAIN (≥15 YEARS OF AGE)

	Wemindji		Eastmain	
	N	Percentage (n)	N	Percentage (n)
Women	77	1.3% (2)	70	5.7% (4)
Men	65	1.5% (1)	41	0.0

A. Diagnosis was obtained from medical chart

TABLE 5.4.15 PREVALENCE OF DIAGNOSED[A] HYPERTHYROIDISM IN PARTICIPANTS FROM WEMINDJI AND EASTMAIN (≥15 YEARS OF AGE)

	Wemindji		Eastmain	
	N	Percentage (n)	N	Percentage (n)
Women	77	1.3% (1)	70	1.4% (1)
Men	65	0.0	41	0.0

A. Diagnosis was obtained from medical chart

Table 5.4.16 lists the prevalence of subclinical hypothyroidism by gender in participants from both communities. These were individuals with a TSH level above 4.5 mIU/L and a free T4 concentration higher than 8 pmol/L, and who had not previously been diagnosed with overt thyroid disease. In Wemindji, the prevalence of subclinical hypothyroidism in men was 6.2% and 3.9% in women; and 4.9% (men) and 8.6% (women) in Eastmain. No participant had thyroid parameter results indicative of subclinical hyperthyroidism (TSH < 0.1 mIU/L, free T4 < 22 pmol/L). Subclinical and clinical hypothyroidism and hyperthyroidism are risk factors for hyperlipidemia, hypercholesterolemia, hyperhomocysteinemia, atrial fibrillation, cardiac dysfunction, osteoporosis and neuropsychiatric diseases (Braverman & Utiger, 2005; Surks *et al.,* 2004).

TABLE 5.4.16 PREVALENCE OF UNDIAGNOSED SUBCLINICAL HYPOTHYROIDISM IN WEMINDJI AND EASTMAIN PARTICIPANTS (≥15 YEARS OF AGE)

	Wemindji		Eastmain	
	N	Percentage (n)	N	Percentage (n)
Women	77	3.9% (3)	70	8.6% (6)
Men	65	6.2 (4)	42	4.9% (2)

Iodine status is the most immediate measure of whether the thyroid gland has adequate iodine to function normally and protect the individual from the manifestations of iodine deficiency. The median urinary iodine concentration best reflects population status and is the indicator most commonly assessed (WHO, 2007). Figure 5.4.4 shows the frequency distribution of urinary iodine concentrations in residents of Eastmain and Wemindji. According to the WHO (2007), the median urinary iodine concentration in the general population should be within the range 100–199 µg/l. The median concentration in the two Cree communities was 116 µg/L, and therefore there is no iodine deficiency at the population level. Participants with goitre, diagnosed hyperthyroidism or hypothyroidism (as recorded in the medical file) were excluded from this analysis. Percentages of participants from the two commutities belonging to the five categories of iodine status are presented in Table 5.4.17. In both communities combined, 10.3% of the population had a moderate-to-severe deficiency in iodine (<50 µg/L). In the USA, data from 2003-2004 NHANES indicate that 11.3% of the 2526 participants had a concentration below 50 µg/L (Caldwell *et al.,* 2008). In Wemindji and Eastmain, 7.4% of participants had excessive levels (>300 µg/L). Three individuals had a urinary iodine concentration exceeding 500 µg/L. The major epidemiological consequence of iodine excess is iodine-induced hyperthyroidism (IIH) (WHO, 2007). This occurs more commonly in older subjects with pre-existing nodular goitres, and may occur even when iodine intake is within the normal range.

Clinical hyperthyroidism was found in 2.3% (6/258) of women and 0.5% (1/184) of adult male participants in the 3 communities visited since the beginning of the study. The expected prevalence of hyperthyroidism in women ranges 0.5% to 2%, and women are more affected than men (10-fold higher prevalence) (Canaris *et al.,* 2000; Hollowell *et al.,* 2002; Hoogendoorn *et al.,* 2006; Vanderpump *et al.,* 1995*)*. Although the prevalence of this disorder in these 3 Cree communities appears to be slightly above the range reported in other populations, no conclusion can be reached at this time due to the small number of participants.

In geographical areas where there is no iodine deficiency, the prevalence of hypothyrodism varies between 1% and 2% in women; the prevalence in men is 10-fold lower than in women (Canaris *et al.,*

2000; Hollowell *et al.,* 2002; Vanderpump *et al.,* 1995). In the three communities visited up to now (Mistissini, Wemindji and Eastmain), the prevalence of clinical hypothyroidism was 4.7% (12/258) in women and 1.6% (3/184) in men. Therefore it appears that the prevalence of overt hypothyroidism is higher than expected in men and women in these Cree communities. Again, because the total number of participants is small, one should await the completion of our study in all communities before drawing conclusions about the prevalence of thyroid disorders in this population.

In this survey, criteria used in defining subclinical and clinical forms of hypothyroidism were based on population-based reference intervals and not on clinical criteria. From a clinical point of view, other information such as the presence of symptoms and quantified anti-peroxidase antibodies (TPOAb; a thyroid antibody known as a risk factor for hypothyroidism) would have been useful in classifying subclinical and clinical hypothyroidism cases. Unfortunately, these data were not collected during the survey.

The prevalence of subclinical and clinical hypothyroidism and hyperthyroidism obtained in the framework of this survey should be analysed with caution since information on several factors influencing thyroid hormone concentrations were not available. These factors include use of thyroid medication, pregnancy, level of thyroid antibodies (TPOAb and thyroglobulin autoantibodies), presence of other thyroid disorders, estrogen, androgen and lithium use. Measurements of thyroid antibodies would be necessary in order to adequately estimate the prevalence of thyroid disorders in the Cree communities.

FIGURE 5.4.4 FREQUENCY DISTRIBUTION (NUMBER OF INDIVIDUALS, N) OF URINARY IODINE CONCENTRATIONS IN WEMINDJI AND EASTMAIN PARTICIPANTS (≥15 YEARS OF AGE)

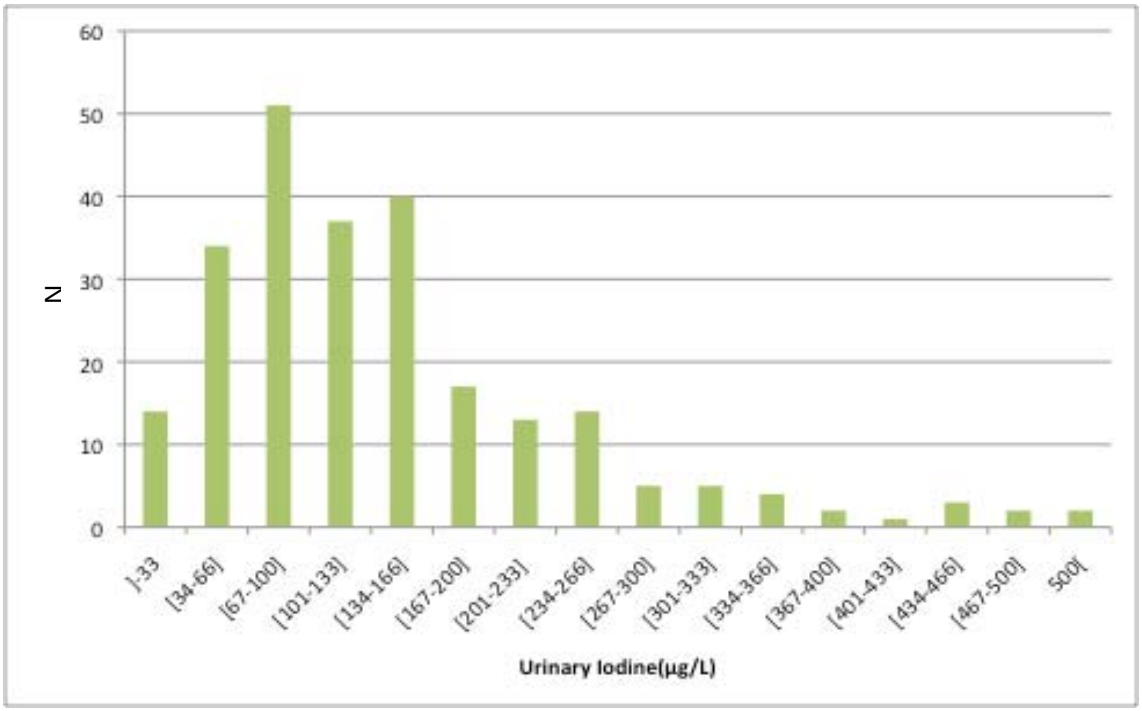


TABLE 5.4.17 IODINE STATUS IN WEMINDJI AND EASTMAIN PARTICIPANTS (≥15 YEARS OF AGE) ACCORDING TO URINARY IODINE CONCENTRATIONS (µG/L)

		Percentage in each iodine status category				
	N	**Moderate to severe deficit**	**Mild deficit**	**Optimal level**	**More than adequate**	**Excessive**
		<20-49 µg/L (n)	50-99 µg/L (n)	100-199 µg/L (n)	200-299 µg/L (n)	>300 µg/L (n)
Wemindji	137	11.7 (16)	32.6 (45)	36.2 (50)	13.0 (18)	5.8 (8)
Eastmain	106	12.3 (13)	22.6 (24)	42.4 (45)	13.2 (14)	9.4 (10)

5.4.3.2 Osteoporosis: risk factors for osteoporotic fractures among peri- and post-menopausal *Eeyou* women

Osteoporotic fractures are the major cause of disabilities among menopausal women (Orcel, 1995; Saag and Guesens, 2009; Waugh et al. 2009). The risk of osteoporotic fractures and the associations between ultrasound bone parameters, lifestyle and environmental factors, among peri- and post-menopausal *Eeyou* women were evaluated.

The target study group within the *Eeyou* study participants consisted of 37 women each from Wemindji and Eastmain. The mean ages were 48 (Wemindji) and 45 (Eastmain). At time of the study, none were using hormonal replacement therapy (HRT). Thirty five percent of the women in Wemindji and 49% in Eastmain were smokers. Moreover, 55% (Wemindji) and 84% (Eastmain) of them walked less than one hour per day.

The quantitative ultrasound parameters (QUS) parameters were measured at the right calcaneum (data not shown). Mean values for Broadband Ultrasound Attenuation (BUA), Speed of Sound (SOS), and Stiffness Index (SI) were respectively 118 dB/MHz (standard deviation, SD = 15), 1 545 m/sec, (SD = 44) and 91% (SD = 20) in the Wemindji women; and 123 dB/MHz (SD = 15), 1 554 m/sec, (SD = 33) and 97% (SD = 18) in Eastmain.

The T-score (data not shown) of the Wemindji women showed that 59.5% had low risk of osteoporotic fracture (T score), 37.8% had a moderate risk, and 2.7% a high risk. In Eastmain, 67.6% had low risk of fracture, 32.4% (moderate) and none were in the high risk group. The Z-score, which is the age-matched comparison, showed that 89.2% of the Wemindji women had a low risk of osteoporotic fracture *versus* 81.1% of the Eastmain women (data not shown).

We also tested relations between quantitative ultrasound parameters (QUS) and selected risk factors for osteoporosis and noted that the women who had reached menopause, and were consequently older, had lower values of all three QUS parameters compared to their respective counterparts (Table 5.4.18).

Age was the major risk factor that explained roughly 31.4% of the ultrasound measurement variations. This is consistent with published findings.

Other known risk factors such as calcium and vitamin D intake, anthropometric measurements, body weight, and the use of certain drugs, will be investigated in more detail later, as well as the effect of exposure to environmental chemicals. This is to be done in a multivariate analysis once the data from all the other *Eeyou* communities visited become available

TABLE 5.4.18 UNIVARIATE ANALYSES OF RELATIONSHIPS BETWEEN QUANTITATIVE ULTRASOUND MEASUREMENTS AND SELECTED RISK FACTORS FOR OSTEOPOROSIS IN 74 PERI- AND POST-MENOPAUSAL *EEYOU* WOMEN (WEMINDJI AND EASTMAIN COMMUNITIES)

Wemindji (n = 37)			
	BUA (dB/MHz)	**SOS (m/sec)**	**Stiffness index (%)**
	Mean (95% CI) *	**Mean (95% CI)***	**Mean (95% CI)***
Smoking habits			
Smoker (n = 13)	117.6 (108.1-127.1)	1539.6 (1513.2-1565.9)	89.5 (76.7-102.2)
Former smoker (n = 22)	119.1 (112.8-125.4)	1552.6 (1533.3-1571.9)	94.0 (85.1-102.8)
Never smoker (n = 2)	104.0 (94.7-113.3)	1500.7 (1283.4-1717.9)	69.5 (-0.4-139.4)
Menopause			
Yes (n = 19)	112.4 (105.5-119.3)	1531.2 (1511.4-1551.0)	83.5 (74.5-92.6)
No (n = 18)	123.4 (117.0-129.9)	1560.0 (1538.9-1581.1)	99.0 (89.4-108.6)
Oral contraceptive use			
Yes (n = 2)	127.3 (95.5-159.0)	1584.1 (1235.2-1932.9)	108.0 (31.8-184.2)
No (n = 35)	117.2 (112.1-122.3)	1543.0 (1528.1-1557.9)	90.1 (83.1-97.1)
Walking (hours per day)			
≤1 (n = 17)	122.1 (116.2-128.0)	1549.5 (1527.0-1572.0)	95.2 (85.7-104.6)
>1 (n = 14)	119.5 (110.6-128.4)	1559.1 (1535.5-1582.7)	96.0 (84.5-107.5)
Eastmain (n = 37)			
	BUA (dB/MHz)	SOS (m/sec)	Stiffness index (%)
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
Smoking habits			
Smoker (n = 18)	124.1 (116.5-131.6)	1548.3 (1533.5-1563.1)	96.1 (87.2-104.9)
Former smoker (n = 17)	122.1 (113.8-130.3)	1562.1 (1543.3-1580.8)	98.7 (88.5-108.9)
Never smoker (n = 2)	113.3 (38.4-188.2)	1534.8 (1249.7-1819.9)	85.0 (-42.1-212.1)
Menopause			
Yes (n = 15)	117.2 (109.4-125.1)	1542.1 (1524.6-1559.5)	89.9 (80.1-99.7)
No (n = 22)	126.2 (119.6-132.9)	1562.0 (1547.5-1576.5)	101.3 (93.4-109.2)
Oral contraceptive use			
Yes (n = 7)	130.0 (120.1-139.9)	1562.6 (1535.0-1590.2)	104.0 (90.1-117.9)
No (n = 30)	120.8 (115.0-126.7)	1551.9 (1539.1-1564.6)	95.0 (87.9-102.0)
Walking (hours per day)			
≤1 (n = 31)	123.0 (117.7-128.3)	1553.8 (1541.4-1566.1)	96.9 (90.3-103.6)
>1 (n = 6)	120.2 (99.3-141.0)	1554.7 (1519.5-1589.9)	95.3 (72.3-118.3)

* CI = confidence interval

6. SEROPREVALENCE OF TEN ZOONOTIC DISEASES IN EASTMAIN AND WEMINDJI

6.1 Synopsis and Introduction

Cree populations are likely to be exposed to zoonotic agents due to their close interactions with wildlife. We assessed the seroprevalence for ten zoonotic infections in Eastmain and Wemindji. Overall, there was no statistical difference between the two communities. *Leptospira sp.* seroprevalence (23%) was higher than that found in previous studies in other parts of Quebec. However, *Toxoplasma gondii* seroprevalence (6%) was lower than in other regions of Northern Quebec and many industrialized countries. The seroprevalence of *Francisella tularensis* (17%, titer >1/20) was comparable to a previous study conducted in Nunavik and higher than in Southern Quebec. *Coxiella burnetii* seroprevalence (1%) was comparable to rates among Inuit population of Northern Quebec, but lower than that already documented for a Southern Quebec population. This is the first time that seroprevalence data is presented for the California serogroup viruses (Jamestown Canyon and snowshoe hare) in Northern Quebec (10%). No evidence of Sin Nombre virus exposure was found in Eastmain-Wemindji (0%). The other zoonoses *(E. granulosus, T. canis and Trichinella sp.*) had a prevalence of less than 5%, comparable to the seroprevalence previously estimated in other parts of Northern Quebec. The design of the study was dedicated to verify past exposures to the pathogens investigated without knowing if clinical manifestations of disease were present. A review of the medical records of seropositive individuals revealed some consultations for illnesses possibly related to these zoonoses, but no major morbidity. Considering the potential for exposure, it would be of value to inform clinicians and the population about the zoonotic diseases, especially those in close contact with fauna.

Eastmain and Wemindji are Cree communities of 592 and 1178 residents respectively, and are located on the eastern shore of James Bay, Quebec, Canada. Local residents have close contact with the local fauna. The boreal forest, mainly composed of black spruce and larch, surrounds the communities and the area is rich in wetlands and lakes. It is recognized for its diversity in waterfowl as well as the abundance of mosquitoes in the summer. Goose hunting is an important traditional activity in the fall (Wemindji Cree Nation, 2006; Delormier and Kuhnlein, 1999).

The traditional diet consists of fish, large and small game, a variety of waterfowl, and plant food from the local environment (Schaeffer, 1977). Changes in lifestyle and diet have been reported over recent decades, moving from traditional to market foods (Delormier and Kuhnlein, 1999). Exposure to wildlife and some dietary practices are likely risk factors for exposure to various zoonotic agents. Previous studies have documented zoonotic agent exposure among Cree trappers (Lévesque et al., 2007), and other populations from Northern Quebec (Tanner et al., 1987; Messier et al., 2007). This study presents the seroprevalence of ten zoonotic infections in the general population of Eastmain and Wemindji.

6.2 Material and methods

6.2.1 Data collection

In the summer of 2007, people from Eastmain and Wemindji were asked to answer three questionnaires (individual questionnaire (demographics and lifestyle), wildlife and zoonosis exposure, traditional food frequency) as part of the "Multi-Community Environment-and-Health Longitudinal Study in *Eeyou Istchee*". It is a survey designed to gather social and health information on a variety of themes including different health indicators, standardized physical measurements, and social, environmental and living conditions. The participants constituted a random sample that represented the population of each community.

After obtaining written informed consent, the questionnaires were administered to participants (see Appendix 1) and blood samples were collected. Only samples for participants 15 years and older were used to test for antibody responses to ten zoonotic infections. The pathogens evaluated included three bacteria *(Coxiella burnetii*, *Francisella tularensis* and *Leptospira* sp.), three viruses [Sin Nombre virus, California serogroup viruses – Jamestown Canyon (JC) and snowshoe hare (SSH) viruses], and four parasites (*Trichinella* sp., *Toxoplasma gondii*, *Toxocara canis* and *Echinococcus granulosus*). A total of 251 participants were included in the zoonosis project.

6.2.2 Laboratory blood tests

Immunoenzymatic methods (ELISA) were used for the detection of IgG antibodies against *Trichinella sp*., *T. canis*, *E. granulosus* (IVD Research Inc, Carlsbad, CA), *T. gondii* (AxSYM, Abbott Diagnostics, Abbott Park, IL), *Leptospira sp*. and *C. burnetii* (Virion/Serion, Serion Immundiagnostica GmbH, Würzburg). ELISA assays were also used as previously described for the detection of IgG and IgM specific for the Sin Nombre virus (Feldmann et al., 1993) and for the California serogroup viruses (JC and SSH) (Martin et al., 2000; Johnson et al., 2000). For the California serogroup viruses, the presence of JC or SSH specific antibody was confirmed in ELISA positive samples by a plaque reduction neutralization test (PRNT). The detection of antibodies against *F. tularensis* was assessed by means of a tube agglutination test (Snyder, 1980; Stewart, 1981). Table 6.1 lists the criteria used to interpret the results and the estimated persistence of antibodies for each serology. For technical reasons, not all tests were performed on all samples (e.g. insufficient amount of serum, or sample was not received in the laboratory).

TABLE 6.1 CRITERIA FOR THE INTERPRETATION OF SEROLOGIC ANALYSES AND ESTIMATED ANTIBODIES PERSISTENCE FOR TEN ZOONOTIC INFECTIONS (FROM LÉVESQUE ET AL., 2007 UNLESS OTHERWISE INDICATED)

Pathogens	Criteria			Antibodies persistence
	Negative	Equivocal	Positive	
Optical density				
Trichinella sp.	<0.25	≥0.25 to <0.35	≥0.35	9-18 months
Toxocara canis	<0.25	≥0.25 to <0.35	≥0.35	Unknown
Echinococcus granulosus	<0.35	≥0.35 to <0.45	≥0.45	Possibly life-long
Sin Nombre Virus (IgG-IgM), serum diluted 1/400	<0.30	≥0.30 to <1.0	≥1.0	Possibly >10 years
Units IgG (IU/ml)				
Leptospira sp.	<5	≥5 to ≤9	>9	6 months – >20 years[1]
Coxiella burnetii	<20	≥20 to <30	≥30	~ 5 years[2]
Toxoplasma gondii	<2	≥2 to <3	≥3	Life-long
Titer				
Francisella tularensis	<1/20	-	≥1/20	>10 years[3]
California serogroup [4] (IgG-IgM), serum diluted 1/400	<1/20	-	≥1/20	>5 years [5]

1. Faine (1998)
2. Virion/Serion, Serion Immundiagnostica GmbH, Würzburg
3. Young et al. (1969)
4. Serology tested for snowshoe hare (SSH) and Jamestown Canyon (JC). These are titres that correspond to the confirmatory serology (plaque reduction neutralization tests) carried out on the samples.
5. Tsai (1991)

6.2.3 Medical records review

The medical records were reviewed for the last five years for people who had a positive serology for *C. burnetii*, *Leptospira* sp. and *Trichinella* sp.; and for the last ten years for those with positive serologies for *F. tularensis*, the three parasites (*T. canis, T. gondii and E. granulosus*) and the California serogroup viruses (SSH and JC).

6.2.4 Statistics

The frequency distribution of the seroprevalence data for the ten pathogens was calculated for all the data and stratified by community. A "zoonoses" variable was created to describe people positive for any of the ten pathogens tested. For this variable, and for pathogens that had high enough seroprevalence to provide statistically valid results, univariate logistic regression analyses were conducted to verify the relation between positive serologies and different variables (community, age, gender, pet animal at home,

exposure to wildlife, schooling). Equivocal values were grouped with the negative results. Age, gender and all other variables related to seropositivity ($p \leq 0.1$) were included in a stepwise multivariate logistic regression model to control the confounding variables. To test the co-linearity between the "age" and "hunting" variables, a co-linearity test was also carried out.

6.3 Results

6.3.1 Population studied

Of the 251 participants who provided blood samples for the study, 140 were from Wemindji and 111 from Eastmain. There were 76 women (mean age = 37.75 and median = 34.5) and 64 men (mean age = 42.61 and median = 38) in Wemindji, and 70 women (mean age = 35.77 and median = 36) and 41 men (mean age = 35.88 and median = 34) in Eastmain.

6.3.2 Prevalence of infections

There was no statistical difference in the prevalence of the infections between the two communities, therefore the statistical analyses were conducted on the combined sample. A total of 59 participants (28 men, 31 women) tested positive for at least one pathogen in Wemindji and 54 participants (28 men, 26 women) did so in Eastmain. The most prevalent pathogens were *Leptospira sp*., *F. tularensis* and the California serogroup viruses for both communities. The prevalence results found in the study are summarized in Table 6.2. Concerning exposure to California serogroup viruses, 13 individuals (9%) were IgG-positive for either JC or SSH in Wemindji. In Eastmain, 11 participants (10%) had been exposed to JC or SSH based on IgG/PRNT antibody titres. The majority of confirmed California serogoup exposures were to JC viruses (12 in Wemindji, 7 in Eastmain). Two people were IgG-positive for both pathogens in Eastmain and in Wemindji one person was affected.

TABLE 6.2 RESULTS OF SEROLOGICAL ANALYSES FOR TEN ZOONOTIC INFECTIONS PERFORMED ON BLOOD SAMPLES OBTAINED FROM MEMBERS OF THE COMMUNITIES OF WEMINDJI (N = 140) AND EASTMAIN (N = 111)[1]

	Wemindji			Eastmain			Total		
Name	Pos.[2] n (%)	Neg.[2] n (%)	Equ.[2] n (%)	Pos. n (%)	Neg. n (%)	Equ. n (%)	Pos. n (%)	Neg. n (%)	Equ. n (%)
Bacterium									
Leptospira sp.	35 (25)	76 (55)	28 (20)	23 (21)	62 (56)	26 (23)	58 (23)	138 (55)	54 (22)
C. burnetii	3 (2)	128 (92)	8 (6)	1 (1)	106 (95)	4 (4)	4 (1)	234 (94)	12 (5)
F. tularensis	20 (14)	118 (86)	0	22 (20)	89 (80)	0	42 (17)	207 (83)	0
Parasite									
T. gondii	7 (5)	133 (95)	0	6 (5)	105 (95)	0	13 (5)	238 (95)	0 (0)
E. granulosus	4 (3)	134 (96)	2 (1)	5 (4)	103 (92)	3(4)	9 (4)	237 (94)	5 (2)
T. canis	2 (1)	138 (99)	0	6 (5)	104 (94)	1(1)	8 (3)	242 (96)	1 (1)
Trichinella sp.	2 (1)	135 (96)	3 (2)	0	110 (99)	1 (1)	2 (1)	245 (98)	4 (1)
Virus									
Sin Nombre virus	0	140 (100)	0	0	111 (100)	0	0	251(100)	0
California serogroup[3]	13 (9)	112 (80)	15 (11)	11 (10)	88 (79)	12 (11)	24 (10)	200 (80)	27 (10)

1. For technical reasons, some samples for certain pathogens were not analyzed (e.g., insufficient amount of serum, sample not received to the laboratory etc.).

2. Pos: positive, neg: negative, equ: equivocal.

3. Serology tested for snowshoe hare (SSH) and Jamestown Canyon (JC)

6.3.3 Review of the medical records

Among individuals seropositive for *F. tularensis* there were no documented cases of classical ulceroglandular disease during the preceding ten years. However, a 50-year-old woman was diagnosed with an atypical pneumonia and treated with antibiotics in 2004. There were three cases of people aged from 30 to 50 years who had conjunctivitis; one with recurrent episodes between 1998 and 2003; one who had an associated dacryocystitis; and another who had an episode of palpebral oedema in 2005. Six other people had pharyngitis. Three of them were treated with antibiotics (a 17-year-old in 2002, a 21-year-old in 2003, and a 30-year-old in 2006). The 21-year-old also had cervical adenopathy and a negative test for mononucleosis.

The medical records review did not reveal a classical case of hepatorenal failure in patients who were seropositive for *Leptospira* sp. One 35-year-old woman had an influenza-like illness for three weeks in 2003, and three patients had ocular pathology. A 29-year-old man had uveitis in 2004 and two patients had conjunctivitis (a 26-year-old woman in 2006 and a 29-year-old man in 2007).

Among those with positive serology for *C. burnetii,* we found one case of atypical pneumonia in a 33-year-old man in 2007. Of those with positive serology for California serogroup viruses (either JC or SSH), a 39-year-old man had an intense headache lasting 10 days in 2005.

For individuals with a positive serology for *E. granulosus*, none had typical symptoms or signs indicative of the disease after reviewing their medical file. However, these people were seen in a clinic by the health authorities as there is a possibility that silent cysts could form. Some had a few symptoms that were possibly compatible with an infection. Three out of nine had a past history of itchy cutaneous rash. Three had complained of occasional mild abdominal discomfort. Others had no symptoms at that moment. The only participant with a highly positive serology (optical density higher than 1) had a chest x ray and a liver ultrasound which did not reveal the presence of the infection. For *T. canis,* we have documented one 17-year-old woman with a history of eosinophilia in 2005-2006 as well as a 65-year-old woman in 2003 with the same history. These two people did not have any symptoms related to the *T. canis* infection. Finally, a 48-year-old man with a positive result for *Trichinella* sp. also had eosinophilia in 2002 with no classical symptoms of the disease; however he had been investigated for an abdominal pain that resolved without treatment in 2004. Files of patients with positive serology for *T. gondii* did not reveal the appearance of any relevant symptoms or signs.

6.3.4 Identification of potential risk factors

Univariate analysis

There were 5 variables significantly associated with seropositivity to the California serogroup viruses: age ($p = 0.025$), being male ($p = 0.013$), hunting ($p = 0.019$), and owning a dog ($p = 0.006$). A univariate analysis was not conducted on the other 8 pathogens as their seroprevalence was too low to obtain statistically valid results.

From all the variables examined, the only factors significantly associated with seropositivity for at least one pathogen ("zoonoses" variable) were: owning a dog ($p = 0.017$), being male ($p = 0.036$), and hunting ($p = 0.043$). Age was not a significant factor. None of the variables studied were significantly associated with *F. tularensis* or *Leptospira sp.* seropositivity.

Multivariate analysis

The multivariate logistic stepwise analysis identified risk factors associated with seropositivity to the California serogroup viruses and to testing positive for at least one pathogen (zoonosis) (see Tables 6.3 and 6.4). A test of colinearity between "hunting" and "gender" revealed a strong correlation between these variables ($R^2 = 0.454$ ($p < 0.0001$)). Therefore, they were treated in two separate models.

TABLE 6.3 RESULTS OF THE MULTIVARIATE LOGISTIC STEPWISE ANALYSIS SHOWING THE RELATIONSHIP BETWEEN SEVERAL VARIABLES AND SEROPOSITIVITY TO THE CALIFORNIA SEROGROUP VIRUSES (EASTMAIN AND WEMINDJI)

Variable	Details	Odds Ratio Point Estimate	95% Confidence interval	p-value
a. Variables: age, community, hunting and owning a dog				
Age		1.040	1.011- 1.070	0.006
Community	Eastmain vs. Wemindji	1.175	0.472- 2.923	0.729
Hunting	Hunt vs. no hunting	2.857	1.089-7.493	0.033
Owning a dog	Yes vs. no	6.072	2.018-18.274	0.001
b. Variables: age, community, gender and owning a dog				
Age		1.041	1.012- 1.071	0.005
Community	Eastmain vs. Wemindji	1.165	0.466- 2.916	0.744
Gender	Female vs. male	0.277	0.107- 0.722	0.009
Owning a dog	Yes vs. no	7.096	2.298-21.908	0.001

TABLE 6.4 RESULTS OF THE MULTIVARIATE LOGISTIC STEPWISE ANALYSIS SHOWING THE RELATIONSHIP BETWEEN SEVERAL VARIABLES AND SEROPOSITIVITY TO AT LEAST ONE OF THE TEN ZOONOTIC INFECTIONS INVESTIGATED (EASTMAIN AND WEMINDJI)

Variable	Details	Odds Ratio Point Estimate	95% Confidence interval	p-value
a. Variables: age, community, hunting and owning a dog				
Age		1.007	0.990-1.024	0.439
Community	Eastmain vs. Wemindji	1.489	0.880-2.520	0.138
Hunting	Hunt vs. no hunting	1.777	1.052-3.001	0.032
Owning a dog	Yes vs. no	2.848	1.210-6.706	0.017
b. Variables: age, community, gender and owning a dog				
Age		1.007	0.990-1.024	0.419
Community	Eastmain vs. Wemindji	1.438	0.853-2.424	0.172
Gender	Female vs. male	0.544	0.322-0.921	0.023
Owning a dog	Yes vs. no	3.040	1.289-7.169	0.011

6.4 Discussion

6.4.1 Summary

Of the ten infections tested, the highest seroprevalence rates were for *Leptospira sp*. (23%), *F. tularensis* (17%), and the California serogroup viruses (JC and SSH) (10%). A seroprevalence of 5% was estimated for *T. gondii* and of less than 5% for the 3 other parasites and *Coxiella burnetii*. Antibodies against the Sin Nombre virus were undetectable in this study population sample.

6.4.2 Related studies

Other zoonosis seroprevalence studies conducted in the past few years in Québec had different sampling, analytical or laboratory methods (Lévesque et al., 1995; Lévesque et al., 2007; Messier et al., 2007; Tanner et al., 1987). This makes seroprevalence comparisons challenging. Nevertheless, data from these previous studies help to estimate the relative importance of the data reported here.

A study conducted in the mid-1980s estimated seroprevalence for 5 zoonotic parasitic infections (*E. granulosus*, *Entamoeba histolytica, T. canis, T. gondii, Trichinella sp.*) in 18 Inuit and Cree communities of Quebec, using 2600 sera obtained from patients treated in two Quebec regional hospitals (Tanner et al., 1987). About ten years later (1995), another study measured seroprevalence for three bacterial zoonotic diseases (*F. tularensis, C. burnetii, L. interrogans* and serovars *bratislava, hardjo, icterohaemorrhagiae)* in the Québec City region. The sample was composed of trappers (n = 165) who were compared to an equal number of controls similar in age and location (Lévesque et al., 1995). A study conducted in 2004, in 14 Inuit communities of Nunavik examined the seroprevalence of eight zoonotic pathogens (*Brucella* sp., *C. burnetii*, *F. tularensis, Leptospira* sp., *E. granulosus*, *T. canis, T. gondii, Trichinella sp.)* in a randomly selected sample of 917 persons aged 18 to 74 (Messier et al., 2007). Finally in 2005, the seroprevalence for eight zoonotic infections (*C. burnetii*, *F. tularensis, Leptospira* sp., *E. granulosus*, *T. canis, T. gondii, Trichinella sp,* Sin Nombre virus) was determined on a sample of 28 women and 22 men composed of active trappers and their spouses in the Cree community of Mistissini (Lévesque et al., 2007).

6.4.3 Bacterial infections

There was a 17% seroprevalence (titer >1/20) for *F. tularensis* in Eastmain and Wemindji, which is comparable to the 18.9% prevalence found in Nunavik (Messier et al., 2007) but higher than the 2.4% prevalence found in the trappers of Southern Québec (or the 0.6% prevalence in controls from the southern Québec study) (Lévesque et al., 1995). On the other hand, it seems lower than the 26% prevalence found in Mistissini which had a selected study population that was heavily exposed to local fauna (Lévesque et al., 2007). In fact, trapping statistics (number and species of prey trapped) revealed a much greater exposure to wildlife in Mistissini than in the southern Quebec study, where trappers live in peri-urban areas and only practice trapping as a hobby

In Mistissini, *F. tularensis* seroprevalence was positively associated to the variable "fishing, hunting and trapping on land" (Lévesque et al., 2007). In Southern Québec, the association between hunting muskrat and *F. tularensis* seroprevalence was statistically significant (Lévesque et al., 1995). Tularemia transmission patterns may change over time. In Canada, contact with rabbits was the most common route of infection before the 1950s, while later, the water-living muskrat appeared to be of greater importance (Martin et al., 1982). Our study failed to identify risk factors for *F. tularensis* seroprevalence, but the comparable rates found in Nunavik for a sample of the general population and the higher prevalence obtained in Mistissini for a sample of trappers seem to indicate a link to exposure to fauna.

Although tularemia is a notifiable disease in Québec, no case has been declared on the Cree territory between 1990 and 2006 (Carlin, 2007). It is not uncommon for mild, rare diseases to go unnoticed by a passive surveillance system, especially if healthcare workers are unaware of it. Tularemia can occur in six different clinical forms depending on the route of entry of the bacteria in the body: ulceroglandular, glandular, oculoglandular, pharyngeal (oropharyngeal), typhoidal and pneumonic (Meric et al., 2008). *F. tularensis* subsp. *tularensis* (Jellison type A) and *F. tularensis* subsp. *holarctica* (Jellison type B) are the most common subspecies in human diseases (WHO, 2007). This latter subspecies is associated with relatively milder diseases than the former (Meric et al., 2008). A review of medical records revealed some cases of pharyngeal and conjunctival infections. In Turkey, most tularemia cases are oropharyngeal including an outbreak of 145 cases that was recently caused by *F. tularensis* subsp. *holartica* (Meric et al., 2008). The oculoglandular form is uncommon but it can occur (Steineman et al., 1999*)*. Pharyngitis and conjunctivitis are common diseases with multiple causes, and our current study design does not allow us to establish a causal relationship between the infection and the diseases. Because of the virtual absence of the classical clinical manifestations of tularemia documented in Mistissini (Lévesque et al., 2007), the Eastmain and Wemindji findings might indicate that the relatively non-virulent subspecies *holarctica* (type B) is responsible for seropositivity there. Our literature review did not find animal studies that would have estimated the distribution of the pathogen in animal populations.

Leptospira sp. had a higher seroprevalence in the present study (23%) than in other studies: Mistissini trappers (14%) (Lévesque et al., 2007), Nunavik (5.9%) (Messier et al., 2007), and Southern Québec (trappers: 9.1%; controls: 4.8%) (Lévesque et al., 1995). As in Mistissini (Lévesque et al., 2007*)*, the present study failed to identify risk factors that could explain *Leptospira sp.* seroprevalence. The higher prevalence found in a general population compared to trappers could indicate that the bacteria are found in the village vicinity rather than being related to wildlife as Lévesque et al. (2007) suggested. Rodents are well known vectors for *Leptospira sp*. Dogs are another possible source, as they are a known reservoir for leptospires and can be asymptomatic (WHO, 2003). The incidence of infections in domestic dogs has risen markedly in recent years in the United States and Canada (Brown and Prescott, 2008; Prescott et al.,

2002; Vincent, 2000). However, we did not find any association with the presence of a dog in the family. *Leptospira sp.* has also been reported in wildlife in northern regions such as wolves in Alaska and the Yukon (0 to 1% prevalence), or bobcats and lynxes (a few cases) in Québec (Labelle et al., 2000; Zarnke et al., 2004).

As for tularemia, no case of leptospirosis was declared for the population of Eastmain and Wemindji from 1990 to 2006 (Carlin, 2007). Few clinical manifestations were documented in the medical records of those seropositive for *Leptospira sp.*: one influenza-like illness, and three cases of ocular pathology including one case of uveitis were recorded. The incidence of ocular signs varies from 2 to 90% during the acute systemic phase of leptospirosis. However, ocular manifestations may be sub-clinical or overlooked (Rathinam, 2005).

The seroprevalence of *C. burnetii* (1%) was very low in Eastmain and Wemindji. This is much less than the 18% seroprevalence estimated in Mistissini, a population with a greater exposure to wildlife (Lévesque et al., 2007). In Nunavik*, C. burnetii* seroprevalence was less than 1% (Messier et al., 2007), almost similar to the percentage presented here for people living near James Bay.

In the southern Québec study, both the trappers and controls had a prevalence of 15%. No risk factors could be identified (Lévesque et al., 1995). This was surprising, as it implies a similar risk of infection for both trappers and the general population in southern Québec. The trappers in the latter study were people who used to trap during their leisure time, and were therefore less exposed to wildlife than Cree trappers like those in Mistissini who are heavily exposed to the fauna of the boreal forest. These data seem to demonstrate that the exposure to *C. burnetii* follows a South-North gradient in Québec.

A risk factor for *C. burnetii* is contact with infected animals primarily cattle, sheep and goats. The bacteria are excreted in urine, feces, and especially birth products (Marrie and Raoult, 2004). *C. burnetii* outbreaks in Québec have primarily been associated with cattle, sheep or goat farming, slaughterhouses or packing plants, which are absent from Quebéc's northern regions (Herbert et al., 1965; Lang, 1989; Vincent and Desjardins, 2001). This could explain the low prevalence found in our study and the higher prevalence in the south of the province, even for the general population more exposed to domestic animals. Moreover exposure to infected cats, a domestic animal extensively present in southern Quebéc, has also been demonstrated to be a major cause of Q-fever in the Mauricie region of Québec (Goyette, 1994; Dolcé et al., 2003), as well as and in Nova Scotia (Marrie et al., 2008). However, it is important to note that other species more related to wildlife such as racoons, skunks, and foxes can also be involved in the exposure to *C. burnetii* (Lévesque et al., 1995), which could explain the higher rates for Cree trappers in Mistissini.

No case of Q-fever was declared to the health authorities of the Cree territories for the period of 1990-2006 (Carlin, 2007). The medical records review revealed one case of atypical pneumonia in a man seropositive for *C. burnetii,* an infection which is often unrecognized (Marrie and Raoult, 2004). However, the low seroprevalence documented here indicates infrequent exposure for the populations of Eastmain and Wemindji, as already documented for people living in Nunavik (Messier et al., 2007).

6.4.4 Viral Infections

The presence of California serogroup viruses has been demonstrated in all provinces and territories in Canada (Artsob, 1990; Public health agency of Canada, 2007). SSH and JC are two of approximately 10 viruses classified under the California serogroup (Public Health Agency of Canada, 2007). JC and SSH viruses are considered to be emerging or newly recognized as medically-relevant viruses circulating in regions of Canada contiguous to Alaska (Walters et al., 1999).

We estimated a prevalence of 9-10% for JC and SSH viruses in Eastmain and Wemindji. The JC virus has been reported in Alaska and in several Canadian provinces including Québec (Artsob, 1990). Seroprevalence was observed in native populations of Alaska for the JC (6.5%) and SSH (3.5%) viruses, and for any of the California serogroup viruses tested (JC, SSH, INK-Inkoo) (21.8%). These rates are consistent with our findings.

There has been one symptomatic case of infection due to a California serogroup virus per year between 1978 and 1989 for a total of 20 cases in Canada; most of these were attributable to SSH virus (Meier-Stephenson et al., 2007). Encephalitis caused by arthropods is a notifiable disease in Québec. Again, there were no reported cases between 1990 and 2006 in the Cree territory (Carlin, 2007). The review of medical records of patients seropositive for California serogroup viruses in Eastmain and Wemindji showed that one person had an intense headache lasting a period of 10 days. This is a symptom that could be in related to a California serogroup virus infection.

California serogroup viruses are transmitted through mosquitoes and maintained through wildlife (Walters et al., 1999). Free-ranging mammals tested in Alaska had a 96.7% seroprevalence to at least one of the eight viruses tested (Walters et al., 1999). Elk (57%) in Michigan and moose (71%) from Ontario have been known to be seropositive to the JC virus (Grimstad et al., 1986). As well, white-tailed deer in Connecticut (Zamparo et al., 1997) and in other regions in North America are believed to be important amplification hosts for this virus. California serogroup viruses are known to infect a variety of animals including squirrels, chipmunks, hares, deer, moose, cattle, horse and swine (Public Health Agency of Canada, 2007).

The colinearity between two variables, hunting and being a male, did not allow for a statistical distinction between these factors for California serogroup viruses seropositivity (Table 6.3). Based on the mode of transmission of these viruses, it is likely that hunting is the true risk factor. It is difficult to explain the finding of an association between California serogroup virus seroprevalence and owning a dog. California serogroup viruses are known to infect a variety of mammals and it is not unlikely that dogs could also be infected. Nevertheless, the literature does not report dogs as a known carrier of the disease (Grimstad et al., 1986; Zamparo et al., 1997; Public Health Agency of Canada, 2007). There have been documented cases of viral encephalitis in dogs, but none attributed to the California serogroup viruses, which were not included in the emergent viral pathogens for dogs in Canada (Njaa, 2008). Moreover among the people who participated in our study, only 28 have declared owning a dog. Since the odds ratio for the owning-a-dog variable has wide confidence intervals (Table 6.3), we should be cautious in inferring the involvement of the dog as a vector.

In the Alaska study, significant risk factors for human exposure to California serogroup viruses were age category, ethnic-linguistic group, biotic province, climate zone, terrestrial vegetation, and presence of some ungulates and small mammals in communities (Walters et al., 1999). The presence of small mammals (voles, squirrels, hares), that can act as amplification/reservoir hosts, was a risk factor for SSH virus seroprevalence while the presence of moose in the village vicinity was found to be a risk factor for JC virus seroprevalence (Walters et al., 1999). The anticipated climate warming in northern regions including Quebéc could result in a longer breeding season and possibly a range expansion among mosquito vector species.

Cases of Hantavirus pulmonary syndrome (HPS) have been described in Quebec, Manitoba, Saskatchewan, Alberta and British Columbia (Drebot and Artsob, 2000; Lindsay et al., 2001; Webster et al., 2007; Drebot unpublished data). As of October 1, 2008, there have been 70 cases of HPS. However, only one case has been identified east of Manitoba (Quebec, Drebot, unpublished data). Of the four Hantavirus species implicated as etiologic agents of HPS in North America, Sin Nombre virus has been associated with the largest proportion of cases (Drebot and Artsob, 2000). Antibodies for Sin Nombre virus were not detected in the population of Eastmain and Wemindji, similarly to the findings in Mistissini (Lévesque et al., 2007), indicating no or infrequent exposure in the Cree communities for which we have data. Considering the potential severity of hantavirus infection, this is good news for the population and corresponds to the low numbers of HPS cases in eastern Canada.

6.4.5 Parasitic infections

T. gondii is found worldwide. Known risk factors include consumption of raw meat, unwashed foods or drinking contaminated water (Dubey, 2004). The prevalence of antibodies for *T. gondii* for the general

populations of Eastmain and Wemindji (6%) was of the same order of magnitude as the prevalence documented for trappers in the Mistissini study (10%) (Lévesque et al., 2007). Seroprevalence estimates of 10% or less are quite low (AFSSA, 2005). A survey, conducted from 1988 to 1994, for a representative sample of the US population of 27 145 persons aged ≥12 years, showed an age-adjusted seroprevalence of 22.5% (CI 95%: 21.1- 23.9) (Jones et al., 2001). The seroprevalence estimate for a recent representative sample of the Nunavik population was 59.8% (Messier et al., 2007). This difference in prevalence estimates between the Eastmain-Wemindji study and the Nunavik study may be explained by different dietary and culinary habits. Inuit regularly consume their meat raw, which increases the risk of exposure (Messier et al., 2007).

A toxoplasmosis outbreak, due to the contamination of the municipal water supply, caused 100 cases of acute toxoplasmosis and infected a few thousand people in Victoria, British Columbia (Bowie et al., 1997; Dubey, 2004). The water source was believed to be a possible risk factor to explain the high prevalence in Nunavik (Messier et al., 2007). Both Inuit and Cree populations may drink untreated water from adjacent watersheds. Therefore, the low prevalence found in Eastmain-Wemindji does not corroborate water as a toxoplasmosis source.

The low seroprevalence of *T. gondii* found in Eastmain and Wemindji is reassuring. Nevertheless, pregnant women should be aware of the pathogen, as it could have a serious health impact on the unborn child. However, for *T. gondii* as for the other parasites, we were unable to verify the influence of different risk factors due to the low seroprevalence.

The prevalences estimated in our study were 4% for *E. granulosus*, 3% for *T. canis* and 1% for *Trichinella sp.* This is comparable to the prevalence documented by Messier et al. (2007) in Nunavik (*E. granulosus*: 8.3%, *T.* canis: 3.9%, *Trichinella sp.*: 1%). Tanner et al. (1987) had previously estimated a prevalence of about 4%, 1% and 1% in Wemindji, and of 8%, 8% and 0% in Eastmain for *E. granulosus*, *T. canis* and *Trichinella sp.* respectively. The Mistissini study reported a prevalence of 0%, 4% and 0% for these same parasites (Lévesque et al., 2007).

In northern North America, *E. granulosus* is maintained in cycles involving wolves and dogs and moose and other cervids (Moro and Shantz, 2006). There are two types of *E. granulosus* infections: the pastoral variant which is transmitted via sheep as the intermediary host and the sylvatic variant for which the caribou or moose is an intermediary host (Somily et al., 2005). Molecular techniques allow one to distinguish the two forms (Somily et al., 2005). In areas where there are no sheep, it is assumed that it is the sylvatic variant (Somily et al., 2005).

Exposure to *E. granulosus* is generally due to the ingestion of eggs from dog feces, which can be present in the environment in soil, on plants or animals. The presence of a large number of dogs infected with *E. granulosus*, especially stray dogs, is a risk factor to echinococcosis emergence (Eckert and Deplazes, 2004). Again, low seroprevalence precluded the analysis of specific risk factors in Eastmain-Wemindji. However, considering the potential importance of dogs in the exposure to *E. granulosus*, we verified the owning of a dog in relation to seropositivity to this pathogen. Only one person out of nine seropositive for *E. granulosus* owned a dog.

Echinococcosis may remain asymptomatic for years and form cysts in the lungs, the liver or subcutaneous tissues (Public Health agency of Canada, 2001a). The sylvatic form of the disease seems to be more benign than the pastoral form (Somily et al., 2005). Pulmonary cysts are more common in children and young adults, while the hepatic cysts are more common in older people (Somily et al., 2005). Cyst rupture can have very serious consequences, especially in the pastoral form. The sylvatic variant is known to rupture without complications or anaphylaxis (Somily et al., 2005). Echinococcosis is not a notifiable disease in Québec. However, after a review of the literature, we found only one case of echinococcosis reported in the Cree territory in 1955 (Bégin et al., 1956*)*.

Seroprevalence of *T. canis* was low in Eastmain and Wemindji. An existing study of *T. canis* prevalence in dogs on First Nations settlements in the prairies and Northwest Territories in the 1970s revealed a very low prevalence (Unruh et al., 1973). *T. canis* prevalence was higher in puppies than in older dogs (Unruh et al., 1973). In the Eastmain-Wemindji study, some seroprevalent people had eosinophilia documented but none were of the typical symptoms usually associated with toxocariasis such as ocular problems or more rarely bronchitis or pneumonia associated with migrating larvae in the internal organs. However, only people over 15 years old participated in the study, and toxocariasis is more common in children.

Risk factors for *Trichinella sp.* in Northern Canada have been associated with consuming black bear or walrus meat (Public Health Agency of Canada, 2001b; McIntyre et al., 2007). Large outbreaks associated with consuming infected fermented walrus meat have occurred in Nunavik (Public Health Agency of Canada, 2001b).

Trichinellosis is a mandatory reportable disease and no confirmed cases have been reported from Cree territory between 1990 and 2006 (Carlin, 2007). However, there was one suspected case (personal communication, Dr. Rob Carlin, Cree Board of Health). The nature of the symptoms and the percentage of individuals who experienced them in a trichinellosis outbreak in the Arctic were the following: diarrhea (50%), muscle pain (47%), fatigue (47%), rash (32%), fever (17%) and edema (Public Health Agency of Canada, 2001b), all of which are non-specific symptoms. In our medical record review, a man had eosinophilia and was investigated for abdominal pain a few years ago, but this seems to have been resolved without treatment. The short time that antibodies persist for this infection might limit detection.

Our study revealed that being male, owning a dog and hunting were risk factors for testing positive for at least one infection (Table 6.4). As for California serogroup viruses data (Table 6.3), the variables "gender" and "hunting" were autocorrelated and cannot be presented in the same model. However, as already stated, considering the mode of transmission of these microorganisms, hunting is probably the best explanation for exposure. As for California serogroup viruses, it is difficult to explain the relationship with "owning a dog", but considering that only 28 people declared owning a dog, we should interpret these data with caution.

6.4.6 Concluding remarks

This study presents the seroprevalence of ten zoonotic infections in the general populations of Eastmain and Wemindji. As a whole, with the exception of *T. gondii,* the seroprevalences documented are of the same order of magnitude as those documented for the population of Nunavik (Messier et al., 2007) reflecting a relatively similar exposure. The discrepancies for *T. gondii* seroprevalence could probably be explained by differences in diet and food preparation. In comparison with trappers from Mistissini, the low seroprevalence for *C. burnetii,* indicating a lower exposure, is an interesting fact.

The seroprevalences documented for people from Eastmain and Wemindji were highest for *Leptospira* sp., *F. tularensis,* and California serogroup viruses. However no single case of these infections was identified during the period 1990-2006 in the Cree territories, and we did not find major morbidity in the medical files for these pathogens and the others investigated. Few cases of pharyngitis were identified in the medical files of people seropositive for *F. tularensis,* and a few cases of ocular pathologies were documented in the medical files for people seropositive for *F. tularensis* and *Leptospira* sp. The seroprevalence for *T. gondii* was lower than in other regions of northern Québec and many industrialized countries. The other parasitic zoonoses *(E. granulosus, T. canis and Trichinella sp.*) had a prevalence of less than 5% and no evidence of Sin Nombre virus exposure was found. As a whole these results are reassuring, but they also show that people from Eastmain and Wemindji (particularly hunters and trappers) are exposed to zoonotic infections.

6.5 Recommendations

Healthcare workers

- Considering the high exposure for Cree people to wildlife, and the non-specific character of many zoonoses, physicians should be aware of these infections in the population; particularly for those caused by *F. tularensis* and *Leptospira* sp., which seem to be more prevalent in the population of Eastmain and Wemindji.

- Considering the signs and symptoms found in the medical files of people seropositive for the different pathogens investigated, physicians could investigate for *F. tularensis* in persistent cases of pharyngitis and for *F. tularensis* and *Leptospira* in cases of severe ocular pathologies.

- Be careful about the messages that are given to the communities. The fear of zoonotic diseases should not prevent people from consuming traditional food.

Population level

- The population, particularly hunters and trappers who seem to be more at risk, should be made aware of the clinical features of different zoonotic infections (particularly *F. tularensis* and *Leptospira* sp.). Safe procedures for handling dead animals need to be practiced.

- Cree hunters and trappers already contribute to the prevention of human diseases by using their knowledge of wildlife in selecting animals and rejecting organs that they believe are not fit for consumption. They should continue to be vigilant.

7. MICROBIAL CONTAMINATION OF FRESHWATER ECOSYSTEMS

7.1. Introduction

7.1.1 Rationale

Water of good microbiological quality is essential for maintaining human health. Nevertheless, climate change, anthropic modifications of the landscape (*i.e*., dams and road construction) and animal migrations could have indirect impacts on infectious disease epidemiology in northern regions of the world.

Water is an important route of transmission for many of the most widespread and debilitating diseases that afflict humans (Reiff *et al.*, 1996). In order to benefit from water of healthy microbiological quality, most North-American citizens use public or privately treated water. Some indigenous community members, such as people of the Canadian Cree communities of Mistissini, prefer to use water from lakes, rivers and creeks for drinking purposes but also for tea and juice preparation (Bernier et al., 2009). Most often, this water is kept at home in plastic containers. Water from natural environments is generally not free of infectious microorganisms such as viruses, bacteria and protozoa.

Current water testing microbiology methods are generally culture-based, except for microscopy-based methods for parasites in their cyst form. For economical and practical reasons, the microbiological quality of potable water is assessed by testing for bacterial fecal contamination indicators (FCIs) such as total coliforms, fecal coliforms, *Escherichia coli*, and more recently enterococci (US EPA, 1986; Edberg et al., 2000; US EPA, 2005a). FCIs are used to give indications of the presence of gastrointestinal pathogens released by humans, animals, or introduced in the distribution network through infrastructure failures or human error (US EPA, 1993; Sinton *et al.*, 1998). Furthermore, it has often been demonstrated that there is an equivocal correlation between the presence or absence of fecal contamination indicators and that of human pathogens of viral (e.g., *Norovirus*), bacterial (e.g., *Vibrio cholerae*), or parasitic origin (e.g., *Cryptosporidium parvum/hominis*, *Giardia intestinalis*, etc.) (Chauret *et al.*, 1995; Lemarchand and Lebaron, 2003). By itself, this situation would warrant the development and implementation of adaptable, sensitive, specific, cost- and time-effective methods for the detection of emerging pathogens in water sources, especially those for which fecal contamination indicators are inadequate in predicting their presence (Atlas, 1998; Gostin *et al.*, 2000; Loge *et al.*, 2002). Molecular microbiology offers promising new tools based on specific nucleic acid amplification (RNA or DNA) of target microorganisms.

In the field of water microbiology, there is a need for more rapid, sensitive, specific, and affordable tests to improve water safety. It is vital to test the microbiological quality of drinking and environmental water used by members of *Eeyou* communities for consumption.

The current approved procedure for the detection of waterborne parasites such as *C. parvum*, *C. hominis* or *G. intestinalis* (US EPA Method 1623; US EPA, 2005b) is lengthy (3-4 days for analysis), cumbersome (sample volume of 10 litres), expensive (more than 400 US$ per sample of 10 litres), and complicated. We believe that the specific detection of these pathogens by molecular amplification is desirable and we are currently developing a novel approach enabling the molecular amplification of *C. parvum/hominis* (oo)cysts and *G. intestinalis* cysts with a sensitivity (approx. 2 (oo)cysts/L; Maheux *et al.*, in preparation). The cost will be more acceptable for outbreak analysis by public health agencies and for routine surface water analysis by drinking water production plants prior to treatment and distribution.

7.1.2 Microbiology component objective

The main objective of the study is to evaluate water consumption habits that may put individuals at risk in the Cree communities. Microbial targets, including fecal contamination indicators and selected human pathogen microorganisms, will be primarily tested by classical culture-based methods, but also by more rapid, specific, and adaptable molecular amplification methods.

7.2. Methods

7.2.1 Detection of fecal contamination indicators by classical and molecular microbiology

As shown in Figure 7.1, fieldwork essentially consists of collecting water samples from plastic jugs used to store raw water from natural springs and lakes used as drinking-water sources. According to recommendations, water samples are transported on ice (4^{o} C) to the Classical and Molecular Microbiology (CMM) module of the mobile laboratory where they are split into several aliquots: 400 mL being reserved for testing fecal contamination indicators and up to 1 litre for the detection of protozoan parasites pathogens *C. parvum/hominis* and *G. intestinalis*. Classical and molecular microbiology tests for fecal contamination indicators were performed on site, while nucleic acid preparations were conserved for future analyses with molecular assays under development or validation. Two distinct classical microbiology techniques were used in this study to assess the detection of Total Coliform (TC), Escherichia coli (EC) and Enterococci (EI) in water samples: membrane filtration (MF) and Most Probable Number (MPN). The former technique is recommended to detect EC or EI [US EPA Methods 1603(EPA 2002) and 1600(EPA 2005a)]; Dufour et al., 1981), and MPN was used to detect TC, EC and EI (Bernier et al, 2009).

7.2.2 Detection of protozoan parasite and bacterial pathogens by molecular microbiology

In addition to onsite monitoring by MPN and MF for the presence/absence of fecal contamination indicators(coliform bacteria, EC and EI), environmental water samples taken from most of the sites studied were tested for the presence of nucleic acids from parasite pathogens *C. parvum* and *G. intestinalis*. These tests were performed using a relatively new molecular detection method. Briefly, one-

litre samples were filtered and the total cellular genetic material on the membrane was submitted to a whole genome amplication (WGA) molecular enrichment procedure originally designed for use onsite in the CMM module. This amplified total genetic material (40 µL) was frozen and stored until further testing by PCR for DNA from specific microorganisms (*ef-1α* gene target, analysed by gel electrophoresis). Due to the restricted space available for work in the mobile laboratory and DNA contamination issues, PCR amplification was done in our laboratory at the Centre de recherche en infectiologie de l'Université Laval in Québec City where strict precautions were used: i) pre- and post-PCR manipulations were conducted in separate rooms; ii) aerosol-resistant tips were used to handle all reagents and samples; and iii) control reactions to which no DNA was added were routinely performed to verify the absence of DNA carryover.

7.2.3 Quality control: classical and molecular microbiology diagnosis

Bacterial cultures of reference strains were grown onboard the CMM module as quality controls for media used in the determination of fecal contamination indicators. An internal control was also designed to assess the amplification performance of the molecular detection strategies. Positive and negative controls were also present to monitor the integrity of reagents and check for possible DNA carryover contamination that might arise from laboratory manipulations.

7.2.4 Analysing of inorganic parameters in environmental water sources

Inorganic parameters were determined in water sampled in Wemindji at community used springs located at Km5 and Km12 of the access road by Bodycote testing group (Pointe-Claire, Québec, Canada). Samples collected on 27 June 2007 were analyzed between the 9 and 11 July 2007.

7.2.5 Water sampling

The selected raw water sampling sites were chosen around Wemindji and Eastmain, with the help of community members and the local environmental administrator (LEA).

In Wemindji, four local water sources (3 springs and 1 surface water hole) were analyzed, as well as 20 plastic household containers over a period of 24 days from 6 June to 30 June, 2007. A few of the analyzed household containers contained water from a source at Sakami Road, but this source was not field tested because of the long distance from the village (around 200 km from Wemindji) and the results are not reported.

In Eastmain, samples from three local water sources (1 spring, 1 surface water hole, and 1 well) were analyzed, as well as 11 plastic household containers over a period of 14 days, from 6 to 20 August, 2007

The frequency of visits at natural water sources (spring or surface water) depended upon transportation availability and the relative importance of these sources of drinking water for interviewed community

members. Water sampling was usually performed between 8 am and 11 pm and sites were visited from 1 to 9 times during the study period. Water was collected at the surface of the spring or surface water hole, or directly from the flowing water stream when the source was from a piped outlet. Gloves were used to avoid human contamination. Surface water samples from selected environmental sites were collected in two sterile 1 L plastic bottles transported in a cooler with frozen ice packs, and processed for analysis within 4 hours (Bordner and Winter 1978).

Turbidity of water samples was measured at the mobile laboratory before initiating the microbiological assays. Field data collected included water temperature, pH, turbidity were measured at sampling sites with a portable pH and turbidity meter (Orion 250A plus; Thermo Electron Corporation, Waltham, Mass., U.S.A.), while total rain data was compiled from the daily weather report issued by the Chibougamau/ Chapais airport.

Twenty (20) households in Wemindji and 11 households in Eastmain were visited once, mostly between 7:30 am and 11:30 am (depending on their availability), in order to sample their portable water containers. Two sterile 1 L plastic bottles were filled and transported in a cooler with frozen ice packs, and processed for analysis within 4 hours (Bordner and Winter 1978). A short questionnaire was administered to 56 study participants (randomly selected) that sought the following information: location of water collection site; when collected; where stored and how; and use (drinking, cooking and preparing tea). For water kept in plastic containers, respondents reported that water collection occurred once a week or a few times per year. Water was usually stored in 5-gallon (18.93-litre) plastic containers.

Microbiological and field data analyses were accomplished onboard the mobile environmental laboratory complex.

7.3 Results

7.3.1 Drinking water-related habits

Out of 56 participants surveyed in Wemindji for their drinking water habits, 55.4% of them used reverse osmosis treated water purchased from the local store exclusively; 25.0% were using water from natural sources only; and 14.3% used water from both sources. Only 3 participants surveyed (5.4%) were using tap water as a source of drinking water but they were also using alternative sources such as natural or commercial sources. Additional information on water use sources and use by the participants of the *Nituuchischaayihtitaau Aschii* is provided in Section 5.1.3 of this technical report.

In addition, residents who had their house water containers sampled were questioned on their consumption habits. All but one indicated they were using natural water for the preparation of tea, while tap water was mostly used for cooking purposes (Tables 7.1A,B). Further, most of the surveyed

households were also using natural water for drinking, and took either tap or natural water for the preparation of juices. The LEA of Wemindji confirmed our finding that the source at Km5 was the most visited by the community (Table 7.1A). In Eastmain, the Km381 water well was the most frequently used natural water source (Table 7.1B).

7.3.2 Monitoring of natural drinking water sources of Wemindji

TC bacteria were found in all four natural water sources analyzed (Table 7.2). TC counts were somewhat lower at Km12 than the other natural water sources monitored. In water from Km5, TCs were found with both MPN and MF methods in every sample analyzed (Table 7.2). No TC was found in the first two samples collected at Km12 with either method (6 and 7 June 2007), but was observed by MPN in all four samples tested at Km34 and in three by MF. For the Km60 samples, TC was determined to be present by MF in all 7 samples analyzed, but none was found with the MPN in 4 of 7 samples. During the month of June 2007, EC were found on four separate occasions in natural water sources at Km34 and Km60, but never in water from Km5 and Km 12 (Table 7.2). EI were not detected by MF, but were found twice with the MPN method at Km60.

Inorganic parameters measured at Km5 and Km12 were all well below the Québec regulations on drinking water quality (Table 7.3).

We observed that the water source at Km34 was very dirty, presenting plants and wood detritus. Water at Km34 was not sampled on 27 and 30 June 2007, because the spring was dry during this period. Tadpoles and larvae were sometimes observed in water samples analyzed from Km60.

7.3.3 Monitoring of domestic water containers in Wemindji

Most domestic containers that we analyzed contained water reported as filled from the spring at Km5 (Table 7.1A). TC counts were found with MF in water from all domestic containers filled from Km5, Km12, Km34 and Km60, except sample HW10 (Table 7.4). MPN did not detect any TC in 3 containers collected at Km5 (HW10, HW13, and HW18). Among the two samples said to come from Km12, the MPN method did not find any TC in sample HW18 while a count of 171 was detected by MF in the same sample. EC have not been found with either MF or MPN in the domestic containers during the sampling period. EI were found in 4 domestic containers reportedly filled at Km5 and Km 12. Both MF and MPN methods detected EI in sample HW12 with identical counts. Samples HW05, HW11, and HW18 from Km5 were positive for EI with the MPN method, while none were detected by MF. Reverse osmosis water available at the community store was analyzed once by us, and was free of microbial indicators.

7.3.4 Monitoring of natural drinking water sources of Eastmain

TC bacteria detected in the water sampled at Km381, by either method (Table 7.5). By contrast, in the 2 samples from Km394 TC was detected by both. We found no EC at Km381, independent of method. One EC positive test occurred in one sample from Km394 by both MF and MPN. Km70 water showed the highest counts for EC by both methods (23.8 and 49), although it was sampled only once. One colony presenting the characteristics of enterococcus has been found only once in natural sources of Eastmain (Table 7.5).

7.3.5 Monitoring of domestic water containers in Eastmain

Many households in Eastmain could not be visited during the study because most participants preferred to visit the Multi-Services Day Care Center (MSDC) for their medical examination and questionnaires related to the *Nituuchischaayihtitaau Aschii* study. For this reason, fewer domestic containers were analyzed in Eastmain then in Wemindji. Most of those analyzed contained water harvested at Km381 (8/11) (Table 7.1B). TCs were found to be abundant in one of the containers from Km381, with a count >200 with both the MPN and MF methods (Table 7.6). No EC nor EI were found in containers from Km 381 by either method. Two containers filled with rainwater were also analyzed during the study period (Tables 7.1B and 7.6).

7.3.6 Detection of Cryptosporidium and Giardia DNA in Wemindji water

Molecular amplification products of a size and weight compatible with that of *G. intestinalis* DNA were detected twice in spring water from Km5 but was not found in any other natural water source analyzed during the sampling period (Table 7.2). Molecular amplification products compatible with *Cryptosporidium* DNA were not found in the four natural water sources analyzed in Wemindji (Table 7.2). *Giardia* amplification products were found in three domestic containers (HW01, HW10, and HW16) containing water from the Km5 source, while no *Cryptosporidium* DNA was amplified from the nucleic acids extracted from samples of the 20 home containers. Only Wemindji data are reported since Eastmain results were invalidated by the control samples.

7.4 Discussion

7.4.1 Water consumption habits

Our limited drinking-water source survey results generally concur with the questionnaire data reported in Tables 5.1.3A,B. Clearly, the household tap is not a primary source of drinking water; bottled water is. The household survey findings reported in Tables 7.1 A,B also suggest that natural water is most often used for making tea. Some community members reported that tea turns black when tap water is employed, and cite this as the reason for doing so. Tap water appears to be mostly selected for cooking according to the results of this mini survey.

7.4.2 Microbiology monitoring of natural water used by the Cree communities.

The presence of EC is a reliable sanitary indicator for the monitoring of fecal pollution in water (Edberg *et al.*, 2000). Its presence in drinking water indicates recent fecal contamination, and thus represents a public health concern. In this study, EC were detected only a few times in low counts in natural water sources tested (both communities), but were not found in domestic house jugs. This suggests that, generally speaking, there was no fecal contamination at the moment of sampling. It might have been interesting to pursue the monitoring of EC for a longer period, especially after heavy rainfalls.

TCs are naturally found in the environment. Because coliform bacteria do not live naturally in drinking water, they constitute environmental pollution indicators and reflect the treatment efficiency of the water distribution system (Rompré *et al*., 2002; Health Canada 2006). Clearly, the significance of the presence of these organisms is different in water analyzed after passage in a controlled distribution system than that obtained from an untreated natural source (Edberg *et al.,* 1997). Detecting TCs in drinking water in the absence of EC is not necessarily a public health concern. However, the presence of TCs in high numbers in natural sources, as well as in domestic water stored in containers, requires that water be boiled before consumption (Sabir and Farooqi 2008).

Km381 (Eastmain; Tables 7.1B and 7.5) was the only natural water source that was free of TC during the length of the survey period. This result is not surprising knowing that the source was protected by a well, which presumably prevents environmental pollution. One colony presenting the phenotypic characters of EI genera was found in only one of the five Km381 samples analyzed, which suggests either a fecal or environmental pollution origin (Morgan *et al.,* 2007). The majority of TCs found in water from Km70 in Eastmain belonged to the species EC, and suggests fecal pollution. Unfortunately, only one sample was collected at that source.

EI were not found in the Wemindji samples analyzed from natural water from Km5 and Km12 (Tables 7.1A and 7.2). However, they were found three times in domestic jugs containing water from Km5 and once in a container filled with water from Km12 with counts under 2.0 (Table 7.4). Consequently, EI contamination of household plastic containers suggests that their handling and inadequate cleanliness might contribute to the microbial contamination. Date of collection of the water and its storage time in the household jugs may also contribute to the presence of EI due to variability of microbial occurrence in natural water sources. Indeed, EI are persistent organisms that are capable of surviving for long periods in the environment (Morgan *et al.,* 2007).

Traditional water drinking habits and the absence of formal microbiological surveillance of the sources facilitate contact with fecal contamination containing viral, bacterial and protozoan waterborne human pathogens. Apart from the well at Km381, all environmental sites tested yielded a positive microbiology

result, pointing to fecal contamination at least once. In all cases except one (sample HW10 (Km5)), the presence of parasite pathogens DNA correlated with the presence of at least one fecal contamination indicator, either TC, EC and/or EI. However, the molecular methods for the detection of *Cryptosporidium* spp. and *Giardia* spp. are still being refined to improve their specificity and sensitivity.

Although we measured field parameters like water temperature, pH, turbidity and mean daily rain precipitation, our sample number was rather low, and more samples would be needed to explore correlations of these parameters with the microbiological findings. Several authors (e.g., Olyphant and Whitman, 2004; Olyphant, 2005) found a strong correlation between such factors and EC concentrations in beach waters.

The low frequency observed of contaminated water in storage containers may well, in part, reflect that the least contaminated environmental sources constituted the primary sources, However, storage conditions post-collection could cause the death of target microorganisms, or their induction into a viable but non-culturable (VBNC) state.

Nevertheless, it is recommended that water from natural sources and water stored in plastic containers should be boiled, at least 1 minute, before drinking.

Although molecular methods offer more rapid testing of microbes, their high sensitivity exposes them to inadvertent carryover contamination problems. New procedures and technologies need to be explored and implemented to circumvent this operational drawback. However, a significant advantage of the molecular approach is that enriched total genetic material can be archived for future analysis. Such material is very useful for method improvement, fundamental research on genetic diversity, and especially for retrospective studies of unforeseen health issues.

FIGURE 7.1 WATER MICROBIOLOGY EXPERIMENTAL SCHEME

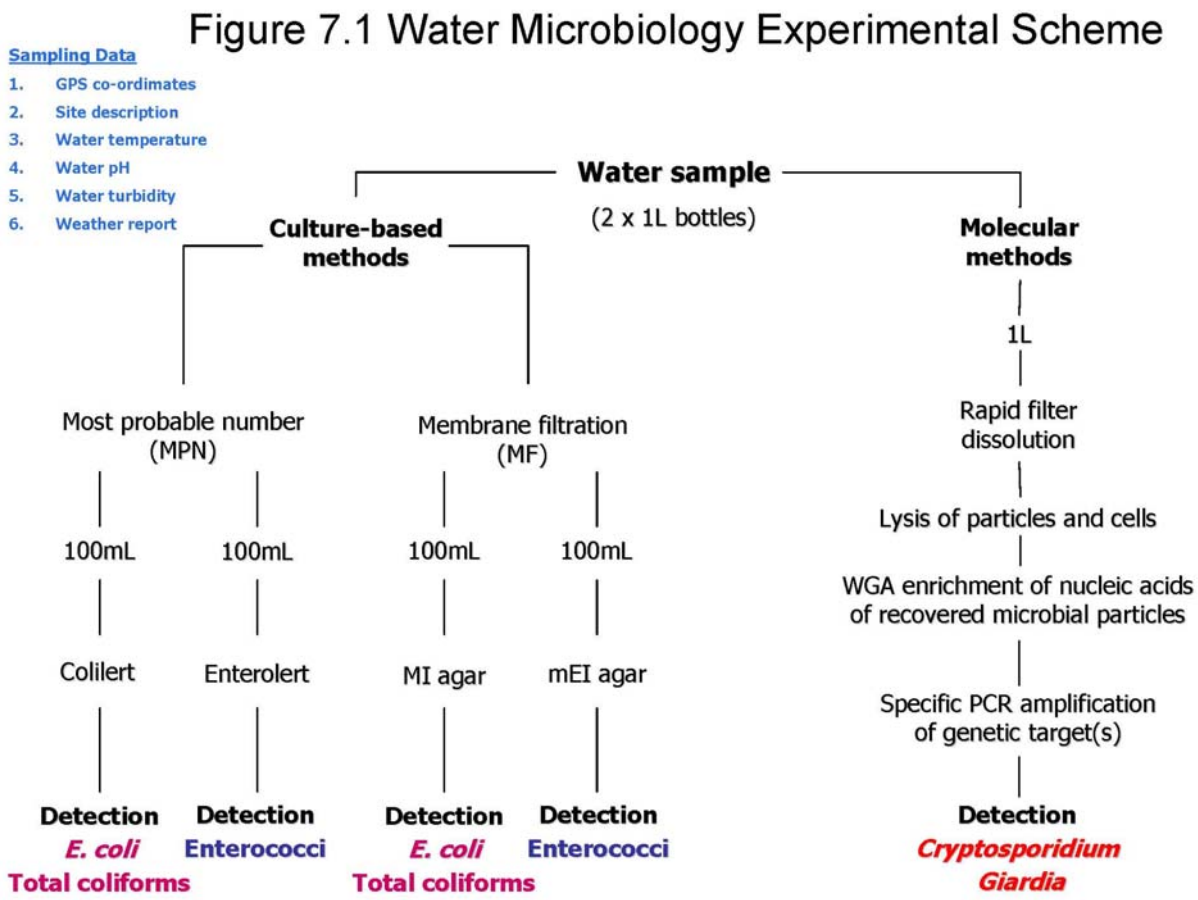


TABLE 7.1A RESULTS OF WATER CONSUMPTION HABITS FOR THE VISITED WEMINDJI HOUSEHOLDS

House jug sample (Site of sampling)	Type of water used to drink	Type of water used to prepare juice	Type of water used to cook	Type of water used to prepare tea
HW01 (Km 5)	Natural	Natural	Tap	Natural
HW02 (Km 5)	Tap	Tap	Natural	Natural
HW04 (Km 5)	Natural	Natural	Natural	Natural
HW05 (Km 5)	Natural	Natural or Tap	Tap	Natural
HW10 (Km 5)	Store	Tap	Tap	Natural
HW11 (Km 5)	Natural or Tap	Natural or Tap	Tap	Natural
HW13 (Km 5)	Natural or Store	Natural or Tap	Tap	Natural
HW14 (Km 5)	Store	Tap	Tap	Natural
HW15 (Km 5)	Store	Tap	Tap	Natural
HW16 (Km 5)	Natural	Natural or Tap	Tap	Natural
HW18 (Km 5)	Natural	Natural or Tap	Tap	Natural
HW19 (Km 12)	Natural	Natural	Natural or Tap	Natural
HW20 (Km 12)	Natural	Natural or Tap	Natural	Natural
HW08 (Km 34)	Natural	Natural	Tap	Natural
HW22 (Km 34)	Natural	Natural or Tap	Natural	Natural
HW21 (Km 60)	Natural	Tap	Natural or Tap	Natural
HW06 (Sakami Road)	Natural or Store	Store	Natural or Tap	Natural
HW09 (Sakami Road)	Natural	Tap	Tap	Natural
HW12 (Sakami Road)	Natural	Natural	Natural or Tap	Natural

TABLE 7.1B RESULTS OF THE WATER CONSUMPTION HABITS FOR THE VISITED EASTMAIN HOUSEHOLDS

House jug sample (Site of sampling)[a]	Type of water used to drink	Type of water used to prepare juice	Type of water used to cook	Type of water used to prepare tea
HE02 (Km 381)	Natural	b	Tap	Natural
HE03 (Km 381)	Natural	b	Natural	Natural
HE04 (Km 381)	Natural	b	Natural	Natural
HE05 (Km 381)	Natural	Natural	Natural	Natural
HE07 (Km 381)	Natural	Natural	Tap	Natural
HE08 (Km 381)	Natural	Natural	Tap	Natural
HE10 (Km 381)	Natural	Natural	Natural or Tap	Natural
HE11 (Km 381)	Tap	Tap	Tap	Natural
HE01 (Km 324)	Natural	Natural	Natural	Natural
HE06 (Rain water)	Same as HE03			
HE09 (Rain water)[c]	Tap	Tap	Tap	Tap

a. Sample HEO1 was not analyzed; it was reported collected at Km234.

b. The answer was not available, or people were not drinking juice.

c. Not Eeyou

TABLE 7.2 SUMMARY OF THE NUMBER OF SAMPLES POSITIVE FOR INDICATORS OR PATHOGENS IN NATURAL DRINKING WATER SOURCES ANALYZED IN WEMINDJI

Indicator or pathogen detected	Detection technique used[b]	Number of positive samples out of total of samples analyzed from natural water source[a] (Sample type)			
		Km 5 (Spring)	Km 12 (Spring)	Km 34 (Spring)	Km 60 (Surface)
Total coliforms	**MPN**	9/9	7/9	4/4	3/7
	MF	9/9	7/9	3/4	7/7
E. coli	**MPN**	0/9	0/9	0/4	1/7
	MF	0/9	0/9	1/4	2/7
Enterococci	**MPN**	0/9	0/9	0/4	2/7
	MF	0/9	0/9	0/4	0/7
Cryptosporidium	**Molecular**	0/8	0/8	0/4	0/6
Giardia	**Molecular**	2/8	0/8	0/4	0/6

a. ≥1 detected was considered as a positive sample.

b. MPN: Most probable number; MF: Membrane filtration.

TABLE 7.3 INORGANIC PARAMETERS MEASURED AT KM 5 AND KM 12 IN THE COMMUNITY OF WEMINDJI

Parameter (mg/L)	Québec regulation (maximum allowed)	Km 5	Km 12
Antimony (Sb)	0.006	<0.001	<0.001
Arsenic (As)	0.025	<0.001	<0.001
Barium (Ba)	1	0.01	<0.01
Boron (B)	5	<0.02	<0.02
Cadmium (Cd)	0.005	<0.001	<0.001
Chromium (Cr)	0.05	<0.001	0.001
Copper (Cu)	1	0.001	0.001
Cyanides (CN)	0.2	<0.02	<0.02
Fluorides (F)	1.5	<0.20	<0.20
Magnesium (Mg)	-	0.80	2.14
Manganese (Mn)	-	0.006	0.027
Mercury (Hg)	0.001	<0.0002	<0.0002
Nitrates + nitrites (N)	10	0.05	0.03
Lead (Pb)	0.01	<0.001	0.001
Selenium (Se)	0.01	<0.001	<0.001
Uranium	0.02	<0.005	<0.005

TABLE 7.4 SUMMARY OF THE NUMBER OF SAMPLES POSITIVE FOR INDICATORS OR PATHOGENS IN NATURAL DRINKING WATER CONTAINED IN DOMESTIC JUGS IN WEMINDJI

Indicator or pathogen detected	Detection technique used[b]	Number of positive samples out of total of samples analyzed from natural water source contained in house jugs[a] (Sample type)			
		Km 5 (Spring)	Km 12 (Spring)	Km 34 (Spring)	Km 60 (Surface)
Total coliforms	**MPN**	8/11	1/2	2/2	1/1
	MF	10/11	2/2	2/2	1/1
E. coli	**MPN**	0/11	0/2	0/2	0/1
	MF	0/11	0/2	0/2	0/1
Enterococci	**MPN**	3/11	1/2	0/2	0/1
	MF	0/11	1/2	0/2	0/1
Cryptosporidium	**Molecular**	0/11	0/1	0/2	0/1
Giardia	**Molecular**	3/11	0/1	0/2	0/1

a. ≥1 detected was considered as a positive sample.

b. MPN: Most probable number; MF: Membrane filtration.

TABLE 7.5 SUMMARY OF THE NUMBER OF SAMPLES POSITIVE FOR INDICATORS OR PATHOGENS IN NATURAL DRINKING WATER SOURCES ANALYZED IN EASTMAIN

Indicator or pathogen detected	Detection technique used[c]	Number of positive samples out of total of samples analyzed from natural water source[a,b] (Sample type)		
		Km 381 (Well)	Km 394 (Spring)	Km 70 (Surface)
Total coliforms	**MPN**	0/5	2/2	1/1
	MF	0/5	2/2	1/1
E. coli	**MPN**	0/5	1/2	1/1
	MF	0/5	1/2	1/1
Enterococci	**MPN**	0/5	0/2	0/1
	MF	1/5	0/2	0/1
Cryptosporidium	**Molecular**	NV	NV	NV
Giardia	**Molecular**	NV	NV	NV

a. ≥1 detected was considered as a positive sample.

b. NV: Not valid, because control samples failed.

c. MPN: Most probable number; MF: Membrane filtration.

TABLE 7.6 SUMMARY OF THE NUMBER OF SAMPLES POSITIVE FOR INDICATORS OR PATHOGENS IN NATURAL DRINKING WATER CONTAINED IN DOMESTIC JUGS IN EASTMAIN

Indicator or pathogen detected	Detection technique used[c]	Number of positive samples out of total of samples analyzed from natural water source contained in house jugs[a,b] (Sample type)		
		Km 381 (Well)	Km 324 (Spring)	Rain water (Rain water)
Total coliforms	**MPN**	1/8	0/1	1/2
	MF	1/8	1/1	2/2
E. coli	**MPN**	0/8	0/1	0/2
	MF	0/8	0/1	0/2
Enterococci	**MPN**	0/8	0/1	0/2
	MF	0/8	0/1	1/2
Cryptosporidium	**Molecular**	NV	NV	NV
Giardia	**Molecular**	NV	NV	NV

a. ≥1 detected was considered as a positive sample.

b. NV: Not valid, because control samples failed.

c. MPN: Most probable number; MF: Membrane filtration.

8. EDUCATIONAL ACTIVITIES

8.1 Summary

The main purpose of the educational activities was to use the curiosity and interest raised by the arrival of the mobile laboratory as an opportunity to build bridges between the community members, the visiting scientists, the Cree Health Board representatives, and local administrators. A specific objective was to build stronger and more efficient communication channels that could be used to share information about health and environmental issues. The 2005 evaluation of the Mistissini pilot project (Bonnier-Viger et al., 2007) process proposed several guidelines for improving the communications and educational components of the *Nituuchischaayihtitaau Aschii* project.

1. **Develop and implement a communication strategy** employing diverse methods known to be effective in the community, including collaboration with Cree authorities and local organizations, and begin promoting the project in the community several months before the arrival of the full study team. Improve local understanding of the project by providing accessible background documentation about the research questions and hypotheses, ensuring that the sampling method is well-communicated, and involving the study's principal investigators in communications with the community;
2. **Expand the educational component of the program** by involving interested people in the school system as fully as possible, engaging high school and elementary students in curriculum-related science activities during the school year, and expanding opportunities for youth to be employed within the project team, and;
3. **Open and promote the mobile laboratory as a learning opportunity** through scheduled tours, public events, and links with the youth science activities.

These recommendations guided the approach to educational activities employed in Eastmain and Wemindji. In September 2006, the Cree Board of Health opened a temporary full-time position for an Educational Activities Coordinator. Given that the education and communications team employ similar channels to target the community members, this individual also provided input for the development of a communication strategy and the production of relevant communication tools.

As in Mistissini, youth in Eastmain and Wemindji were targeted through environmental workshops and tours of the mobile laboratory and the project's clinical facilities. The educational activities also included focus groups and workshops with local teachers in order to gather information about existing measures to promote science within each community and identify needs related to science education. Furthermore, the Educational Activities Coordinator assisted directly with the Eastmain school's science fair during the regular school year.

Employment was provided for a number of local teenagers, in the roles of Science Activities Assistant, Welcomer and Microbiology Intern. The selected candidates received some training on the subjects of science, health and the environment, and ways to develop their communication and leadership skills.

8.2 Collaboration with Local Organisations

8.2.1 Environmental Workshops in a Summer Camp Setting

The environmental workshop model developed in Mistissini was considered successful and was repeated in Eastmain. The workshops aimed to foster a deeper appreciation and interest for science among local youth by presenting science outside of the school framework as something fun and non-intimidating. Links to scientific careers and study pathways were made through informal conversations between the workshop animators and young participants.

Workshop activities were not necessarily directly related to the *Nituuchischaayihtitaau Aschii* project. Many of the participants had a low level of background knowledge in science disciplines; it was thus relevant to address some of the more basic science concepts and focus on hands-on activities to catch their interest.

Eastmain's Cultural Center provided facilities for a science summer camp. During a four week period, 13 afternoons of activities and two movie nights were offered. Activities were open to all, but were mainly attended by youth between the ages of 6 and 14. On average 10 to 15 kids attended each afternoon workshop, with a maximum of 29 on one particular day. A total of about 60 different kids participated in at least one science activity during the summer. Some parents also came to visit during afternoons.

Several activities were offered in collaboration with community members and organizations. A Cree Health Board nutritionist provided the background material to organize workshops on healthy cooking. Also, the Cultural Center Coordinator arranged to have an Elder lead an activity related to traditional medicine and fish netting, which was greatly appreciated by the kids. The Band Office's Environment Representative helped organize one of the two movie nights. This activity attracted about 39 people (including parents and older youth) for a projection about climate change. The Local Environment Officer (LEO) at the Band Office arranged to have youth visit the drinking water purification station. Local staff provided explanations about the water quality analyses and the manager, Chris Mariman, offered the kids handouts and coloring books related to science.

Summer science workshops were only organized in Eastmain, as Wemindji youth already benefited from the presence of a science summer camp, coordinated by McGill University students.

8.2.2 Other collaborators

Links were established with other science summer camp coordinators operating in the James Bay communities in order to share successful hands-on activities and logistical tips. These individuals were Katherine Scott and Bettina Choo. Katherine was from the McGill anthropology team and had organized the science camp in Wemindji in 2006 in collaboration with the local Band Office; Bettina Choo, also a McGill medical student, had coordinated the science workshop mentioned above in Waskaganish. Contacts were also made with other community organizations that conduct other summer camps, namely the Wellness Center in Eastmain and the Recreational Center in Wemindji. We offered to either join their activities or complement them, as was previously done in Mistissini. These organizations expressed interest in incorporating environmental workshops into their programs but, for various reasons, no concrete collaboration occurred.

8.3 Collaboration with the School

8.3.1 Consultation with Science Teachers

One of the main recommendations from the pilot project was to expand the educational component by involving key interested personnel from the school system. Therefore, during the year prior to the project's arrival in the communities, a consultation was initiated with the school administration, as well as the elementary and high school science teachers in Wemindji and Eastmain. This consultation had the following objectives.

1. Announce the upcoming environmental health project and promote it as a learning opportunity for the students and a teaching tool for teachers;
2. Collect information about the science education initiatives that are already in place in the communities in order to assess the need for science promotion, and;
3. Evaluate the feasibility of various ways in which the *Nituuchischaayihtitaau Aschii* educational activities could support or complement existing science education initiatives in the communities.

The teachers warmly welcomed the arrival of the mobile laboratory and the learning opportunities it could offer for students. They expressed interest in the project and in the topic of environmental health, and asked for tools to address it within their teaching practice. They also expressed concerns about the disposal of expired hazardous chemicals, and mentioned interest in setting up a recycling system. In discussions, it became evident that special science education initiatives were in place and these are summarized below.

Beyond the regular science curriculum, science-related activities are usually organized at both local and regional levels. These include science trips to Montréal and Toronto during which youth visit science museums and receive a guided tour of an engineering firm. There is also a science fair competition, held

at both local and regional levels, which receives technical support from the *Elephant Thoughts*. The latter is a science consultant company in charge of running the science fair in schools all over the territory. This organization also offers thematic science workshops during school year, upon request from schools. The *Mad Sciences* organization was also mentioned as a resource for science promotion.

In addition to the McGill University science camp activity, Wemindji's Recreational Centre also has a budget reserved to promote science among youth. Its manager worked closely with the School Principal and the Orientation Consultant to implement this priority.

During the focus groups, teachers also expressed many educational needs beyond those specifically related to science teaching. Concerns regarding teaching conditions, as well as other public health concerns to be addressed with the students were seen as prerequisite to any meaningful intervention targeting the quality of science education. These included the challenges of teaching in a second or even third language, the need for more discipline and family support for students, and a lack of material resources (space, adapted recent books, etc). After gathering a substantial overview of this context, the facilitator planned the *Nituuchischaayihtitaau Aschii* educational activities to involve realistic ways of science promotion.

Given that the framework of *Nituuchischaayihtitaau Aschii* only allows for short term engagement with the schools in each community, the most realistic and desirable solution identified was to offer science pedagogical support to teachers. Most of the teachers did not have any academic background in science and had to master the domain pretty much on their own. Unfortunately, the Science Pedagogical Consultant position within the Cree School Board (CSB) has been vacant for many years.

In Eastmain, individual pedagogical counselling related to science was offered to teachers, their needs were assessed, and some support was provided. For example, a list of relevant websites that provide tool kits or lessons plans related to science and environmental health was presented to them. Also, the Eastmain school principal agreed to book two pedagogical days in order to accommodate three group workshops requested by teachers. The topics covered had three components:

1. **Group discussion: Toward a First Nation Cross-Cultural Sciences and Technology Curriculum.** It involved brainstorming based on an article written by Glen S. Aikenhead, University of Saskatoon, who proposes a culturally-adapted curriculum-development strategy;
2. **Science lesson planning: Using Online Pedagogical Resources**. On-line resources were proposed as an alternative to textbooks, due to limited access of the latter. Since searching the web for appropriate teaching tools can be quite time consuming, the list of online resource provided was highly appreciated by the teachers, and;

3. **Share Your Expertise!** As a group, teachers examined science teaching situations they had faced in order to extract relevant motivational elements. They were encouraged to create a space to work individually and together for collaborative improvement.

In Wemindji, the school administration did not respond proactively to the proposed workshops, despite requests from the teachers.

8.3.2 Support for the Science Fair

The Educational Activities Coordinator provided direct assistance to the Eastmain youth team's participation in the regional science fair competition. This was done by integrating activities proposed by the *Elephant Thoughts* organization.

Considering their expertise with the target audience, together with their reputation with the CSB, *Elephant Thoughts* should be a considered an excellent partner for developing and implementing any health program within schools. The organization expressed interest in the possibility of developing health-education material to be integrated in their activities.

8.4. Educational Opportunities through the Mobile Laboratory

8.4.1 Official Opening Ceremonies

An official opening ceremony took place in Wemindji on June 4, 2007. It was organized by the assistant coordinator of the *Nituuchischaayihtitaau Aschii* project, Reggie Tomatuk, in collaboration with the local Public Health Officer (Joey Georgekish) and the local Cree Health Board Director (Elmer Georgekish). Wemindji Deputy Chief, Arden Visitor, made an opening speech and several of the principal investigators and researchers, including Drs Eric Dewailly, Evert Nieboer, Maurice Boissinot, and Louise Johnson-Down presented details about the study. Dr. Yv Bonnier Viger, Public Health Director of the CBHSSJB, was also present. The presentations were attended by about 75 community members, and were followed by a traditional feast, which was attended by about 150 people.

A similar opening ceremony was organized in Eastmain during the month of August 2007 by the Project Coordinator (Mathieu Trépanier), in collaboration with the Local Project Coordinator (Rita Gilpin). The ceremony took place under the mobile laboratory tent and included an open-house visit of the facilities. Eastmain Deputy Chief, John Brown, gave an opening speech, the project coordinator explained the goals of the project, and then local and visiting project staff introduced themselves and their roles on the team. This format was positive because the project was explained to the community members in plain English and Cree language. The opening was followed by a traditional feast, and the event was attended by at least 40 people.

8.4.2 Laboratory Tours and Open House

Bonds established with the school staff before the study's arrival in the community facilitated the implementation of educational activities during the 2007 field-work period. However, the project's timing was far from ideal from the point of view of working with the schools. In Wemindji the fieldwork overlapped with the exam review period, which prevented collaboration during school hours. In Eastmain, the fieldwork took place during the first days of the new school year. One Eastmain teacher graciously accepted to organize class visits to the mobile laboratory, starting the second day of the school year. A more rewarding partnership could occur if these activities were offered during the late fall or winter, after the school dynamic is established and before the exam period begins.

Wemindji: Primary and secondary school visits

Two afternoon open houses were held at the project facilities, one targeting primary school students and the other for high-school youth. Flyers were distributed in class when or after school, and on the day of the open house to advertise this activity. About 20 kids showed up for the primary school visit and 15 teens on the following day. The Educational Activities Coordinator introduced the project, served "spectacular drink" and animated a hands-on science experiment. The students were then given a guided tour resembling a participant's journey through the clinic in the Multi-Service Day Center (MSDC) building and the mobile laboratory during which various staff members presented their roles within the project.

Eastmain: Secondary school aged group

In Eastmain, six secondary classes visited the study facilities with their teachers, for a total of about 75 teens. Visits were scheduled ahead of time to accommodate the teachers. An hour long pre-visit presentation was done in each class, followed by an hour-long tour of the project facilities.

The pre-visit presentation focused on the research process, referring to the science-fair method, as well as on introducing the Environmental Health project's objectives and components. The '*What's going on inside the lab?*' video was presented and the research process poster was used as visual support. Both were highly appreciated by students and teachers, although the last part of the video was found to be highly complex. The tour of the clinic and laboratory provided an opportunity for students to learn about different career paths related to science. The project team members introduced themselves, telling the story of how they got interested in their careers, and explaining the educational path they followed starting from high school. Then, they described and demonstrated their specific tasks. Most of study team members contributed in some way to this guided tour and a diversity of roles were highlighted (project coordinator, science educator, recruiter, nutritionist, nurse, microbiologist, biochemist, and laboratory technician). Promotional pens and rulers were distributed to all the pupils at school.

8.4.3 Posters and Video Development

A poster presenting the project team, along with their job titles and photo, was displayed in the study facilities and was quite popular. This tool presented the staff in a friendly way and also visually demonstrated the variety of jobs that made up the research team. The poster was actively used during the school visits to the project facilities.

A second poster was developed to present the research process followed. Its aim was to provide the Welcomer with a visual support for explaining the *Nituuchischaayihtitaau Aschii* project to study participants. It was useful to clarify each step and highlight the timeframe for the analysis and communications of the project's results.

The Centre hospitalier de l'Université Laval (CHUL) partners supervised the production of the mentioned video about the mobile laboratory facility. The Educational Activities Coordinator was involved in revising the scenario and provided comments for future video making and use. The video was shown to the high school students before their tour of the facility.

8.5 Training Opportunities for Teenagers and Adults

8.5.1. Funding for Summer Student Interns

Cree Human Resources Development (CHRD) provided funding to hire two local summer students: Dorianne Cheezo, who assisted with the educational activities, and Caitlin Gilpin, a microbiology intern. The *Far Area Medicine Student Program* also provided a valuable staff member, Annie Lévesque, a medical student who helped with the environmental workshops part-time and also held an internship at the local clinic.

8.5.2. Laboratory Assistant and Welcomer Training

The Welcomer position was implemented following a recommendation to improve communication with participants and to maximize the use of the mobile laboratory. Each study participant was welcomed inside the tent when they arrived for their clinic visit in the MSDS building. The participants were shown the facilities and given information about the study. Participants were also invited to return to the laboratory tent for a more information when they had free time in between various interviews and clinical tests.

The Educational Activities Coordinator provided three (3) days of training for the Welcomer in each community. The Welcomer received information about the project's background, environmental health, contaminants, public health activities and their role within the project team. A training manual was also developed.

The microbiology intern was trained to prepare and process water samples by the mobile laboratory technician. Her activities also involved collecting water samples, experimental manipulations, quality control measures, administering the household questionnaire, as well as data collection and analysis. A second youth was employed as a laboratory dispatch assistant and received some verbal training, but did not wish to participate in hands-on lab techniques.

8.5.3 Cooking booklet

The *Nituuchischaayihtitaau Aschii* project employed a chef who provided lunches and suppers for the team. Local staff involved in the project got a chance to taste new dishes, many of which were based on simple, healthy recipes. A cooking booklet, complete with pictures, was put together and distributed to project staff. From a public health perspective, this tool promoted healthy and diversified food choices.

9. REPORTING OF RESULTS TO INDIVIDUAL STUDY PARTICIPANTS

The protocol for reporting test results to individual study participants was slightly revised from that used in the Mistissini pilot study (Bonnier-Viger et al., 2007) to ensure appropriate interpretation and follow-up of test results. Our objectives were to: help study participants better understand their laboratory results; distinguish between urgent and non-urgent findings; avoid undue anxiety for the participants; and circumvent overburdening the clinical system. During the protocol development process in Mistissini in 2005, there was ongoing consultation with stakeholders and collaboration with experts in toxicology and environmental health. As summarized in Table 9.1, the outcome measures were divided into four categories, namely A, B, C, and D. First there are "category A" test results that are known at the time of testing (e.g. blood pressure), and if these results are dangerously high, patients are advised in person to present immediately to the clinic. Next, there are "category B" test results that require minimal delay for referral if abnormal (e.g. Holter monitor data, and certain zoonotic antibodies). In these cases, the head nurse and/or MD at the local clinic are notified by telephone to discuss management on a case-by-case basis, the patient is phoned, and the appropriate referral and follow-up will already have been arranged for the patient by the time they receive the notification of an abnormal result. "Category C" test results are generally non-urgent (e.g. low levels of toxic metals and PCBs, or mildly abnormal glucose, lipids, thyroid function tests) and can be followed up by the local clinic over a period of weeks.

Nonetheless, the batch of results are first reviewed to ensure there are no cases which should be managed as in "category B" by phone. For the remaining non-urgent cases, the results are sent to the clinic physician, and the participants are notified in a letter. The process of notifying participants about non-urgent results is discussed in greater detail below. Finally, "category D" results (for research purposes only; for example, inflammatory markers) will not be given to individuals unless the result is so abnormal that the expert responsible thinks there may be clinical relevance.

Another aspect of the reporting protocol involved the preparation of guidance for physicians and clinical staff. This was a particularly difficult area and primarily concerned Category C results for chronic exposure to environmental contaminants. General guidance in case of acute exposure to environmental contaminants has been included, although that is likely to be very rare. For each of the major contaminants tested in the study (i.e., cadmium, lead, mercury and PCBs), there is a 2-page "Clinical Algorithm" intended for health professionals with a brief description of key signs and symptoms associated with chronic exposure, suggested laboratory tests, as well as treatment and prevention strategies. Copies are provided in Appendix 5.

On completion of the interviews and clinical tests, each participant (or guardian) received a Health Passport. Results for the following parameters were recorded in it: blood pressure, pulse rate, temperature,

body measurements (weight, height etc.), body mass index, body fat, and bone density. Normal values were provided for comparison in both Cree and English. A brief explanation of the *Nituuchischaayihtitaau Aschii* project is also provided, as well as contact details. A copy is provided in Appendix 6.

TABLE 9.1 TEST RESULTS REPORTING CATEGORIES

Reporting Category	Tests in Category
A – abnormal clinical results available immediately	Blood pressure Body measurements – height and weight Temperature
B – abnormal results available after analysis, participant and clinic notified by phone	Holter monitor Carotid Doppler (artery blood flow to the brain) Selected zoonotic antibodies
C – normal and abnormal lab results – participant notified by letter (phone if more urgent)	Glucose, insulin Lipids Heel ultrasound Thyroid Environmental toxins: lead, cadmium, mercury and PCBs Other zoonotic antibodies.
D – for research purposes, in group report only, results not reported to individuals	Other persistent organic pollutants (POPS), vitamins, apolipoproteins and CRP (heart disease markers), PFOS, selenium, omega fatty acids, others.

10. PROJECT EVALUATION

Multi-Community Environment-and-Health Longitudinal Study in Eeyou Istchee: Evaluation Report, Year 2: Summary (Eastmain and Wemindji)

10.1 Objectives

The objectives of the participatory, formative evaluation of the multi-community study are to:

1. Document and assess the quality and effectiveness of the implementation of the multi-community study in the participating communities, including community engagement in the research process and appropriation of research tools and opportunities;
2. Determine the success of the study in achieving its formal objectives (from the points of view of the research team stakeholders) and the anticipated benefits for the communities (from the perspectives of community members and Cree entities);
3. Inform the planning of each successive implementation of the study in the Cree communities.

The evaluation is directed by a stakeholder committee composed of representatives of the Cree Nations in which the study is being carried out, Cree Board of Health (Environmental Health, Evaluation), Cree Regional Authority (Environment Department), principal investigators and project staff. The Evaluation Committee's role is to finalize and approve the evaluation plan, approve the data collection instruments, and participate in the interpretation and the findings and development of recommendations. The first evaluation report examined the study's implementation and effectiveness as it was carried out in the 2005 Mistissini pilot study (Bonnier-Viger et al., 2007).

For the 2007 field year, this report focuses on the following evaluation questions.

1. How appropriate and effective were the planning processes for the study, including involvement of participating communities in decision-making processes?
2. How effectively was the study implemented in each of the communities?

The full report for Eastmain and Wemindji is provided in Appendix 7.

10.2 Methodology

This report present results from interviews conducted during the study period in the summer of 2007. The interviews were conducted by telephone (pre-implementation) or in person in the two communities during the last week of study operation (thus in June and August). The interviews were based on structured evaluation questions using an open-ended approach. They were conducted in English or French and the interviewees were Cree Health Board staff , research/project team members, and community liaison persons and representatives.

The issues assessed were as follows:

i. Liaison between the research team and the Cree Health Board;
ii. Liaison between the Cree Health Board and the communities;
iii. Staffing, training and coordination;
iv. Study processes and measurement components;
v. Educational component;
vi. Physical arrangements and working conditions;
vii. Community and participant response.

10.3 Findings and conclusions

The approach taken to planning and implementing the multi-community study in 2007 incorporated many lessons learned from the Mistissini study. While not all challenges were anticipated, many were, and so solutions were available and applied readily. Overall, the planning and implementation of the study were highly effective in 2007, and the level of community involvement and engagement in both of the 2007 communities was higher than it had been in Mistissini.

Two lessons that have emerged from the 2007 implementation are:

- It is advisable to have a clear backup plan in place from the outset for each of the study's main elements, including logistical arrangements, facilities, and the educational component, so that any last-minute changes or adaptations will be easier to deal with;
- In developing a relationship with the communities where the study is to be carried out, a systematic and strategic assessment of the community dynamics and most effective liaison points and persons would be helpful (i.e., a one-size-fits-all model for community liaison should not be assumed, nor that all community stakeholders will have the same views on what the proper processes are for engagement).

These evaluation data show that there was effective collaboration between the research team and the CBHSSJB, and the CBHSSJB and communities at the level of research operations. However, there is some evidence of slippage at the level of the interface between the team of principal investigators and the study operational level, with last-minute scientific decision-making and a perceived lack of connection to the communities having some negative effects on the study as a whole.

In addition, there seemed to be a sense that more could have happened in the educational component of the study. It is not clear whether the objectives of this component of the study should be reviewed and re-articulated, or whether its role in the overall study needs to be re-affirmed.

11. STUDY FINDINGS AND KEY MESSAGES

11.1 Food Harvesting and Consumption

Geese were the most frequently consumed traditional food, with 98% of study participants having eaten it at least once in the past year. The most commonly consumed game meats in Eastmain were moose (89%), bear (73%) and rabbit (66%), whereas moose (93%), rabbit (80%), and caribou (64%) were most often consumed in Wemindji. Participants over 19 years old reported higher percentages of traditional foods consumed than those under 19.

Traditional foods are known to be good sources of essential metals such as iron, zinc, copper and the element selenium, as well as healthy fats (i.e., omega-3 fatty acids) and vitamins. Consumption of traditional foods also reduces the risk of eating store-bought foods high in *trans* fats, saturated fats and carbohydrates. Clearly, traditional food continues to be an important dietary component.

Overall in both communities, there are some concerns about the relatively low consumption of fruits and vegetables leading to low intakes of the essential macronutrient magnesium, as well as fibre and some vitamins (e.g., folate). Calcium and vitamin D intakes were also low. The presence of these essential substances in the diet promotes good health.

Optional parts of the diet, such as soft drinks and other sugared drinks, as well as snack foods, fast foods, and baked goods, account for as much as 40-50% of the energy intake. This is not only a concern for weight gain and the development of diabetes but also the intake of man-made *trans* fats, especially by children and teenagers. Consumption of *trans* fats constitute a risk factor for heart disease, and being overweight is an important risk factor for diabetes. Measured levels of these substances in red blood cell membranes were similar in both communities and decreased with age. Store-bought foods of low nutritional quality are the suspected source.

11.2 Physical activity

It is generally accepted that regular exercise can improve one's health status. Results in Mistissini have shown that dedicated walkers improved their health status (Egeland et al., 2008). The number of participants in Wemindji and Eastmain were insufficient to confirm similar results. Further analyses combining all the communities will be explored in a future report.

11.3 Environmental contaminants

Compared to earlier assessments of blood lead and mercury in blood and hair for First Nation communities (including in *Eeyou Istchee*), the Eastmain and Wemindji results are encouraging. Compared to Eastmain, the observed average concentrations of these toxic metals for the various age groups were

somewhat higher in Wemindji, but for both communities were somewhat below what was observed in Mistissini in 2005 (Bonnier-Viger et al., 2007). Three adults over 40 in Wemindji needed a medical follow-up for elevated lead levels. No children 8-14 years exceeded the action levels for lead or mercury; and the same can be said for children 0-7 in case of lead. When combining the data for Eastmain, Wemindji and Mistissini, there is a suggestion in the present study of a small increase in blood pressure associated with mercury levels in blood and some negative impact on heart variability. In recent publications, low blood concentrations of this toxic metal have been associated with cardiovascular disease. For these reasons, the release of mercury into the environment and accumulation in the food chain need to be further reduced and controlled. Lead exposure is most likely related to the use of lead ammunition and contamination of the bagged animals by lead shot pellets and/or their fragments. The use of non-lead containing ammunition must continue to be encouraged in order to reduce the introduction of lead into the environment, and therefore into animal tissues (especially birds).

Cadmium is both a lifestyle and an environmental issue because of cigarette smoking (including secondary smoke). Because this metal damages the kidneys and smoking causes respiratory cancer, it is prudent and wise to quit smoking and avoid exposure to second-hand smoke. The smokers in Eastmain and Wemindji are at risk of reduced kidney function based on their blood cadmium levels.

The blood selenium levels reflect the consumption of fish and other traditional meats and are adequate for good health. Selenium is essential to our bodies and is believed to protect us from processes linked to the development of cancer and perhaps heart disease. Although too much selenium can be detrimental, the concentrations observed in Eastmain and Wemindji indicate safe and protective levels.

Organochlorines such as PCBs and pesticides accumulate in the traditional food chain, are persistent, and stay in the environment and in our bodies for a long time. It is for this reason that the blood plasma levels found increased strongly with age. They were also community dependent, decreasing in the order Mistissini > Wemindji > Eastmain. Careful statistical (factor) analysis strongly suggested that the exposure to PCBs and pesticides occurs by way of traditional foods. Although there are health concerns associated with these compounds, the exact concentrations that affect health are not well established. The observed levels in both communities for individuals under 40 years of age were relatively low. Careful scrutiny of children and women of reproductive age was undertaken because they constitute the most sensitive subgroups to the detrimental effects on growth and development of some persistent organic pollutants. Clinical follow-up tests were not necessary. Higher plasma levels were observed among the 40-year and older group, although the establishment of a follow-up protocol requires additional research. Even though we have no evidence for ill-health effects in this older group of individuals, they were invited to contact the research team for consultation if they had concerns and, if warranted, follow-up was

offered. Of the emerging persistent toxic chemicals, perfluorooctane sulfonate (PFOS; an industrial grease repellent) was found to be associated with the consumption of traditional foods, while polybrominated diphenyl ethers (fire retardants) and pentachlorophenol (an industrial wood preservative) were not.

11.4 Health outcomes

In both communities, we observed a similar pattern for the risk factors of CVD. We found a relatively high prevalence (around 35%) of hypertension. Low HDL-cholesterol and elevated triglycerides were detected in more than 1/3 of the population sample. However, we also noticed relatively low prevalences of elevated LDL-cholesterol, total cholesterol and of the total cholesterol/HDL-cholesterol ratio, all of which are significantly associated with lower risk of CVD. These risk factors were associated positively with general obesity and also with abdominal obesity. Furthermore, the polyunsaturated fatty acids EPA+DHA concentrations were approximately half the values found among Inuit of Nunavik (Dewailly *et al.* 2001), but about 2-3 times those of the general population of Québec. This is a positive finding, as these polyunsaturated fatty acids are believed to be protective. Carotid artery intima media thickness (an indication of clogging) was higher in hypertensive individuals and those with high lipid levels.

In prediabetes, the body struggles to keep the blood sugar healthy by making large amount of insulin. After 5 or 10 years of prediabetes the body can not keep up making such large amounts of insulin, and the blood sugar starts to rise and this causes diabetes. We observed elevated plasma insulin levels in more than 75% of participants from both communities, specifically in women and young girls. The presence of high insulin levels despite normal plasma glucose concentrations highlighted the significant morbidity associated with the high rates of obesity (BMI > 30 kg/m^2) documented in both communities (71% of participants in Eastmain and 66% in Wemindji).

Overall, in both communities issues related to obesity and other risk factors for Type 2 diabetes (T2D) need specific attention. The prevalence of obesity exceeded 65% in both Eastmain and Wemindji. Abdominal obesity, known as a core risk factor in the metabolic cascade that confers increased risk of both cardiovascular disease and diabetes, was also alarmingly high (more than 80%) in both communities. The mentioned hyperinsulinemia among women and young girls is of particular concern, as it is a precursor to pre-diabetes and diabetes. These results identify an urgent need to reduce these conditions, especially in younger age groups, by intensifying health promotion programs. Thus more intensive screening and preventive strategies are recommended.

Due to small population sample size, the somewhat elevated prevalences of both hypo- and hyperthyroidism observed in both communities need to await the completion of the *Nituuchischaayihtitaau Aschii* project before definite conclusions are drawn. Based on urinary levels of

the essential element iodine, there was no iodine deficit at the population level. Similarly to results obtained in the US population, about 11% of participants from Eastmain and Wemindji had urinary iodine concentrations below that indicating moderate iodine deficiency.

Bone density measurements indicated that the percentage of women with a high risk of bone fracture was low.

11.5 Natural drinking water sources

Some of the drinking water collected from natural sources (mostly from springs) during June (Wemindji) and August (Eastmain) of 2007 tested positive for microbial contamination. Although the level of contamination was modest, residents are advised to boil their water before use when drinking water is obtained from a spring, river or lake.

11.6 Zoonotic diseases

Overall, seroprevalence rates were similar between the two communities. Nearly half the individuals tested were seropositive for at least one zoonosis. The highest seroprevalence rates were for *Leptospira sp*. (23%), *F. tularensis* (17%), and the California serogroup viruses (JC and SSH viruses) (10%). The other zoonoses *(T. gondii, C. burnetii*, *E. granulosus*, *T. canis* and *Trichinella sp.*) had seroprevalence rates of 5%; no exposures were identified to hantaviruses (Sin Nombre Virus). Overall, seropositivity was related to age, gender, hunting and owning a dog. There was no medical history suggestive of overt diseases. Nonetheless, physicians should consider these agents when confronted with difficult or confusing diagnoses. In particular, the bacterial zoonoses should be ruled out in individuals with high or prolonged fever.

11.7 Educational activities

The workshops for youth were organized in order to stimulate scientific curiosity and to create a link between the *Nituuchischaayihtitaau Aschii* project team and the community. About 110 elementary and high school students had a chance to tour the mobile laboratory facilities and further 60-100 youths participated in science summer camp activities and movie nights. In Eastmain, the educational activities coordinator ran focus groups and workshops with local teachers to identify needs related to science education, and also provided assistance with the school's science fair. In both Eastmain and Wemindji, employment was provided for several local teenagers in the roles of Science Activities Assistant, Welcomer and Microbiology Intern.

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APPENDIX 1: QUESTIONNAIRES

Reference #: Id. |___|___|___|___|

C

Clinical

Questionnaire

This questionnaire is to be administered only to women aged 15 years or more

0. Start time

|___|___|:|___|___|
HH MM

Reference #: Id. |___|___|___|___|

4. Do you <u>still</u> have your period?

1 ☐ Yes, regularly &

b) Specify start date of your last period: |___|___|___|___| (YYYY) |___|___| (MM) |___|___| (DD) 9999 ☐ DNK/NR/R

2 ☐ Yes, irregularly &

b) Specify start date of your last period: |___|___|___|___| (YYYY) |___|___| (MM) |___|___| (DD) 9999 ☐ DNK/NR/R

3 ☐ Not anymore &

c) Specify age of your last period: |___|___| 99 ☐ DNK/NR/R

If participant is aged <u>55 or more</u>, Go to Q 6

4 ☐ I never had my period

9 ☐ DNK/NR/R

5. Do you use oral contraceptives (the pill) or other hormonal contraceptives (Depo-Provera, implants, patches, etc.) at the <u>present time</u>?

1 ☐ Yes &

b) Specify contraceptive name: _____

2 ☐ No

9 ☐ DNK/NR/R

6. Are you post-menopausal?

1 ☐ Yes

2 ☐ No ▸ _____

9 ☐ DNK/NR/R ▸ _____

Go to Q 8

7. Do you take hormonal medication for your menopausal status at the <u>present time</u>?

1 ☐ Yes &

b) Specify medication name: _____

2 ☐ No

9 ☐ DNK/NR/R

8. Have you ever been pregnant?

1 ☐ Yes

2 ☐ No ▸ _____ **Go to End of questionnaire**

9 ☐ DNK/NR/R ▸ _____

9. How many children did you give birth to?

_____ child/children ▸ _____ **If none, write "0" and Go to Q 13**

99 ☐ DNK/NR/R ▸ _____ **Go to Go to Q 13**

10. Are you breastfeeding at the present time?

1 ☐ Yes

2 ☐ No

9 ☐ DNK/NR/R

11. How many children have you previously breastfed?

_____ child/children ▸ _____ **If none, write "0" and Go to Q 13**

99 ☐ DNK/NR/R ▸ _____ **Go to Go to Q 13**

12. Can you tell me your youngest and oldest children's year and month of birth?

	Child	Year and month of birth YYYY MM	DNK/NR/R
a)	First	|___|___|___|___| |___|___|	9999 ☐ DNK/NR/R
b)	Last	|___|___|___|___| |___|___|	9999 ☐ DNK/NR/R

13. How many pregnancies did you have that resulted in a miscarriage?

_____ miscarriage(s) ▸ _____ **If none, write "0" and Go to Q 10**

9 ☐ DNK/NR/R ▸ _____ **Go to Q 10**

Reference #: Id. |___|___|___|___|

Thank you for your participation!

14. The interview was held in:

1 ☐ English

2 ☐ Cree

3 ☐ Both English and Cree

15. Name of nurse

_____

16. Date of interview

|___|___|___|___| |___|___| |___|___|
YYYY MM DD

17. End time

|___|___|:|___|___|
HH MM

End of Clinical questionnaire

Reference #: Id. |___|___|___|___|

Individual

Questionnaire

The first section of this questionnaire is to be asked to persons aged 8 years or more

0. Start time

|___|___|:|___|___|
HH MM

Reference #: Id. |___|___|___|___|

1. Gender

1 ☐ Female

2 ☐ Male

Thank you for agreeing to answer the following questions.
I would like to ask you some questions about you, your household and lifestyle.

2. What is your birth date?

|___|___|___|___| |___|___| |___|___|
YYYY MM DD

9999 ☐ DNK/NR/R

3. How old are you?

Validate age using <u>birth date</u> and <u>Card A</u>

_____ years old

99 ☐ DNK/NR/R

4. What language, or languages, do you <u>usually</u> speak at home?

Check all that apply

1 ☐ Cree

2 ☐ English

3 ☐ French

9 ☐ DNK/NR/R

5. What is the highest level of schooling you have <u>completed</u>?

1 ☐ No formal schooling

2 ☐ Some or completed elementary school

3 ☐ Some or completed secondary school

4 ☐ Some or completed college or higher education level (not university)

5 ☐ Some or completed university

9 ☐ DNK/NR/R

7. Which of the following <u>best</u> describes your <u>present</u> working status?

1 ☐ Work full time
2 ☐ Work part time
3 ☐ Work occasionally
4 ☐ Student
5 ☐ Housework
6 ☐ Retired or on pension
7 ☐ Unemployment insurance
8 ☐ Income Security Program
9 ☐ Social welfare
10 ☐ Not working for health reasons &
b) Specify: _____
11 ☐ Other &
b) Specify: _____
99 ☐ DNK/NR/R

9. How many <u>bedrooms</u> are there in your house or apartment?

_____ bedrooms
99 ☐ DNK/NR/R

10. How many persons of each of the following age groups live in your house or apartment at this time?

Give an answer for each item			
a) **Children aged <u>14 yrs or less:</u>**	# _____	14-	99 ☐ DNK/NR/R
b) **Adults aged <u>15 to 49 yrs:</u>**	# _____	15-49	99 ☐ DNK/NR/R
c) **Adults aged <u>50 yrs or more:</u>**	# _____	50+	99 ☐ DNK/NR/R

11. While <u>in the community</u>, how often do you drink water from these different sources?

Give an answer for each item	All the time 1	Most of the time 2	Some-times 3	Rarely 4	Never 5	DNK/ NR/R 9
a) **Store bought bottled water**	☐	☐	☐	☐	☐	☐
b) **Water from a local spring**	☐	☐	☐	☐	☐	☐
c) **Water from a lake or river**	☐	☐	☐	☐	☐	☐
d) **Melted ice or snow**	☐	☐	☐	☐	☐	☐
e) **Tap water**	☐	☐	☐	☐	☐	☐

12. While <u>in the bush</u>, how often do you drink water from these different sources?

Give an answer for each item	All the time 1	Most of the time 2	Some-times 3	Rarely 4	Never 5	DNK/ NR/R 9
a) **Store bought bottled water**	☐	☐	☐	☐	☐	☐
b) **Water from a local spring**	☐	☐	☐	☐	☐	☐
c) **Water from a lake or river**	☐	☐	☐	☐	☐	☐
d) **Melted ice or snow**	☐	☐	☐	☐	☐	☐
e) **Tap water brought from the community**	☐	☐	☐	☐	☐	☐

Reference #: Id. |___|___|___|___|

21. Do you hunt?

1 ☐ Yes
2 ☐ No ▸ _____
9 ☐ DNK/NR/R ▸ _____

Go to Q 24

22. When you hunt, do you use a gun?

1 ☐ Yes
2 ☐ No ▸ _____
9 ☐ DNK/NR/R ▸ _____

Go to Q 24

23. Do you use <u>any</u> of the following ammunitions and, if so, <u>how many boxes per year</u> do you use?

Use visual support to show types of ammunition available. Give an answer for each item.			
	Yes 1	No 2	DNK/ NR/R 99
a) **Bullets**	☐ &	☐	☐
ax) <u>If yes</u>, how many boxes per year do you use?	_____ # of boxes		☐
b) **Lead shot for shotguns**	☐ &	☐	☐
bx) <u>If yes</u>, how many boxes per year do you use?	_____ # of boxes		☐
c) **Non-leaded shot (steel, etc.) for shotguns**	☐ &	☐	☐
cx) <u>If yes</u>, how many boxes per year do you use?	_____ # of boxes		☐

24. Do you smoke cigarettes?

1 ☐ Every day &

b) How many cigarettes do you smoke per day? _____ # of cigarettes ▸ _____ **Go to Q 26**

2 ☐ Occasionally &

b) How many cigarettes do you smoke per week? _____ # of cigarettes ▸ _____ **Go to Q 26**

3 ☐ Ex-smoker

4 ☐ Never smoked _____ **Go to Q 27**

9 ☐ DNK/NR/R _____

25. When you used to smoke, did you smoke:

1 ☐ Every day &

b) How many cigarettes did you smoke per day? _____ # of cigarettes

2 ☐ Occasionally &

b) How many cigarettes did you smoke per week? _____ # of cigarettes

9 ☐ DNK/NR/R

26. At what age did you smoke your first whole cigarette?

_____ years old

99 ☐ DNK/NR/R

27. Does anyone living in your house, including yourself, smoke cigarettes, pipes or cigars inside the house on a regular basis?

1 ☐ Yes

2 ☐ No

9 ☐ DNK/NR/R

Reference #: Id. |___|___|___|___|

Clinical questions

1. In general, would you say your health is...

1 ☐ Excellent
2 ☐ Very Good
3 ☐ Good
4 ☐ Fair
5 ☐ Poor
9 ☐ DNK/NR/R

2. Are you worried about the pollution of the environment (land, water or air) in Iiyiyiu Aschii?

1 ☐ Not at all
2 ☐ Somewhat
3 ☐ Fairly
4 ☐ Very much
9 ☐ DNK/NR/R

Ask the following questions if participant is aged 15 to 69 years,
else if participant is aged 14 years or less, Go to End of Questionnaire,
else if participant is aged 70 years or more, Go to Zoonoses questions.

I am going to ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Think about the activities you do at work, as part of your house and yard work, to get from place to place, while in the bush or during sport activities.

Now think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for exercise.

34. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

\# _____ days per week ▸ _____ **If "0" write "0" and Go to Intro Q 28**

8 ☐ DNK/not sure ▸ _____

9 ☐ Refused ▸ _____ **Go to Intro Q 28**

Clarification: Think only about the walking you do for at least 10 minutes at a time

35. How much time did you usually spend walking on one of those days?

\# _____ hours per day ▸ _____

\# _____ minutes per day ▸ _____ **Go to Intro Q 28**

998 ☐ DNK/not sure

999 ☐ Refused ▸ _____ **Go to Intro Q 28**

Clarification: Think only about the walking you do for at least 10 minutes at a time

An average time for one of the days on which the respondent walks is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, ask:

36. What is the <u>total</u> amount of time you spent walking over the <u>last 7 days</u>?

\# _____ hours per <u>week</u>

\# _____ minutes per <u>week</u>

998 ☐ DNK/not sure

999 ☐ Refused

Intro Q 28: Now, think about all the <u>vigorous</u> activities which take <u>hard physical effort</u> that you did in the last 7 days. Vigorous activities make you breathe much harder than normal and may include heavy lifting, digging or running. Think only about those physical activities that you did for <u>at least 10 minutes at a time.</u>

28. During the <u>last 7 days</u>, on how many days did you do <u>vigorous</u> physical activities?

\# _____ days per week ▸ _____ **If "0" write "0" and Go to <u>Intro</u> Q 31**

8 ☐ DNK/not sure ▸ _____

9 ☐ Refused ▸ _____ **Go to <u>Intro</u> Q 31**

Clarification: Think only about those physical activities you do for at least 10 minutes at a time

29. How much time did you usually spend doing <u>vigorous</u> physical activities on one of those days?

\# _____ hours per <u>day</u> ▸ _____

\# _____ minutes per <u>day</u> ▸ _____ **Go to <u>Intro</u> Q 31**

998 ☐ DNK/not sure

999 ☐ Refused ▸ _____ **Go to <u>Intro</u> Q 31**

Clarification: Think only about those physical activities you do for at least 10 minutes at a time

An average time for one of the days on which the respondent does vigorous activity is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, ask:

30. How much time <u>in total</u> would you spend <u>over the last 7 days</u> doing vigorous physical activities?

\# _____ hours per <u>week</u>

\# _____ minutes per <u>week</u>

998 ☐ DNK/not sure

999 ☐ Refused

Intro Q31: Now think about activities which take <u>moderate physical effort</u> that you did in the last 7 days. Moderate physical activities make you breathe somewhat harder than normal and may include carrying light loads, traditional dancing and activities while in the bush. Do not include walking. Again, think about only those physical activities that you did for <u>at least 10 minutes at a time</u>.

31. During the <u>last 7 days</u>, on how many days did you do <u>moderate</u> physical activities?

\# _____ days per week ▸ _____ **If "0" write "0" and Go to <u>Clinical questions</u>**

8 ☐ DNK/not sure ▸ _____

9 ☐ Refused ▸ _____ **Go to <u>Clinical questions</u>**

Clarification: Think only about those physical activities you do for at least 10 minutes at a time

32. How much time did you usually spend doing <u>moderate</u> physical activities on one of those days?

\# _____ hours per <u>day</u> ▸ _____

\# _____ minutes per <u>day</u> ▸ _____ **Go to <u>Clinical questions</u>**

998 ☐ DNK/not sure

999 ☐ Refused ▸ _____ **Go to <u>Clinical questions</u>**

Clarification: Think only about those physical activities you do for at least 10 minutes at a time

An average time for one of the days on which the respondent does moderate activity is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, ask:

33. What is the <u>total</u> amount of time you spent over the <u>last 7 days</u> doing moderate physical activities?

\# _____ hours per <u>week</u>

\# _____ minutes per <u>week</u>

998 ☐ DNK/not sure

999 ☐ Refused

Reference #: Id. |___|___|___|___|

Zoonoses questions

Some diseases are carried by animals and may be transmitted to humans by contact or handling of these animals and consumption of some of their parts.
<u>Such diseases are called zoonoses.</u>
The following questions are to document your potential exposure to such diseases from wild game.

1. In the past 12 months, how many of the following animals did you handle? (gut, clean, skin or tan)

Animals	None 1	1 to 2 2	3 to 9 3	10 to 29 4	More than 30 5	DNK/ NR/R 9
a) Moose	☐	☐	☐	☐	☐	☐
b) Caribou	☐	☐	☐	☐	☐	☐
c) Beaver	☐	☐	☐	☐	☐	☐
d) Fox	☐	☐	☐	☐	☐	☐
e) Wolf	☐	☐	☐	☐	☐	☐
f) Bear	☐	☐	☐	☐	☐	☐
g) Lynx	☐	☐	☐	☐	☐	☐
h) Rabbit	☐	☐	☐	☐	☐	☐
i) Porcupine	☐	☐	☐	☐	☐	☐
j) Groundhog	☐	☐	☐	☐	☐	☐
k) Muskrat	☐	☐	☐	☐	☐	☐
l) Small predator (such as: otter, mink, marten, weasel, etc.)	☐	☐	☐	☐	☐	☐
Any other animals? (specify)						
m) _____	☐	☐	☐	☐	☐	☐
n) _____	☐	☐	☐	☐	☐	☐

2. In the past 12 months, how many of the following birds did you handle? (gut, clean, skin or pluck)

Birds	None 1	1 to 2 2	3 to 9 3	10 to 29 4	More than 30 5	DNK/ NR/R 9
a) Partridge, grouse or ptarmigan	☐	☐	☐	☐	☐	☐
b) Ducks	☐	☐	☐	☐	☐	☐
c) Geese	☐	☐	☐	☐	☐	☐
Any other birds? (specify)						
d) _____	☐	☐	☐	☐	☐	☐
e) _____	☐	☐	☐	☐	☐	☐

3. While handling these animals and birds, did you wear gloves?

1 ☐ Never
2 ☐ Rarely
3 ☐ Sometimes
4 ☐ Most of the time
5 ☐ Always
9 ☐ DNK/NR/R

8. In the past 5 years, did you have a pet animal living in your home?

1 ☐ Yes
2 ☐ No ▸ _____
9 ☐ DNK/NR/R ▸ _____

Go to End of questionnaire

9. What kind of animal or animals is it?

Check all that apply

1 ☐ Dog

2 ☐ Cat

3 ☐ Other &

3x Specify: _____

9 ☐ DNK/NR/R

End of questionnaire

Thank you for your participation!

39. The interview was held in:

1 ☐ English

2 ☐ Cree

3 ☐ Both English and Cree

40. Name of interviewer

_____

41. Date of interview

|___|___|___|___| |___|___| |___|___|
YYYY MM DD

42. End time

|___|___|:|___|___|
HH MM

Reference #: Id. |___|___|___|___|

24-Hour Recall

Questionnaire

Codes for Portion Size Model
See Santé Québec Kit
Codes for Thickness
See Santé Québec Kit

This questionnaire is to be administered to persons aged 9 years or more

0. **Start time**

|___|___|:|___|___|
HH MM

Reference #: Id. |___|___|___|___|

Time				Description of food and how prepared	Portion size		
H	H	M	M		Quant.	Model	Thickness
				WATER (total for the whole 24 hours)			

Reference #: Id. |___|___|___|___|

Time				Description of food and how prepared	Portion size		
H	H	M	M		Quant.	Model	Thickness

Reference #: Id. |___|___|___|___|

1. Was this a typical day?

1 ☐ Yes

2 ☐ No ▸ _____ Why? (specify) _____

2. Do you take vitamin or mineral supplements?

1 ☐ Yes

2 ☐ No ▸ _____ **Go to Q 4**

3. Can you give the following information on the vitamin or mineral supplements you take?

DIN	Manufacturer/Company	Description	Quantity	Frequency	
				Daily	Per week

Thank you for your participation!

4. Recall #

1 ☐ 1

2 ☐ 2

5. Date of interview

|___|___|___|___| |___|___| |___|___|
YYYY MM DD

6. Name of interviewer

_____

7. End time

|___|___|:|___|___|
HH MM

Reference #: Id. |___|___|___|___|

M

Market Food Frequency

Questionnaire

This questionnaire is to be administered to persons aged 9 years or more

0. Start time

|___|___|:|___|___|
HH MM

Reference #: Id. |___|___|___|___|

How often did you eat these foods in last 30 days?		
Fruits	**Last 30 days**	
	Frequency	**D-W-M**
1. **Fresh fruit** (apples, pears, bananas, berries, grapes, oranges, grapefruit)		
2. **Canned fruit**		
3. **Dried fruit** (raisins, dates, apricots, etc.)		
Vegetables		
4. **Potatoes** (instant or homemade mashed, boiled, baked – **not fried**)		
5. **Carrots, peas or corn**		
6. **Salad or coleslaw**		
7. **Tomatoes** (fresh, canned, sauce)		
Sweets		
21. **Cakes, snack cakes, boudin cake, donuts, pies, pastries**		
22. **Cookies**		
Miscellaneous		
42. **Chips, crisps, cheese puffs**		
43. **Nacho chips with melted cheese**		
44. **Microwave Popcorn** What is your usual choice? (select one): 1 ☐ Regular 2 ☐ Light or Low fat		
47. **Poutine**		
48. **French fries, fried potatoes or hash browns**		
49. **Deep fried snacks** (onion rings, cheese sticks, etc.)		

Reference #: Id. |___|___|___|___|

How often did you drink these beverages in last 30 days?		
Beverages	**Last 30 days**	
	Frequency	**D-W-M**
25. **Soft drinks** What is your usual choice? (select one): 1 ☐ Regular 2 ☐ Diet		
26. **Ice tea** What is your usual choice? (select one): 1 ☐ Regular 2 ☐ Diet		
27. **Fruit drinks or Sports drinks** (Tang, punch, Kool-Aid, Sunny D, Gatorade)		
28. **Real fruit juice** (100% pure, bottled or frozen)		
29. **Milk** What is your usual choice? (select one): 1 ☐ Whole 2 ☐ 2%, “Grand Pré” 3 ☐ 1% 4 ☐ Skim		
30. **Chocolate milk**		
32. **Beer** What is your usual choice? (select one): 1 ☐ Regular 2 ☐ Light		
33. **Wine**		
34. **Alcohol** What is your usual choice? (select one): 1 ☐ Mixed with juice or pop 2 ☐ Shooters or on ice		

Reference #: Id. |___|___|___|___|

How often did you use the following fats and oil (by adding them to your foods OR in your cooking and baking)?		
Fats and oil	**Last 30 days**	
	Frequency	**D-W-M**
50. Butter		
51. Margarine		
52. Lard or shortening		
53. Vegetable oil		

Thank you for your collaboration!

The interview was held in:

1 ☐ English

2 ☐ Cree

3 ☐ Both English and Cree

Name of interviewer

_____

Date of interview

|___|___|___|___| |___|___| |___|___|
YYYY MM DD

End time

|___|___|:|___|___|
HH MM

End of Market Food Frequency questionnaire

Reference #: Id. |___|___|___|___|

Traditional Food Frequency

Questionnaire

Dates for Seasons	
Fall	September 21 to December 20
Winter	December 21 to March 20
Spring	March 21 to June 20
Summer	June 21 to today
Codes for Frequency	
D	Day
W	Week
M	Month
S	Season

This questionnaire is to be asked to persons aged 9 years old or more

0. Start time

|___|___|:|___|___|
HH MM

Reference #: Id. |___|___|___|___|

In the past 12 months, did you eat any of the following Animals? If yes, how often did you eat these Animals for each of the following seasons?

Animals	Eaten		Fall		Winter		Spring		Summer	
	Yes	No	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S
1. **Bear** meat, dried	☐	☐								
2. **Bear** meat, cooked	☐	☐								
3. **Bear** liver or kidney	☐	☐								
4. **Moose** meat, dried	☐	☐								
5. **Moose** meat, cooked	☐	☐								
6. **Moose** liver or kidney	☐	☐								
7. **Caribou** meat, dried	☐	☐								
8. **Caribou** meat, cooked	☐	☐								
9. **Caribou** liver or kidney	☐	☐								
10. **Beaver** meat	☐	☐								
11. **Rabbit** meat	☐	☐								
12. **Smoked game animal meat**	☐	☐								
Any other Game Animals that you ate in the past 12 months? (specify on line)										
13. _____	☐	☐								
14. _____										
15. _____										
16. _____										

Reference #: Id. |___|___|___|___|

In the past 12 months, did you eat any of the following Fish? If yes, how often did you eat these Fish for each of the following seasons?

Fish	Eaten		Fall		Winter		Spring		Summer	
	Yes	No	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S
17a. **Speckled trout (from fresh water)**	☐	☐								
17b. **Speckled trout (from saltwater)**	☐	☐								
18. **Walleye**	☐	☐								
19a. **Whitefish (from fresh water)**	☐	☐								
19b. **Whitefish (from saltwater)**	☐	☐								
20. **Pike**	☐	☐								
21. **Lake Trout**	☐	☐								
22. **Sturgeon**	☐	☐								
23. **Burbot**	☐	☐								
24. **Red or White Sucker**	☐	☐								
25. **Fish from the ocean**	☐	☐								
26. **Fish eggs**	☐	☐								
27. **Smoked wild fish**	☐	☐								
Any other Wild Fish that you ate in the past 12 months? (specify species on line)										
28. _____	☐	☐								
29. _____										
Did you eat Fish liver? (specify species on line)										
30. _____	☐	☐								
31. _____										

Reference #: Id. |___|___|___|___|

In the past 12 months, did you eat any of the following Birds and Ducks? If yes, how often did you eat these Birds and Ducks for each of the following seasons and what is your usual portion size?

Birds and Ducks	Eaten		Fall		Winter		Spring		Summer	
	Yes	No	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S
32. **Loon or Merganser**	☐	☐								
33. **Geese (all types, including Brent)**	☐	☐								
34. **Dabblers** (Mallard, American Black duck and Northern Pintail)	☐	☐								
35. **Sea Ducks** (Golden eye, Old Squaw and Black Scoter)	☐	☐								
36. **Other Ducks**	☐	☐								
37. **Ptarmigan, partridge and other birds**	☐	☐								
Did you eat Bird and Duck gizzards in the past 12 months? (specify species on line)										
38. _____	☐	☐								
39. _____										
40. _____										
41. _____										
Did you eat Bird and Duck livers or kidneys? (specify species on line)										
42. _____	☐	☐								
43. _____										
44. _____										
45. _____										

In the past 12 months, did you eat any Wild Berries or Wild Berry Jam? If yes, how often did you eat Wild Berries or Wild Berry Jam for each of the following seasons?

Berries	Eaten		Fall		Winter		Spring		Summer	
	Yes	No	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S
46. **Wild berries**	☐	☐								
47. **Wild berry jam**	☐	☐								

In the past 12 months, did you use any of the following Animal Fats for spreading, dipping, baking or frying? If yes, how often did you use these Animal Fats for each of the following seasons?

Animal fats	Eaten		Fall		Winter		Spring		Summer	
	Yes	No	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S	Freq.	D-W-M-S
48. **Bear** grease	☐	☐								
49. **Goose** grease	☐	☐								
Did you use other Animal Fats for spreading, dipping, baking or frying? (specify on line)										
50. _____	☐	☐								
51. _____										
52. _____										
53. _____										

Thank you for your participation!

56. The interview was held in:

1 ☐ English

2 ☐ Cree

3 ☐ Both English and Cree

57. Name of interviewer

_____

58. Date of interview

|___|___|___|___| |___|___| |___|___|
YYYY MM DD

59. End time

|___|___|:|___|___|
HH MM

End of Traditional Food Frequency questionnaire

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (August 2002)

SHORT LAST 7 DAYS SELF-ADMINISTERED FORMAT

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health–related physical activity.

Background on IPAQ

The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (14 sites) during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages, and are suitable for national population-based prevalence studies of participation in physical activity.

Using IPAQ

Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instruments.

Translation from English and Cultural Adaptation

Translation from English is supported to facilitate worldwide use of IPAQ. Information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se. If a new translation is undertaken we highly recommend using the prescribed back translation methods available on the IPAQ website. If possible please consider making your translated version of IPAQ available to others by contributing it to the IPAQ website. Further details on translation and cultural adaptation can be downloaded from the website.

Further Developments of IPAQ

International collaboration on IPAQ is on-going and an ***International Physical Activity Prevalence Study*** is in progress. For further information see the IPAQ website.

More Information

More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000). *Assessment of Physical Activity: An International Perspective*. Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

APPENDIX 2: CONSENT FORMS

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

Conseil Cri de la santé et des services sociaux de la Baie James
Cree Board of Health and Social Services of James Bay

CHUQ Centre hospitalier universitaire de Québec
McMaster University
McGill

Information Sheet and Consent Form (0-7 years old)
(Eastmain, Spring/Summer 2007)

The new Mercury Agreement (2001) provides money to the communities to promote the fishery. The Agreement also provides money for the Public Health Department to ensure that Eeyouch are protected from mercury and other contaminants in the environment. This research project has been developed to give the Chief and Council of the Cree Nation of Eastmain and the Public Health Department of the Cree Board of Health and Social Services (referred to as the Cree Health Board (CHB)) more knowledge about environment-and-health issues in Eastmain. This study is being financed by the Niskamoon Corporation.

Purpose and who participate:
The study will gather information to understand whether Eeyouch:

- have been exposed to heavy metals, PCBs and other contaminants;
- are healthy;
- and the relationship between health, contaminants and the kind of food people are eating

This study will be conducted in the Cree Nation of Eastmain during spring 2007. All communities will be visited over a 7-year period. One hundred fifty (150) people in Eastmain will be invited to participate. Pregnant women will not be invited to do so because they participate in a regular monitoring programme as part of the Maternal and Infant Health Programme.

What your child will be asked to do:
The entire visit will take less than 30 minutes. The nurse will

a. Take a blood sample (about 1/2 tablespoon for lead).
b. Take a small hair sample (about the size of a pen) to test for mercury.

What will be done with your child's blood, and hair samples:
Your child's samples will be kept under the authority of the CHB and shipped to the Quebec National Public Health Institute (INSPQ) in Quebec City for analysis. They will be studied for environmental contaminants. Together, the analyses of these factors will give you and your child and the study information about the state of your child's health. Your child's blood samples will be stored for the CHB in a -80°C freezer in the laboratory of Dr. Éric Dewailly (INSPQ), for 15 years. Later, if the CHB needs to test your child's blood for new emergent diseases, you and your child will be asked to sign a new paper saying you both agree to the new test. Your child's samples will be identified with a study number, not his or her name.

Benefits:
By participating in this study, your child will be helping the CHB and the Chief and Council of the Cree Nation of Eastmain to understand whether environmental contaminants are a problem in Eastmain. Your

child will help them to better understand the state of health of the people of your community, and to understand his or her current health and make improvements as needed. Once the results of your child's medical tests have been received, a doctor working for the Public Health Department will send your child's results to the Eastmain clinic. You will be informed by letter if your child's results are either normal or abnormal, and be invited to meet with a doctor or a nurse if needed. It is recommended that your child consult the clinic for any abnormals results as it will be suggested at the follow up.

Risks or Discomfort:
We do not think that being in the study will cause your child any harm. When your child will give the blood sample, he or she may develop a light bruise where the sample has been taken.

Confidentiality:
All information gathered for this study will be kept confidential. Your child's name will only appear on what is called the 'Master List' which matches your name and your study numbers. There will be strict rules controlling who can see this list. After the entire study has been completed in all the Eeyou communities and the final report written, the Master List will be destroyed. The information that the study obtains from your child's medical tests and questionnaires will only be used by the researchers involved with this study, with no names and will be kept by the Public Health Department. The researchers will prepare popular reports to be passed around the community. Your child's name will not appear in any publication or report.

Financial compensation:
Your child will receive $10 as a compensation for your time for participating in this study.

Withdrawal from the Study:
Participating in this study is entirely up to you and your child. Even after you have agreed to have your child participate in the study, you can decide you do not want your child to continue. This can be at any time. Participating or not will have no effect on any services that you, your child, and your family members receive from your local health clinic and other offices of the CHB.

Who is doing the study:
This study is being done by the Public Health Department of the CHB in partnership with your Chief and Council of the Cree Nation of Eastmain. Our research partners for this project are:

- Quebec National Institute of Public Health (your Public Health Department works closely with the Institute on a regular basis)
- Laval University Hospital (CHUL-CHUQ)
- McMaster University
- McGill University

This study has been approved by the Research Ethics Committees of CHUL-CHUQ, McGill University, McMaster University, and the Cree Board of Health and Social Services.

For more information:
If you have any questions about the project, you can contact:

- **Dr. Yv Bonnier Viger**, principal researcher on this study and Director of Public Health, Cree Board of Health and Social Services at 819-855-9001 (ext. 5335) in Chisasibi or at 418 770-6899
- **Ms Suzanne Côté**, field coordinator and nurse, from Public Health Research Unit of the CHUL-CHUQ: (418) 656-4141, ext. 46536 and (418) 563-0113 (Québec City)
- **Dr. Éric Dewailly**, principal researcher on this study, researcher at the National Quebec Public Health Institute and professor at Laval University : (418) 656-4141 ext. 46518 (Québec City)
- **Dr. Daria Pereg**, principal researcher on this study, researcher at the Public Health Research Unit of CHUL-CHUQ : (418) 656-4141 ext. 46537 (Québec City)
- **Professor Evert Nieboer**, principal researcher on this study, professor at McMaster University (905) 525-9140 ext. 22048 (Hamilton)

If you have any concerns or complaints, you are invited to call or write to:

The Cree Nation of Eastmain representative to the Cree Board of Health and Social Services
C/o Office of the Chief of the Cree Nation of Eastmain
Administration Building
Eastmain, Quebec, (819) 977-0211

Moreover, if you have questions concerning the rights of your child as a subject of research, you can contact the professional services director of the CHUQ at the following number; 418 691-5521

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

CONSENT FORM TO PARTICIPATE IN NITUUCHISHAAYIHTITAAU ASCHII
(Eastmain, 0-7 years old)

- I have read and understand what is involved in the study and hereby consent and voluntary agree to have my child participate in the Nituuchischaayihtitaau; Multi-Community Environment and Health Study in Eeyou Istchee.

Yes ☐ **No** ☐

- I will be advised in a letter if my child's results are normal or abnormal, and to consult with my child my local clinic doctor/nurse in the case of any abnormal results. I authorize the Cree Board of Health & Social Services of James Bay to send my child's results of his/her clinical tests to the Eastmain clinic (or a doctor of my choice) as a preventive measure.

Yes ☐ **No** ☐

The doctor of my choice is (If other than doctor of Eastmain): Name _____

Address_____

Other choices (You do not need to agree to any of these to be in the study)

I agree to allow a research nurse to review my child's medical file to find out about his/her health.

Yes ☐ **No** ☐

I agree that the researchers can contact me for follow-up tests and for other analyses not mentioned above.

Yes ☐ **No** ☐

I would like to receive a short report of the study's results.

Yes ☐ **No** ☐

_____
Name of participant

_____	_____	____/____/____
Name of parent or tutor (Participant's under 18 years old)	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of witness	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of principal investigator /or his/her designated representative	Signature	Date (yy / mm / dd)

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

Conseil Cri de la santé et des services sociaux de la Baie James
Cree Board of Health and Social Services of James Bay

CHUQ Centre hospitalier universitaire de Québec
McMaster University
McGill

Information Sheet and Consent Form (0-7 years old)
(Wemindji, Spring/Summer 2007)

The new Mercury Agreement (2001) provides money to the communities to promote the fishery. The Agreement also provides money for the Public Health Department to ensure that Eeyouch are protected from mercury and other contaminants in the environment. This research project has been developed to give the Chief and Council of the Cree Nation of Wemindji and the Public Health Department of the Cree Board of Health and Social Services (referred to as the Cree Health Board (CHB)) more knowledge about environment-and-health issues in Wemindji. This study is being financed by the Niskamoon Corporation.

Purpose and who participate:
The study will gather information to understand whether Eeyouch:

- have been exposed to mercury, lead, manganese, PCBs and other contaminants;
- are healthy;
- and the relationship between health, contaminants and the kind of food people are eating

This study will be conducted in the Cree Nation of Wemindji during summer 2007. All communities will be visited over a 7-year period. 200 people in Wemindji will be invited to participate. Pregnant women will not be invited to do so because they participate in a regular monitoring programme as part of the Maternal and Infant Health Programme.

What your child will be asked to do:
The entire visit will take less than 30 minutes. The nurse will

a. Take a blood sample (about 1/2 tablespoon for lead).
b. Take a small hair sample (about the size of a pen) to test for mercury.

What will be done with your child's blood, and hair samples:
Your child's samples will be kept under the authority of the CHB and shipped to the Quebec National Public Health Institute (INSPQ) in Quebec City for analysis. They will be studied for environmental contaminants. Together, the analyses of these factors will give you and your child and the study information about the state of your child's health. Your child's blood samples will be stored for the CHB in a -80°C freezer in the laboratory of Dr. Éric Dewailly (INSPQ), for 15 years. Later, if the CHB needs to test your child's blood for new emergent diseases, you and your child will be asked to sign a new paper saying you both agree to the new test. Your child's samples will be identified with a study number, not his or her name.

Benefits:
By participating in this study, your child will be helping the CHB and the Chief and Council of the Cree Nation of Wemindji to understand whether environmental contaminants are a problem in Wemindji. Your child will help them to better understand the state of health of the people of your community, and

to understand his or her current health and make improvements as needed. Once the results of your child's medical tests have been received, a doctor working for the Public Health Department will send your child's results to the Wemindji clinic. You will be informed by letter if your child's results are either normal or abnormal, and be invited to meet with a doctor or a nurse if needed. It is recommended that your child consult the clinic for any abnormals results as it will be suggested at the follow up.

Risks or Discomfort:
We do not think that being in the study will cause your child any harm. When your child will give the blood sample, he or she may develop a light bruise where the sample has been taken.

Confidentiality:
All information gathered for this study will be kept confidential. Your child's name will only appear on what is called the 'Master List' which matches your name and your study numbers. There will be strict rules controlling who can see this list. After the entire study has been completed in all the Eeyou communities and the final report written, the Master List will be destroyed. The information that the study obtains from your child's medical tests and questionnaires will only be used by the researchers involved with this study, with no names and will be kept by the Public Health Department. The researchers will prepare popular reports to be passed around the community. Your child's name will not appear in any publication or report.

Financial compensation:
Your child will receive $10 as a compensation for your time for participating in this study.

Withdrawal from the Study:
Participating in this study is entirely up to you and your child. Even after you have agreed to have your child participate in the study, you can decide you do not want your child to continue. This can be at any time. Participating or not will have no effect on any services that you, your child, and your family members receive from your local health clinic and other offices of the CHB.

Who is doing the study:
This study is being done by the Public Health Department of the CHB in partnership with your Chief and Council of the Cree Nation of Wemindji. Our research partners for this project are:

- Quebec National Institute of Public Health (your Public Health Department works closely with the Institute on a regular basis)
- Laval University Hospital (CHUL-CHUQ)
- McMaster University
- McGill University

This study has been approved by the Research Ethics Committees of CHUL-CHUQ, McGill University, McMaster University, and the Cree Board of Health and Social Services.

For more information:
If you have any questions about the project, you can contact:

- **Dr. Yv Bonnier Viger**, principal researcher on this study and Director of Public Health, Cree Board of Health and Social Services at 819-855-9001 (ext. 5335) in Chisasibi or at 418 770-6899
- **Ms Suzanne Côté**, field coordinator and nurse, from Public Health Research Unit of the CHUL-CHUQ: (418) 656-4141, ext. 46518 and (418) 563-0113 (Québec City)
- **Dr. Éric Dewailly**, principal researcher on this study, researcher at the National Quebec Public Health Institute and professor at Laval University : (418) 656-4141 ext. 46518 (Québec City)
- **Dr. Daria Pereg**, principal researcher on this study, researcher at the Public Health Research Unit of CHUL-CHUQ : (418) 656-4141ext. 46537 (Québec City)
- **Professor Evert Nieboer**, principal researcher on this study, professor at McMaster University (905) 525-9140 ext. 22048 (Hamilton)

If you have any concerns or complaints, you are invited to call or write to:

The Cree Nation of Wemindji representative to the Cree Board of Health and Social Services
C/o Office of the Chief of the Cree Nation of Wemindji
Administration Building
Wemindji, Quebec, (819) 978-0264

Moreover, if you have questions concerning the rights of your child as a subject of research, you can contact the professional services director of the CHUQ at the following number; 418 691-5521

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

CONSENT FORM TO PARTICIPATE IN NITUUCHISHAAYIHTITAAU ASCHII
(Wemindji, 0-7 years old)

- I have read and understand what is involved in the study and hereby consent and voluntary agree to have my child participate in the Nituuchischaayihtitaau; Multi-Community Environment and Health Study in Eeyou Istchee.

Yes ☐ **No** ☐

- I will be advised in a letter if my child's results are normal or abnormal, and to consult with my child my local clinic doctor/nurse in the case of any abnormal results. I authorize the Cree Board of Health & Social Services of James Bay to send my child's results of his/her clinical tests to the Wemindji clinic (or a doctor of my choice) as a preventive measure.

Yes ☐ **No** ☐

The doctor of my choice is (If other than doctor of Wemindji): Name _____

Address_____

Other choices (You do not need to agree to any of these to be in the study)

I agree to allow a research nurse to review my child's medical file to find out about his/her health.

Yes ☐ **No** ☐

I agree that the researchers can contact me for follow-up tests and for other analyses not mentioned above.

Yes ☐ **No** ☐

I would like to receive a short report of the study's results.

Yes ☐ **No** ☐

_____
Name of participant

_____	_____	____/____/____
Name of parent or tutor (Participant's under 18 years old)	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of witness	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of principal investigator /or his/her designated representative	Signature	Date (yy / mm / dd)

Participant's initials_____ Witness' initials_____

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

Conseil Cri de la santé et des services sociaux de la Baie James
Cree Board of Health and Social Services of James Bay

CHUQ Centre hospitalier universitaire de Québec

McMaster University

McGill

Information Sheet and Consent Form (8-14 years old)
(Eastmain, Spring/Summer 2007)

The new Mercury Agreement (2001) provides money to the communities to promote the fishery. The Agreement also provides money for the Public Health Department to ensure that Eeyouch are protected from mercury and other contaminants in the environment. This research project has been developed to give the Chief and Council of the Cree Nation of Eastmain and the Public Health Department of the Cree Board of Health and Social Services (referred to as the Cree Health Board (CHB)) more knowledge about environment-and-health issues in Eastmain. This study is being financed by the Niskamoon Corporation.

Purpose and who participate:
The study will gather information to understand whether Eeyouch:

- have been exposed to heavy metals, PCBs and other contaminants;
- are healthy;
- and the relationship between health, contaminants and the kind of food people are eating

This study will be conducted in the Cree Nation of Eastmain during spring 2007. All communities will be visited over a 7-year period. One hundred fifty (150) people in Eastmain will be invited to participate. Pregnant women will not be invited to do so because they participate in a regular monitoring programme as part of the Maternal and Infant Health Programme.

What your child will be asked to do:
The first part of the study with the nurse will take about 30 minutes. The nurse will

a. Take a fasting blood sample (about 3 tablespoon).
b. Take an urinary sample to test iodine, creatinine, arsenic and metabolites of contaminants.
c. Measure your child's weight, height, waist and hip circumference, and your sitting height.
d. Measure how much muscle, fat and water are in your child's body (to do this you stand on a machine that looks like a bathroom scale).
e. Take your child's blood pressure.
f. Take a toenail sample to test for selenium (a mineral found in the environment).
g. Take a small hair sample (about the size of a pen) to test for mercury and arsenic.

Secondly, during a face-to-face interview of approximately 2 hours, an interviewer will ask you or your child questions about your child's lifestyle, health, and eating habits. You and your child will also be asked to tell what your child have eaten during the past day and some will be invited to make an appointment later to repeat this questionnaire only. The questions related to diet will be administered to children aged 9 years old and over.

What will be done with your child's blood, toenails, urine and hair samples:
Your child's samples will be kept under the authority of the CHB and shipped to the Quebec National Public Health Institute (INSPQ) in Quebec City for analysis. They will be studied for cardiovascular parameters and environmental contaminants. Together, the analyses of these factors will give you and your child and the study information about the state of your child's health. Your child's blood and urine samples will be stored for the CHB in a -80°C freezer in the laboratory of Dr. Éric Dewailly (INSPQ), for 15 years. Later, if the CHB needs to test your child's blood for new emergent diseases, you and your child will be asked to sign a new paper saying you both agree to the new test. Your child's samples will be identified with a study number, not his or her name.

Benefits:
By participating in this study, your child will be helping the CHB and the Chief and Council of the Cree Nation of Eastmain to understand whether environmental contaminants are a problem in Eastmain. Your child will help them to better understand the state of health of the people of your community, and to understand his or her current health and make improvements as needed. Once the results of your child's medical tests have been received, a doctor working for the Public Health Department will send your child's results to the Eastmain clinic. You will be informed by letter if your child's results are either normal or abnormal, and be invited to meet with a doctor or a nurse if needed. It is recommended that your child consult the clinic for any abnormals results as it will be suggested at the follow up.

Risks or Discomfort:
We do not think that being in the study will cause your child any harm. The physical tests are not painful. When your child will give the blood sample, he or she may develop a light bruise where the sample has been taken. Finally, your child may feel tired after answering the questionnaires.

Confidentiality:
All information gathered for this study will be kept confidential. Your child's name will only appear on what is called the 'Master List' which matches your name and your study numbers. There will be strict rules controlling who can see this list. After the entire study has been completed in all the Eeyou communities and the final report written, the Master List will be destroyed. The information that the study obtains from your child's medical tests and questionnaires will only be used by the researchers involved with this study, with no names and will be kept by the Public Health Department. The researchers will prepare popular reports to be passed around the community. Your child's name will not appear in any publication or report.

Financial compensation:
Your child will receive $20 as a compensation for your time for participating in this study. Those who complete a second interview about diet will receive an extra $10.00.

Withdrawal from the Study:
Participating in this study is entirely up to you and your child. Even after you have agreed to have your child participate in the study, you can decide you do not want your child to continue. This can be at any time. Participating or not will have no effect on any services that you, your child, and your family members receive from your local health clinic and other offices of the CHB.

Who is doing the study:
This study is being done by the Public Health Department of the CHB in partnership with your Chief and Council of the Cree Nation of Eastmain. Our research partners for this project are:

- Quebec National Institute of Public Health (your Public Health Department works closely with the Institute on a regular basis)
- Laval University Hospital (CHUL-CHUQ)
- McMaster University
- McGill University

This study has been approved by the Research Ethics Committees of CHUL-CHUQ, McGill University, McMaster University, and the Cree Board of Health and Social Services.

For more information:
If you have any questions about the project, you can contact:

- **Dr. Yv Bonnier Viger**, principal researcher on this study and Director of Public Health, Cree Board of Health and Social Services at 819-855-9001 (ext. 5335) in Chisasibi or at 418 770-6899
- **Ms Suzanne Côté**, field coordinator and nurse, from Public Health Research Unit of the CHUL-CHUQ: (418) 656-4141, ext. 46536 and (418) 563-0113 (Québec City)
- **Dr. Éric Dewailly**, principal researcher on this study, researcher at the National Quebec Public Health Institute and professor at Laval University : (418) 656-4141 ext. 46518 (Québec City)
- **Dr. Daria Pereg**, principal researcher on this study, researcher at the Public Health Research Unit of CHUL-CHUQ : (418) 656-4141 ext. 46537 (Québec City)
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If you have any concerns or complaints, you are invited to call or write to:

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Moreover, if you have questions concerning the rights of your child as a subject of research, you can contact the professional services director of the CHUQ at the following number; 418 691-5521

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

CONSENT FORM TO PARTICIPATE IN NITUUCHISHAAYIHTITAAU ASCHII
(Eastmain, 8-14 years old)

- I have read and understand what is involved in the study and hereby consent and voluntary agree to have my child participate in the Nituuchischaayihtitaau; Multi-Community Environment and Health Study in Eeyou Istchee.

Yes ☐ **No** ☐

- I will be advised in a letter if my child's results are normal or abnormal, and to consult with my child my local clinic doctor/nurse in the case of any abnormal results. I authorize the Cree Board of Health & Social Services of James Bay to send my child's results of his/her clinical tests to the Eastmain clinic (or a doctor of my choice) as a preventive measure.

Yes ☐ **No** ☐

The doctor of my choice is (If other than doctor of Eastmain): Name _____

Address_____

Other choices (You do not need to agree to any of these to be in the study)

I agree to allow a research nurse to review my child's medical file to find out about his/her health.

Yes ☐ **No** ☐

I agree that the researchers can contact me for follow-up tests and for other analyses not mentioned above.

Yes ☐ **No** ☐

I would like to receive a short report of the study's results.

Yes ☐ **No** ☐

_____	_____	____/____/____
Name of participant	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of parent or tutor (Participant's under 18 years old)	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of witness	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of principal investigator /or his/her designated representative	Signature	Date (yy / mm / dd)

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

Conseil Cri de la santé et des services sociaux de la Baie James
Cree Board of Health and Social Services of James Bay

CHUQ CENTRE HOSPITALIER UNIVERSITAIRE DE QUÉBEC

McMaster University

McGill

Information Sheet and Consent Form (8-14 years old)
(Wemindji, Spring/Summer 2007)

The new Mercury Agreement (2001) provides money to the communities to promote the fishery. The Agreement also provides money for the Public Health Department to ensure that Eeyouch are protected from mercury and other contaminants in the environment. This research project has been developed to give the Chief and Council of the Cree Nation of Wemindji and the Public Health Department of the Cree Board of Health and Social Services (referred to as the Cree Health Board (CHB)) more knowledge about environment-and-health issues in Wemindji. This study is being financed by the Niskamoon Corporation.

Purpose and who participate:
The study will gather information to understand whether Eeyouch:

- have been exposed to heavy metals, PCBs and other contaminants;
- are healthy;
- and the relationship between health, contaminants and the kind of food people are eating

This study will be conducted in the Cree Nation of Wemindji during summer 2007. All communities will be visited over a 7-year period. Two hundred (200) people in Wemindji will be invited to participate. Pregnant women will not be invited to do so because they participate in a regular monitoring programme as part of the Maternal and Infant Health Programme.

What your child will be asked to do:
The first part of the study with the nurse will take about 30 minutes. The nurse will

a. Take a fasting blood sample (about 3 tablespoon).
b. Take an urinary sample to test iodine, creatinine, arsenic and metabolites of contaminants.
c. Measure your child's weight, height, waist and hip circumference, and your sitting height.
d. Measure how much muscle, fat and water are in your child's body (to do this you stand on a machine that looks like a bathroom scale).
e. Take your child's blood pressure.
f. Take a toenail sample to test for selenium (a mineral found in the environment).
g. Take a small hair sample (about the size of a pen) to test for mercury and arsenic.

Secondly, during a face-to-face interview of approximately 2 hours, an interviewer will ask you or your child questions about your child's lifestyle, health, and eating habits. You and your child will also be asked to tell what your child have eaten during the past day and some will be invited to make an appointment later to repeat this questionnaire only. The questions related to diet will be administered to children aged 9 years old and over.

What will be done with your child's blood, toenails, urine and hair samples:
Your child's samples will be kept under the authority of the CHB and shipped to the Quebec National Public Health Institute (INSPQ) in Quebec City for analysis. They will be studied for cardiovascular parameters and environmental contaminants. Together, the analyses of these factors will give you and your child and the study information about the state of your child's health. Your child's blood and urine samples will be stored for the CHB in a -80°C freezer in the laboratory of Dr. Éric Dewailly (INSPQ), for 15 years. Later, if the CHB needs to test your child's blood for new emergent diseases, you and your child will be asked to sign a new paper saying you both agree to the new test. Your child's samples will be identified with a study number, not his or her name.

Benefits:
By participating in this study, your child will be helping the CHB and the Chief and Council of the Cree Nation of Wemindji to understand whether environmental contaminants are a problem in Wemindji. Your child will help them to better understand the state of health of the people of your community, and to understand his or her current health and make improvements as needed. Once the results of your child's medical tests have been received, a doctor working for the Public Health Department will send your child's results to the Wemindji clinic. You will be informed by letter if your child's results are either normal or abnormal, and be invited to meet with a doctor or a nurse if needed. It is recommended that your child consult the clinic for any abnormals results as it will be suggested at the follow up.

Risks or Discomfort:
We do not think that being in the study will cause your child any harm. The physical tests are not painful. When your child will give the blood sample, he or she may develop a light bruise where the sample has been taken. Finally, your child may feel tired after answering the questionnaires.

Confidentiality:
All information gathered for this study will be kept confidential. Your child's name will only appear on what is called the 'Master List' which matches your name and your study numbers. There will be strict rules controlling who can see this list. After the entire study has been completed in all the Eeyou communities and the final report written, the Master List will be destroyed. The information that the study obtains from your child's medical tests and questionnaires will only be used by the researchers involved with this study, with no names and will be kept by the Public Health Department. The researchers will prepare popular reports to be passed around the community. Your child's name will not appear in any publication or report.

Financial compensation:
Your child will receive $20 as a compensation for your time for participating in this study. Those who complete a second interview about diet will receive an extra $10.00.

Withdrawal from the Study:
Participating in this study is entirely up to you and your child. Even after you have agreed to have your child participate in the study, you can decide you do not want your child to continue. This can be at any time. Participating or not will have no effect on any services that you, your child, and your family members receive from your local health clinic and other offices of the CHB.

Who is doing the study:
This study is being done by the Public Health Department of the CHB in partnership with your Chief and Council of the Cree Nation of Wemindji. Our research partners for this project are:

- Quebec National Institute of Public Health (your Public Health Department works closely with the Institute on a regular basis)
- Laval University Hospital (CHUL-CHUQ)
- McMaster University
- McGill University

This study has been approved by the Research Ethics Committees of CHUL-CHUQ, McGill University, McMaster University, and the Cree Board of Health and Social Services.

For more information:
If you have any questions about the project, you can contact:

- **Dr. Yv Bonnier Viger**, principal researcher on this study and Director of Public Health, Cree Board of Health and Social Services at 819-855-9001 (ext. 5335) in Chisasibi or at 418 770-6899
- **Ms Suzanne Côté**, field coordinator and nurse, from Public Health Research Unit of the CHUL-CHUQ: (418) 656-4141, ext. 46536 and (418) 563-0113 (Québec City)
- **Dr. Éric Dewailly**, principal researcher on this study, researcher at the National Quebec Public Health Institute and professor at Laval University : (418) 656-4141ext. 46518 (Québec City)
- **Dr. Daria Pereg**, principal researcher on this study, researcher at the Public Health Research Unit of CHUL-CHUQ : (418) 656-4141ext. 46537 (Québec City)
- **Professor Evert Nieboer**, principal researcher on this study, professor at McMaster University (905) 525-9140 ext. 22048 (Hamilton)

If you have any concerns or complaints, you are invited to call or write to:

The Cree Nation of Wemindji representative to the Cree Board of Health and Social Services
C/o Office of the Chief of the Cree Nation of Wemindji
Administration Building
Wemindji, Quebec, (819) 978-0264

Moreover, if you have questions concerning the rights of your child as a subject of research, you can contact the professional services director of the CHUQ at the following number; 418 691-5521

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

CONSENT FORM TO PARTICIPATE IN NITUUCHISHAAYIHTITAAU ASCHII
(Wemindji, 8-14 years old)

- I have read and understand what is involved in the study and hereby consent and voluntary agree to have my child participate in the Nituuchischaayihtitaau; Multi-Community Environment and Health Study in Eeyou Istchee.

Yes ☐ **No** ☐

- I will be advised in a letter if my child's results are normal or abnormal, and to consult with my child my local clinic doctor/nurse in the case of any abnormal results. I authorize the Cree Board of Health & Social Services of James Bay to send my child's results of his/her clinical tests to the Wemindji clinic (or a doctor of my choice) as a preventive measure.

Yes ☐ **No** ☐

The doctor of my choice is (If other than doctor of Wemindji): Name _____

Address_____

Other choices (You do not need to agree to any of these to be in the study)

I agree to allow a research nurse to review my child's medical file to find out about his/her health.

Yes ☐ **No** ☐

I agree that the researchers can contact me for follow-up tests and for other analyses not mentioned above.

Yes ☐ **No** ☐

I would like to receive a short report of the study's results.

Yes ☐ **No** ☐

_____	_____	____/____/____
Name of participant	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of parent or tutor (Participant's under 18 years old)	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of witness	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of principal investigator /or his/her designated representative	Signature	Date (yy / mm / dd)

Participant's initials_____ Witness' initials_____

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

Conseil Cri de la santé et des services sociaux de la Baie James
Cree Board of Health and Social Services of James Bay

CHUQ Centre hospitalier universitaire de Québec
McMaster University
McGill

Information Sheet and Consent Form (15-17 years old)
(Eastmain, Spring/Summer 2007)

The new Mercury Agreement (2001) provides money to the communities to promote the fishery. The Agreement also provides money for the Public Health Department to ensure that Eeyouch are protected from mercury and other contaminants in the environment. This research project has been developed to give the Chief and Council of the Cree Nation of Eastmain and the Public Health Department of the Cree Board of Health and Social Services (referred to as the Cree Health Board (CHB)) more knowledge about environment-and-health issues in Eastmain. This study is being financed by the Niskamoon Corporation.

Purpose and who participate:
The study will gather information to understand whether Eeyouch:

- have been exposed to heavy metals, PCBs and other contaminants;
- are healthy;
- and the relationship between health, contaminants and the kind of food people are eating

This study will be conducted in the Cree Nation of Eastmain during spring 2007. All communities will be visited over a 7-year period. One hundred fifty (150) people in Eastmain will be invited to participate. Pregnant women will not be invited to do so because they participate in a regular monitoring programme as part of the Maternal and Infant Health Programme.

What your child will be asked to do:
The first part of the study with the nurse will take about 45 minutes. The nurse will

a. Take a fasting blood sample (about 6 tablespoons).
b. Take an urinary sample to test iodine, creatinine, arsenic and metabolites of contaminants.
c. You child will be given a 'holter' to wear during his or her appointment to test his or her heart rate variability.
d. Measure your child's weight, height, waist and hip circumference, and your sitting height.
e. Measure how much muscle, fat and water are in your child's body (to do this you stand on a machine that looks like a bathroom scale).
f. Take your child's blood pressure.
g. Take your child's oral temperature.
h. Take a picture (ultrasound) of your child's blood vessel in your child's neck (carotid) to see how healthy his or her blood vessels are.
i. Take a toenail sample to test for selenium (a mineral found in the environment).
j. Take a small hair sample (about the size of a pen) to test for mercury and arsenic.
k. Ask you and your child some questions about his or her health (women only).

Secondly, during a face-to-face interview of approximately 2 hours, an interviewer will ask you or your child questions about your child's lifestyle, health, and eating habits. You and your child will also be

asked to tell what your child have eaten during the past day and some will be invited to make an appointment later to repeat this questionnaire only.

What will be done with your child's blood, toenails, urine and hair samples:
Your child's samples will be kept under the authority of the CHB and shipped to the Quebec National Public Health Institute (INSPQ) in Quebec City for analysis. They will be studied for cardiovascular parameters and markers of heart diseases, environmental contaminants, protective dietary factors, thyroid hormones, variants of genes that might influence the effects of environmental contaminants (enzymes involved in the metabolism of chemicals in the body) and for past infections that may have been transmitted to your child from animals. Together, the analyses of these factors will give you and your child and the study information about the state of your child's health including his or her heart. Your child's blood and urine samples will be stored for the CHB in a -80°C freezer in the laboratory of Dr. Éric Dewailly (INSPQ), for 15 years. Later, if the CHB needs to test your child's blood for new emergent diseases, you and your child will be asked to sign a new paper saying you both agree to the new test. Your child's samples will be identified with a study number, not his or her name

Benefits:
By participating in this study, your child will be helping the CHB and the Chief and Council of the Cree Nation of Eastmain to understand whether environmental contaminants are a problem in Eastmain. Your child will help them to better understand the state of health of the people of your community, and to understand his or her current health and make improvements as needed. Once the results of your child's medical tests have been received, a doctor working for the Public Health Department will send your child's results to the Eastmain clinic. You will be informed by letter if your child's results are either normal or abnormal, and be invited to meet with a doctor or a nurse if needed. It is recommended that your child consult the clinic for any abnormals results as it will be suggested at the follow up.

Risks or Discomfort:
We do not think that being in the study will cause your child any harm. The physical tests are not painful. When your child will give the blood sample, he or she may develop a light bruise where the sample has been taken. Finally, your child may feel tired after answering the questionnaires.

Confidentiality:
All information gathered for this study will be kept confidential. Your child's name will only appear on what is called the 'Master List' which matches your name and your study numbers. There will be strict rules controlling who can see this list. After the entire study has been completed in all the Eeyou communities and the final report written, the Master List will be destroyed. The information that the study obtains from your child's medical tests and questionnaires will only be used by the researchers involved with this study, with no names and will be kept by the Public Health Department. The researchers will prepare popular reports to be passed around the community. Your child's name will not appear in any publication or report.

<u>Mandatory declarations:</u>
The law makes health workers report some diseases when they find them. This applies to some of the diseases that are spread from animals to people (zoonotic diseases, such tularaemia, trichinosis and Q-fever). If your child is diagnosed with one of these diseases in acute phase, the disease will be declared

by your child's doctor and appropriate follow-up will be offered to your child (as for any other abnormal test result).

Financial compensation:
Your child will receive $30 as a compensation for your time for participating in this study. Those who complete a second interview about diet will receive an extra $10.00.

Withdrawal from the Study:
Participating in this study is entirely up to you and your child. Even after you have agreed to have your child participate in the study, you can decide you do not want your child to continue. This can be at any time. Participating or not will have no effect on any services that you, your child, and your family members receive from your local health clinic and other offices of the CHB.

Who is doing the study:
This study is being done by the Public Health Department of the CHB in partnership with your Chief and Council of the Cree Nation of Eastmain. Our research partners for this project are:

- Quebec National Institute of Public Health (your Public Health Department works closely with the Institute on a regular basis)
- Laval University Hospital (CHUL-CHUQ)
- McMaster University
- McGill University

This study has been approved by the Research Ethics Committees of CHUL-CHUQ, McGill University, McMaster University, and the Cree Board of Health and Social Services.

For more information:
If you have any questions about the project, you can contact:

- **Dr. Yv Bonnier Viger**, principal researcher on this study and Director of Public Health, Cree Board of Health and Social Services at 819-855-9001 (ext. 5335) in Chisasibi or at 418 770-6899
- **Ms Suzanne Côté**, field coordinator and nurse, from Public Health Research Unit of the CHUL-CHUQ: (418) 656-4141, ext. 46536 and (418) 563-0113 (Québec City)
- **Dr. Éric Dewailly**, principal researcher on this study, researcher at the National Quebec Public Health Institute and professor at Laval University : (418) 656-4141 ext. 46518 (Québec City)
- **Dr. Daria Pereg**, principal researcher on this study, researcher at the Public Health Research Unit of CHUL-CHUQ : (418) 656-4141 ext. 46537 (Québec City)
- **Professor Evert Nieboer**, principal researcher on this study, professor at McMaster University (905) 525-9140 ext. 22048 (Hamilton)

If you have any concerns or complaints, you are invited to call or write to:

The Cree Nation of Eastmain representative to the Cree Board of Health and Social Services
C/o Office of the Chief of the Cree Nation of Eastmain
Administration Building
Eastmain, Quebec, (819) 977-0211

Moreover, if you have questions concerning the rights of your child as a subject of research, you can contact the professional services director of the CHUQ at the following number; 418 691-5521

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

CONSENT FORM TO PARTICIPATE IN NITUUCHISHAAYIHTITAAU ASCHII
(Eastmain, 15-17 years old)

- I have read and understand what is involved in the study and hereby consent and voluntary agree to have my child participate in the Nituuchischaayihtitaau; Multi-Community Environment and Health Study in Eeyou Istchee.

Yes ☐ **No** ☐

- I will be advised in a letter if my child's results are normal or abnormal, and to consult with my child my local clinic doctor/nurse in the case of any abnormal results. I authorize the Cree Board of Health & Social Services of James Bay to send my child's results of his/her clinical tests to the Eastmain clinic (or a doctor of my choice) as a preventive measure.

Yes ☐ **No** ☐

The doctor of my choice is (If other than doctor of Eastmain): Name _____

Address_____

Other choices (You do not need to agree to any of these to be in the study)

I agree to allow a research nurse to review my child's medical file to find out about his/her health.

Yes ☐ **No** ☐

I agree that the researchers can contact me for follow-up tests and for other analyses not mentioned above.

Yes ☐ **No** ☐

I would like to receive a short report of the study's results.

Yes ☐ **No** ☐

_____	_____	____/____/____
Name of participant	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of parent or tutor (Participant's under 18 years old)	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of witness	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of principal investigator /or his/her designated representative	Signature	Date (yy / mm / dd)

Participant's initials_____ Witness' initials_____

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

Conseil Cri de la santé et des services sociaux de la Baie James
Cree Board of Health and Social Services of James Bay

CHUQ Centre hospitalier universitaire de Québec
McMaster University
McGill

Information Sheet and Consent Form (15-17 years old)
(Wemindji, Spring/Summer 2007)

The new Mercury Agreement (2001) provides money to the communities to promote the fishery. The Agreement also provides money for the Public Health Department to ensure that Eeyouch are protected from mercury and other contaminants in the environment. This research project has been developed to give the Chief and Council of the Cree Nation of Wemindji and the Public Health Department of the Cree Board of Health and Social Services (referred to as the Cree Health Board (CHB)) more knowledge about environment-and-health issues in Wemindji. This study is being financed by the Niskamoon Corporation.

Purpose and who participate:
The study will gather information to understand whether Eeyouch:

- have been exposed to heavy metals, PCBs and other contaminants;
- are healthy;
- and the relationship between health, contaminants and the kind of food people are eating

This study will be conducted in the Cree Nation of Wemindji during summer 2007. All communities will be visited over a 7-year period. Two hundred (200) people in Wemindji will be invited to participate. Pregnant women will not be invited to do so because they participate in a regular monitoring programme as part of the Maternal and Infant Health Programme.

What your child will be asked to do:
The first part of the study with the nurse will take about 45 minutes. The nurse will

a. Take a fasting blood sample (about 6 tablespoons).
b. Take an urinary sample to test iodine, creatinine, arsenic and metabolites of contaminants.
c. You child will be given a 'holter' to wear during his or her appointment to test his or her heart rate variability.
d. Measure your child's weight, height, waist and hip circumference, and your sitting height.
e. Measure how much muscle, fat and water are in your child's body (to do this you stand on a machine that looks like a bathroom scale).
f. Take your child's blood pressure.
g. Take your child's oral temperature.
h. Take a picture (ultrasound) of your child's blood vessel in your child's neck (carotid) to see how healthy his or her blood vessels are.
i. Take a toenail sample to test for selenium (a mineral found in the environment).
j. Take a small hair sample (about the size of a pen) to test for mercury and arsenic.
k. Ask you and your child some questions about his or her health (women only).

Secondly, during a face-to-face interview of approximately 2 hours, an interviewer will ask you or your child questions about your child's lifestyle, health, and eating habits. You and your child will also be

asked to tell what your child have eaten during the past day and some will be invited to make an appointment later to repeat this questionnaire only.

What will be done with your child's blood, toenails, urine and hair samples:
Your child's samples will be kept under the authority of the CHB and shipped to the Quebec National Public Health Institute (INSPQ) in Quebec City for analysis. They will be studied for cardiovascular parameters and markers of heart diseases, environmental contaminants, protective dietary factors, thyroid hormones, and variants of genes that might influence the effects of environmental contaminants (enzymes involved in the metabolism of chemicals in the body) and for past infections that may have been transmitted to you from animals. Together, the analyses of these factors will give you and your child and the study information about the state of your child's health including his or her heart. Your child's blood and urine samples will be stored for the CHB in a -80°C freezer in the laboratory of Dr. Éric Dewailly (INSPQ), for 15 years. Later, if the CHB needs to test your child's blood for new emergent diseases, you and your child will be asked to sign a new paper saying you both agree to the new test. Your child's samples will be identified with a study number, not his or her name.

Benefits:
By participating in this study, your child will be helping the CHB and the Chief and Council of the Cree Nation of Wemindji to understand whether environmental contaminants are a problem in Wemindji. Your child will help them to better understand the state of health of the people of your community, and to understand his or her current health and make improvements as needed. Once the results of your child's medical tests have been received, a doctor working for the Public Health Department will send your child's results to the Wemindji clinic. You will be informed by letter if your child's results are either normal or abnormal, and be invited to meet with a doctor or a nurse if needed. It is recommended that your child consult the clinic for any abnormals results as it will be suggested at the follow up.

Risks or Discomfort:
We do not think that being in the study will cause your child any harm. The physical tests are not painful. When your child will give the blood sample, he or she may develop a light bruise where the sample has been taken. Finally, your child may feel tired after answering the questionnaires.

Confidentiality:
All information gathered for this study will be kept confidential. Your child's name will only appear on what is called the 'Master List' which matches your name and your study numbers. There will be strict rules controlling who can see this list. After the entire study has been completed in all the Eeyou communities and the final report written, the Master List will be destroyed. The information that the study obtains from your child's medical tests and questionnaires will only be used by the researchers involved with this study, with no names and will be kept by the Public Health Department. The researchers will prepare popular reports to be passed around the community. Your child's name will not appear in any publication or report.

<u>Mandatory declarations:</u>
The law makes health workers report some diseases when they find them. This applies to some of the diseases that are spread from animals to people (zoonotic diseases, such tularaemia, trichinosis and Q-

fever). If you are diagnosed with one of these diseases in acute phase, the disease will be declared by your doctor and appropriate follow-up will be offered to you (as for any other abnormal test result).

Financial compensation:
Your child will receive $30 as a compensation for your time for participating in this study. Those who complete a second interview about diet will receive an extra $10.00.

Withdrawal from the Study:
Participating in this study is entirely up to you and your child. Even after you have agreed to have your child participate in the study, you can decide you do not want your child to continue. This can be at any time. Participating or not will have no effect on any services that you, your child, and your family members receive from your local health clinic and other offices of the CHB.

Who is doing the study:
This study is being done by the Public Health Department of the CHB in partnership with your Chief and Council of the Cree Nation of Wemindji. Our research partners for this project are:

- Quebec National Institute of Public Health (your Public Health Department works closely with the Institute on a regular basis)
- Laval University Hospital (CHUL-CHUQ)
- McMaster University
- McGill University

This study has been approved by the Research Ethics Committees of CHUL-CHUQ, McGill University, McMaster University, and the Cree Board of Health and Social Services.

For more information:
If you have any questions about the project, you can contact:

- **Dr. Yv Bonnier Viger**, principal researcher on this study and Director of Public Health, Cree Board of Health and Social Services at 819-855-9001 (ext. 5335) in Chisasibi or at 418 770-6899
- **Ms Suzanne Côté**, field coordinator and nurse, from Public Health Research Unit of the CHUL-CHUQ: (418) 656-4141, ext. 46536 and (418) 563-0113 (Québec City)
- **Dr. Éric Dewailly**, principal researcher on this study, researcher at the National Quebec Public Health Institute and professor at Laval University : (418) 656-4141ext. 46518 (Québec City)
- **Dr. Daria Pereg**, principal researcher on this study, researcher at the Public Health Research Unit of CHUL-CHUQ : (418) 656-4141ext. 46537 (Québec City)
- **Professor Evert Nieboer**, principal researcher on this study, professor at McMaster University (905) 525-9140 ext. 22048 (Hamilton)

If you have any concerns or complaints, you are invited to call or write to:

The Cree Nation of Wemindji representative to the Cree Board of Health and Social Services
C/o Office of the Chief of the Cree Nation of Wemindji
Administration Building
Wemindji, Quebec, (819) 978-0264

Moreover, if you have questions concerning the rights of your child as a subject of research, you can contact the professional services director of the CHUQ at the following number; 418 691-5521

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

CONSENT FORM TO PARTICIPATE IN NITUUCHISHAAYIHTITAAU ASCHII
(Wemindji, 15-17 years old)

- I have read and understand what is involved in the study and hereby consent and voluntary agree to have my child participate in the Nituuchischaayihtitaau; Multi-Community Environment and Health Study in Eeyou Istchee.

Yes ☐ **No** ☐

- I will be advised in a letter if my child's results are normal or abnormal, and to consult with my child my local clinic doctor/nurse in the case of any abnormal results. I authorize the Cree Board of Health & Social Services of James Bay to send my child's results of his/her clinical tests to the Wemindji clinic (or a doctor of my choice) as a preventive measure.

Yes ☐ **No** ☐

The doctor of my choice is (If other than doctor of Wemindji): Name _____

Address_____

Other choices (You do not need to agree to any of these to be in the study)

I agree to allow a research nurse to review my child's medical file to find out about his/her health.

Yes ☐ **No** ☐

I agree that the researchers can contact me for follow-up tests and for other analyses not mentioned above.

Yes ☐ **No** ☐

I would like to receive a short report of the study's results.

Yes ☐ **No** ☐

_____	_____	____/____/____
Name of participant	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of parent or tutor (Participant's under 18 years old)	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of witness	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of principal investigator /or his/her designated representative	Signature	Date (yy / mm / dd)

Participant's initials_____ Witness' initials_____

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

Conseil Cri de la santé et des services sociaux de la Baie James
Cree Board of Health and Social Services of James Bay

CHUQ Centre hospitalier universitaire de Québec
McMaster University
McGill

Information Sheet and Consent Form (18 years old and over)
(Eastmain, Spring/Summer 2007)

The new Mercury Agreement (2001) provides money to the communities to promote the fishery. The Agreement also provides money for the Public Health Department to ensure that Eeyouch are protected from mercury and other contaminants in the environment. This research project has been developed to give the Chief and Council of the Cree Nation of Eastmain and the Public Health Department of the Cree Board of Health and Social Services (referred to as the Cree Health Board (CHB)) more knowledge about environment-and-health issues in Eastmain. This study is being financed by the Niskamoon Corporation.

Purpose and who participate:
The study will gather information to understand whether Eeyouch:

- have been exposed to heavy metals, PCBs and other contaminants;
- are healthy;
- and the relationship between health, contaminants and the kind of food people are eating

This study will be conducted in the Cree Nation of Eastmain during spring 2007. All communities will be visited over a 7-year period. One hundred fifty (150) people in Eastmain will be invited to participate. Pregnant women will not be invited to do so because they participate in a regular monitoring programme as part of the Maternal and Infant Health Programme.

What you will be asked to do:
The first part of the study with the nurse will take about 45 minutes. The nurse will

a. Take a fasting blood sample (about 6 tablespoons).
b. Take an urinary sample to test iodine, creatinine, arsenic and metabolites of contaminants.
c. You will be given a 'holter' to wear during your appointment to test your heart rate variability.
d. Measure your weight, height, waist and hip circumference, and your sitting height.
e. Measure how much muscle, fat and water are in your body (to do this you stand on a machine that looks like a bathroom scale).
f. Take your blood pressure.
g. Take your oral temperature.
h. Take a picture (ultrasound) of your blood vessel in your neck (carotid) to see how healthy your blood vessels are, and for some people the abdomen to measure fat.
i. Take a toenail sample to test for selenium (a mineral found in the environment).
j. Take a small hair sample (about the size of a pen) to test for mercury and arsenic.
k. If you are a woman aged 35 to 74, take a picture (ultrasound) of the bone of your heel to test the strength of your bones.
l. Ask you some questions about your health (women only).

Secondly, during a face-to-face interview of approximately 2 hours, an interviewer will ask you questions about your lifestyle, your health, and eating habits. You will also be asked to tell what you have eaten during the past day and some will be invited to make an appointment later to repeat this questionnaire only.

What will be done with your blood, toenails, urine and hair samples:
Your samples will be kept under the authority of the CHB and shipped to the Quebec National Public Health Institute (INSPQ) in Quebec City for analysis. They will be studied for cardiovascular parameters and markers of heart diseases, environmental contaminants, protective dietary factors, thyroid hormones, variants of genes that might influence the effects of environmental contaminants (enzymes involved in the metabolism of chemicals in the body) and for past infections that may have been transmitted to you from animals. Together, the analyses of these factors will give you and the study information about the state of your health including your heart. Your blood and urine samples will be stored for the CHB in a -80°C freezer in the laboratory of Dr. Éric Dewailly (INSPQ), for 15 years. Later, if the CHB needs to test your blood for new emergent diseases, you will be asked to sign a new paper saying you agree to the new test. Your samples will be identified with a study number, not your name.

Benefits:
By participating in this study, you will be helping the CHB and the Chief and Council of the Cree Nation of Eastmain to understand whether environmental contaminants are a problem in Eastmain. You will help them to better understand the state of health of the people of your community, and to understand your current health and make improvements as needed. Once the results of your medical tests have been received, a doctor working for the Public Health Department will send your results to the Eastmain clinic. You will be informed by letter if your results are either normal or abnormal, and be invited to meet with a doctor or a nurse if needed. It is recommended that you consult the clinic for any abnormals results as it will be suggested at the follow up.

Risks or Discomfort:
We do not think that being in the study will cause you any harm. The physical tests are not painful. When you will give your blood sample, you may develop a light bruise where the sample has been taken. Finally, you may feel tired after answering the questionnaires.

Confidentiality:
All information gathered for this study will be kept confidential. Your name will only appear on what is called the 'Master List' which matches your name and your study numbers. There will be strict rules controlling who can see this list. After the entire study has been completed in all the Eeyou communities and the final report written, the Master List will be destroyed. The information that the study obtains from your medical tests and questionnaires will only be used by the researchers involved with this study, with no names and will be kept by the Public Health Department. The researchers will prepare popular reports to be passed around the community. Your name will not appear in any publication or report.

Mandatory declarations:
The law makes health workers report some diseases when they find them. This applies to some of the diseases that are spread from animals to people (zoonotic diseases, such tularaemia, trichinosis and Q-

fever). If you are diagnosed with one of these diseases in acute phase, the disease will be declared by your doctor and appropriate follow-up will be offered to you (as for any other abnormal test result).

Financial compensation:
You will receive $30 as a compensation for your time for participating in this study. Those who complete a second interview about diet will receive an extra $10.00.

Withdrawal from the Study:
Participating in this study is entirely up to you. Even after you have agreed to participate in the study, you can decide you do not want to continue. This can be at any time. Participating or not will have no effect on any services that you and your family members receive from your local health clinic and other offices of the CHB.

Who is doing the study:
This study is being done by the Public Health Department of the CHB in partnership with your Chief and Council of the Cree Nation of Eastmain. Our research partners for this project are:

- Quebec National Institute of Public Health (your Public Health Department works closely with the Institute on a regular basis)
- Laval University Hospital (CHUL-CHUQ)
- McMaster University
- McGill University

This study has been approved by the Research Ethics Committees of CHUL-CHUQ, McGill University, McMaster University, and the Cree Board of Health and Social Services.

For more information:
If you have any questions about the project, you can contact:

- **Dr. Yv Bonnier Viger**, principal researcher on this study and Director of Public Health, Cree Board of Health and Social Services at 819-855-9001 (ext. 5335) in Chisasibi or at 418 770-6899
- **Ms Suzanne Côté**, field coordinator and nurse, from Public Health Research Unit of the CHUL-CHUQ: (418) 656-4141, ext. 46536 and (418) 563-0113 (Québec City)
- **Dr. Éric Dewailly**, principal researcher on this study, researcher at the National Quebec Public Health Institute and professor at Laval University : (418) 656-4141 ext. 46518 (Québec City)
- **Dr. Daria Pereg**, principal researcher on this study, researcher at the Public Health Research Unit of CHUL-CHUQ : (418) 656-4141 ext. 46537 (Québec City)
- **Professor Evert Nieboer**, principal researcher on this study, professor at McMaster University (905) 525-9140 ext. 22048 (Hamilton)

If you have any concerns or complaints, you are invited to call or write to:

The Cree Nation of Eastmain representative to the Cree Board of Health and Social Services
C/o Office of the Chief of the Cree Nation of Eastmain
Administration Building
Eastmain, Quebec, (819) 977-0211

Moreover, if you have questions concerning your rights as a subject of research, you can contact the professional services director of the CHUQ at the following number; 418 691-5521

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

CONSENT FORM TO PARTICIPATE IN NITUUCHISHAAYIHTITAAU ASCHII
(Eastmain, 18 years old and over)

- I have read and understand what is involved in the study and hereby consent and voluntary agree to participate in the Nituuchischaayihtitaau; Multi-Community Environment and Health Study in Eeyou Istchee.

Yes ☐ **No** ☐

- I will be advised in a letter if my results are normal or abnormal, and to consult my local clinic doctor/nurse in the case of any abnormal results. I authorize the Cree Board of Health & Social Services of James Bay to send my results of my clinical tests to the Eastmain clinic (or a doctor of my choice) as a preventive measure.

Yes ☐ **No** ☐

The doctor of my choice is (If other than doctor of Eastmain): Name _____

Address_____

Other choices (You do not need to agree to any of these to be in the study)

I agree to allow a research nurse to review my medical file to find out about my health.

Yes ☐ **No** ☐

I agree that the researchers can contact me for follow-up tests and for other analyses not mentioned above.

Yes ☐ **No** ☐

I would like to receive a short report of the study's results.

Yes ☐ **No** ☐

_____	_____	____/____/____
Name of participant	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of witness	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of principal investigator /or his/her designated representative	Signature	Date (yy / mm / dd)

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

Conseil Cri de la santé et des services sociaux de la Baie James
Cree Board of Health and Social Services of James Bay

CHUQ Centre hospitalier universitaire de Québec — McMaster University — McGill

Information Sheet and Consent Form (18 years old and over)
(Wemindji, Spring/Summer 2007)

The new Mercury Agreement (2001) provides money to the communities to promote the fishery. The Agreement also provides money for the Public Health Department to ensure that Eeyouch are protected from mercury and other contaminants in the environment. This research project has been developed to give the Chief and Council of the Cree Nation of Wemindji and the Public Health Department of the Cree Board of Health and Social Services (referred to as the Cree Health Board (CHB)) more knowledge about environment-and-health issues in Wemindji. This study is being financed by the Niskamoon Corporation.

Purpose and who participate:
The study will gather information to understand whether Eeyouch:

- have been exposed to heavy metals, PCBs and other contaminants;
- are healthy;
- and the relationship between health, contaminants and the kind of food people are eating

This study will be conducted in the Cree Nation of Wemindji during summer 2007. All communities will be visited over a 7-year period. Two hundred (200) people in Wemindji will be invited to participate. Pregnant women will not be invited to do so because they participate in a regular monitoring programme as part of the Maternal and Infant Health Programme.

What you will be asked to do:
The first part of the study with the nurse will take about 45 minutes. The nurse will

a. Take a fasting blood sample (about 6 tablespoons).
b. Take an urinary sample to test iodine, creatinine, arsenic and metabolites of contaminants.
c. You will be given a 'holter' to wear during your appointment to test your heart rate variability.
d. Measure your weight, height, waist and hip circumference, and your sitting height.
e. Measure how much muscle, fat and water are in your body (to do this you stand on a machine that looks like a bathroom scale).
f. Take your blood pressure.
g. Take your oral temperature.
h. Take a picture (ultrasound) of your blood vessel in your neck (carotid) to see how healthy your blood vessels are.
i. Take a toenail sample to test for selenium (a mineral found in the environment).
j. Take a small hair sample (about the size of a pen) to test for mercury and arsenic.
k. If you are a woman aged 35 to 74, take a picture (ultrasound) of the bone of your heel to test the strength of your bones.
l. Ask you some questions about your health (women only).

Secondly, during a face-to-face interview of approximately 2 hours, an interviewer will ask you questions about your lifestyle, your health, and eating habits. You will also be asked to tell what you have eaten during the past day and some will be invited to make an appointment later to repeat this questionnaire only.

What will be done with your blood, toenails, urine and hair samples:
Your samples will be kept under the authority of the CHB and shipped to the Quebec National Public Health Institute (INSPQ) in Quebec City for analysis. They will be studied for cardiovascular parameters and markers of heart diseases, environmental contaminants, protective dietary factors, thyroid hormones, variants of genes that might influence the effects of environmental contaminants (enzymes involved in the metabolism of chemicals in the body) and for past infections that may have been transmitted to you from animals. Together, the analyses of these factors will give you and the study information about the state of your health including your heart. Your blood and urine samples will be stored for the CHB in a -80°C freezer in the laboratory of Dr. Éric Dewailly (INSPQ), for 15 years. Later, if the CHB needs to test your blood for new emergent diseases, you will be asked to sign a new paper saying you agree to the new test. Your samples will be identified with a study number, not your name

Benefits:
By participating in this study, you will be helping the CHB and the Chief and Council of the Cree Nation of Wemindji to understand whether environmental contaminants are a problem in Wemindji. You will help them to better understand the state of health of the people of your community, and to understand your current health and make improvements as needed. Once the results of your medical tests have been received, a doctor working for the Public Health Department will send your results to the Wemindji clinic. You will be informed by letter if your results are either normal or abnormal, and be invited to meet with a doctor or a nurse if needed. It is recommended that you consult the clinic for any abnormals results as it will be suggested at the follow up.

Risks or Discomfort:
We do not think that being in the study will cause you any harm. The physical tests are not painful. When you will give your blood sample, you may develop a light bruise where the sample has been taken. Finally, you may feel tired after answering the questionnaires.

Confidentiality:
All information gathered for this study will be kept confidential. Your name will only appear on what is called the 'Master List' which matches your name and your study numbers. There will be strict rules controlling who can see this list. After the entire study has been completed in all the Eeyou communities and the final report written, the Master List will be destroyed. The information that the study obtains from your medical tests and questionnaires will only be used by the researchers involved with this study, with no names and will be kept by the Public Health Department. The researchers will prepare popular reports to be passed around the community. Your name will not appear in any publication or report.

Mandatory declarations:
The law makes health workers report some diseases when they find them. This applies to some of the diseases that are spread from animals to people (zoonotic diseases, such tularaemia, trichinosis and Q-

fever). If you are diagnosed with one of these diseases in acute phase, the disease will be declared by your doctor and appropriate follow-up will be offered to you (as for any other abnormal test result).

Financial compensation:
You will receive $30 as a compensation for your time for participating in this study. Those who complete a second interview about diet will receive an extra $10.00.

Withdrawal from the Study:
Participating in this study is entirely up to you. Even after you have agreed to participate in the study, you can decide you do not want to continue. This can be at any time. Participating or not will have no effect on any services that you and your family members receive from your local health clinic and other offices of the CHB.

Who is doing the study:
This study is being done by the Public Health Department of the CHB in partnership with your Chief and Council of the Cree Nation of Wemindji. Our research partners for this project are:

- Quebec National Institute of Public Health (your Public Health Department works closely with the Institute on a regular basis)
- Laval University Hospital (CHUL-CHUQ)
- McMaster University
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This study has been approved by the Research Ethics Committees of CHUL-CHUQ, McGill University, McMaster University, and the Cree Board of Health and Social Services.

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- **Ms Suzanne Côté**, field coordinator and nurse, from Public Health Research Unit of the CHUL-CHUQ: (418) 656-4141, ext. 46536 and (418) 563-0113 (Québec City)
- **Dr. Éric Dewailly**, principal researcher on this study, researcher at the National Quebec Public Health Institute and professor at Laval University : (418) 656-4141 ext. 46518 (Québec City)
- **Dr. Daria Pereg**, principal researcher on this study, researcher at the Public Health Research Unit of CHUL-CHUQ : (418) 656-4141 ext. 46537 (Québec City)
- **Professor Evert Nieboer**, principal researcher on this study, professor at McMaster University (905) 525-9140 ext. 22048 (Hamilton)

If you have any concerns or complaints, you are invited to call or write to:

The Cree Nation of Wemindji representative to the Cree Board of Health and Social Services
C/o Office of the Chief of the Cree Nation of Wemindji
Administration Building
Wemindji, Quebec, (819) 978-0264

Moreover, if you have questions concerning your rights as a subject of research, you can contact the professional services director of the CHUQ at the following number; 418 691-5521

Nituuchischaayihtitaau:
Multi-Community Environment-and-Health Study in Eeyou Istchee

CONSENT FORM TO PARTICIPATE IN NITUUCHISHAAYIHTITAAU ASCHII
(Wemindji, 18 years old and over)

- I have read and understand what is involved in the study and hereby consent and voluntary agree to participate in the Nituuchischaayihtitaau; Multi-Community Environment and Health Study in **Eeyou Istchee**.

Yes ☐ No ☐

- I will be advised in a letter if my results are normal or abnormal, and to consult my local clinic doctor/nurse in the case of any abnormal results. I authorize the Cree Board of Health & Social Services of James Bay to send my results of my clinical tests to the Wemindji clinic (or a doctor of my choice) as a preventive measure.

Yes ☐ **No** ☐

The doctor of my choice is (If other than doctor of Wemindji): Name _____

Address_____

Other choices (You do not need to agree to any of these to be in the study)

I agree to allow a research nurse to review my medical file to find out about my health.

Yes ☐ **No** ☐

I agree that the researchers can contact me for follow-up tests and for other analyses not mentioned above.

Yes ☐ **No** ☐

I would like to receive a short report of the study's results.

Yes ☐ **No** ☐

_____	_____	____/____/____
Name of participant	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of witness	Signature	Date (yy / mm / dd)
_____	_____	____/____/____
Name of principal investigator /or his/her designated representative	Signature	Date (yy / mm / dd)

APPENDIX 3: CHLORINATED AND BROMINATED ORGANIC COMPOUNDS ANALYZED: DETECTION LIMITS, % REPRODUCIBILITY, AND % RECOVERY

Analyte(s)[a]	Detection Limit (µg/L)	Intra-day precision (%)	Recovery (%)	Inter-day precision (%)
Aldrin	0.01	2.3	78	8.2
Aroclor 1260	0.1	1.6	80	7.3
PCB 28	0.05	6.7	89	13.3
PCB 52	0.3	10.2	56	11.0
PCB 99	0.02	3.1	61	8.0
PCB 101	0.03	2.7	127	9.7
PCB 105	0.01	1.4	74	7.4
PCB 118	0.01	1.5	104	7.7
PCB 128	0.01	1.7	79	8.3
PCB 138	0.01	2.2	81	8.6
PCB 153	0.01	1.2	73	7.5
PCB 156	0.01	2.0	73	9.7
PCB 163	0.01	1.3	76	8.0
PCB 180	0.01	2.2	68	8.4
PCB 183	0.01	1.2	66	7.3
PCB 187	0.01	1.3	68	8.4
α-chlordane	0.01	2.3	76	5.0
γ-chlordane	0.005	2.5	74	6.1
ß-HCH	0.01	2.8	75	11.4
Cis-nonachlor	0.005	1.7	79	11.4
p,p'-DDE	0.09	3.0	118	12.7
p,p'-DDT	0.05	2.9	86	16.9
Hexachlorobenzene	0.04	4.6	68	8.9
Mirex	0.01	3.4	85	12.2
Oxychlordane	0.005	3.0	84	14.7
PBB 153	0.02	1.9	80	25.2
PBDE 47	0.03	6.3	96	20.6
PBDE 99	0.02	3.9	86	23.3
PBDE 100	0.02	4.1	87	18.0
PBDE 153	0.02	2.9	82	35.9
Parlar 26	0.005	2.6	76	6.9
Parlar 50	0.005	2.9	69	6.2
Trans-nonachlor	0.01	2.0	82	11.2
PFOS	0.10	4.0	87	6.6
PFOA	0.30	7.4	97	10.8
PFHxS	0.30	7.7	98	7.8

a. Deceased, pregnant, unknown, not shown, disabled, too old.

APPENDIX 4: MEDICAL CHART REVIEW

Nituuchischaayithitauu Aschii Medical File Review

During the interpretation of collected data, on several occasions our analyses encountered a lack of details concerning the health status of the participants. For instance, the dearth of information on medication taken by the participants impeded evaluation of the true prevalence of high blood pressure, diabetes, thyroid problems and other health conditions in the sample population. Medications are also important confounders in some associations that need to be tested regarding the effects of contaminants on certain biological parameters and health conditions. As well, diagnostic confirmation of self-declared health conditions would have been useful in validating aspects of the questionnaire data. Such information could only be a retrieved from medical files. Therefore, it was decided to corroborate by a medical file review some of the clinical chemistry measurement results and health-related information retrieved through the questionnaires.

The form used to record the findings of the medical file reviews included sections for major chronic diseases such as cardiovascular, diabetes, hyper-hypothyroidism, musculoskeletal and metabolic diseases (see below), all of which were addressed in the clinical questionnaire and for which relevant clinical chemistry data were available. It also had space to record hospitalization episodes and their related causes, as well as for information on medications used 12 months prior to the beginning of the study.

Permission was obtained from the Cree Health Board to have access to the archived medical chart of each participant, and help was sought from the head nurse of the local clinics visited. The medical chart review involved one research nurse working full-time in the community concurrent with the clinical field work. The research nurse checked the consent form signed by each participant 8 years old and over to make sure approval for the review had been granted.

We also developed a separate recording form (not shown) for the collection of data from the charts of all participants who were shown to have antibodies related to the following zoonotic pathogen or diseases: California virus, Q fever, leptospirosis, trichinosis, tularemia, toxoplasmosis, toxocariasis and echinococcosis. The information sought pertained to past episodes of infection and when they occurred, as they may have been transmitted from animals. This information was collected by a research nurse a few months following the clinical field work. The individuals who refused to have their medical file reviewed were removed from the zoonoses study participants list. This chart review targeted the period five or ten years prior to the collection of the blood samples.

Information was provided for all health professional of the communities visited to ensure that adequate follow-up ensued for any positive clinical findings.

❑ **Completed** **Multi-Community Environment-and-Health Study in Eeyou Istchee**

MEDICAL REPORT

Date: Reviewed by:

Community:

Participant's last name : _____ Participant's first name: _____

Date of birth: _____/_____/_____ (yy/mm/dd) ≥ 8 years old Medical file number: _____

Sex: ❑$_1$-Female ❑$_2$-Male

Baseline evaluations dates:

Wemindji: June 2007
Eastmain: August 2007

❑ Completed

1. Cardiovascular disorders

code		Heart disease diagnosed	Type	Date(s)	Hospitalised ?	
yes	no			yy/mm/dd	yes	no
		Circulatory system diseases				
❑1	❑2	Rheumatic fever with heart involvement	_____ _____	___/___/___ ___/___/___	❑1	❑2
❑1	❑2	Chronic rheumatic heart diseases	_____ _____	___/___/___ ___/___/___	❑1	❑2
❑1	❑2	Hypertensive diseases	_____ _____	___/___/___ ___/___/___	❑1	❑2
❑1	❑2	**Ischemic heart disease**	_____ _____	___/___/___ ___/___/___	❑1	❑2
❑1	❑2	Diseases of pulmonary circulation	_____ _____	___/___/___ ___/___/___	❑1	❑2
❑1	❑2	Other forms of heart diseases	_____ _____	___/___/___ ___/___/___	❑1	❑2
❑1	❑2	**Stroke**	_____ _____	___/___/___ ___/___/___	❑1	❑2
❑1	❑2	Cerebrovascular diseases	_____ _____	___/___/___ ___/___/___	❑1	❑2
❑1	❑2	Diseases of arteries, arterioles and capillaries	_____ _____	___/___/___ ___/___/___	❑1	❑2
❑1	❑2	Diseases of veins, lymphatic vessels and other diseases of the circulatory system, not elsewhere classified	_____ _____	___/___/___ ___/___/___	❑1	❑2

2. Metabolic disorders

Disease/affliction	yes	no	Type	Code	First Date Of diagnosis yy/mm/dd	Last Date Of remission yy/mm/dd	Hospitalised ? yes	no	How many times? #
Gout- 1st episode	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
Last episode	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
Type I Diabetes	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
			_____	_____	___/___/___	___/___/___	❑1	❑2	_____
Type II Diabetes	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
			_____	_____	___/___/___	___/___/___	❑1	❑2	_____
Gestational Diabetes	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
			_____	_____	___/___/___	___/___/___	❑1	❑2	_____
Dislipidaemia	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
			_____	_____	___/___/___	___/___/___	❑1	❑2	_____
Goitre	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
			_____	_____	___/___/___	___/___/___	❑1	❑2	_____
Hypothyroidism	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
			_____	_____	___/___/___	___/___/___	❑1	❑2	_____
Hyperthyroidism	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
			_____	_____	___/___/___	___/___/___	❑1	❑2	_____
Kidney disease (kidney failure, micro-albuminuria,etc.)	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
				_____	___/___/___	___/___/___	❑1	❑2	_____
Other_____	❑1	❑2	_____	_____	___/___/___	___/___/___	❑1	❑2	_____
			_____	_____	___/___/___	___/___/___	❑1	❑2	_____

3. Bone fractures (only for women 35 yrs old and over)

	yes	no	type	Code	Date yy / mm / dd	Hospitalised ? Yes	No	Hospitalisation #
Wrist fracture	❑1	❑2	Member/type_____	_____	___/___/___	❑1	❑2	_____
Hip fracture	❑1	❑2	Member/type_____	_____	___/___/___	❑1	❑2	_____
Vertebral fracture	❑1	❑2	Member/type_____	_____	___/___/___	❑1	❑2	_____

4. Indoor air quality

	yes	no	type	Code	Date yy / mm / dd	Hospitalised ? Yes	No	Hospitalisation #
Asthma	❑1	❑2	type_____	_____	___/___/___	❑1	❑2	_____
Chronic Sinusitis or Rhinitis	❑1	❑2	type_____	_____	___/___/___	❑1	❑2	_____
Letter sent to band (housing department)	❑1	❑2	type_____	_____	___/___/___			

5. Medication during 12 months before the baseline evaluation

Product	Given for…	Code	Dosage	From yy/mm/dd to yy/mm/dd	Info Relevant (allergies- shocks- etc.)
_____	_____	_____	_____	___/___/___ to ___/___/___	_____
_____	_____	_____	_____	___/___/___ to ___/___/___	_____
_____	_____	_____	_____	___/___/___ to ___/___/___	_____
_____	_____	_____	_____	___/___/___ to ___/___/___	_____
_____	_____	_____	_____	___/___/___ to ___/___/___	_____

______________	________________	_____	________________	___/___/___ to ___/___/___	__________________________
______________	________________	_____	________________	___/___/___ to ___/___/___	__________________________
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				___/___/___ to ___/___/___	
				___/___/___ to ___/___/___	
				___/___/___ to ___/___/___	
				___/___/___ to ___/___/___	
				___/___/___ to ___/___/___	
				___/___/___ to ___/___/___	
				___/___/___ to ___/___/___	

________________	____________________	______	___________________	___/___/___	to ___/___/___	______________________________
________________	____________________	______	___________________	___/___/___	to ___/___/___	______________________________
________________	____________________	______	___________________	___/___/___	to ___/___/___	______________________________
________________	____________________	______	___________________	___/___/___	to ___/___/___	______________________________
________________	____________________	______	___________________	___/___/___	to ___/___/___	______________________________
________________	____________________	______	___________________	___/___/___	to ___/___/___	______________________________
________________	____________________	______	___________________	___/___/___	to ___/___/___	______________________________
________________	____________________	______	___________________	___/___/___	to ___/___/___	______________________________

Date: ______________________________ Signature (nurse): ____

APPENDIX 5: CLINICAL ALGORITHMS FOR CONTAMINANTS[a]

a Based on: Andermann A, *Managing Chronic Exposure to Environmental Contaminants while Promoting the Benefits of a Traditional Diet and Way of Life: Mistissini Environmental Health Study, Draft Protocol for Reporting Results*. Report prepared for the CBHSSJB, October 2005.

Background, Review, Concern and Action Levels of Contaminants

	Upper limit of normal	Level for review of possible sources of exposure	Level for being seen by a doctor	Level for mandatory reporting by laboratory (MADO)
Cadmium (blood)	5 nmol/L	10 nmol/L	45 nmol/L	45 nmol/L
Lead (blood)	0.1 µmol/L	0.5 µmol/L	1.0 µmol/L (0.48 µmol/L)**	0.5 µmol/L
Mercury (blood)	25 nmol/L	100 nmol/L (60 nmol/L)**	500 nmol/L (100 nmol/L)**	60 nmol/L
Mercury (hair)		6 µg/g (4 µg/g)**	30 µg/g (6 µg/g)**	
PCBs (blood)		20 µg/L (5 µg/L)**	100 µg/L (20 µg/L)**	

* Adapted from Table 63 of the report of the Ouje-Bougoumou and Nemaska study http://www.inspq.qc.ca/pdf/publications/349-OujeBougoumou_Report.pdf, the INSPQ report on the levels for declaration of chemical substances by laboratories (http://www.inspq.qc.ca/pdf/publications/327-SeuilsDeclarationLabo-RapporFinal.pdf), A Handbook for Health Professionals Health Canada and Ontario Ministry of Health, March, 1995 (DRAFT), and the Nunavik lead protocol (http://www.ehjournal.net/content/pdf/1476-069X-7-25.pdf)

** ***Women of childbearing age, pregnant women and children < 15 years old***

For converting units see: http://www.irsst.qc.ca/ut_conversion_unite.htm

Chronic Exposure to Cadmium

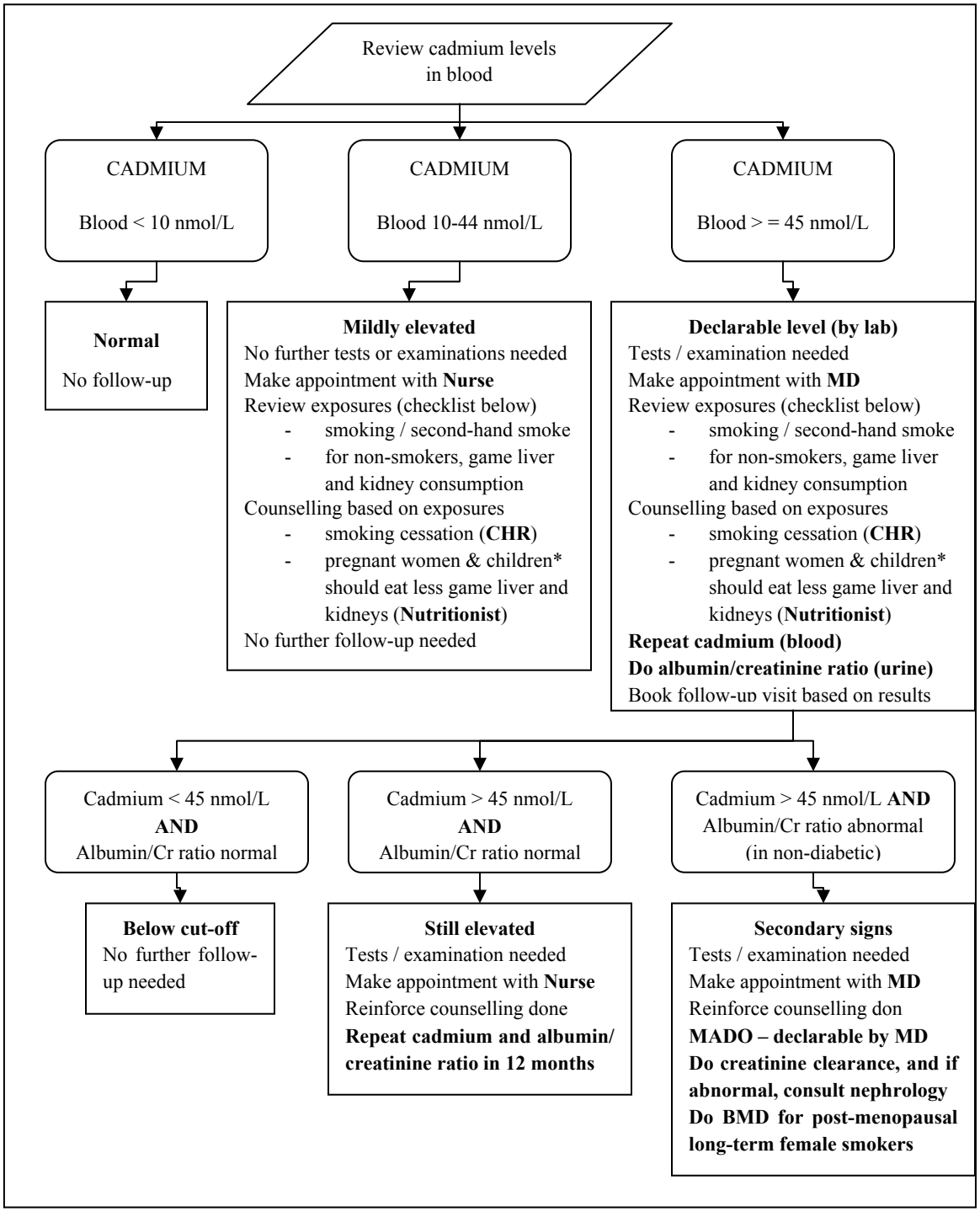
Cadmium is a metal that mostly affects the kidneys and can also disrupt calcium-phosphate-vitamin D metabolism, leading to renal dysfunction particularly affecting the proximal renal tubules, renal calculi and bone disorders such as osteoporosis and pseudofractures. Cigarette smoking is a major cause of elevated cadmium levels in the blood. In non-smokers, regular consumption of game liver and particularly kidneys can also be a possible (but minor) contributing factor. For more detailed information on cadmium, please see:

http://www.atsdr.cdc.gov/toxprofiles/tp5.pdf
http://www.atsdr.cdc.gov/tfacts5.pdf

Cadmium concentration in blood (nmol/L)	**Predicted health effects at the indicated levels***
90	16% predicted prevalence of renal tubular dysfunction
80	Upper limit seen in heavy smokers
50-60	10% predicted prevalence of mild renal tubular dysfunction
20-30	5% predicted prevalence of mild renal tubular dysfunction
20	Upper limit seen in non-smokers

* A Handbook for Health Professionals Health Canada and Ontario Ministry of Health, March, 1995 (DRAFT)

Simplified clinical algorithm for managing chronic cadmium exposure



* Pregnant women, children under 15 and women of childbearing age.

Chronic Exposure to Lead

As is evident from the information in the table below, lead is a systemic poison and there is considerable debate about whether there is a threshold below which there is no measurable adverse effect.

TABLE 1: EFFECTS OF INORGANIC LEAD ON CHILDREN AND ADULTS (MINIMUM CONCENTRATION PRODUCING AN OBSERVED HARMFUL EFFECT[1])

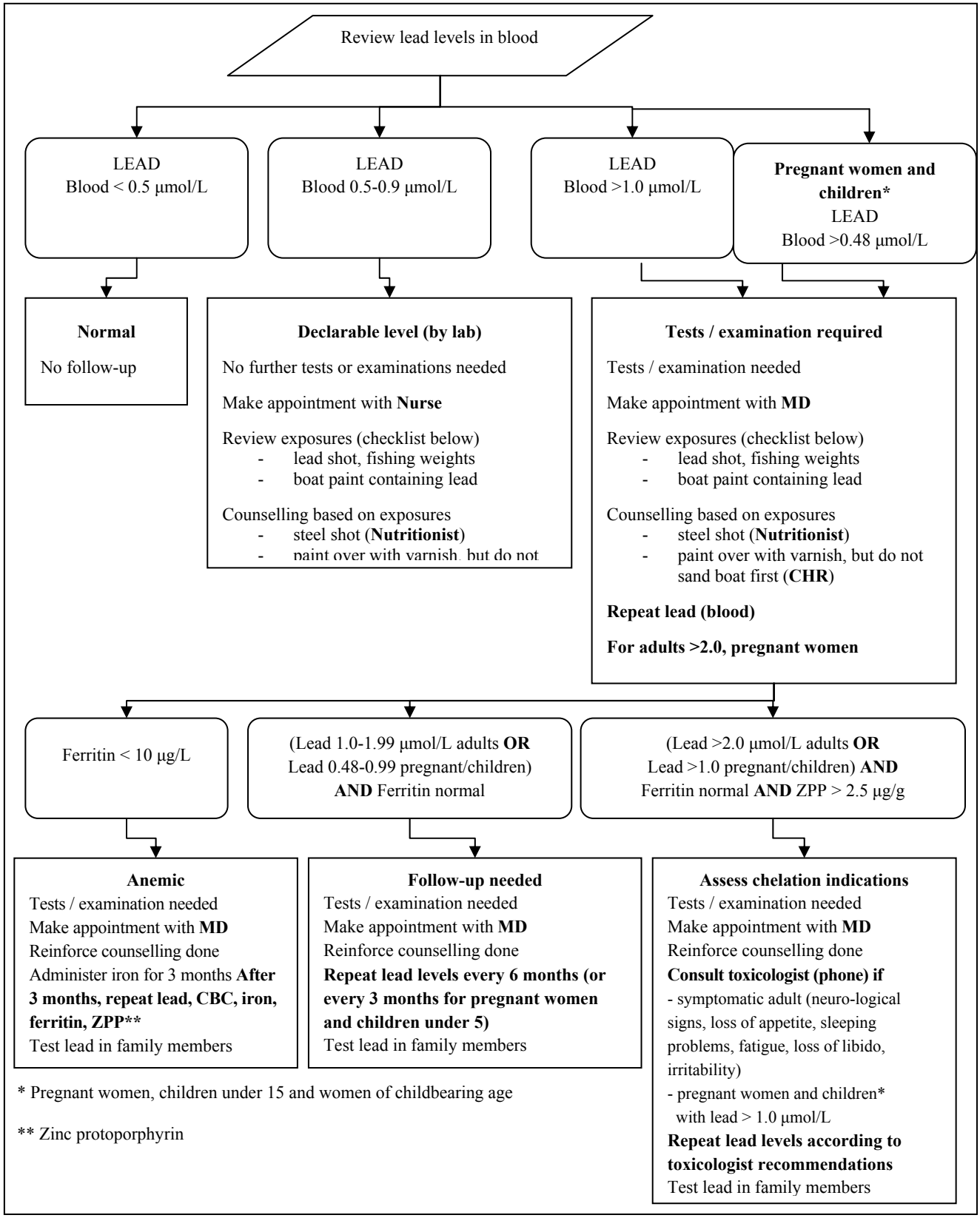
Child	Blood Lead Content µmol/L (µg/L)	Adult
	7.0 (1 400)	
	5.0 (1 000)	⇐Encephalopathy
Encephalopathy/nephro-pathy/obvious anemia⇒		
		⇐Obvious anemia
Colic⇒		
	2.5 (500)	⇐↓Hemoglobin synthesis
↓Hemoglobin synthesis⇒	2.0 (400)	⇐Peripheral neuropathy/nephropathy
Metabolism of vitamin D[2] (change)⇒		⇐Effects on reproduction
	1.5 (300)	
		⇐↑Erythrocytic protoporphyrin (men)
↓Nerve conduction velocity⇒		
	1.0 (200)	
↑Erythrocytic protoporphyrin⇒		
	0.75 (150)	
		⇐↑Erythrocytic protoporphyrin (women)
Metabolism of vitamin D[2] (change)⇒		
Toxicity related to development⇒	0.5 (100)	
↓I.Q.[2]		
		⇐Hypertension[2]

1. Reproduced from the Toxicological Profile for Lead (1990), US Agency for Toxic Substances & Disease Registry (ATSDR), by the Federal-Provincial Committee on Environmental and Occupational Health, September 1994. Source: Lévesque, B., et al. *Protocole d'investigation et de suivi en regard de l'exposition au plomb au Nunavik.* Québec, QC: Direction de santé' publique de Quebec, March 1999.

2. No minimum value has yet been established.

For more detailed information on lead please see: http://www.ehjournal.net/content/pdf/1476-069X-7-25.pdf; http://www.atsdr.cdc.gov/toxprofiles/tp13.pdf; http://www.atsdr.cdc.gov/tfacts13.pdf

Simplified clinical algorithm for managing chronic lead exposure



Chronic Exposure to Mercury

Methyl mercury is a form of this metal that concentrates in the blood and brain, and the major route of excretion is via bile into feces. The effects of chronic methyl mercury exposure (short chain alkyl mercury) are different from classical mercurialism, and include the classic triad of parasthesia, ataxia and visual field defects. Pregnant women, children and patients with heart disease are at greater risk. Earliest signs and symptoms may be non-specific and can take months to appear. Exposure reduction is the primary therapeutic approach. For more detailed information on mercury please see:

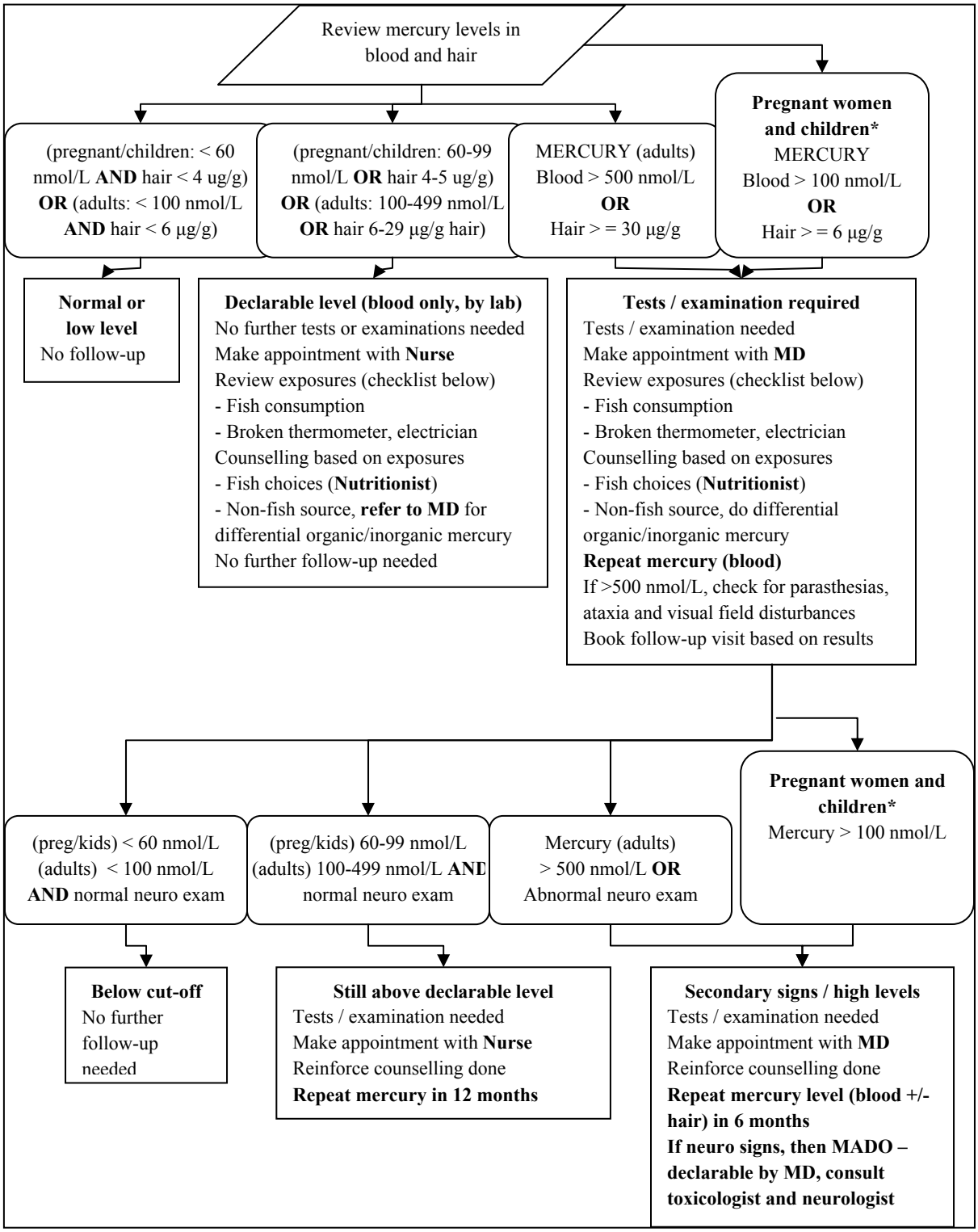
http://www.atsdr.cdc.gov/toxprofiles/tp46.pdf

http://www.atsdr.cdc.gov/tfacts46.pdf

Mercury in blood (nmol/L)	**Mercury in hair (µg/g)**	**Predicted health effects at the indicated levels***
1000	50	Observed motor and central nervous system effects
500	30	Health Canada "at risk" level
250	------	Threshold for adverse health effects in the fetus if this level is present in maternal blood
200	10	Maternal levels with observed motor and CNS effects in infants
100	6	Health Canada "no risk" level
20	1	Basal level, no specific exposure

* A Handbook for Health Professionals Health Canada and Ontario Ministry of Health, March, 1995 (DRAFT)

Simplified clinical algorithm for managing chronic mercury exposure



* Pregnant women, children under 15 and women of childbearing age

Chronic Exposure to PCBs

PCBs are man-made chemicals metabolized by the liver and excreted through urine and bile. However, this process occurs very slowly and therefore bioaccumulation occurs even at low exposures. Chronic exposure can cause dermatological and cognitive manifestations, hepatotoxicity, induction of enzymes that can lead to increased metabolism of drugs and drug-induced toxicity. PCBs are also associated with low birth weight, stillbirths and are probable carcinogens. Acute effects are very rare. Pregnant women, children and patients with liver disease are at greater risk. There may be no overt signs or symptoms. There is also no specific treatment for PCBs toxicity, therefore the goal is to attempt to limit exposure.

For more detailed information on PCBs please see:

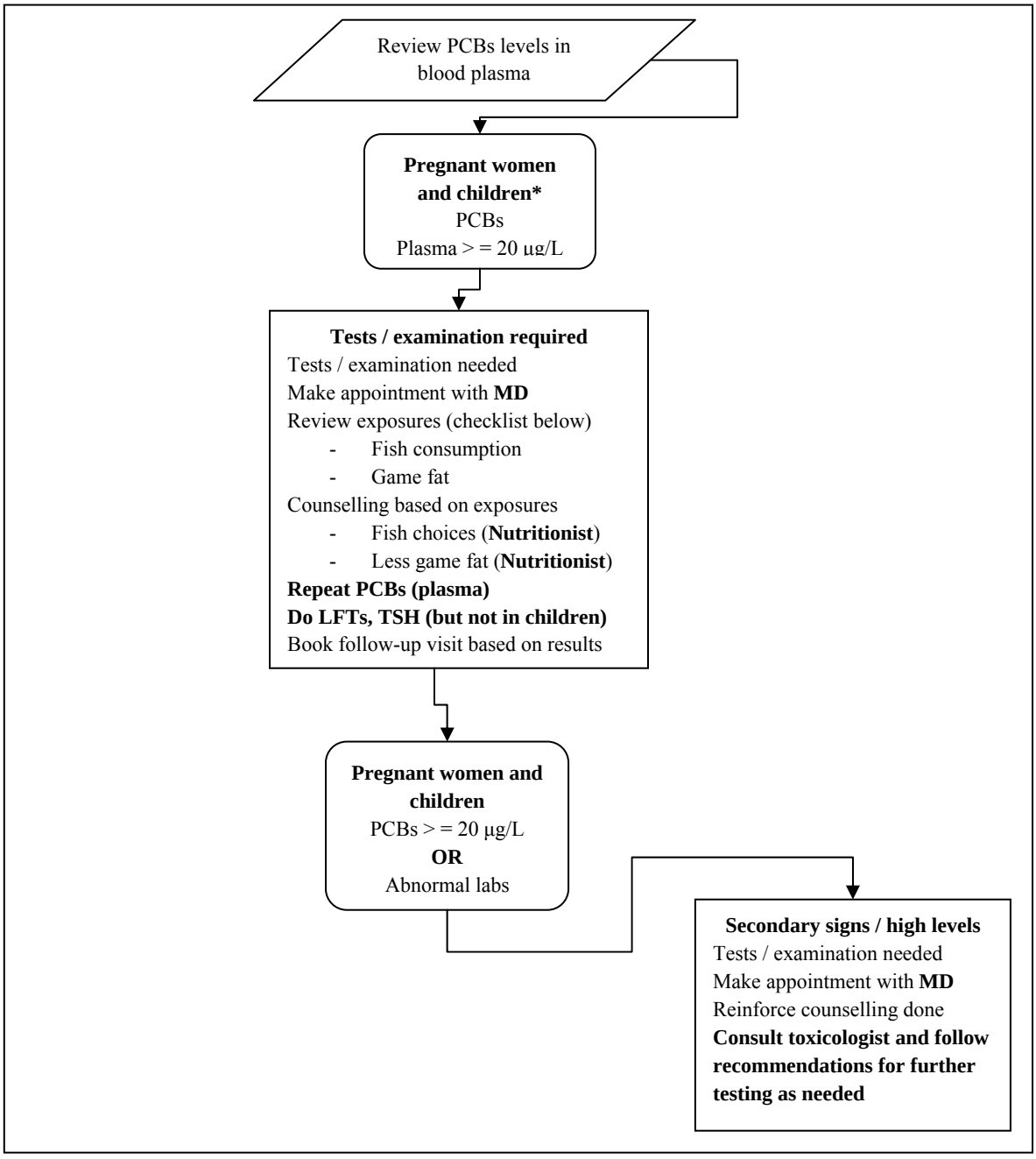
http://www.atsdr.cdc.gov/toxprofiles/tp17.pdf

http://www.atsdr.cdc.gov/tfacts17.pdf

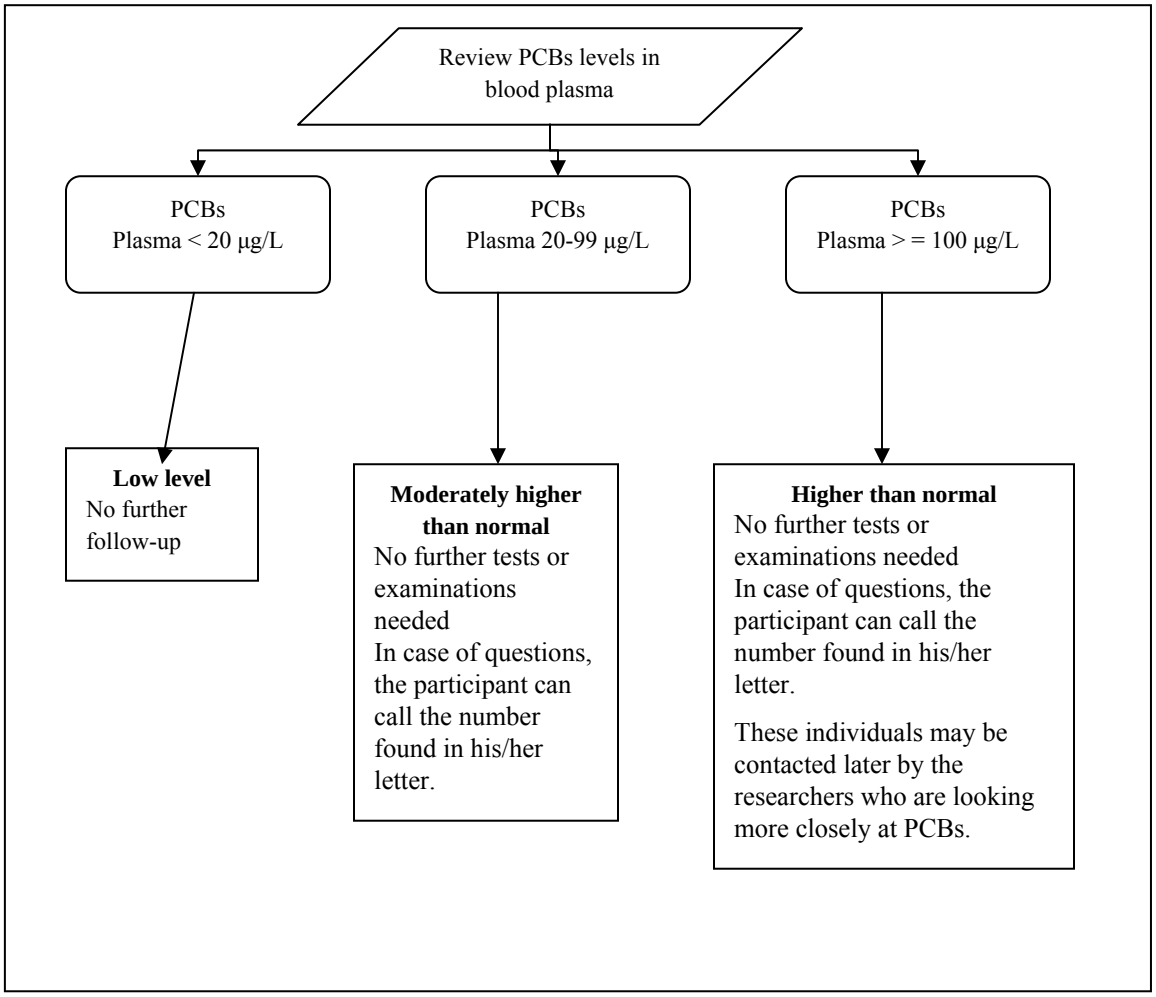
PCBs concentration in blood plasma (as Aroclor, or sum of congeners) (µg/L)	**Predicted health effects at the indicated levels***
300	Upper range of occupational exposure, dermal effects, respiratory irritation, general malaise
35	Average levels for people consuming fish from St Laurence and North Shore
27	Average levels for Quebec Inuit population survey
6	Average levels for people consuming fish from the great lakes
4	Average levels for people *not* consuming fish from the great lakes
2	Typical Canadian level, no specific exposure

*A Handbook for Health Professionals Health Canada and Ontario Ministry of Health, March, 1995

Simplified Clinical Algorithm for Managing Chronic PCBs Exposure for Pregnant Women, Children under 15 and Women of Childbearing Age



Simplified Clinical Algorithm for Managing Chronic Pcbs Exposure (Excluding Pregnant Women, Children under 15 and Women of Childbearing Age)



Repeat blood testing and further investigation may be suggested by the research team in the case of individuals having exceptionally high levels.

APPENDIX 6: HEALTH PASSPORT

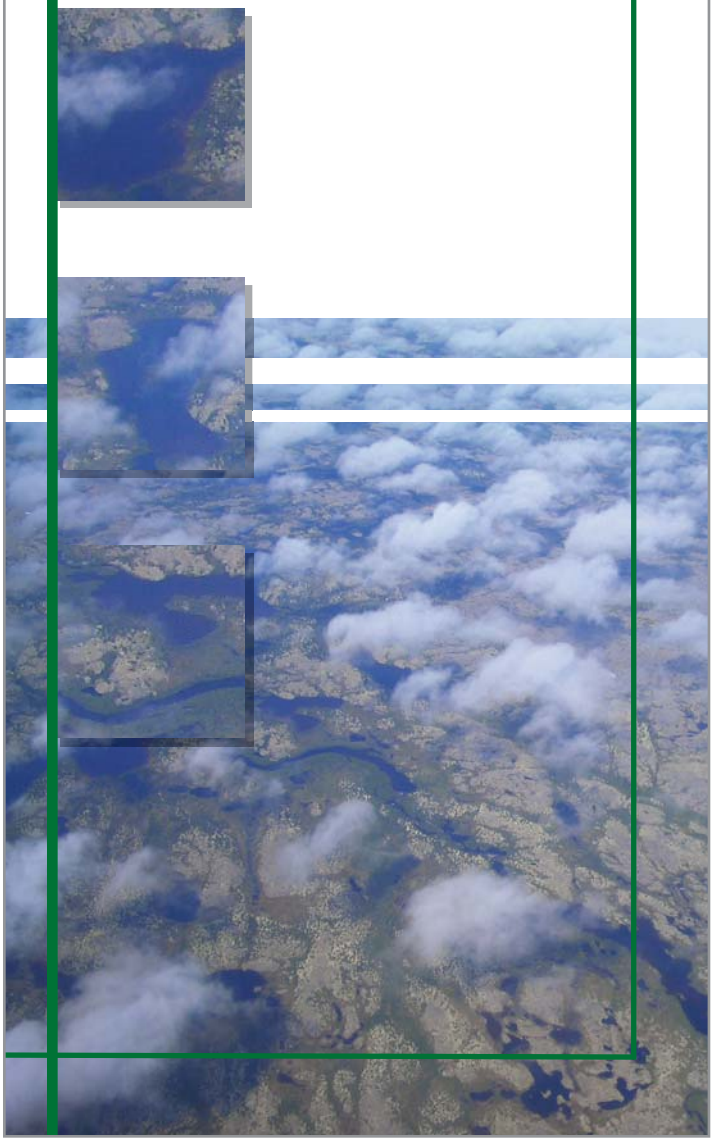
Health Passport

ᒥᔪᐃᒼᐱᑎᓱᐧᐃᓐᐦᐃᑭᐃᓐ

Miyubimätsïu'sin'hïkin

ᓂᔨᔨᐣᐱᓂᒋᐤ ᐊᐢᑎ

Let's learn about our land
Let's learn about ourselves



This Health Passport belongs to:

ᐃᐤ ᑯᐅᓂᐊᐅᓯᑦ ᐅᑦ ᒥᔪᐱᒪᑎᓱᐅᓯᓂ"ᐁᑭᓂᐅᐤ:

Mäu däbïwäusit uyä miyubimätsïu'sin'hïkin'yu:

Name _____

ᓂᑎᓱᓂ"ᑲᓱᐧᐃᐧᐞ

Nit'sin'käsün

Address _____

ᐊᑦ ᐧᐃᑭᐳᐞ_____

Ä wïchiyän

Birth date _____
Day / Month / Year

ᑯᐃᔭᐸ ᑲ ᐃᓕᓕᐅᐳᐞ

Däisp kä ïyyuyän

Date of test _____
Day / Month / Year

ᑯᐃᔭᐸ ᑲ ᓂᔨᑭᔭᓪᒪᔪᐳᐞ

Däisp kä ndü'chischäy'mikuyän

Blood Pressure
ᐊᑯ ᓂᑎᐦᐅᑯᔪᓐ
Ä Sït'hüküyän

Systolic _____/mm HG
ᐊᑯ ᔑᐦᕈᐱᔨᐠ ᓂᑦᐃᐦ
Ä shïhchibiych ndäih

Between 90 and 139 is **normal**.
90 ᐋᐦᐊᒻ 139, ᐊᑯᐅᑯ **ᓴᐦᐊᑯ ᓰᔪᐤᓯ**
90 bïham 139, äukw **nähäu mäyäu**.

Diastolic _____/mm HG
/ᐊᑯ ᕈᐅᐱᔨᐠ ᓂᑦᐃᐦ
Ä chïubiych ndäih

Between 50 and 89 is **normal**.
50 ᐋᐦᐊᒻ 89, ᐊᑯᐅᑯ **ᓴᐦᐊᑯ ᓰᔪᐤᓯ**
50 bïham 89, äukw **nähäu mäyäu.**

Consult a doctor or a nurse. ☐
ᓰ ᐊᔨᒥᐦᐃᐢ ᓂᑐᐦᑯᔨᓐ ᑭᔪᐦ ᓰᐟ
ᓂᑐᐦᑯᔨᓂᕀᐧᐤᓯ
Chä ayim'hït ntukuyn kiyäh mäk
ntukuyn'skow.

Pulse

ᐊ ᐱᐟᑭᐟᐊᓗ ᓂᑦᐃᐞ

Ä pihk'hach ndäih

Beats per minute _____

ᑎᐟᓯᐣ ᐊ ᐱᐟᑭᐟᐊᓗ ᐊᔪᓄᒪ ᒥᓂᓄᔪᓴ

Ditow ä pihk'hach äshikum minikush

Between 60 and 80 beats per minute is **normal.**

60 ᐋᐟᐊᒪ 80 ᑎᐟᓯᐣ ᐊ ᐱᐟᑭᐟᐊᓗ, ᐊᐅᐳᓄ

ᓇᐟᐊᐣ ᒪᓵᐣₓ

60 bïham 80 ditow ä pihk'hach äshikum minikush, äukw **nähäu mäyäu**.

Temperature
ᐊ ᐃᓕᐱᔪ ᑭᓯᓂᔭᓄ
Ä ishbish chis'suyän

(This test is only for people 15 years old and older) ☐ not applicable
(ᒥᐟ ᐊᓂᑦ 15 ᑲ ᐃᐢᑐᐧᓀᓯᓗ ᑭᔾᐢ ᐊᑎᑐ ᑲ ᑭᓱᔭᐧᐃᓗ ᑭᑭ ᓂᑐᕋᑦᓗᔭᒪᑭᓂᐧᐃᐧᐃᓗ)
(Muk inchï 15 kä itup'bunosich kiyäh it'dü kä chishäyyuwich chik chï ndü'chis-chäy'mäkinüwich)

Degrees Celsius _____

38 degrees Celsius is **normal**.
38 ᐊ ᐃᓕᐱᓕ ᐃᐢᑎᔪᐢᓗ ᓂᑐᑭᑭᓄ, ᐊᑲᐅᔪ
ᓀᐢᐊᑲᐤ ᒪᓴᐤᓰ
38 ä ishbish itikuhch ndüchikin, äukw **nähäu mäyäu**.

If temperature is above 38 degrees Celsius for more than 48 hours, consult a doctor or a nurse.
ᐊᑎᑐ ᒪᑲ ᐃᓕᐱᒥᓗ ᐃᐢᑎᔪᐢᓗ ᐊᓄ 38 ᐊᓄ ᐧᐃᓕᑦᐢ 48 ᑎᐢᐧᑦᐤ ᐊᑲ ᑭᓂᐧᑲᓂᐢᑦᑦᐤ, ᓗ ᐊᔾᒥᐢᐃᑦ ᓂᑐᐢᔪᓄ ᑭᔾᐢ ᒪᑲ ᓂᑐᐢᔪᓂᔭᐧᑲᐤᓰ
It'dü mäk ïshbim'hch itikuhch in 38 in wishdäh 48 ditow ä chïn'kon'tät bïsum'kän, chä ayim'hït ntukuyn kiyäh mäk ntukuyn'skow.

Body measurements
ᐊᑦ ᑎᐱᓂᑯᔨᓐᓄ ᓂᔨᖏᖅ
Ä dibin'küyän niyähch

Weight _____/kilograms
ᐊᑦ ᐃᔅᐱᐦᑎᓂᑯᑎᔨᓐᓄ
Ä ispitinikudiyän

Height _____/centimetres
/ᐊᑦ ᐃᔅᑲᐱᐧᐃᔨᓐᓄ
Ä iskäbüyän

Hips _____/centimetres
ᓂᐧᐁᑭᓂᖏᖅ
Ndükin'hch

Waist _____/centimetres
ᐊᑦ ᑭᑲᓯᔨᓐᓄ
Ä chikäsiyän

Sitting height _____/centimetres
ᑦᓐᓄ ᐊᑦ ᐃᔅᓂᐱᔨᓐᓄ
Dän ä iskubiyän

Body Mass Index

ᐊ ᑎᐱᒋᓂᑲᓂ·ᐃᓄ·ᐃᓗ ᐊ ᐃᔨᐱᑎᑐᓂᔨᓐ

Ä dibich'shkonüch ä ispitinikudiyän

Body Mass Index (BMI) _____

Less than 18.5 is **too thin**.

ᐊᐞ ·ᐊ·ᐊᓗ 18.5, ᐊᐅᐣ **·ᐋᓱ ᐊ ᐱᔨᑦᐋᓱᓐᔨᓐ**

Äkä wäwäch 18.5, äukw **wäshä ä bischäwäyän.**

Between 18.5 and 24.9 is **normal**.

18.5 ᐲᐦᐊᒪ 24.9, ᐊᐅᐣ **ᓀᐦᐋᐤ ᒪᔨᐤ**

18.5 bïham 24.9, äukw **nähäu mäyäu**.

Between 25 and 29.9 is **overweight**.

25 ᐲᐦᐊᒪ 29.9, ᐊᐅᐣ **ᐋ ᑯᐦᑭᐳᔨᓐ**

25 bïham 29.9, äukw **ä dähchibuyän**.

Higher than 30 is **obese**.

·ᐃᓴᑯᐦ 30, ᐊᐅᐣ **ᐋ ·ᐋᔨᓘ ᑯᐦᑭᐳᔨᓐ**

Wishdäh 30, äukw **ä wäsäm dähchibuyän**.

Body fat

ᐊ ᐃᓕᐱᔪ ·ᐃᓱᓪᓗᓐᓄᐢ

Ä ishbish wiyyüyän

_____ % of your body weight is **fat**.

% ᐅᖃᑉ ᐊᓄ ᐊ ᐃᔨᐱᖏᑎᓂᔨᓄᐢ, ᐊᐅᔨᓄ ᐊᓄ **·ᐃᓱᓪᓗᓐᓄᓵ**

% uhch in ä ispitinikudiyän, äukw in **wiyyü**.

Women under 30 years ᐃᔨ·ᑲᐅᔨᑎ ᐊᑲᒃ ᐊᓂᓄ 30 ᐊ ᐃᑐᐳ·ᓇᓕᑎ Iskowch äkä äshkw 30 ä itup'bunosich	Between 20 and 27 is normal. 20 ᐋᖅᐊᒻ 27, ᐊᐅᓄ ᓇᖅᐊᐅ ᒪᓴᐟₓ 20 bïham 27, äukw nähäu mäyau.
Men under 30 years ᓇᐸᐅᑎ ᐊᑲᒃ ᐊᓂᓄ 30 ᐊ ᐃᑐᐳ·ᓇᓕᑎ Näbäuch äkä äshkw 30 ä itup'bunosich	Between 17 and 23 is normal. 17 ᐋᖅᐊᒻ 23, ᐊᐅᓄ ᓇᖅᐊᐅ ᒪᓴᐟₓ 17 bïham 23, äukw nähäu mäyau.
Women over 30 years ᐃᔨ·ᑲᐅᔨᑎ ·ᐃᓂᒋᖅ 30 ᐊ ᐃᑐᐳ·ᓇᓕᑎ Iskowch wishdäh 30 ä itup'bunosich	Between 17 and 24 is normal. 17 ᐋᖅᐊᒻ 24, ᐊᐅᓄ ᓇᖅᐊᐅ ᒪᓴᐟₓ 17 bïham 24, äukw nähäu mäyau.
Men over 30 years ᓇᐸᐅᑎ ·ᐃᓂᒋᖅ 30 ᐊ ᐃᑐᐳ·ᓇᓕᑎ Näbäuch wishdäh 30 ä itup'bunosich	Between 14 and 20 is normal. 14 ᐋᖅᐊᒻ 20, ᐊᐅᓄ ᓇᖅᐊᐅ ᒪᓴᐟₓ 14 bïham 20, äukw nähäu mäyau.

Bone density
ᐊ ᐃᓂᐱᔪ ᓄᖅᑭᓐᓇᓂᓪ
Ä ishbish sühchikinäyän

(This test is only for women 35 to 74 years old) ☐ not applicable
(ᒥᑉ ᐊᓕᑯ ᐃᔭᐅᐅᓪ 25 ᐋᖅᐊᒻ 74 ᐅ ᐃᖅᑐᓕᓴᓐᓇᓂᓪ ᑭᑭ ᑯ ᓕᑐᔭᓄᑦᑎᓇᑭᓕᓕᓴᐃᓐᓇᓪ)
(Muk inchï iskowch 25 bïham 74 kä itup'bunosit chik chï ndü'chischäy'mäk-inüwich)

Bone mineral density (T-Score) _____
ᑕᓪ ᐊ ᐃᓂᐱᔪ ᓄᖅᑭᓐᓇᓂᓪ
(ᐊᑭᖅᑕᓄᓪ ᐅ ᒥᔭᑭᖅᐊᖅᑕᑭᓕᓴᐃᓐᓇᓪ)
Dän ä ishbish sühchikinäyän
(Ach'stän kä miskuwätäkinüch)

If the result is **minus 1 (–1)** or lower, consult a doctor or a nurse.
ᐊᓪ ᒪᔪ ᐊᑭᖅᑕᓄᓪ **ᓅᖅᑕᖅᑐ 1 (-1)** ᐃᖅᑎᓂᖅᑐᒃ ᑭᐳᖅ ᒪᔪ ᐊᑎᑐ ᓅᖅᑕᖅᑐ, ᒃ ᐊᔪᒥᖅᐃᓪ ᓂᑐᓂᓂᓪ ᑭᐳᖅ ᒪᔪ ᓂᑐᓂᓕᔪᓪᔭᐅᓪ.
In mäk ach'stäsun **nïtähch 1 (-1)** itikuhchä kiyäh mäk it'dü nïtähch, chä ayim'hït ntukuyn kiyäh mäk ntukuyn'skow.

About this study
ᒑᐧᑳᓐ ᐆ ᐧᐋᐦᒋ ᒌ ᓂᑑᒋᔅᒑᔨᐦᑖᑭᓂᐧᐃᒡ
Chäkon ü wähch chï ndü'chischäy'täkinüch

Nituuchischaayihtitaau Aschii is a long-term scientific project, led by the Cree Health Board, to get information about the health and well-being of our land and our people. The Cree Health Board is collaborating with Laval University and many other partners to carry out this study. The study is financed by the Niskamoon Corporation.

Thank you for agreeing to take these tests. We are pleased to give you some of your results that are already available.

Don’t hesitate to contact us if you have any questions about these results.

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Ü Ndü'chischäy'tidäu Aschï kä ishin'kädäch, äukw in näush ä ndü'chischäy'täkinüch ä it isbiyich Ïyyuch ubimätsïwin'wähch kiyäh inyä ä ïsh däk'hükuch chäkoyu aschïhch, äukunch bämbiy'täch Ïyyu Ntukuyn Äbitsïwin. In mäk Ïyyu Ntukuyn Äbitsïwin, äyükw wäch'hïkuch Laval University kiyäh ninähkü indäh uhch wïch'häkinüwich uhch uyä ä ïsh ndü'chischäy'tich. Äukw mäk bäch'stinät shüyän'h Niskamoon Corporation.

Chiniskum'dinän mäk ü kä ïsh niskumuyäkw chä ïsh ndü'chischäy'miküyäkw. Shäsh mäk chik chï chischäy'dïdinän in bishch shäsh kä ïsh miskuwä'täyähch.

Akäwï chik shäkoy'munäwäu chä bäch ayim'hïyähch uhch in ä wïh kukochischämuyäkw chäkon uhch in kä ïsh miskuwä'täkinüch.

Suzanne Côté, Nurse
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Suzanne Côté, Ntukuyn'skow

Telephone
ᑕᖏᑲᐱᖏᓱᓂᑭᓵ
Dähkäp'chänikin:
418 656-4141 ext. 46536

Email
ᒥᔨᓂᖏᐃᓱᐱᑎᒉᑐ·ᐃᓵ
Misin'hïchäbidimädün:
Suzanne.cote@crchul.ulaval.ca

Conseil Cri de la santé et des services sociaux de la Baie James
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Cree Board of Health and Social Services of James Bay

Research Partners:
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- Quebec National Institute of Public Health (INSPQ)
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APPENDIX 7: EVALUATION REPORT

MULTI-COMMUNITY ENVIRONMENT-AND-HEALTH LONGITUDINAL STUDY IN EEYOU ISTCHEE:

Preliminary evaluation report, Year 2

Multi-community Study Evaluation Committee

Joanne Cheezo, Public Health Officer, Eastmain Cree Nation

Iain Cook, Communications Officer, Cree Board of Health and Social Services

Suzanne Coté, Unité de recherche en santé publique CHUL-CHUQ,
Clinical Field Coordinator

Joey Georgekish, Public Health Officer, Wemindji Cree Nation

Natalie Kishchuk, Evaluation Consultant

Evert Nieboer, McMaster University, Co-Principal Investigator

Alan Penn, Cree Regional Authority

Jill Torrie, Research, Cree Board of Health and Social Services

Mathieu Trépannier, Cree Board of Health and Social Services,
Chef de mission

Isabelle St-Cyr, Cree Board of Health and Social Services,
Education Coordinator

Version 1, January 11 2008

Wemindji, June 2007

1. OBJECTIVES

The Multi-Community Environment-and-Health Longitudinal Study in Eeyou Istchee is a multi-year, multidisciplinary monitoring/surveillance project that will document current exposure to mercury and other contaminants, food consumption patterns, and nutrient and health status of the Eastern James Bay Eeyouch. It is being funded as part of the successive Mercury Agreements between the Cree and Hydro-Québec. In addition to documenting baseline environmental health conditions prior to further energy and mining development in the region, the study aims to provide the Cree Board of Health and Social Services of James Bay (CBHSSJB) with information that can be used to design more effective awareness and health promotion activities. Each of the region's nine communities will participate successively in the study, between 2005 and 2012. The research process aims to involve the communities as much as possible, in order to enhance understanding of environment-and-health issues in the general population and foster a greater interest in scientific pursuits by youth.

The multi-community study is being evaluated using a formative, participatory approach involving key stakeholders and facilitated by an external evaluator. The evaluation objectives are to:

1) Document and assess the quality and effectiveness of the implementation of the multi-community study in the participating communities, including community engagement in the research process;
2) Determine the success of the study in achieving its formal objectives and the anticipated benefits for the communities;
3) Inform the planning of each successive implementation of the study in the Cree communities.

The evaluation is directed by a stakeholder committee composed of representatives of the Cree Nations in which the study is being carried out, the Cree Board of Health (Environmental Health, Evaluation), the Cree Regional Authority (Environment Department), principal investigators and project staff. The Evaluation Committee's role is to finalize and approve the evaluation plan, approve the data collection instruments, and participate in the interpretation and the findings and development of recommendations. The first evaluation report examined the study's implementation and effectiveness as it was carried out in Mistissini in 2005[2].

[2] Multi-community environment-and-health longitudinal study in Eeyou Istchee: Final evaluation report, Year 1 and evaluation plan, Year 2, November 2006.

In 2007, the study was carried out in Eastmain and Wemindji. For the 2007 field year, this report focuses on the following evaluation questions:

1.1 How appropriate and effective were the planning processes for the study, including involvement of participating communities in decision-making processes?

1.2 How effectively was the study implemented in each of the communities?

The remaining evaluation questions, about the effectiveness of results communication, achievement of study's research objectives, and impacts on the participating communities, will follow in a subsequent report once the results of the study have been produced and disseminated.

2. METHODS

The evaluation plan for the second year of the study was similar to that used in Year 1 while incorporating suggestions made by the study team during their planning session held in October 2006. This report presents results from interviews conducted prior to and during the study period in summer 2007. These interviews were conducted by telephone (pre-implementation) or in person (in the two communities, in both cases during the last week of the study operation in June and August 2007). The interviews were conducted in English or French, using an open-ended approach based on the evaluation questions. As some of the staff worked at both sites, they were interviewed in both locations about that site. The interviews conducted are summarized in the table below. (Further interviews will be conducted after the results communication.)

TABLE 1: INTERVIEWS CONDUCTED

Data source and method	Number	
	Wemindji	Eastmain
CBHSSJB staff and research team: pre-implementation	4	
Regional organization: pre-implementation	1	
Community liaisons: pre-implementation	1	1
Community representatives	2	3
Project staff: recruiters, welcomers, nurses, interviewers	10	12
Total	34 interviews, 27 individuals	

The interview notes were synthesized using standard qualitative evaluation methods.

3. FINDINGS

3.1 Planning processes

Use of lessons learned from the 2005 study

The study planning team systematically used lessons learned from the 2005 study in Mistissini to inform planning of the 2007 studies in Wemindji and Eastmain. All of the study information, negotiation, and implementation steps were managed by the Cree Health Board team, so as to streamline the linkages between the study and the community. In the 2007 study, this team intensified its approach to liaising with the communities in the months prior to the study, in order to ensure community input and support. In both communities, a local liaison person was identified and arrangements made for formal recognition of their role. Meetings and presentations were held, beginning in the fall of 2006, with relevant stakeholders and collaborators in each community, including the community governance (Chiefs or deputies, health representatives), public health officials and local coordinators, environment officers, managers of the multi-service facilities where the study's clinical or coordination offices were to be set up, housing officers, and schools. In both communities, good support was obtained from the community, and levels of community awareness and involvement were stronger than had been the case in 2005.

Those involved in operational planning of the study in 2007 used information from the 2005 teams' field and technical reports to inform their planning for 2007. They were able to address proactively some of the issues that arose in the Mistissini study, with staff training and community communications (aiming to facilitate recruitment) being the two most important areas. A communication plan was produced that incorporated the production of a promotional video and other material for the communities based on feedback and analysis of the Mistissini experience, in particular making the Atlantis laboratory more accessible and understandable. In terms of training, a four-day training program with a training manual was developed for local staff (recruiters, welcomers, interviewers). The training program included trainee participation in a simulation of the study participants' trajectory, to ensure that they were aware of all the components and could explain them to potential participants (an area that had been found to be problematic in the 2005 study). The training also integrated learnings from the experiences of recruiters and interviewers in the previous study, for example by providing recruiters who had difficulty dealing with refusals with some alternative strategies for helping people decide to participate.

Results of the Mistissini study

The results of the study in Mistissini in 2005 had a bearing on the planning process for the 2007 study. According to study staff, some decisions about research elements were informed by the 2005 study, including streamlining of the questionnaire, greater quality control for collection of the nutritional data, elimination of one clinical measurement, addition of another, and addition of medical chart review for all participants. It was also decided to use PC tablets for data entry to expedite this part of the data management process.

However, the delay in production and release of the final report from the 2005 Mistissini field season (the report was not released until the fall of 2007) was seen as a negative factor for the planning of the 2007 study by the Cree Regional Authority who was not privy to the informal research results communication among the research team. From this organization's perspective, it was difficult to judge the pertinence or value of the study questions and arms as well as the quality of the methodology, particularly in terms of documenting routes of contaminant exposure, differences among subpopulations, and plans for comparative analysis across communities. Concern was expressed that although the Cree Health Board has stated that this multi-community study will meet its obligations with respect to monitoring of environmental health risk in the context especially of fisheries promotion and ongoing hydro and mining development, that this has not been adequately substantiated. In this context, the effectiveness of the liaison between the research program and the Cree Health Board was questioned.

Other respondents questioned the value of some parts of the 2007 study based on the 2005 results, as they appeared to offer no information that was not already known about health status and risk factors (specifically, that the most pressing health issues are attributable to behavioural factors: diet, smoking, exercise) and thus of perhaps limited added value to the public health systems, either of the CHB or locally. The cost-benefit value (in terms of direct costs as well as opportunities costs for use of CHB resources) was thus called into question.

From the research team's standpoint, the production of results from Mistissini, although longer than anticipated, will serve as a template for the future years' reports. The decision to conduct the study in two sites the third year allowed for more analysis of the first year's findings and integration of these results into the plans for 2007. In addition, planning for the longitudinal part of the study, with follow-up measures in each of the communities to begin after this baseline phase, is beginning, as is the publication of results in scientific journals.

Liaison between the research team and the Cree Health Board

From the perspective of the investigation team regarding the liaison between the research team and the Cree Health Board, the study planning processes were generally seen to be very satisfactory. Communication was timely and responsive, and all key planning elements were accomplished effectively: sample design and frame; Atlantis transfer and installation; clinical data collection plan, and local staff hiring needs and training plan and tools. No technical or logistical difficulties were encountered.

From the staff's perspective, the planning was not quite so smooth. A perceived lack of presence of scientific leadership seemed to result in some decisions falling between chairs, contributing to a lack of coordination at the investigator level. Some staff interviewees commented that there was a gap in scientific planning, and that some study design elements were decided only at the last minute, which affected the staff's ability to organize and plan adequately.

One aspect that was noted as having been somewhat less than satisfactory was related to the planning of the linkages between the study design and the educational component. From the perspective of the CHB team, postponement of decisions by the research team about study components throughout the fall resulted in pushing back the development of educational interventions linked to the study and consequently the establishment of working relationships with the local education system in the communities. This was seen as unfortunate, because one of the motivating factors for changing the study implementation period to coincide with the school year (as opposed to in mid-summer, as had been the case in Mistissini), was to be able to strengthen the educational component of the study for the communities.

Liaison between the Cree Health Board and the communities

Overall, the liaison between the Cree Health Board and the communities at the planning stage was effective. Respondents from the communities stated that their communities were strongly supportive of the project, and satisfaction with communications was generally high (with one exception, described below) on both sides. The participation of a CHB staff person from one of the communities in the planning and presentation for that community helped to facilitate the relationships.

However, a few challenges were identified by interviewees. From the Cree Health Board's perspective, the first of these was maintaining continuity in communications with the communities, given frequent travel or unavailabilities of the liaison persons. This was dealt with insofar as possible by ensuring that there were backup individuals for key persons, so that important decisions would not be delayed. A second issue, resolved effectively although requiring considerable time investment, were major and last-minute changes in the communities about facilities and housing that could be made available to the team. It was suggested by both community and CHB representatives that planning should systematically include at least one backup alternative for the main logistical elements.

From the community perspective, although the liaison at the time of planning was perceived to be going well, some challenges were noted related to the hiring of local staff. Although positions were advertised through radio spots in both communities, response was not strong, perhaps because of timing (Goose Break in one case, and summer vacation in the other) and in the end most of those hired learned of the project through word of mouth. In one of the communities, there were differences of opinion among those interviewed about the arrangements that had been made for hiring, and a feeling in the community that the

study at one point had created frustrations. In this community, staff recruitment was difficult and some staff hired ended up being workers from the centre where the project was being housed. In the other community, timing of some pre-implementation activities such as developing and testing the radio spots was awkward because it coincided with Goose Break. Representatives of this community suggested that these activities should occur prior to the break.

Relationships with the local representative were in general somewhat less smooth in one community than in the other. While project staff attributed this to ongoing local dynamics and lack of mutual respect between the community and the CHB in some key positions, community members felt that proper planning processes had not been followed – that the project should have approached the local collaborators to ensure the feasibility of activities before seeking approval from the Band. A Band representative of the same community disagreed, and in fact praised the project for seeking Band approval at the outset. It was suggested by project staff that the choice of local representative should perhaps depend more on compatibility and complicity than on formal positions, in order to facilitate relationships. Community representatives emphasized that the project should become informed about local planning processes to ensure that meetings are planned with adequate timeframes.

In response to community concerns, the study in 2007 included a component on identifying mould in housing. From the community perspective, this addition was welcomed because it provided an opportunity to address and systematically investigate an issue of concern for which there were no adequate data. From the Cree Health Board perspective, inclusion of this component enhanced the credibility of the study at the planning stage and hence support from the community leadership.

For the study's educational component, receptivity to the study was perceived to be adequate, more so in Eastmain. The approach taken with the schools was different in the two communities: in one case, CHB staff were able to meet with and plan directly with teachers, while in the other, the principal played a gatekeeping role that was somewhat frustrating.

3.2 Study implementation

As the implementation results for the two communities are quite similar, they are presented together.

Staffing, training and coordination

From the project management's perspective, local staff hired in one community was excellent, but in the other there were some differences in abilities and motivation that were likely related to age or education level, and that affected performance. In that community, some individuals that had been recruited as interviewers left after the training; this meant that some time was lost, and overall, that there was limited choice in staffing. For the non-local staff, flexibility and adaptability were found to be essential to making a positive contribution to the study; according to the study managers, there were variations in these

qualities particularly among the nursing staff. There were some challenges identified with role clarity and task descriptions, especially for the positions of head interviewer and head recruiter. As well, there were differences between the communities in the perceptions of local staff about what tasks (e.g., translation) should be remunerated, and how. One community representative recommended that the study make a greater effort to recruit Cree staff, especially Cree nurses.

Project staff interviewed were all very satisfied with the training they received, finding that it had prepared them well for their tasks. Only one person said that the training had not covered everything she needed to know. The practice sessions were appreciated by the nursing staff, and the walk-through was appreciated by the recruiting and interviewing staff. (For those staff that moved to the second community with the project, no additional training was needed.) It was noted that it would have been helpful to train some recruiters as backup interviewers who were fluent in Cree, in order to ensure maximum efficiency in scheduling. The project management noted that while it was important that all staff acquire a global understanding of the entire project, this was not always the case for the nurses even after the training.

Project coordination was seen to be very effective, by all levels; those coordinating, those coordinated, and those managing the project. Staff felt comfortable raising issues and generally felt that their concerns were listened to, although an interviewer noted that more positive feedback could have been given to workers. Issues that had created challenges in Mistissini had been generally smoothed out, although there were occasional tensions about equity issues in scheduling and workload (specifically, about some staff leaving the project earlier than others). This had some negative effects on morale. In general though, morale was high and team members enjoyed supportive relationships.

It was mentioned that informal socializing tended to occur separately for the Cree and non-Cree staff. One Cree staff person mentioned that the Cree staff were uncomfortable when the non-Cree staff spoke French, as they thought they might be being talked about.

Study processes and measurement components

The study processes were smoothly implemented in both communities. An opening ceremony was held in both communities, with a positive reception and higher attendance than had been the case is Mistissini. Staff felt that holding the ceremony on the first clinical day, as it was in Wemindji, created too much pressure, but a community member in Eastmain noted that it would have been preferable to hold the opening before the start of the project. The participation of the Cree team in the Eastmain ceremony, each explaining their component of the study, was seen as having a positive impact on the perception of the project, more so than having the researchers present as was the case in Wemindji. Community members in Eastmain in fact commented positively on the participation of the Cree team in the presentation. Others made positive comments about the food and duration of the Wemindji ceremony.

Response to recruitment was strong, especially at the beginning of the study period, when very high numbers of participants were seen each day. Care was taken to ensure that the first contact with participants about the study was in Cree. According to recruiters, if people had hesitations about participating in the study, it was mostly about the time involved and need to miss work, or about the early morning appointments. Ongoing recruitment was facilitated by having the substitute samples list earlier than had been the case in Mistissini; it was suggested that having the third list earlier would also be helpful. As the study period wound down in both communities, there were more empty time slots as the sample became progressively more difficult to recruit. Working men proved to be more difficult to recruit than working women, as the latter were more likely to have office jobs and be easier to reach, and the former to be working outside or to be harder to reach. Hunters in particular tended to be away from their homes between 4 a.m. and 10 p.m., so were very difficult to reach. It was also observed that some trappers declined to participate in the study because they did not want to be told about their exposure to contaminants. Alternative formulations for gaining participation were proposed, focussing more on food quality than contamination.

The consent process was generally satisfactory, although some interviewers noted that it was quite long. Consents were generally obtained the evening before the study so that fasting participants could go directly into their measurement sessions the next morning. Viewing of the DVD for the consent allowed the whole family to learn about the study; many participants chose to watch it in Cree. According to the interviewers, only occasionally was a DVD player not available. Interviewers noted that participants quite often preferred to read the consent form. One staff member expressed concern that the DVD was not used by individuals who did not adequately understand the written English form. On the other hand, an interviewer noted that she felt that she was showing a lack of trust to respondents if she read the form to them. It was suggested to assign one interviewer to complete the consent process with people who were having more difficulties with it.

The welcomer role was important for some participants, although not all. When participants had questions about the study or why they had been selected or did not understand what they had been told previously, the welcomer was able to explain more clearly and ensure understanding. It was also important for people who were anxious or impatient about the study, as the welcomers engaged them in light-hearted or joking ways, allaying fears and passing the time. The welcomer was also responsible for showing people the material in the tent, but this was not of interest to everyone. Welcomers also served to interpret the content of the video.

According to those involved, the interviewing and clinical data collection processes were conducted efficiently and effectively. This was facilitated not only by a highly organized and streamlined process but also by a physical layout that allowed easy communication and monitoring. Interviewers felt that their interviews had generally gone smoothly. They found the translation helpful, as the questionnaires contained some words that they did not know in Cree. Some noted that the recall of food frequency was difficult for participants, as they did not really keep track. The longest interviews – up to 90 minutes – were with elders who had difficulty with the traditional foods sections. For example, there appeared to be some confusion about cooked and dried meat. Two interviewers noted that elders sometimes found some questions funny.

A few small problems were noted. Occasionally, participants arrived having just clipped their toenails or shaved their hair; it was suggested that the need for these samples be better communicated to participants ahead of time. Nurses also noted an issue in dealing with some participants (mainly men who would not say that they were not feeling well) who needed to lie down during the testing. This was difficult to manage for nurses working solo in peoples' homes (some data was collected at home for patients who could not come to the clinic), and resulted in time loss and keeping people waiting during clinical time. Nurses tried to double up whenever it was thought this might be an issue. Special arrangements were also needed for participants with special needs – deaf, mentally ill, paraplegic – but these had not been foreseen. Some complaints were received about the snacks served (muffins, cheese): elders would have preferred bannock.

In one community, it was noted that there were concerns and rumours that the study was going to be testing for HIV. Those aware of this felt that it was important that the study presentations be clear from the outset about what it was testing for.

Coordination with the laboratory was smooth, from both the clinicians' and the laboratory staff's point of view.

Educational component

In Wemindji, difficulties in liaising with the school hierarchy resulted in somewhat last-minute arrangements for the educational activities. Educational units had been developed for teachers, but their implementation in the schools proved challenging. Two after-school educational activities were held in the primary school, and about 20 children visited the Atlantis laboratory. In the high school, the planned timing of the activities coincided with the examination period, and collaboration from the school hierarchy was not obtained to involve students. However, community representatives stated that spring was still the best time of the year to conduct the project. A pre-CEGEP intern worked with one of the technicians in the laboratory for part of the study period.

In Eastmain, educational activities relating to the study had been proposed to existing summer camps, but from the perspective of the project, there was little uptake for this. From the perspective of the camp organizers and band representative, the request was not timely in terms of securing the necessary resources to integrate the activities and inform parents – it would have had to have been made in November 2006. Instead of the summer camp option, a series of 16 afternoon workshops was offered in Eastmain over four weeks, beginning June 29. 60 children between 6 and 15 years of age participated. These activities involved collaborations with the Elders from the cultural centre and included activities on nutrition and food preparation. Once the school year started, planning with the schools was undertaken. Here, receptivity was higher. It was possible to collaborate directly with teachers and integrate activities in the classroom, and then have groups of students visit the Atlantis laboratory. These sessions went very well, with children asking many questions and especially the younger ones seeming quite enthusiastic. Seven groups of students, for a total of 96, participated in these activities.

Overall, there was a feeling by those involved in planning and conducting the educational activities that these are not a priority for the multi-community study. There was a view among some of those interviewed that the activities had not been well-supported by the project and that this had contributed to challenges in gaining credibility and cooperation in the communities. It is particularly important to work directly with teachers in order to be able to reach teenagers, who are less likely to become engaged in voluntary or after-school activities than younger children. However, interview feedback from the community about the summer educational activities was very positive: a community representative noted that the children were being exposed to things that they had not seen in school yet.

Physical arrangements and working conditions

Overall, the logistical arrangements in the two communities ended up being quite satisfactory, despite some last minute changes. In Eastmain, the clinic staff who were supposed to have moved out of the building designated for the study had not done so because mould had been found in the clinic, so the project co-existed with the clinic staff for two weeks. The nursing staff on this site also found that their workspace was inadequate. A satisfactory solution was found, but some tensions were created and remained. The placement of one study worker in a hallway was less than ideal.

Staff found the housing to be adequate. In one community, the housing was not within walking distance of the study site, which naturally created some needs for coordination in terms of sharing of vehicles. Food arrangements seem to have been excellent, and some difficulties experienced in Mistissini had been ironed out.

When asked about satisfaction with their working conditions, some interviewers noted that they would have liked to have had more hours, as some of their working days were turning out to be very short. There appeared to have been a lack of clear communication about the working hours that would be expected of

local staff in one of the communities. In one of the communities, the working hours of the project were changed to better suit that community's cycle of daily activities, which start later than in the Québec public service norm.

Community and participant response

According to interviewees, response from study participants was quite enthusiastic. There seemed to be a high level of awareness in the communities about the study, and collaboration with employers and community organization was good. Local staff members reported that community members, both selected and not-selected, who had heard about the study from family or friends asked if they could also participate, sometimes calling them at home. Recruiters also mentioned that many people contacted had heard about the study through the radio spots. There was approval and support for the idea of looking after the Nation's health, especially since some told the staff that they had seen deterioration in the community and had some concerns, about fish, mercury and other contaminants.

According to interviewers and recruiters, many people were motivated to participate in order to learn about their health. However, some questioned the random selection approach, saying for example that someone from every household should be chosen, as all the people living there eat the same food and drink the same water. Many participants were curious and asked questions about what the various tests were looking for. Participants who wore the Holter in the community also generated a lot of questions for staff. All staff felt that many were eager to receive the study results, as many asked questions about this. Reactions to the health passport were positive, and some staff noted that it seemed to be a motivating factor for some people to be more concerned about their health or undertake some health-related changes.

Reactions to the video were positive, and staff felt that it created a link for study participants between the environment and their health. However, welcomers felt that the video should have been available in Cree, and that many people who watched it did not understand all of it.

Men seemed to be more reticent to participate than women, especially concerning the blood sample. As well, recruiters and interviewers felt that young people, especially teens, were harder to recruit, and quite hesitant to ask questions. They were also shy about providing some information that they did not want their parents to know about, such as smoking status.

Liaison with the research team

Liaison with the research team was an issue for some of the project staff. While the attendance of the investigators at one of the opening ceremonies was appreciated, it was also noted that the lack of ongoing presence and integration of the researchers with the project sent a negative message about their level of interest in the community.

4. CONCLUSIONS

The approach taken to planning and implementing the multi-community study in 2007 incorporated many lessons learned from the Mistissini study. While not all challenges were anticipated, many were, and so solutions were available and applied readily. Overall, the planning and implementation of the study were highly effective in 2007, and the level of community involvement and engagement in both of the 2007 communities was higher than it had been in Mistissini.

Two lessons that have emerged from the 2007 implementation are:

- It is advisable to have a clear backup plan in place from the outset for each of the study's main elements, including logistical arrangements, facilities, and the educational component, so that any last-minute changes or adaptations will be easier to deal with.
- In developing a relationship with the communities where the study is to be carried out, a systematic and strategic assessment of the community dynamics and most effective liaison points and persons could be helpful, i.e., a one-size-fits-all model for community liaison should not be assumed, and it should not be assumed that all community stakeholders will have the same views of what the proper processes are for engaging the community.

These evaluation data show that there was effective collaboration between the research team and the CHB, and the CHB and the communities at the level of research operations. However, there is some evidence of slippage at the level of the interface between the team of principal investigators and the study operational level, with last-minute scientific decision-making and a perceived lack of connection to the communities having some negative effects on the study as a whole.

In addition, there seemed to be a sense that more could have happened in the educational component of the study. It is not clear whether the objectives of this component of the study should be reviewed and re-articulated, or whether its role in the overall study needs to be re-affirmed.