# Mercury levels in the Cree population of James Bay, Quebec, from 1988 to 1993/94

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## Abstract

**Background:** High levels of mercury in the Cree population of James Bay, Que., have been a cause of concern for several years. This study examines changes in mercury levels within the Cree population between 1988 and 1993/94 and identifies potential determinants of high mercury levels.

**Methods:** Data on mercury levels among the Cree were obtained through a surveillance program undertaken by the Cree Board of Health and Social Services of James Bay. In 1988 and again in 1993/94 surveys were carried out in all 9 Cree communities of northern Quebec. Hair samples were obtained and analysed for mercury content. Analyses were carried out to determine the proportion of people who had mercury levels in excess of established norms. Changes in mercury levels between 1988 and 1993/94 and determinants of high levels were estimated by means of regression methods.

**Results:** The proportion of the Cree population with mercury levels in excess of 15.0 mg/kg declined from 14.2% in 1988 to 2.7% in 1993/94. Wide variations in mercury levels were observed between communities: 0.6% and 8.3% of the Eastmain and Whapmagoostui communities respectively had mercury levels of 15.0 mg/kg or greater in 1993/94. Logistic regression analyses showed that significantly higher levels of mercury were independently associated with male sex, increasing age and trapper status. There was a correlation between the mercury level of the head of the household and that of the spouse.

**Interpretation:** Mercury levels in the Cree of James Bay have decreased in the recent past. Nevertheless, this decrease in mercury levels may not be permanent and does not necessarily imply that the issue is definitively resolved.

## Résumé

**Contexte :** Pendant plusieurs années, les taux élevés de mercure dans la population crie de la Baie James, au Québec, ont été préoccupants. Cette étude examine l'évolution des taux de mercure dans la population crie entre 1988 et 1993/1994 et définit des facteurs déterminants possibles des taux de mercure élevés.

**Méthodes :** On a réuni des données sur les taux de mercure chez les Cris dans le cadre d'un programme de surveillance entrepris par le Conseil cri de la santé et des services sociaux de la Baie James. En 1988, et de nouveau en 1993/1994, on a procédé à des sondages dans les neuf communautés cries du nord du Québec. On a prélevé des échantillons de cheveux qu'on a analysés pour en déterminer la teneur en mercure. Des analyses ont visé à déterminer la proportion de personnes chez lesquelles les taux de mercure dépassaient les normes établies. Le changement des taux de mercure entre 1988 et 1993/1994 et les facteurs déterminants des taux élevés ont été estimés au moyen de méthodes de régression.

**Résultats :** La proportion de la population crie où les taux de mercure dépassent 15,0 mg/kg est tombée de 14,2 % en 1988 à 2,7 % en 1993/1994. On a observé des variations importantes des taux de mercure entre les communautés : chez 0,6 % et 8,3 % des membres des communautés d'Eastmain et de Whapmagoostui, les taux de mercure atteignaient 15,0 mg/kg ou plus en 1993/1994. Des analyses de régression logistique ont montré qu'il y avait un lien indépen-

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dant entre des taux beaucoup élevés de mercure et le sexe masculin, le vieillissement et le métier de trappeur. Il y avait un lien entre le taux de mercure du chef du ménage et celui de son conjoint.

**Interprétation :** Les taux de mercure chez les Cris de la Baie James diminuent depuis quelque temps. Il se peut néanmoins que cette baisse ne soit pas permanente et elle ne signifie pas nécessairement que le problème soit réglé définitivement.

Throughout the past decades Crees have been exposed to methylmercury through the consumption of contaminated fish from natural lakes and, more recently, from hydroelectric reservoirs.[1,2] Fish become contaminated during the first decades of impoundment of a reservoir, when the mercury present in the environment is methylated by bacteria that multiply in recently flooded decomposing organic matter.[3,4] Fish represents a substantial part of the traditional diet of the Crees living in the 9 communities of northern Quebec[5] (Fig. 1).

Methylmercury is a known neurotoxin. When exposed in utero, a child may experience delays in speaking and walking,[6] changes in muscle tone and reflexes, and, at higher doses, a syndrome resembling cerebral palsy.[7] Adults may experience paresthesia, tremors, ataxia, deafness and constriction of the visual fields, and may die.[8]

Limited and general surveys of mercury levels among the Cree have been carried out over the past 2 decades.[1,9–11] In 1988 and in 1993/94 general surveys were carried out by the Cree Board of Health and Social Services of James Bay to determine the mercury levels of the population of all 9 Cree communities of northern Quebec.[12]

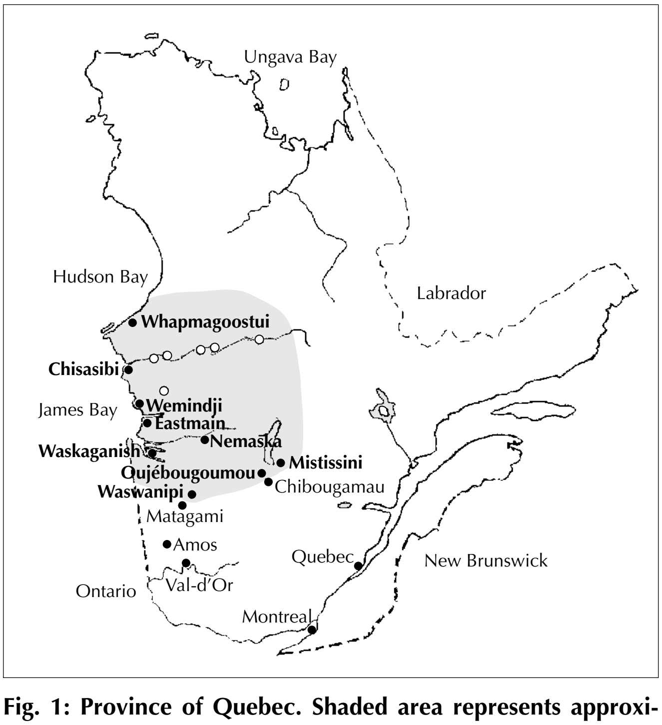


**Fig. 1: Province of Quebec. Shaded area represents approximate Cree territory. White circles represent approximate location of hydroelectric reservoirs.**

During the past 10 years several educational activities have been carried out in the Cree communities to encourage Crees to avoid contaminated species of fish while still carrying on their traditional way of life.[13] These educational activities have included radio presentations and phone-in shows, brochures, pamphlets, posters, a video, booths in public places and health fairs. Both environmental and health issues are discussed, and fish consumption guidelines are provided.

We studied changes in mercury levels since 1988 in this population by analysing the results of the prior surveys.

## Methods

The population of the communities was obtained from the list of James Bay and Northern Quebec Agreement beneficiaries of the Ministry of Health and Social Services of Quebec, except for the 1988 population of Oujébougoumou. The 1988 list of beneficiaries for the population of that community was incomplete and was adjusted with the list obtained from the band office.

In 1988, hair samples were taken in a standardized fashion.[14] All female residents of childbearing age (15 to 39 years) and all women and men aged 40 years or more in all 9 communities formed the target population.

In 1993/94 a random sample was taken in the following fashion. A list of the houses in each community was obtained from the band council, and the houses were numbered. A random sample of these numbers was chosen within each community. In communities whose population was initially estimated to be less than 1000, every household was sampled, in communities with a population between 1000 and 2000, 50% of the households were sampled, and in communities with a population over 2000, 25% of the households were sampled. All people aged 4 years or more living in a sampled household were asked to give a hair sample. The hair samples were taken in the same standardized fashion as in 1988.[14] Children below the age of 4 years were not sampled for cultural reasons (for some parents there is symbolic value in the cutting of hair at this early age). The purpose of our sampling method was to attempt to determine whether there was any relation between the mercury level of the head of the household and that of the other members of the family. In this 1993/94 survey the inland communities were studied in

1993 and the coastal communities the following year.

In both sampling periods, 1988 and 1993/94, August was the month chosen for conducting the survey because it has been found to be the period of peak exposure in many communities[5] (peak exposure to methylmercury is generally used in the literature to establish a relation with toxicity[6,7]) and for logistic reasons (everyone is in the community during the summer, and more people are available to help with the sampling).

In both surveys the first centimetre of hair corresponding to the month before sampling was analysed by the Laboratoire de santé publique du Québec for mercury by means of a modification of Magos' method.[15] Hair was assumed to grow at a rate of 1 cm per month, although the literature gives a rate of 0.9–1.3 cm per month.[16–18]

The testing program was approved by the James Bay Mercury Committee, a committee set up pursuant to the James Bay Mercury Agreement (1986) composed of an equal number of Cree and non-Cree representatives. Meetings were held with the band councils to explain the purpose of the testing and to obtain the councils' consent. The communities were notified by radio of the purpose of the testing and were told that testing was encouraged but voluntary. The subjects gave oral consent to the person doing the sampling (a Cree) when they came to the clinic for testing.

### *Statistical analyses*

Mercury levels were classified into 5 categories: under the detection limit (2.5 mg/kg or less), 2.6–5.9 mg/kg, 6.0–14.9 mg/kg, 15.0–29.9 mg/kg, and 30 mg/kg or greater. These categories were chosen because they correspond to the World Health Organization guideline (6.0 mg/kg)[19] or to the various levels of intervention used by the Cree Board of Health and Social Services of James Bay (15.0 mg/kg is the level of intervention for women of childbearing age, and 30.0 mg/kg is the level of intervention for all other people[12]).

Frequencies and proportions were used to describe the mercury levels for each community and age group and by sex, trapper status and year of the survey. Weighted proportions were used to account for the stratified sampling approach taken.[20] Multiple logistic regression[21] was done to evaluate the independent effects of community, age, sex and trapper status on mercury levels both in 1988 and in 1993/94. Two cutoff points were used to dichotomize mercury levels for modelling: 6.0 mg/kg and 15.0 mg/kg. For the subsample of subjects surveyed in both periods, we used the generalized estimating equation method[22] to model the dichotomized mercury level and to evaluate the main effect of time, community, age group, sex and trapper status, and the interaction of time with these latter effects. This generalized estimated equation method is an extension of the generalized linear models, for which logistic regression is a particular case, to the analysis of longitudinal data. Thus, this method allowed us to take into account, in the subsample analysis, the correlation among repeated measurements of mercury level for a given subject over time. Finally, we computed the Spearman correlation coefficient with 95% confidence intervals (CIs) to evaluate the relation between the mercury level of the head of the household and that of other family members. All analyses were done with SAS software (version 6.12, SAS Institute Inc., Cary, NC).

## Results

The distribution of people tested according to community in 1988 and 1993/94 is shown in Table 1. In 1988, of the target population of 3565, 2613 people were tested, giving a participation rate of 73.3%. In 1993/94, of the target sample of 4855, 3599 people were tested, for a participation rate of 74.1%. A total of 1084 people were tested in both

**Table 1: Total population, target population and sampled population among James Bay Cree in 1988 and 1993/94**

| | 1988 | | | 1993/94 | | | | |
|---|---|---|---|---|---|---|---|---|
| Community | Total population | Target population | No. (and %) of people tested | Total population | Target population | Target sample | No. (and %) of people tested | No. of people tested in both 1988 and 1993/94* |
| Chisasibi | 2 331 | 1 012 | 647 (63.9) | 2 798 | 2 543 | 633 | 513 (81.0) | 140 |
| Eastmain | 377 | 169 | 144 (85.2) | 460 | 399 | 399 | 336 (84.2) | 119 |
| Mistissini | 2 046 | 776 | 613 (79.0) | 2 258 | 2 082 | 515 | 378 (73.4) | 122 |
| Nemaska | 375 | 144 | 131 (91.0) | 443 | 429 | 429 | 352 (82.0) | 97 |
| Oujébougoumou | 463 | 131 | 92 (70.2) | 477 | 424 | 424 | 231 (54.5) | 58 |
| Waskaganish | 1 240 | 465 | 381 (81.9) | 1 437 | 1 314 | 588 | 461 (78.4) | 156 |
| Waswanipi | 915 | 329 | 183 (55.6) | 957 | 878 | 491 | 298 (60.7) | 69 |
| Wemindji | 815 | 332 | 297 (89.4) | 943 | 851 | 851 | 656 (77.1) | 228 |
| Whapmagoostui | 458 | 207 | 125 (60.4) | 572 | 525 | 525 | 374 (71.2) | 95 |
| Total | 9 020 | 3 565 | 2 613 (73.3) | 10 345 | 9 445 | 4 855 | 3 599 (74.1) | 1 084 |

*Community of residence in 1988 (only 17 people in the sample had moved from one community to another between 1988 and 1993/94).

periods. Although some people in the target sample were not tested because they refused to participate, most people not tested were out of the community at the time of testing.

Table 2 shows the distribution of mercury levels by year of testing and community for the cross-sectional component. Analysis of the results for the subsample of people tested in both periods showed a similar pattern. There was wide variation in the distribution of mercury levels between communities. Eastmain and Waskaganish had the lowest proportions of people with a mercury level of 15.0 mg/kg or greater (1.4% and 1.6% respectively in 1988, and 0.6% and 0.2% respectively in 1993/94). Whapmagoostui had the highest proportion of people with this mercury level (27.2% in 1988 and 8.3% in 1993/94). Among the subjects tested in both periods, the proportion of people with a mercury level of 15.0 mg/kg or greater decreased from 12.9% in 1988 to 7.6% in 1993/94.

Table 3 presents the distribution of mercury levels by year of testing and age, sex and trapper status for the cross-sectional component. Analysis of the results for the subsample of people tested in both periods showed a similar pattern. The information on trapper status was recorded in 1993/94 only. Trappers are those considered by their community at the time of sampling to be spending a significant amount of their time in the bush (children who accompany their parents in the bush for trapping are considered trappers). The mercury levels increased with increasing age except for people aged 70 years or more, whose results were similar to those for people aged 60 to 69 years. Men aged 40 years or more tended to have higher mercury levels than women in the same age group, and trappers tended to have higher levels than nontrappers.

The results of the multiple logistic regression analyses, presented in Table 4 for both periods of testing with the cutoff point of 6.0 mg/kg, confirm the descriptive observations presented in Table 3. The variable community was included in the models (data not shown), and the differences observed in Table 2 were found to be statistically significant. Results for the cutoff point of 15.0 mg/kg showed essentially the same trends with even larger odds ratios in general (data not shown). Table 5 summarizes the results obtained in the generalized estimating equation analyses for the subsample of people tested in both periods. The final models do not include interactions between year of testing and community, trapper status (as measured in 1993/94), sex and age because none of these variables was significant. The odds ratios of 2.5 (95% CI 2.1–3.1) for 1988 (compared with 1993/94) for the cutoff point of 6.0 mg/kg and of 2.1 (95% CI 1.6–2.7) for the cutoff point of

**Table 2: Mercury levels in 1988 and 1993/94 by community and year of testing**

| | | Mercury level, mg/kg; % of subjects | | | | |
|---|---|---|---|---|---|---|
| Community | Year | Under detection limit (≤ 2.5) | 2.6–5.9 | 6.0–14.9 | 15.0–29.9 | ≥ 30.0 |
| Chisasibi | 1988 | 32.9 | 23.8 | 25.4 | 13.3 | 4.6 |
| | 1993/94 | 77.0 | 14.2 | 7.2 | 1.4 | 0.2 |
| Eastmain | 1988 | 50.7 | 31.9 | 16.0 | 1.4 | 0.0 |
| | 1993/94 | 81.0 | 14.3 | 4.2 | 0.6 | 0.0 |
| Mistissini | 1988 | 34.9 | 22.0 | 27.4 | 15.0 | 0.7 |
| | 1993/94 | 71.7 | 13.5 | 10.6 | 4.2 | 0.0 |
| Nemaska | 1988 | 32.1 | 28.2 | 22.1 | 15.3 | 2.3 |
| | 1993/94 | 63.4 | 19.3 | 13.9 | 3.4 | 0.0 |
| Oujébougoumou | 1988 | 40.2 | 21.7 | 24.0 | 12.0 | 2.2 |
| | 1993/94 | 62.8 | 17.8 | 13.4 | 6.1 | 0.0 |
| Waskaganish | 1988 | 57.0 | 24.9 | 16.5 | 1.6 | 0.0 |
| | 1993/94 | 82.7 | 15.9 | 1.3 | 0.2 | 0.0 |
| Waswanipi | 1988 | 36.1 | 20.8 | 24.6 | 15.3 | 3.3 |
| | 1993/94 | 66.8 | 16.1 | 13.8 | 3.0 | 0.3 |
| Wemindji | 1988 | 32.7 | 27.3 | 30.3 | 9.4 | 0.3 |
| | 1993/94 | 76.5 | 13.3 | 9.0 | 1.2 | 0.0 |
| Whapmagoostui | 1988 | 32.0 | 16.8 | 24.0 | 22.4 | 4.8 |
| | 1993/94 | 49.2 | 27.3 | 15.2 | 7.5 | 0.8 |
| Total unadjusted proportion | 1988 | 38.2 | 24.0 | 24.3 | 11.5 | 2.0 |
| | 1993/94 | 71.5 | 16.4 | 9.3 | 2.7 | 0.1 |
| Total weighted proportion* | 1988 | 37.8 | 23.7 | 24.3 | 12.0 | 2.2 |
| | 1993/94 | 73.0 | 15.5 | 8.8 | 2.6 | 0.1 |
| Total for subsample tested in both periods | 1988 | 36.1 | 24.4 | 26.6 | 11.2 | 1.7 |
| | 1993/94 | 47.8 | 24.3 | 20.3 | 7.4 | 0.2 |

*See Methods.

15.0 mg/kg show a highly statistically significant decrease in mercury levels between 1988 and 1993/94.

In 1993/94 there were 317 households for which the head was identified and tested. In this subset of households a positive correlation was found between the mercury level of the head of the household and that of the spouse or, if the spouse could not be identified, of the oldest other member of the household (Spearman correlation coefficient 0.69, 95% CI 0.62–0.74). The correlations between the mercury level of the head of the household and that of the other members of the household were much weaker (Spearman correlation coefficients varied from 0.28 to 0.33 with the third, fourth and fifth member of the family). Finally, there were 98 households in Mistissini and Waswanipi in which the husband and wife were clearly identified and tested. In this subsample, there was a positive correlation between the husband's level and that of the wife (Spearman correlation coefficient 0.81, 95% CI 0.72–0.87). Once again, the correlations between the mercury level of the head of the household and that of the other members of the household were much weaker (Spearman correlation coefficients varied from 0.22 to 0.38 with the third, fourth and fifth member of the family). The correlation coefficients were similar when the analysis was restricted to households in which the head had a mercury level greater than the detection limit (2.5 mg/kg).

## Interpretation

Mercury levels decreased in all communities, in both sexes and all age groups between 1988 and 1993/94. There were wide variations in levels between communities. Trappers had higher levels than nontrappers. Mercury level increased with increasing age. In previous surveys, there was no evidence that people with high levels were more likely not to be sampled. There is no reason to suggest that this survey was different.[23]

The significance of these mercury levels for the health

**Table 3: Mercury levels in 1988 and 1993/94 by age, sex and trapper status**

| Variable | Year | No. of subjects | Mercury level, mg/kg; weighted %: Under detection limit | 2.6–5.9 | 6.0–14.9 | 15.0–29.9 | ≥ 30.0 |
|---|---|---|---|---|---|---|---|
| **Age, yr** | | | | | | | |
| 4–9 | 1988 | 0 | | | | | |
| | 1993/94 | 590 | 94.1 | 5.3 | 0.7 | 0.0 | 0.0 |
| 10–14 | 1988 | 0 | | | | | |
| | 1993/94 | 495 | 93.0 | 5.9 | 1.1 | 0.0 | 0.0 |
| 15–19 | 1988 | 361 | 76.9 | 18.9 | 3.9 | 0.3 | 0.0 |
| | 1993/94 | 396 | 92.3 | 6.8 | 0.9 | 0.0 | 0.0 |
| 20–29 | 1988 | 556 | 67.6 | 26.6 | 5.0 | 0.8 | 0.0 |
| | 1993/94 | 689 | 85.2 | 12.9 | 1.9 | 0.0 | 0.0 |
| 30–39 | 1988 | 368 | 45.6 | 32.5 | 19.6 | 2.3 | 0.0 |
| | 1993/94 | 507 | 72.2 | 22.4 | 5.2 | 0.2 | 0.0 |
| 40–49 | 1988 | 477 | 21.3 | 28.2 | 36.4 | 12.9 | 1.1 |
| | 1993/94 | 365 | 51.0 | 28.9 | 17.5 | 2.7 | 0.0 |
| 50–59 | 1988 | 315 | 8.4 | 18.2 | 43.0 | 23.4 | 7.0 |
| | 1993/94 | 240 | 22.5 | 30.8 | 37.7 | 8.5 | 0.4 |
| 60–69 | 1988 | 288 | 6.4 | 17.0 | 38.9 | 31.3 | 6.4 |
| | 1993/94 | 159 | 16.3 | 28.8 | 36.0 | 16.8 | 2.0 |
| ≥ 70 | 1988 | 248 | 11.2 | 17.3 | 38.6 | 28.1 | 4.8 |
| | 1993/94 | 158 | 13.4 | 29.0 | 34.2 | 23.1 | 0.3 |
| **Sex; age, yr** | | | | | | | |
| Male | | | | | | | |
| 4–14 | 1993/94 | 503 | 92.5 | 6.4 | 1.1 | 0.0 | 0.0 |
| 15–39 | 1993/94 | 742 | 79.0 | 17.1 | 3.8 | 0.2 | 0.0 |
| ≥ 40 | 1988 | 610 | 10.6 | 17.6 | 41.3 | 24.3 | 6.2 |
| | 1993/94 | 430 | 28.7 | 27.2 | 32.1 | 11.1 | 0.9 |
| Female | | | | | | | |
| 4–14 | 1993/94 | 582 | 94.6 | 4.8 | 0.6 | 0.0 | 0.0 |
| 15–39 | 1988 | 1285 | 63.9 | 26.1 | 8.9 | 1.1 | 0.0 |
| | 1993/94 | 850 | 86.7 | 11.7 | 1.6 | 0.0 | 0.0 |
| ≥ 40 | 1988 | 718 | 15.2 | 24.5 | 37.0 | 20.5 | 2.8 |
| | 1993/94 | 492 | 33.6 | 31.4 | 25.9 | 9.0 | 0.1 |
| **Trapper** | | | | | | | |
| Yes | 1993/94 | 961 | 41.3 | 24.8 | 24.2 | 9.1 | 0.6 |
| No | 1993/94 | 2638 | 82.3 | 12.8 | 4.3 | 0.7 | 0.0 |

of the Cree population remains unknown. The low levels in women of childbearing age is reassuring in terms of fetal exposure, particularly in view of the recent re-analysis of data from Iraq.[24] Although it is unlikely that present mercury levels represent a serious health risk for the unborn Cree children, the possibility of subtle developmental changes cannot be excluded. The levels observed in adults were lower than that at which effects have been reported in Iraq and Minamata, Japan.[8,25] However, the Crees have seasonal lifelong exposure, which may cause effects at doses lower than those observed with shorter-term exposure.

Decreases in the mercury concentration in fish in the hydroelectric reservoirs are not sufficient to explain why mercury levels decreased among the Crees between 1988 and 1993/94.[26] It is likely that Crees have changed the type of fish eaten, from contaminated fish to less contaminated fish, or have decreased their total fish consumption considerably, or both.

Economic conditions leading to more difficult access to store-bought food, a decrease in the variety of other available bush food (e.g., because of game cycles) or construction of roads giving easy access to contaminated sites could theoretically lead to increases in fish consumption in the future.

It has been shown that increased fishing in contaminated sites can lead to higher mercury levels among the Cree.[27] Communities with historically low levels can thus experience increases rapidly. The present low mercury levels in the Cree communities may not be permanent and must not lull health authorities into believing that the mercury problem has been definitively resolved.

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**Table 4: Multiple logistic regression analysis of sociodemographic variables* to model mercury level (cutoff point 6.0 mg/kg) in subjects tested in 1988 and in those tested in 1993/94**

| Variable | Odds ratio (and 95% CI) |
|---|---|
| | **1988** |
| **Female; age, yr** | |
| 15–29 | 1.0 (–) |
| 30–39 | 6.0 (4.0–8.9) |
| 40–49 | 18.0 (12.1–26.7) |
| 50–59 | 52.5 (32.9–83.7) |
| 60–69 | 83.1 (49.7–138.9) |
| ≥ 70 | 54.2 (32.1–91.4) |
| **Male; age, yr** | |
| 40–49 | 36.3 (23.4–56.3) |
| 50–59 | 103.6 (60.5–177.5) |
| 60–69 | 110.6 (64.8–188.8) |
| ≥ 70 | 83.1 (49.0–141.1) |
| | **1993/94** |
| **Age, yr** | |
| 4–29 | 1.0 (–) |
| 30–39 | 3.8 (2.3–6.3) |
| 40–49 | 15.7 (10.0–24.5) |
| 50–59 | 50.2 (31.2–80.8) |
| 60–69 | 100.9 (58.7–173.6) |
| ≥ 70 | 94.7 (55.0–162.9) |
| **Sex (male)** | 1.7 (1.3–2.2) |
| **Trapper (yes)** | 4.1 (3.0–5.5) |

Note: CI = confidence interval.
*The variable community was included in the multiple logistic regression model, but the odds ratios are not presented in the table.

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**Table 5: Odds ratios and 95% CIs for sociodemographic variables in generalized estimating equation analyses to model mercury level in subjects tested in both years**

| Variable | Cutoff point; odds ratio (and 95% CI) 6.0 mg/kg | | 15.0 mg/kg | |
|---|---|---|---|---|
| **Community** | | | | |
| Waskaganish | 1.0 | (–) | 1.0 | (–) |
| Chisasibi | 6.6 | (3.7–11.8) | 16.5 | (3.9–70.9) |
| Eastmain | 0.5 | (0.3–1.0) | 1.6 | (0.3–8.7) |
| Mistissini | 9.4 | (5.2–17.1) | 23.5 | (5.4–102.2) |
| Nemaska | 13.5 | (7.1–25.5) | 32.7 | (7.5–141.6) |
| Oujébougoumou | 8.4 | (3.9–18.3) | 30.9 | (6.6–144.1) |
| Waswanipi | 8.5 | (4.1–17.6) | 23.8 | (5.3–107.3) |
| Wemindji | 6.1 | (3.5–10.5) | 11.0 | (2.6–46.1) |
| Whapmagoostui | 15.2 | (8.0–28.9) | 55.8 | (12.9–241.0) |
| **Sex and age, yr** | | | | |
| Female ≥ 40 | 1.0 | (–) | 1.0 | (–) |
| Female 15–39 | 0.07 | (0.05–0.11) | 0.05 | (0.02–0.12) |
| Male ≥ 40 | 1.7 | (1.3–2.4) | 1.7 | (1.2–2.5) |
| **Trapper (yes)** | 4.3 | (3.2–5.9) | 1.8 | (1.2–2.7) |
| **Year (1988)** | 2.5 | (2.1–3.1) | 2.1 | (1.6–2.7) |

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