Mortality among the James Bay Cree of northern Quebec : 1982 - 1986

by

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Abstract

This report examines the mortality of the James Bay Cree of northern Quebec during the period 1982-1986. Life expectancy at birth is higher in this population than among most other North American Indians. Infant mortality remains high, due to high death rates in the postneonatal period. Genetic diseases, infections, and accidents take a heavy toll among Cree infants and children. The Cree continue to experience lower mortality rates than Canada as a whole from cancer and cardiovascular diseases. The rate of drownings remains ten times the Canadian rate, but the Cree are still relatively exempt from the high incidence of accidental and violent deaths which affect many North American Indian groups.

Résumé

Ce rapport étudie les décès survenus chez les Cris de la région de la Baie de James, au Québec, pendant la période 1982-1986. L'espérance de vie chez les Cris est plus élevée que chez la plupart des groupes autochtones d'Amérique du Nord. La mortalité infantile reste élevée, et se concentre dans la période postnéonatale. Les enfants cris sont menacés par des maladies d'origine génétique, les infections et les accidents. Les Cris continuent à être relativement épargnés par les maladies cardiovasculaires et les cancers. Le taux de noyades est dix fois plus élevé que le taux canadien, mais on n'observe pas chez les Cris les hauts taux de morts accidentelles et violentes qui affectent plusieurs groupes autochtones d'Amérique du Nord.

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1. Introduction

Surveillance of deaths and death rates is an important activity for a community health department. While attention of public health planners has shifted in recent years towards indicators of morbidity, disability, and quality of life, prevention of unnecessary and untimely deaths still remains a key public health objective.

The present study provides a comprehensive analysis of mortality statistics available for the Cree population of the James Bay area in northern Quebec (administrative Region 10B) for the period extending from January 1st 1982 to December 31st 1986. Results will be reported to the Cree Board of Health and Social Services, set up in 1978 to deliver health care to all residents of Region 10B, situated east of James Bay between the 49th and 55th northern parallel in the province of Quebec. This research is being conducted as a specific surveillance tool for the Northern Quebec Module of the Montreal General Community Health Department, whose role is to fulfill community health mandates for this population, in collaboration with the Cree Board.

2. Background

2.1 Trends in Mortality Indicators in North America

2.1.1 Life expectancy

Life expectancy of men and women has been increasing in Canada since the end of the last century.[1] In 1984, the life expectancy of Canadian men was 73.3 years, and that of women 81.3 years, among the highest in the world next to Switzerland and Sweden. Life expectancy at birth in Quebec is now similar to that in Canada for both males and females, after several decades of more rapid improvement.[2]

From 1971 to 1981, for the first time in decades, the gain in years of life expectancy in Canada was the same for both sexes - 2.6 years. Moreover, the gain for males in the latter half of the 1970's was slightly higher than that for females - 1.7 years compared with 1.5 years, and this tendency has persisted in the early 1980s.[3]

Lower mortality rates among the advanced age groups is the key contributing factor to the longer life expectancy of women. This longer survival among women over 65 years "accentuates the aging of the female population from the top down, and increases the numerical imbalance between the sexes in the advanced age groups" [4]

Increases in life expectancy have slowed in recent years in developed countries, after the huge increases of the 1976-1981 period. For example, Americans gained 2.9 years in life expectancy during the 1970's, but only 1.2 years from 1980 to 1986.[5] This is not unexpected, since declines in adult mortality have had a smaller impact than fertility or infant mortality. The strongest declines in fertility and infant mortality are behind us, and although more people are living their full life cycle, a greater reduction in mortality would be required to achieve the same gain as when life expectancy was lower.

Life expectancy seems to be related to socio-economic status. A classic example is the persistent gap between whites and blacks in the U.S. : black males lived to age 65.4 in 1983 while their white counterparts reached an average age of 71.7 years; Black females lived 73.6 years, and White females 78.7.[6] In Quebec, the gap in life expectancy at birth between the richest and the poorest districts of Montreal is of almost ten years.[7]

2.1.2 Infant mortality

In Canada and most industrialized countries, the long-term decline in infant mortality continued over the 1970's and the first half of the 1980's. In Canada, the rates declined from 86 per 1000 live births in 1931 to 8 in 1984. Moreover, the decline between 1966-68 and 1983 was faster than in the preceeding 15 years. At the start of the 1980's, Canada's rate fell below the "barrier" of 10 deaths per 1000 live births, and this country now has a very favourable rate internationally.

In Canada from 1921 to 1981, most of the improvement occurred in survival during the first week of life in the early neonatal period (85% of neonatal deaths). The mortality rate from congenital anomalies decreased by 34% in Canada between 1966 and 1983[8], to reach a new low of 2-3 per 1000 live births, which is probably the population base rate. Reduction in this cause, along with the decline in low birth weight, may be the major factor responsible for the favorable overall infant mortality rates (Shulman, op. cit.).

The extent of improvement in the rates of the postneonatal period has been considerable from the beginning of the century, but these rates have apparently stabilized, reaching a rate of 3 per 1000 in 1983. Further improvements might be expected only among groups of lower socio-economic levels.

2.1.3 General mortality trends

The crude death rate of the population over the last six decades of Canada's recorded mortality declined from 11.6 per 1000 to 7.0 in 1983. If one makes allowance for the change in age structure by standardizing the rates to the 1956 Canadian Census population, the decline is sharper still, from 12.0 in 1921 to 5.4 in 1983.

The difference between male and female mortality rates is one of the strongest features of the trends. This male excess is somewhat higher for the prime ages (35-64), and much higher for ages 15-34. For children 1-14, the excess is "only" around 45%, but this is over three times what it was in 1931.

Since 1969, death rates for heart diseases generally, and particularly from ischemic heart diseases, have declined for both sexes and all age groups, at an annual rate of about 2.7 per 100,000 for males and 3.3 for females. These universal declines were due primarily to declines in rates for acute myocardial infarction, which are not fully understood. Rates of death from cerebrovascular diseases have declined over the past four decades, and faster for women than for men, in parallel with the decline in the prevalence of hypertension.

In spite of the apparent increases in cancer deaths over the past two decades, progress was made against cancer over the past 15 years. The higher number of deaths and rates in 1984 for both sexes was due to the aging of the population and the greater proportion of elderly. The gains in mortality become apparent only when the rates are age-standardized, and remain despite increasing death rates from lung cancer (especially in women), pancreatic and lymphatic cancers, and malignant melanoma.[9]

There was a steady reduction of age-standardized diabetes death rates over the last 30 years, with deaths occurring mainly over 65 years in both sexes. The age-standardized rates for accidental and violent deaths increased over the first half of the 1970's to a peak in 1973, and then declined very sharply. All accidental and violent causes of death (except perhaps for male suicides) declined in the last 15 years, and particularly since 1980. The greatest impact on the accidental death rates was due to the very strong and sustained declines in motor vehicle traffic accidents.[10] Age-standardized male rates of accidental drownings have declined very sharply, from 7 per 100,000 in the mid-sixties, to around 3 in the early 1980's. Rates are substantially lower in females, and in the 1980's declined to below 1 per 100,000.

2.2 Mortality studies in North American Native populations

Many reports of the mortality experienced by various native populations around the world have been published in recent years. Generally, these populations show elevated mortality rates when compared to the general populations in their country or area.

In Canada, residents of Indian reserves experienced elevated all-cause mortality during the period 1977-1982, particularly under age 40.[11] The pattern of a two to three-fold elevation in this age range followed by a convergence in mortality rates by approximately age 70 is consistent with available national and regional results.[12 13]

Lung cancer mortality was significantly lower among males but similar to that of Canadians for females living on Indian reserves. A higher mortality rate for cervical cancer was observed, while low breast and colon cancer mortality rates were the rule. Indian females experienced increased mortality from diabetes, and deaths from cirrhosis and alcoholism were relatively frequent, especially among young women (Mao et al., op. cit.).

Age-standardized circulatory disease mortality rates among Indians were similar to Canadian rates for men, but significantly elevated among women below age 70. The 1974 Indian Survey Report[14] found a lower prevalence of elevated serum cholesterol among Canadian Indians but a higher prevalence of obesity, particularly among women. The same survey reported a higher percentage of current smokers among Indians of age 30 or more, compared to the general population.

Infant mortality rates of the native population have declined more rapidly than for the rest of Canada over the last decade.[15] In 1974, the Indian and total population rates were 39.6 and 15.0 per 1000 live births, respectively. By 1983, the rates were 18.2 and 8.5, respectively. The very sharp decline is attributed to the remarkable decline in the Indian fertility rate.[16] Nevertheless, the reduction in Indian infant mortality rate is special in view that there was little reduction in low birth weights, one of the most important causes of early neonatal mortality but a remote cause of postneonatal deaths. In fact, there was an increase in the low birth weight rate among registered Indians and Inuit, except in the Pacific region and N.W.T. (Shulman E., op.cit.).

Almost all the excess in Indian infant mortality occurs during the postneonatal period, and most causes in excess during this period appear to have social rather than biological origins, and could be related to the isolation and poverty which characterize many Indian reserves in Canada.[17]

Many similarities were noted between infant and adult deaths among Canadian Indians. Like their counterparts, Canadian Indian infants experienced excess mortality from accidental causes, especially from fires. Excesses were also noted for deaths from infectious diseases and from pneumonia, the latter attributed to infant feeding patterns, parental attitudes towards medical care, and to parental smoking.[18] Some causes of death specific to infants were also significantly elevated. The most dramatic increase was from SIDS, with an over three-fold excesss found for both the neonatal and postneonatal periods. This is in agreement with most findings on native Indians in North America.[19]

The sudden infant death syndrome is the leading cause of postneonatal mortality (28 days to one year) for infants in the United States, accounting for one of every three infant deaths during this period. In 1980 there were more than 5,510 reported deaths in the United States due to SIDS. Studies indicate that the rate of SIDS varies with ethnic background. In the U.S., the rate of SIDS is higher for Black infants (2.8 / 1000 live births), Alaskan Natives (4.5 / 1000) and American Indians (6.5 / 1000) as compared to overall rates of 1.5 / 1000.[20] In Canada, the reported incidence rate for SIDS in 1984 was 1.1 / 1000 live births.[21]

The epidemiology of SIDS has been incompletely defined. It is known, however, that SIDS occurs more commonly among infants who are male (1.3 / 1000 vs. 0.8 in females in Canada in 1984), between 1 and 5 months of age, prematurely born, small for gestational age, and members of a multiple birth. Maternal factors that place an infant at higher risk of SIDS include age less than 20 years, short intergestational interval, multiparity, single marital status, low socioeconomic group, cigarette smoking and narcotic abuse.[22]

Excesses for neonatal deaths due to conditions originating in the perinatal period were also found among residents of Canadian Indian reserves, with much of this excess resulting from deaths from low birthweight. However, the prevalence of low birthweight on many Indian reserves in Canada and the U.S. was comparable to that of the non-reserve populations.[23] These findings confirm earlier studies of Indians, including the James Bay Cree[24], and suggest that low birthweight is a more serious condition on Indian reserves, and results in a higher case fatality rate.

2.3 Cree mortality study 1975-1981

From the standpoint of mortality statistics, the analyses of trends and patterns over time is particularly useful. Much of the interest in the present study, covering a 5-year period, will rest on the comparisons with another study conducted by Robinson in the same population for the 6-yea:' period 1975-1981.[25]

In this study, using indirectly standardized death rates, the number of deaths observed among the Cree was 1.4 times higher than the number expected if the 1978 Canadian death rates by age and sex had prevailed in the Cree population.

Cree infant mortality was higher than that of Canadian Indians and Alaska Natives but did not appear as high as that of the Quebec Inuit population. Within the Cree population, infant mortality from 1975 to 1981 was higher in the 3 inland villages (49.2 / 1000 live births) than in the 5 coastal villages (27.4 / 1000). Causes of infant mortality were classified according to the ICD-9 categories, and a large excess in mortality from postneonatal period infections was reported, much of it potentially preventable.

Postneonatal mortality at 29.0 / 1000 was more than 8 times the Quebec rate. However, only 1 out of of the 51 deaths reported during the postneonatal period was attributed to SIDS, while 12 were labeled "unknown". This could reflect the reluctance of medical and nursing personnel to positively label as SIDS a number of deaths occurring outside health facilities, and for which few specific diagnostic clues were available retrospectively. We expect the rates of SIDS to be somewhat higher in the present study, in accordance with trends in the general population.

Age-specific death rates among the Cree were compared with rates in Quebec and for American Indians and Alaska Natives. Cree death rates were much higher than Quebec rates for children under age 15, and remained higher up to age 44. However, rates among Cree adults 15 to 44 were not as high as those of American Indians and Alaska Natives, which are 3 times those of the U.S. population in these age groups.

For the period 1975-1981, standardized Cree death rates for tumors and heart disease were lower than those for Canada, while rates for respiratory and infectious diseases, and injuries and poisoning were higher. The age-adjusted rate of drownings for the Cree was 12 times the Canadian rate. Almost 10% of Cree deaths were due to drowning, and nearly half of all deaths due to injuries and poisonings were drownings. Nevertheless, deaths in the category "injuries and poisonings" appeared to be less common than in other native groups. Injuries and poisonings caused 35.7% of deaths in Canadian registered Indians in 1978 and 1979, but only 20.3% of Cree deaths from 1975 to 1981. Unexpectedly, rates of suicides were not found to be elevated between 1975 and 1981. This raised the question of the completeness and accuracy in recording of this type of deaths, because of the discrepancy with perceptions of the importance of the problem within the Cree communities.

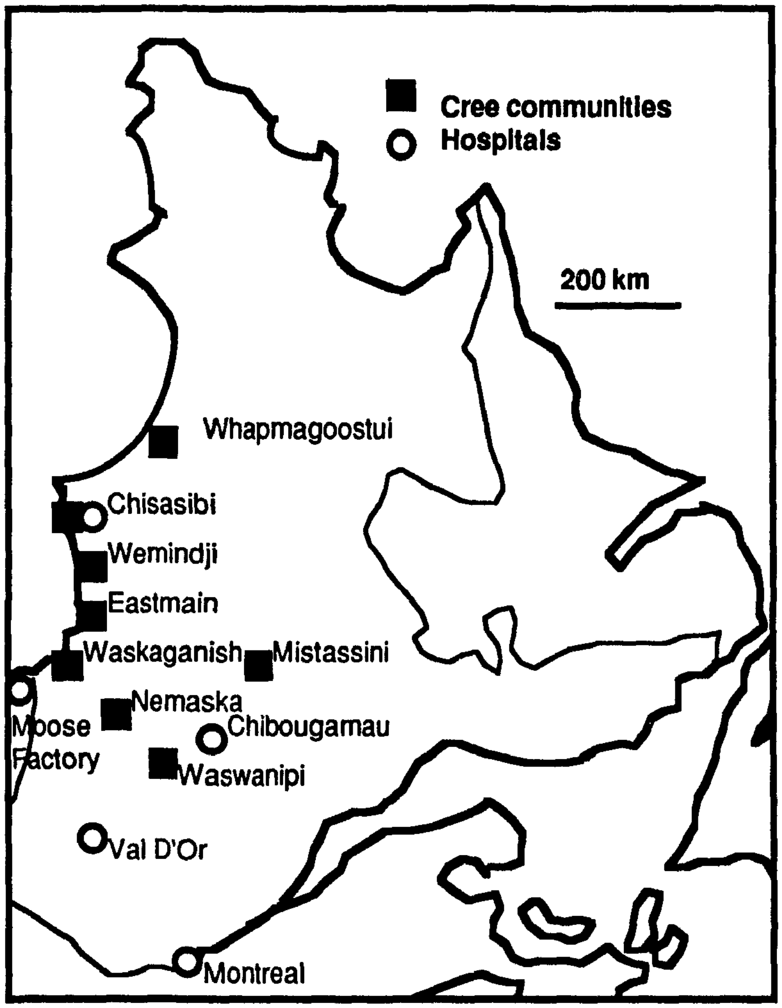
In conclusion, it seems that most patterns of mortality typical to Canadian Indians were present, although to a lesser degree, in the James Bay Cree population. The magnitude and direction of changes for the present study period will be indicative of trends in public heath problems and needs for solutions. We expected persisting elevated mortality in younger age groups, with excesses still primarily during the postneonatal period and from accidental causes and poisoning in young adults. Anecdotal evidence indicated that the excesses due to drownings would persist and that the overall trends in accidental and violent deaths would show a narrowing of the existing difference between the Cree and other North American Native populations. Furthermore, we expected the favourable mortality ratios in deaths due to tumors and cardiovascular disease to be gradually disappearing as nutrition and other lifestyle habits evolve.

2.4 Demographics

Region 10B includes 8 communities scattered across a large territory situated east of James Bay, in the province of Quebec (Figure 1). Region 10B had a population of 8,840 on January 27th 1989. The population varies considerably among villages. The two largest ones are Chisasibi and Mistassini, with populations of over 2 000 each, while the smallest, Nemaska, only had 399 inhabitants in January 1989. The Cree villages of Whapmagoostui, Chisasibi, Wemindji, Eastmain and Waskaganish are often refered to as "coastal", by opposition to Nemaska, Waswanipi and Mistassini which are called "inland".

Figure 1

James Bay Cree communities and referral hospitals



Recent large scale demographic information on Region 10B comes from 2 main sources: the List of Beneficiaries of the James Bay Agreement and the Canadian Census of 1986. Eligibility to the List of Beneficiaries was determined by the James Bay Agreement as applying to Cree living in the Territory on November 14th 1974, and their descendants. The list of beneficiaries does not include non-natives living permanently or temporarily in the region, although these people are part of the population under the responsability of the Cree Board of Health. The non-native population is small, and contributes little to mortality.

Region 10B includes the eight Cree villages (2,158 square miles), where the Cree have exclusive ownership, and pieces of land surrounding each of the communities (25,130 square miles), on which the Cree have fishing and hunting rights. The Cree "Territory", as defined by the James Bay Agreement, includes the communities, the surrounding land, and a vast area that corresponds more or less to the part of the Province of Quebec where rivers flow into James Bay. The Territory includes the northern towns of Val D'Or, Senneterre, Chapais, and Chibougamau, where the Cree form a significant portion of the population.

The complete list of beneficiaries includes "residents" living in the communities and surrounding land, "off-reserve" Cree and "off-territory" Cree. The "off-reserve" and "off-territory" beneficiaries are affiliated to one of the 8 Cree bands but live outside region 10B. The "off-reserve" Cree live within the Territory defined by the Agreement, while the "off-territory" beneficiaries live in the "South". Only the Cree residents are under the jurisdiction of the Cree Board of Health and Social Services, and off-territory and most off-reserve beneficiaries depend upon other regional public health services. Several hundred Cree living in and around Chibougamau regrouped at the end of 1988 to form a 9th Cree community called Oujé-Bougoumou. This population does not have a village at the present time, and does not yet depend on the Cree Board for health services.

The Canadian Census taken in 1981 for the population of the James Bay area was used in the assessment of denominators for death rates calculated for the period 1979-1983 by the Ministère de la Santé et des Services Sociaux in a recent publication.[26] However, the reliability of the Census is thought to be lesser than that of the Registry of Beneficiaries in the numeration of the James Bay area's population, and furthermore the undercount in the Census taken in 1986 is considered by the Ministère and by Statistics Canada[27] to be much worse than in 1981 because of logistic and methodologic problems. The Ministère is considering alternative methods for estimating the population of Region 10B for its 1984-1987 surveillance report.

The Cree population is relatively younger than that of the province of Quebec, with a greater proportion of young people less than 20 years of age (52% vs 31% in 1984), and a smaller proportion of elderly 65 years and over (5% vs 9%). Surprisingly, men over 65 years of age were more numerous than women in 1985 (232 vs 205). In recent years the age pyramid of the Cree population demonstrated increasing proportions of the elderly groups. Birth rates, which were traditionaly higher than for the Quebec general population (13.1 births per 1000 population in 1985), also tend to decrease (30.1 births per 1000 in 1975-81 vs 29.4 in 1985). The same tendency can be observed in terms of rates in the childbearing age groups.[28]

Traditional activities such as hunting and fishing are widely practiced and follow traditional seasonal patterns. Family income tends to be lower than in Quebec as a whole, and formal education levels are generally lower. The native Cree language is widely used, although an important proportion of the population speaks English. French is spoken by a small minority, and at least 25% speak neither English or French.[29]

2.5 Health status

Apart from mortality statistics, indicators of morbidity have been drawn from studies of utilization of health services in the Cree communities. From these, various priority health problems have been documented. Medical problems surrounding pregnancy and childbirth, contamination by methylmercury, childhood infections, congenital malformations, incomplete immunization status, poor dental hygiene, nutritional problems, contamination of drinking water, tobacco and alcohol consumption, respiratory illnesses and tuberculosis, injuries, sexually transmitted diseases, cardiovascular diseases, diabetes and obesity in general as well as cancer, all constitute to various degrees threats to the health of the Cree population.[30]

Many studies have been conducted in recent years either to assess the prevalence or the incidence of various disorders or risk factors, or to evaluate programs which have been implemented to reduce morbidity or mortality attributable to specific health conditions.

2.6 Health services

To date, the James Bay Cree are the only group of Indians in the country who have signed away their traditional health care relationship with the federal government, and they have been criticized for this by other Indian groups.[31] However, the James Bay Cree of northern Quebec have a degree of control over their health care system which is unavailable to most other Indian groups. They assume full responsibility for administering the health care facilities in the region and for all health problems including public health. The Cree Board of Health and Social Services, modelled after the Regional Health Boards established in Quebec in the 1970s, chose to associate itself with the Montreal General Hospital DSC in public health programming and evaluation, and is directly responsible for the administration of the Chisasibi Hospital, of the nursing clinics in the seven other communities, and of a social services centre.

There are now two CLSCs on the territory, one inland and one coastal. Nursing stations offer outpatient curative and preventive services in all the communities except Chisasibi. The only hospital in the territory is located there, and serves the five villages along the James Bay coast. At present, there are about ten family physicians working in the Chisasibi Hospital. The practice is a full family practice, including emergency, hospitalisations, obstetrics and community health programs. Physicians in Chisasibi also collaborate with nurse practitioners in the nursing stations of the other coastal communities. They provide telephone consultations and monthly on-site visits.

There is permanent medical staff in Mistassini which offers outpatient services in close collaboration with nurse practitioners. Patients can be easily refered by road to Chibougamau for consultation or hospitalisation. A family physician stays in Waswanipi two weeks per month, and provides on-site 24-hour medical availability in the community during this period.

As there are no specialists within 500 miles of Chisasibi, a reliable communication system (by radio, telephone, or airplane) allows for medical consultations and / or evacuations at all times. The Northern Quebec Module provides coordination with tertiary care services in Montreal, and secondary care services in Val D'Or are also used. The Cree Health Board is responsible for patient services in Val D'Or.

2.7 Death certificates

Analyses of information recorded on death certificates or their predecessors comprise one of the oldest and most extensive public health surveillance systems. The "International Form of Medical Certification of Cause of Death" currently in use internationaly was designed by the Sixth Decennial International Revision Conference held in Paris in 1948. It is both a legal and a statistical document.

Two major limitations of the death certificate as a surveillance tool have long been acknowledged: (1) a design intended to identify an underlying cause of death, and (2) the uncertain accuracy of diagnoses that have been recorded.[32]

The shortcomings of analyzing mortality statistics based only on the underlying cause of death are well recognized. This procedure does not convey the complexity of the reported medical conditions at the time of death, and is increasingly inaccurate in reflecting the growing proportion of deaths from chronic disease.[33]

In the present study, we will rely on the underlying cause of death for conventional analyses of rates, trends and comparisons, but we will also look for associations among selected medical conditions reported at the time of death, such as alcohol-related diagnoses vs deaths from violent or accidental causes. Similar associations can be described between alcohol and CVD deaths, diabetes and obesity vs deaths from infectious diseases, etc.

The second limitation of death certificates pertains to their accuracy in describing the true etiology of death. Numerous studies have been conducted to assess the quality of cause-of-death statistics under a variety of different conditions and based on a variety of different methodologies.[34] For instance, it is widely acknowledged that major diagnoses of clinical relevance are missed in around 8% of cases confirmed by autopsies.[35] But for the community health planner, the intended use of mortality data is to characterize time trends and socio-demographic patterns in broad disease groupings, and for these functions the informations gathered from death certificates are more accurate.[36]

Death certificates are subject to the variability and biases present in all clinical data. Carelessness and lack of training of physicians in completing death certificates[37] and failure of diagnoses to reflect information obtained after death from autopsies are major problems which can selectively alter reporting and validity.[38]

What are the alternatives to the use of death certificates for mortality surveillance? One involves review of available material regarding the deaths and the events preceding it by a panel of physicians. This method seems sound for mortality surveillance in the Cree population, since the small number of deaths involved could be investigated by interviews, chart reviews and data from local registries. On the other hand, it is presumed that the nosologist, because of the use of standard coding rules, will exhibit greater reliability than a panel of experts.[39] When trends and comparisons with other populations are of primary interest, the standardized coding rules theoretically assure comparability of the data, thus external validity. For these reasons, we have chosen to rely mainly on causes of death derived from death certificates in this study, as coded by trained nosologists of the Ministère des Affaires Sociales. When official coding was not available, we proceeded to code the causes reported in clinic registries ourselves, and the process was then submitted to a nosologist of the University of Montreal for approval.

Who completes the death certificates in the Cree communities? In Chisasibi and Mistassini, where physicians are always available, completion by physicians is the rule. In the other communities however, and under special circumstances, completion can be delayed or sometimes is not done at all. Because the death certificate is a legal document, some nurses may feel they are not authorized or competent to complete it, and a visiting physician asked to label a death which occurred a week before can be reluctant to do so as well. This could account for many incomplete or missing death certificates.

2.8 Multiple-cause-of-death approach

Epidemiologists often rely on cause-specific mortality data as an aid in generating hypotheses about disease etiology, in tracing patterns of change over time in diseases, and in helping to depict the prevalence of disease among population groups and across geographic areas. Until now, descriptions of cause-specific mortality data have been presented almost entirely in terms of a single cause of death, termed "underlying" and selected on the death certificate by trained nosologists.

There is increasing interest in the analysis of multiple cause-of-death data from death certificates, and multiple coding is already taking place in the U.S.[40] Quebec has planned "space" on its computerized surveillance system for immediate and contributive causes of death and this information is expected to appear at the Registre de la Population in 1989. Many methodological pathways have been elaborated in recent years to describe mortality data from the multiple-cause standpoint, and alternative coding rules for contributive causes of death have been established in the U.S. and also in Quebec on an experimental basis.[41] There are many logical explanations to such interest.

Deaths due to chronic diseases are often not well characterized by a single cause; rather, they are more likely to result from a number of coexisting conditions among which there may be no direct etiologic chain to facilitate the identification of a single underlying cause. Multiple cause-of-death statistics can be valuable in describing the contribution of selected conditions to acute causes as well. Any state-of-the-art mortality study in the future will probably be based on a multiple-cause approach, as well as on "classic" features of such studies.

2.9 Potential Years of Life Lost Indicator

The analysis of mortality statistics is ultimately used to answer an important question: which causes of death are the most amenable to prevention or postponement? Analyses of death rates by cause have traditionaly played an important role in the process of setting priorities and monitoring progress towards the achievement of public health goals. Although these rates are important measures of a population's health status, they often fail to reveal the social burden of untimely deaths. Since most deaths occur among persons in older age groups, crude and adjusted mortality rates of a population are dominated by the underlying disease processes of the elderly.[42]

Alternative measures have been proposed to reflect the mortality experience of younger age groups. These measures provide a more accurate picture of premature mortality by weighting deaths occurring at younger ages more heavily than those occurring in older populations. One of these measures is the potential years of life lost (PYLL). There are many methods of calculating PYLL and we will discuss further the choices we made for our analyses in the present study.

Analyses of age-standardized rates of potential years of life lost in Canada and the U.S. have pointed to motor vehicle accidents, ischemic heart disease, various cancers and suicide as the major contributors to premature deaths in recent years.[43] Rates of potential years of life lost are known to differ considerably among racial groups in the United States, with ratios of blacks to whites ranging from 1.1 to 3.6 in 1982.[44]

When the mortality in the native population of Greenland from 1968 to 1983 was analyzed using the concept of PYLL, the age-standardized PYLL rates from all causes except heart diseases in males were higher, as compared to the non-native population of Denmark. This was especially the case for violent deaths, which in Greenland accounted for 65% of all PYLL and showed considerable increases in both sexes during the study period.[45] We expected the indicator to reveal similar excesses in the James Bay Cree population.

3. Specific objectives

1. To provide a valid, complete and accurate coding of the deaths which have occured in the population under the jurisdiction of the Cree Board of Health and Social Services, for the period extending from January 1st 1982 to December 31st 1986.

2. To determine the appropriate population at risk corresponding to these deaths and to establish the population at mid-period of our study for calculations of death rates.

3. To calculate all-cause crude death rates and age-specific death rates in this population.

4. To calculate standardized mortality ratios by the indirect standardization method, using the mortality experience of Canada in 1984 as reference to describe the underlying causes of death in the Cree for the study period.

5. To calculate the birth rate and general fertility rate for the Cree population during the study period and provide an analysis of trends and external comparisons.

6. To calculate the infant mortality rate for the study period, describe the causes of infant deaths and time trends, and provide comparisons with other native and non-native populations.

7. To calculate perinatal, neonatal, and postneonatal mortality rates and provide an analysis of trends and external comparisons with other populations.

8. To provide detailed life tables for the Cree population, calculate various indices of life expectancy for the study period and discuss trends and external comparisons.

9. To calculate the potential years of life lost from deaths recorded during the study period, and to provide a discussion of the implications of our findings for public health priorisation.

10. To achieve an analysis of the differences in mortality patterns between the inland and coastal Cree communities, and to provide a summary of deaths for each Cree community.

11. To provide a comprehensive discussion of the results of this study and of their implications for public health planning and future mortality surveillance.

4. Methods

4.1 Study design

The present study is a descriptive study in the field of Vital Statistics, intended for demographic and mortality surveillance of the Cree population of the James Bay area of northern Quebec for the period extending from January 1st 1982 to December 31st 1986. ***Demographic surveillance*** refers to measurement of the size of the population, its age and sex composition, and other demographic characteristics. It is a prerequisite for the measurement of a community's health, since it provides information about the "denominator" population.

Mortality surveillance will be achieved through a descriptive approach of available data on deaths. All individuals in the study population will be synthetically followed using existing information, to the end-point of the study, for either survival or death. The outcome groups experiencing either survival or death will be described and compared in terms of demographic characteristics. Rates of occurrence of various causes of death will be reported in relation to sex, age groups and geographical distribution of the population, and the use of different indicators will allow for comparisons of the population's experience with that of other native and non-native populations.

4.2 Estimate of the population at risk

The precise determination of the population at risk from which deaths are reported is a crucial point in conducting small area mortality studies. Migrations and seasonal variations in place of residence can produce biased estimates of rates of death in small populations.[46]

The purpose of this study is to describe and assess the distribution of deaths in the population under the responsibility of the Cree Board of Health and Social Services (Region 10B), for means of planning, priorisation and evaluation of services. This population is characterized by its geographical location and can only be estimated. We will use the count of "residents" from the provincial List of Beneficiaries of the James Bay Agreement for this estimation.

The study population will thus exclude Cree designated on the List as "off-territory", who are affiliated to one of the eight communities, but live outside the Cree Territory as defined by the James Bay Agreement. Several hundred "off-reserve" beneficiaries living in Chibougamau, Val D'Or, Chapais and other northern towns, will be excluded from the denominator as well, as they depend on other regional health instances for services.

The population at risk used for calculations of rates in our study will be the count at mid-period of resident beneficiaries. The precise numeration of this population will be discussed further, at the beginning of the "results" section.

4.3 Estimate of the number of deaths

There is no valid provincial surveillance system for deaths in the Cree population of administrative region 10B at the present time. Deaths are now analyzed separately for region 10B as part of the permanent provincial health surveillance system but errors in the determination of the number of deaths and the population at risk are important. In January 1987, the MSSS published a report on mortality statistics for the James Bay region, for the periods 1975-1977 and 1979-1983 (MSSS, Direction de la Planification et de l'Evaluation, op.cit.). Deaths were identified from Quebec provincial statistics based on official death certificates, and the population at risk was estimated from provincial demographic information and from national census data.

A careful review of the report, published in 1987, has convinced me that its presentation, completeness, and accuracy are inadequate for its use as a surveillance tool in such a small population, where even a small error in the numerator can be crucial. For example, life expectancy at birth for the population of region 10B during the period 1979-1983 was reported to be 82.49 years in males and 84.85 years in females. This is the highest value reported for any region in the province of Quebec, and seems grossly inaccurate in the light of the information currently available.

In order to obtain the most complete numerator (deaths) for the population at risk in this study, we had to merge information from three data sources. The first was a collection of death certificates which were obtained from the official provincial death certification system, for residence codes located within administrative region 10B :

9980 Waswanipi
9981 Mistassini
9983 Eastmain
9984 Wemindji
9985 Waskaganish (Fort Rupert)
9986 Chisasibi
9987 Nemaska
9988 Whapmagoostui (Great Whale River)

A total of 103 photocopies of death certificates were provided by the MSSS for these communities. Certificates were not available for the year 1986 at the time our request was processed. Certificates for residents of "Mistassini" had to be carefully checked to eliminate francophone residents of a small town with the same name in Lac-Saint-Jean, Quebec. This will have to be remembered in the future, because the search for over 100 unnecessary certificates extended bureaucratic delays. Death certificates for Inuit residents of Great Whale River (9988) were also deleted from the final collection, since this population does not usually depend on the Cree Board for health care.

The second data source we used was the computerized list of deaths of the Northern Quebec Module of the Montreal General DSC. This list is derived from the monthly reports of each of the local nursing clinics and of the Chisasibi Hospital, and it was recently revised and updated for the period 1982 to 1986 by Claudette Lavallée. During the summer of 1987, she conducted a research in community registries and in clinic and hospital records, in an effort to trace and accurately describe all deaths among residents of the eight communities. From previous experience, it was expected that this form of data collection would reveal a number of deaths for which official certification had not been done. Indeed, the data collected was more complete than the provincial certification system, disclosing an average of 7 more deaths per year for the four years for which we had certificates from the MSSS. The 29 deaths for which official certificates were not available were coded carefully to avoid threats to external validity.

We eventually used the greatest number of deaths available from these two sources which could be proven to belong to the determined population at risk, after screening carefully for duplications. We then added five deaths which had been reported only to the List of Beneficiaries of the James Bay Aggreement, and the final numerator of deaths for the study period was updated to **181** (Appendix 2).

The five deaths reported to the List of Beneficiaries occured among older residents of the communities who may have died among members of their family in Chibougamau, Val D'Or, or in other locations in the South, and whose deaths were not brought to the attention of the providers in the local clinics. For a reason or another, the death certificate did not acknowledge their belonging to a Cree community. This hypothesis was provided by Mrs. Helen McLeish, responsible for updating the List in Quebec City, who also mentioned that many residents have to be presumed dead, and their names removed from the List, when their survival (beyond the age of 100 or 110) becomes improbable.

Many practical problems in tracing individuals and avoiding duplications were experienced, given seasonal migrations, inconsistant spelling of names, and name changes from marriages. Date of birth was frequently unknown, especially in the elderly, and January 1st was often allocated arbitrarily on medical records, community registries and death certificates. The date of death was also frequently imprecise, and there was often confusion between the date of declaration and the date of death *per se*.

Given the multiplicity and uneven quality of the data sources available for mortality surveillance in the Cree population, an extensive process of data validation and investigations of "special cases" remain as features of this type of research. Time-consuming manual techniques of cross-validation have to be used; given names were most useful in eliminating duplications when differences between data sources were confusing. In some rare litigious cases, choices had to be made to our best knowledge. Missing data was recorded and analyzed as such, and we made no special effort to interview people in the communities to obtain any missing information retrospectively.

5. Analysis

The precise descriptions, technical discussions and interpretations of the various demographic and health indicators which will be used in this report will be drawn from a comprehensive document published by Statistics Canada in November 1985.[47]

The age groups commonly refered to in the descriptions of these indicators are : 0-1 year, 1-4, 5-14, 15-24, 25-44, 45-64, 65-74, 75 and over (unless specified otherwise). All Canadian and provincial statistics used as bases for comparisons with the Cree population in this study will be drawn from the Vital Statistics series published by Statistics Canada for the years 1984, 1985, and 1986.[48]

5.1 Age pyramid

-Definition: the age (or population) pyramid is a double histogram which shows the age composition of a population on a given date and which is so named because of its pyramidal shape.

-Function: like all histograms, the population pyramid enables one to see at a glance a statistical distribution which is easier to appreciate in its graphic representation than through the underlying table.

- Technical discussion:

1. representation of the age structure of our study population at mid-period.
2. representation of the age structure in the Canadian population as a whole according to the 1984 Census Estimate (reference population).
3. graphic comparison of the previous age pyramids to illustrate the need for standardization of crude death rates.

5.2 Proportional mortality

-Definition : proportional mortality is the numeric or graphic representation of the different proportions of all deaths which are attributable to each cause (or group of causes) of death. A similar representation can be made of the different proportions of deaths occurring in the different age groups of the population.

-Function : this indicator, expressed in % of all deaths or graphically in the form of pie charts, allows a representation of the distribution of all deaths based on groups of causes or chosen characteristics of the deceased.

-Technical discussion :

1. representation of the distribution of deaths in our study population 1982-1986 according to ICD-9 categories and comparison with a similar representation of deaths in Canada for the same period.
2. representation of the age distribution of deaths in our study population 1982-1986.
3. similar representation of deaths in the population of Canada 1982-1986.
4. graphic comparison of these distributions of deaths.

5.3 Crude death rate

- Definition: annual number of deaths per 1000 population.

- Function: this rate is a measurement of the annual frequency of deaths as well as a statistical summary of age-specific death rates.

- Technical discussion:

The numerator for this rate will be the count of all deaths reported for the period extending from January 1st 1982 to December 31st 1986, averaged for one year.

The denominator will be determined by the population of resident beneficiaries of the James Bay Agreement at mid-period of our study (March 25th

1985). The crude death rate will be reported per 1000 population at risk and averaged for one year.

5.4 Standardized death rate

- Definition: annual number of deaths which would have been observed in our population if it had the same age and sex composition as a reference ("standard") population, which will be the Canadian population in 1984.

- Function: as risks of dying vary widely by age and sex, the annual frequency of deaths in a population depends on its age composition and sex ratios for different age groups. Standardized rates permit this exogenous factor to be eliminated in comparative mortality studies.

- Technical discussion:

Standardization by age and sex in our study will be achieved using the indirect method, which is more appropriate for the study of small populations because it avoids the use of age-specific death rates from the smaller population, more subject to wide random fluctuations. The nature and extent of biases introduced by indirect standardization will be discussed further.

The requirements for the calculation of an age-adjusted mortality rate by the indirect method are (1) the distribution by age and sex of the population group under study and (2) the choice of a set of age-specific death rates for each sex in a standard population.

The standard population will be the population of Canada in 1984 as a whole. Canada was chosen rather than Quebec largely because of the availability and reliabiiity of detailed mortality data for 1984 at the time the study was undertaken.

The essence of the calculation involved is the determination in our study population of the expected deaths for males and for females. These are the deaths one would expect to occur in each sex under the presumption that the age-specific rates of the standard population prevailed in the Cree population. The ratios of observed to expected deaths (those observed divided by those expected) are called standard mortality ratios, and will be calculated in both sexes separately, then combined in an age and sex-standardized all-cause mortality ratio for the Cree population. Age and sex-strandardized SMRs will also be calculated for broad ICD-9 categories of causes of death and even for certain selected causes, and 95 % confidence intervals on these ratios will be determined assuming the observed number of deaths by cause is distributed as a Poisson variable [49 50].

5.5 Infant mortality rates

- Definition: rates of deaths among infants under a year old to the number of live births, usually expressed for 1000 live births.

- Function:

When the rate is calculated from statistics available for a population, as it is the case here, the infant mortality rate is in effect a probability. For the newborn infants of the cohort, it represents the probability of dying before their first birthday.

It has long constituted a particularly good indicator of hygiene and health conditions prevailing in a population, and has been traditionaly used to evaluate countries from the standpoint of their overall level of economic and social development.

- Technical discussion :

The denominator for calculation of the infant mortality rate is the number of live births, and rates are usually reported per 1000 live births. A record of births during the study period was obtained from the Northern Quebec Module. In small populations, infant mortality rates are often presented as 3-year running averages, and we will present the data in this form as well as average period rates, trends, and external comparisons.

Infant mortality rates take into account all deaths during the first year of life. We will distinguish early neonatal mortality rates (0-7 days of life), neonatal mortality rates (0-28 days) and postneonatal mortality rates (28 days to 1 year), which reflect different medical and socio-demographic determinants. Birth rates (live births per 1000 population at mid-period) and fertility rates (per 1000 females aged 15 to 49 at mid-period), which are traditionaly very high in the Cree population, will be reported for the period 1982-1986.

We will also describe infant mortality in terms of place of death, as reported at items 1 and 2 on the death certificate, or when mentionned on the list of the Northern Quebec Module. This is an attempt to assess the relative importance of infant deaths which occur outside health facilities. A number of these deaths may be preventable by earlier referral, better availability of communications and / or transport facilities.

Infant mortality rates will be compared between inland and coastal communities, in an attempt to evaluate patterns consistent with community size, availability of health services or social discrepancies.

5.6 Perinatal mortality rate

- Definition : annual number of stillbirths and early neonatal deaths per 1000 total births.

- Function : by its method of calculation, the perinatal mortality rate may be likened to the risk for fetuses considered viable to be stillborn or die before the end of their first week of life.

- Technical discussion :

This indicator is sensitive to changes in the level of perinatal health care, but is not specific insofar as other factors contribute to variation. Some of these are demographic, some institutional, and some economic, and most are related to characteristics of the childbearing population.

Comparisons of perinatal mortality over time and space are hampered by differences in the criteria used for the definition of viability and how these evolve. We will consider stillbirths after 20 weeks gestation, in accord with most of the data presented in Quebec and Canada in recent years. We will calculate three-year running averages and report the average period rate as well.

In addition to standardizing definitions, statistical controls for structural factors, such as the distribution of births by weight, can be used and render perinatal rates more directly comparable across countries. This procedure was not performed in this report, but would be interesting in the light of the low rate of low-birthweight experienced by the Cree of northern Quebec.

5.7 Life expectancy at birth

- Definition : mean length of life, assuming mortality is stabilized at the level observed at each age during a given period.

- Function : The calculation implicitly assumes that members of a cohort are subjected, throughout their lives, to risks of death calculated on the basis of observations made during the period of the study. The indication provided is **prospective** in the sense that the mean length of life calculated has not been achieved at the time of observation, but would be attained in the long term if mortality remained at the level observed.

- Technical discussion :

Observed age-specific death rates or probabilities are used to simulate the history of a cohort whose members would hypothetically be subject to a series of risks of death between successive birthdays, throughout their lives. This permits the calculation of a Life Table specific to our study population, which enables us to calculate the number of years lived by members of our synthetic cohort. Life expectancy at birth is obviously of particular interest since it provides the average duration of life permitted by observed mortality conditions during the study period.

In small populations such as the one we are dealing with, age-specific death rates may be subject to wide random fluctuations and the mortality profile by age must be adjusted using graphic or statistical procedures.[51] In this study, Life Tables were constructed for each sex separately, using five-year age intervals (except for infant mortality). Fractions (fx) of 0.2 and 8.0 were used respectively in the 0-1 and 75+ age groups, in accordance with those observed in other populations around the world with similar infant mortality rates. Values of life expectancy obtained by this method, called the "period approach", can be validly compared with values published for Canada and other countries.[52]

5.8 Potential years of life lost

- Definition : total, or part, of the years of life lost by members of a population who have died from the cause specified during one year of observation.

- Function : the objective here is to estimate the potential "cost" of each specific type of mortality in terms of years of life lost by people who are victims af it during the year. This cost depends on the number of victims and how they are distributed by age at death, as well as on the additional number of years of life they would have had if the cause of their death had been eliminated.

- Technical discussion :

Many options are available for calculations. Deaths occurring between birth or the first birthday and a predetermined superior age limit are taken into consideration. The most commonly selected limits are ages 65, 70 or 75, and we made choices in order to assure valid comparisons with Canadian population reports.

It has to be noticed that infant deaths are sometimes excluded from calculations of this indicator. The authors of the document entitled "Demographic and Health Indicators", Péron and Strohmenger, provide two reasons for this. On the one hand, "most cases of infant mortality are due to causes specific to this early period of life and often have a different aetiology than death later on" (Romeder and McWhinnie, op. cit.). On the other hand, estimating at nearly 70 years the number of years of life lost as a result of such a death appears excessive when one considers that a child dying at a very early age is often replaced by another infant, who then owes its life to the first. Despite this very explicit rationale, two recently published Canadian studies used periods including deaths in the first year of life in their calculations of the indicator, and we had to do the same to establish valid comparisons.

The deaths selected are normally classified by underlying cause of death, grouped according to the organ or system involved, or according to the nature of the morbid process (e.g. accidents). The PYLL indicator enables a classification of causes of premature death through a comparison of their respective effects in the population under study.

6. Results

6.1 Denominator and age structure, birth rate and fertility rate

The practical determination of the best available denominator to calculate death rates for the Cree population was not straightforward. Essentially, the "true" denominator is the count of residents that were alive on June 30th 1984. In practice, the count of residents on the list of beneficiaries on that date underestimates the denominator, because recording of births and deaths is often delayed, and births are about 7 times as frequent as deaths in this population. Therefore, we used a "snapshot" picture of the Cree resident population we had on March 25th 1985 as the best estimation of the true denominator and the most valid representation of the age structure of the Cree population at mid-period of the study. A table showing the age and sex distribution of the study population at mid-period is provided in Appendix 1.

One way to validate this choice of a slightly "shifted" mid-period count of our population was to calculate the true mid-period population retrospectively from the list of beneficiaries available in 1988. The list is believed to be more"responsive" at the present time, as delays in notification of births and deaths have been greatly reduced, mainly by better mechanisms of reporting, both in the communities and in Quebec City, where the list is computerized. The exercise shows that a count of approximately 8000 Cree residents is expected on June 30th 1984, closer to the 7916 obtained from the list of beneficiaries on March 25th 1985 than any count anterior to that one.

The Cree population is relatively young. The birth rate (29.4 per 1000 population) has remained virtually unchanged since the period 1975-1981, and is now about three times Quebec levels[53], which are among the lowest in the world. Crude birth rates for developing countries range from about 35 to 55, and such high levels tend to occur in populations with early marriages and low incidence of sterility. The general fertility rate (116.6 per 1000 females, aged 15 to 49) has declined from 139.0 in the period 1975-1981. It now stands at more than twice Quebec levels (Table 1).

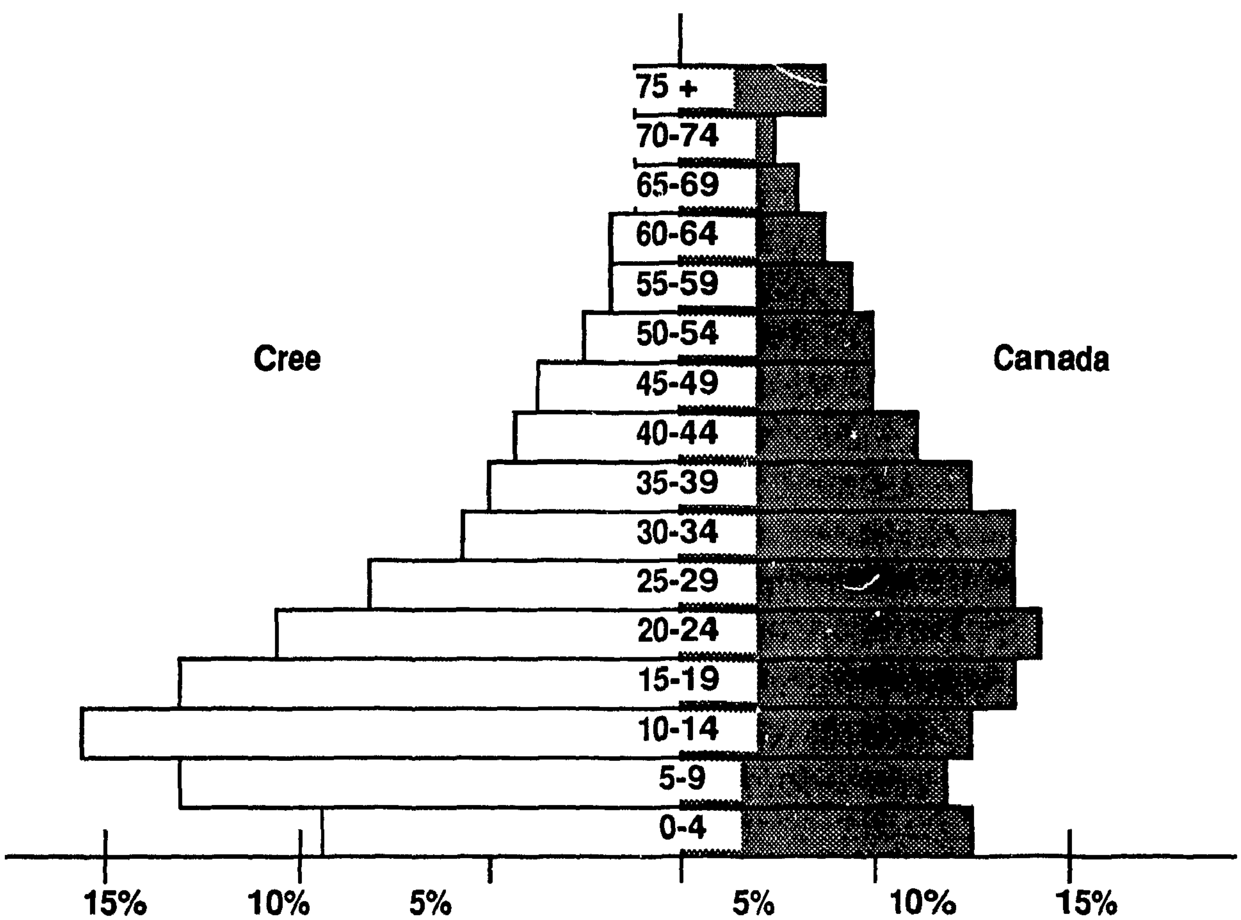
Table 1 : Birth rates and general fertility rates, compared for the Cree 1975-1981 and 1982-1986, and Quebec 1984.

Indicator	Cree 1975-1981	Cree 1982-1986	Quebec 1984*
Birth rate (1000 pop.)	30.1	29.4	13.5
Fertility rate (1000 women 15-49 years)	139.0	116.6	50.3

* Source : Bureau de la Statistique du Québec

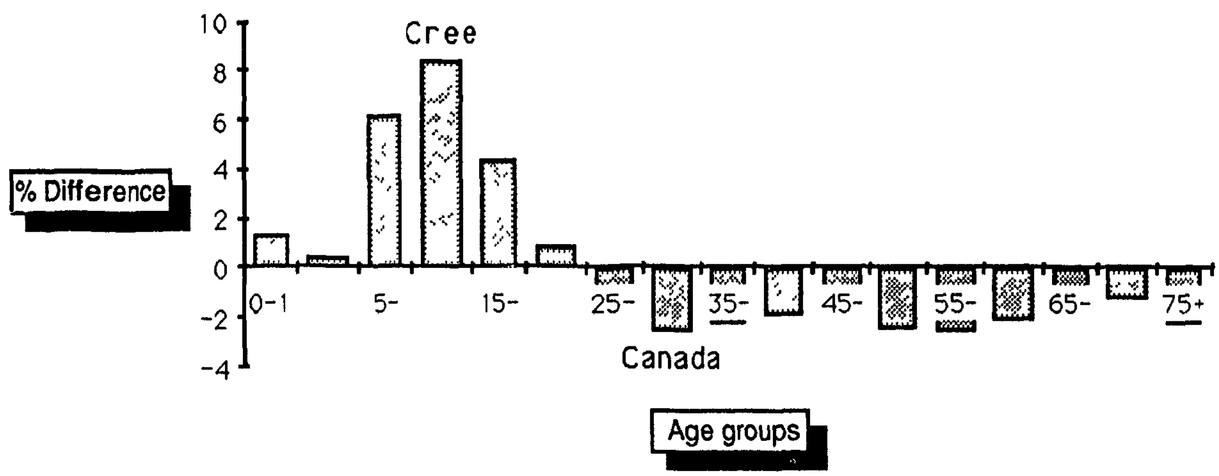
The persistance of these high reproduction indices over the past decades, combined with declining infant and child mortality, have produced a young population where individuals under 15 years represented 38.1% of the population (vs 21.6% for Canada) and elderly 65 and over only 5.1% (vs 10.2% for Canada), at midpoint of the 1982-1986 period. This finding is a constant among the native population of Canada: in 1981, 39% of non-inuit Canadian Natives were less than 15 years old, while only 22% of Canadians were in this age group[54]. Figure 2 shows a conventional display of the age pyramids for the Cree and the Canadian populations.

Figure 2 : Comparison of the age structures of the Cree population at mid-period (March 25th 1985) and of the Canadian population in 1984



The relative youth of the Cree population can be further illustrated as in Figure 3, where the percentages accounted for by each age group in their respective populations are compared. The chart shows that the Cree population has greater proportions of individuals in all age groups under age 25, as compared to the reference population of Canada in 1984. The greatest relative excess is observed in the age group 10-14, whereas the Canadian population has greater proportions of individuals in all age groups over 25. Any comparison of the mortality experiences of these two populations will have to take into account these important differences, and this will be achieved through age standardization.

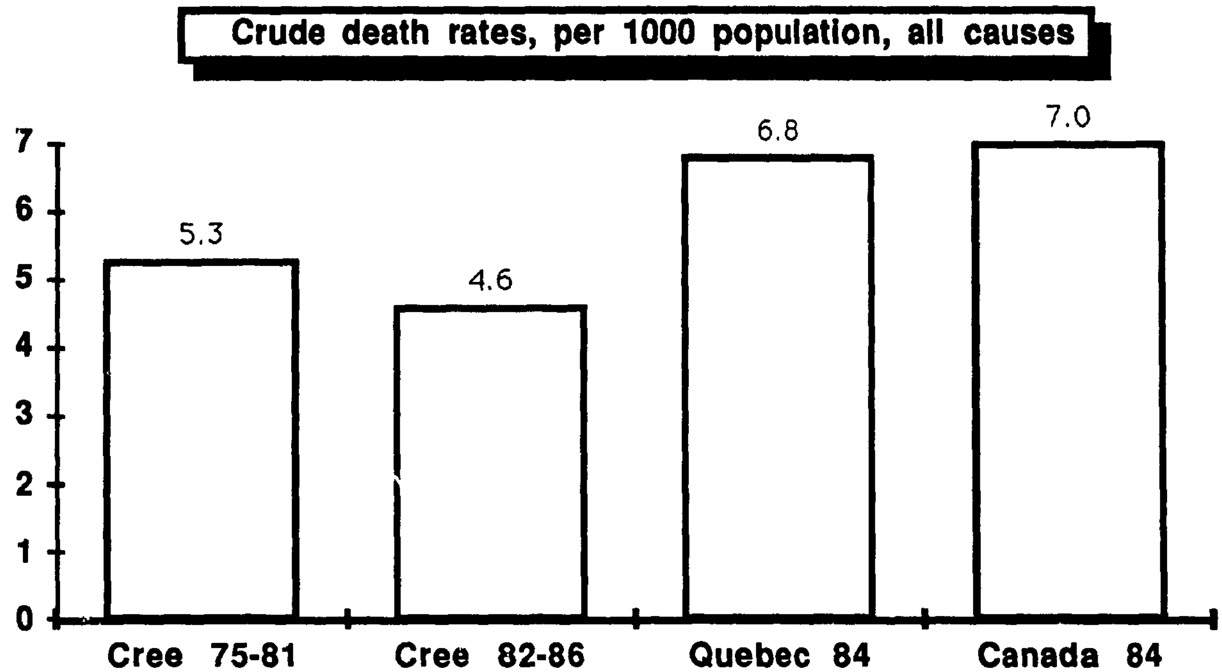
Figure 3 : % Difference in proportions of their respective populations accounted for by each age group, between the Cree population at mid-period 1982-1986 and the Canadian population in 1984



6.2 Crude death rate

Of all the descriptors of mortality, the crude rate is the easiest to obtain, since it is simply the ratio between the average number of deaths recorded in a year and the average size of the population during the time of observation. We observed 181 deaths in the Cree population in the five-year period of observation, 95 in males and 86 in females. Figure 4 shows the crude death rates of the Cree population for the periods 1975-1981 and 1982-1986, and the crude rates observed in the Quebec and Canada populations in 1984.

Figure 4

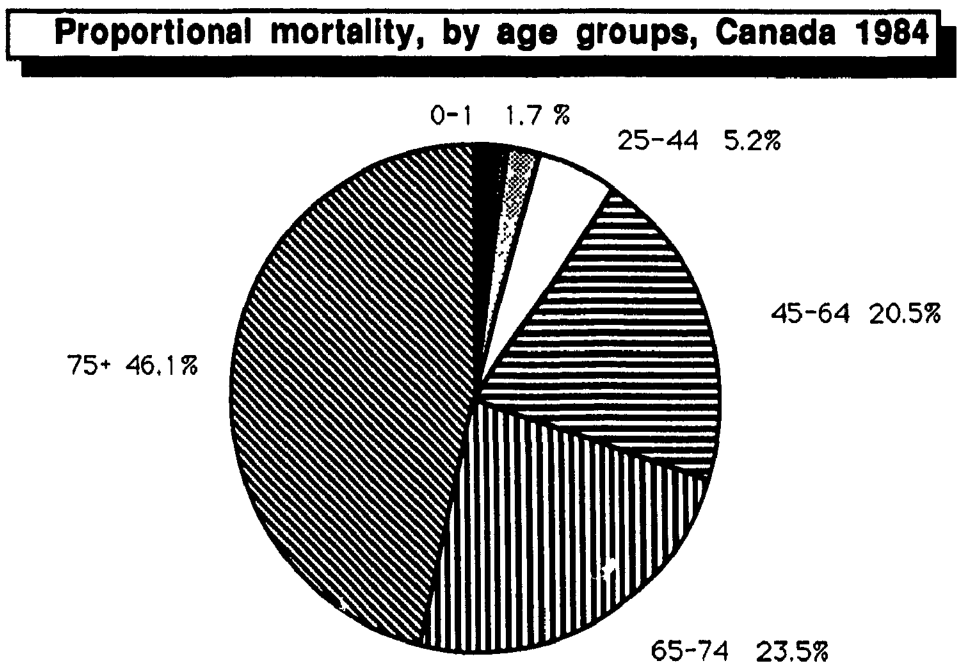


The main limitation of the use of the crude death rate is its lack of validity for comparisons between populations. If the populations enjoy different heath conditions at the various ages, there can be a situation where the greater youth of one population can obscure a mortality experience that is, in fact, a greater burden to that population. This again illustrates the need for age standardization of rates.

6.3 Proportional mortality by age groups

Proportional mortality is often expressed in a graphical way, to show the relative proportions of the deaths which occured in the various age groups of the population. In the Canadian population, and in developed countries in general, an increasingly greater proportion of deaths occurs in the oldest age groups of the population. Over two-thirds of Canadians died over age 65 in 1984, as shown in Figure 5. Infant mortality represented only 1.7% of all deaths in the Canadian population in 1984, and deaths in age groups from one to 25 years about the same proportion[55].

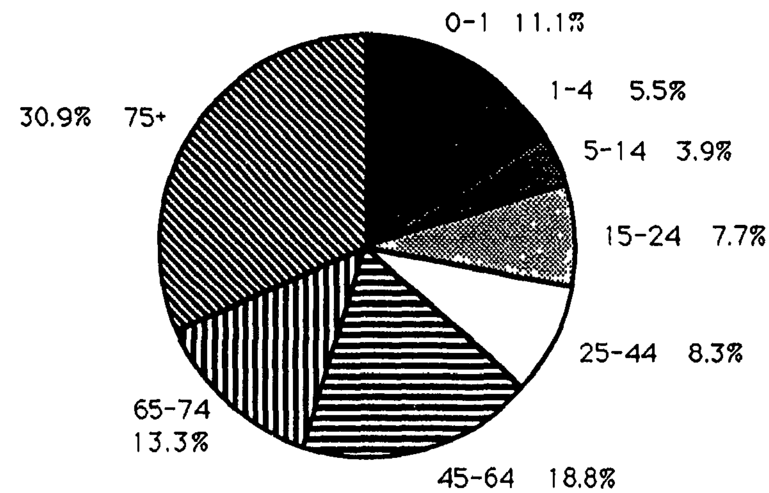
Figure 5



By contrast, let us take a look at the proportions of deaths by age groups in the Cree population for the study period. Infant deaths represent 11.1% of all deaths in this population, and deaths before age 25 over a quarter of the total. This is partly due to the fact that there are more infants and young adults in the Cree, but also due to higher rates, as we will see later. In general, Cree deaths tend to occur earlier, and are more evenly distributed over all age groups of the population, as shown in Figure 6.

Figure 6

Proportional mortality, by age groups, Cree 1982-1986



In appendix 3, we have outlined the proportions of deaths in each age group, respectively for the Cree in the two periods 1975-1981 and 1982-1986, and for Canada in 1984. The table demonstrates that the proportions observed in the present study are intermediate between those observed in 1975-1981, and those of Canada. The proportion of deaths in the first year of life has decreased by half, and increasing proportions of deaths are now occurring at older ages.

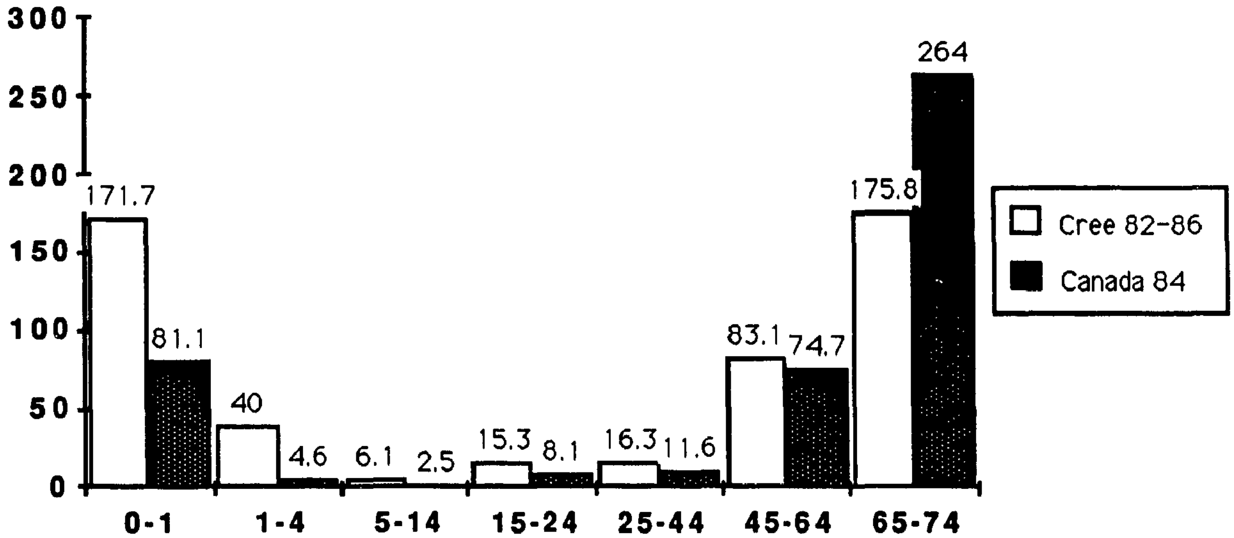
Another variant of proportional mortality will be used a little further in this report, when we will show the distribution of Cree deaths by causes, and specifically by categories of the Ninth International Classification of Diseases.

6.4 Age-specific mortality rates

The sets of age-specific death rates for the Cree population and the population of Canada are illustrated in Figure 7. They allow for a meaningful comparison of the mortality experience of two populations which differ widely in their age composition, by establishing comparisons within each age group for a standard denominator size.

Figure 7

Age-specific mortality rates, compared, Cree 1982-1986 and Canada 1984



Excess mortality in the Cree is the rule in all age groups except the elderly, and the greatest excesses are seen in infants and young children, when rates in the Cree double those observed in Canada. Even without speculating about more sophisticated indicators such as life expectancy and potential years of life lost, we can already see that the Cree have a pattern of premature mortality which affects the base of the demographic pyramid and adults in their socially active years. The set of age-specific death rates is the basis of the calculation of age-specific probabilities of death, which in turn will be used in setting up the synthetic Life Table leading to the estimation of life expectancy.

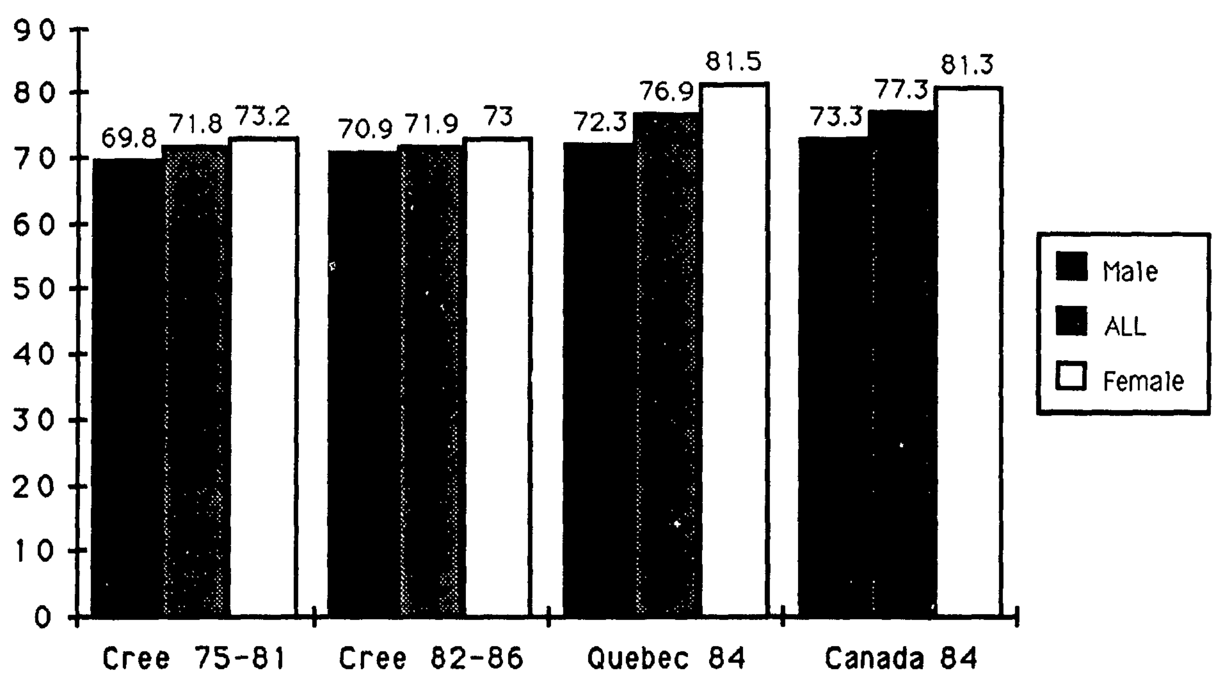
In Appendix 6, you will find an outline of the distribution of Cree deaths during the study period, across age groups and across ICD-9 categories. In Appendix 7, we present an overview of the detailed causes of death that occured in the five year study period, in each of the age groups. In contrast with all the other tables and figures in this report, we did not always respect the official coding in this appendix, in order to provide a more vivid description of the environmental and biological context in which the deaths occurred. This will be of interest to public heath planners and people involved with interventions targeted towards specific groups such as children, adolescents, young adults, and elderly. A review of the causes affecting each age group can give a good sense of the relative importance of targeting a group rather than another in relation with a specific lethal condition.

6.5 Life expectancy

Life expectancy at birth is a very useful indicator for comparing populations around the world, and its meaning is easily understood by people without any background in epidemiology. Its computation requires age-specific death rates and in that sense it is a specific descriptor of the level of mortality at various ages. Life expectancy at birth is compared to that computed for the period 1975-1981, and to the synthetic estimates for Canada and Quebec in 1984 (Figure 8). The complete life tables that were constructed according to the mortality experienced by the Cree population during the five-year study period, are included for males, females, and both sexes combined, in Appendix 4.

Figure 8

Life expectancy at birth, compared for men, women, and both sexes combined ; Cree 1975-1981 and 1982-1986, Quebec 1984 and Canada 1984



Life expectancy at birth is of particular interest since it provioes the average duration of life permitted by observed mortality conditions. In almost all countries, it is greater in females than in males, and the difference tends to be greater in "developed" versus "developing" countries. Since 1975-1981, life expectancy at birth has increased in Cree men and decreased slightly in Cree women. Life expectancy at birth in both sexes combined increased by three years less than in the Quebec population during the same period. Cree men still have a life expectancy approaching that of the Quebec male population, while the life expectancy of Cree women is now 8.5 years shorter than that of Quebec and Canadian women.

6.6 Infant mortality

Death rates in the very young age groups, and specifically in the first year of life, have a great weight in the calculations of indicators of such as life expectancy at birth and potential years of life lost. Infant mortality rates are often used to quantify the degree of socioeconomic development of human populations, and they are related to the quality of care from the family, the social network and health services, as well as to environmental conditions and to the incidence of specific lethal conditions of infancy.

A stillbirth is defined as the complete expulsion or extraction from its mother of a dead fetus after at least 20 weeks of pregnancy. Stillbirths are reported separately from other deaths, on specific certificates, and enter the computation of perinatal mortality rates. Five stillbirths were reported during the period 1982-1986 in the eight Cree communities, for an average stillbirth rate of 4.3 per 1000 live births. For the period 1981 to 1985, Canada as a whole had an average stillbirth rate that was quite comparable at 4.8 per 1000 live births (Canada Year Book 1988).

Early neonatal deaths are those which occur in the first week of life. Three such deaths were reported during the five year study period, two in the first 24 hours of life, and the third during the 7th day of life. No late neonatal death (7-28 days) occured, so all neonatal deaths occured in the first seven days. During the period 1975-1981, 14 neonatal deaths had been reported, for a number of live births that was roughly equivalent.

The postneonatal period extends from the 29th to the 365th day of life. There were 17 Cree postneonatal deaths reported, as compared to 51 in Robinson's study from 1975 to 1981. A summary of the changes in average rates between the two periods is shown in Table 2, and these rates are compared to Quebec and Canadian rates in 1984. The Cree compare favorably with Quebec and Canada in perinatal and neonatal mortality, but have a very high postneonatal period death rate, which accounts for infant mortality reaching more than twice Quebec levels, despite dramatic improvement since 1975.

Table 2

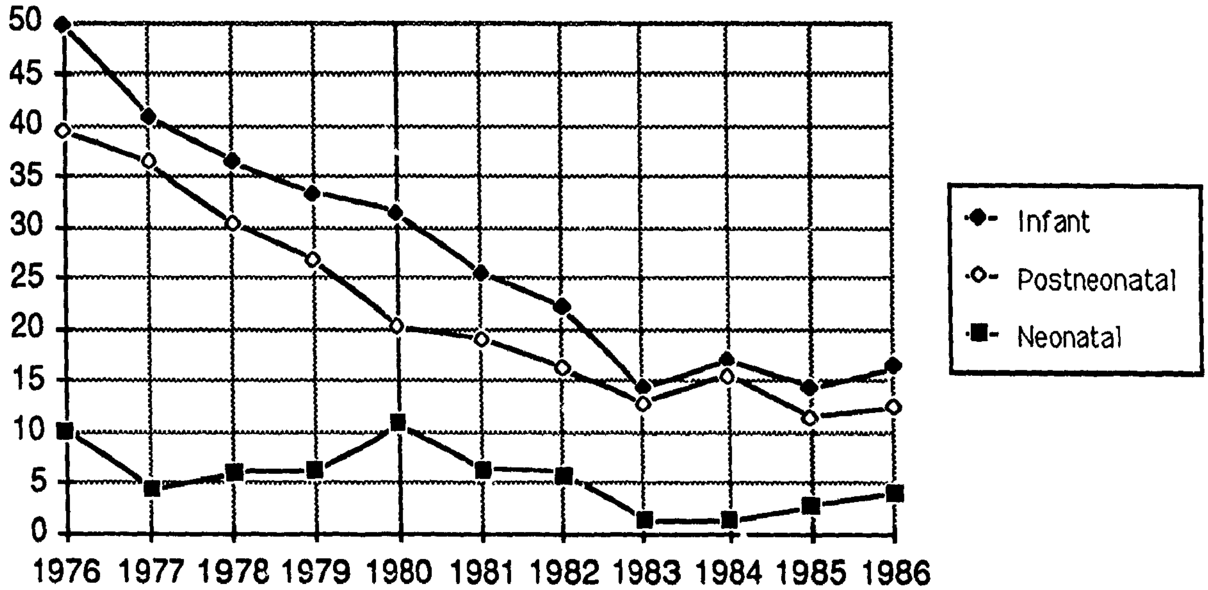
Perinatal, neonatal, postneonatal and infant mortality rates, per 1000, in the Cree 1975-1981 and 1982-1986, in Quebec in 1984 and Canada in 1984[56]

RATE	Cree 75-81	Cree 82-86 (95% CI)	Quebec 84	Canada 84
Perinatal	9.6	6.8 (2.9-13.5)	8.4	8.7
Neonatal	8.0	2.6 (0.5-7.6)	5.2	5.2
Postneo	29.0	14.6 (8.5-23.3)	2.1	3.0
Infant	37.0	17.2 (10.5-26.4)	7.3	8.1

We also used the data available since 1975 and recently published by Robinson in a review article[57], to calculate and plot three-year running averages in Cree infant mortality rates from 1976 to 1986 (Figure 9). For reference, data on live births, stillbirths, neonatal deaths, postneonatal deaths, as well as actual values of three-year running average rates and 95% confidence intervals, are all reported in Appendix 5.

Figure 9

Trends in Cree infant, neonatal, and postneonatal mortality rates, per 1000 live births, three year running averages, 1976 to 1986.



Detailed discussions of these trends will be presented in the following section, but we note immediately that neonatal, postneonatal and infant mortality rates seem to have stabilized at the levels reached around 1982-1983. Whether these rates will remain at an irreducible minimum or will continue to decline in the next few years will give a clear indication on the potential of this population to attain the levels of infant mortality we observe in Canada and Quebec, which are among the lowest in the world. In the discussion section we will show a comparison of trends for the last ten years in infant mortality rates in the Cree and the Canadian populations.

At this point, it might be useful to briefly list the content of each of the seventeen ICD-9 categories, which we will be refering to constantly across the rest of the report, as a Roman numeral or by key words :

I Infectious and parasitic diseases

II Neoplasms

III Endocrine, nutritional, metabolic, and immunity disorders

IV Diseases of blood and blood-forming organs

V Mental disorders

VI Diseases of the nervous system and sense organs

VII Diseases of the circulatory system

VIII Diseases of the respiratory system

IX Diseases of the digestive system

X Diseases of the genitourinary system

XI Complications of pregnancy, childbirth, and the puerperium

XII Diseases of the skin

XIII Diseases of the musculoskeletal system and connective tissue

XIV Congenital anomalies

XV Conditions originating in the perinatal period

XVI Ill-defined and unknown causes of death

XVII Injuries and poisonings

Finally, what are the causes of death among Cree infants which account for the death rates in the first year of life? Table 3 shows the distribution of deaths by ICD-9 categories for both periods 1975-1981 (Robinson, op. cit.) and 1982-1986.

Table 3 : Causes of death in the first year of life, by ICD-9 categories, neonatal and postneonatal periods, Cree 1975-1981 and 1982-1986.

ICD-9 Category	Neonatal (0-28 days)		Postneonatal (29-365)	
	75-81	82-86	75-81	82-86
I. Infections			1	
VI. Nervous			10	5
VII. Circulatory	1			
VIII. Respiratory			12	2
IX. Digestive			7	
XII. Skin			1	1
XII. Congenital	6	1	5	2
XV. Perinatal	4	2	1	
XVI. SIDS Unknown	 2		1 12	4 1
XVII. Injuries	1		1	2
TOTAL	14	3	51	17
Males Females		1 2		5 12

Among the 20 infant deaths recorded between 1982 and 1986, only one was of an unknown cause. Four deaths (20% of infant deaths) were attributed to the Sudden Infant Death Syndrome, versus only one death in the previous period. Genetic diseases, including Cree leukodystrophy, other hereditary encephalopathies, and various congenital malformations, represented 40% of infant deaths (8 deaths), one of which occurred in the first week of life.

Respiratory infections claimed 2 lives and one death was caused by a severe skin infection complicated by septicemia and meningitis. Accidents were responsable for two deaths, one by suffocation and another by multiple trauma in a motor vehicle accident. Obstetrical complications and prematurity each caused one death in the first day of life. Table 4 presents the causes of death observed in the first year of life, by broad groups of causes according to the locus of intervention required for prevention. A detailed discussion of these causes, comparisons of cause-specific rates with Canada, and an overview of possible strategies to achieve gains in Cree infant mortality, will be presented in the following section.

Table 4

Summary of causes of infant deaths observed in the Cree population during the period 1982-1986, presented by groups of causes according to the locus of intervention required for prevention.

Cause of death	Number	%	Group of causes
SIDS	4	20	
Leukodystrophy Encephalopathy Malformations	3 2 3	15 10 15	Genetic 40%
Infections Accidents	3 2	15 10	External 25%
Prematurity Obstetrical	1 1	5 5	Pregnancy and Delivery 10%
Unknown	1	5	
TOTAL	20	100	

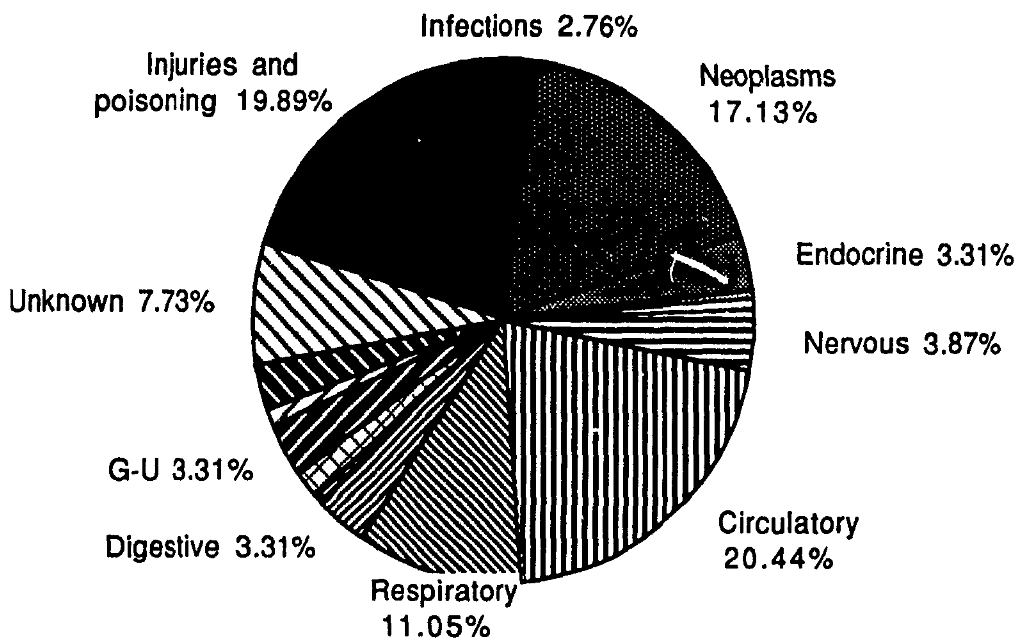
6.7 Proportional mortality, by ICD-9 Categories

A description of the causes which account for the 181 deaths observed in the Cree population in the five-year period of observation begins with an outline of the different proportions of these deaths attributable to each of the ICD-9 disease categories.

Figure 10 is a conventional "pie" illustration of these proportions in our study.

Figure 10

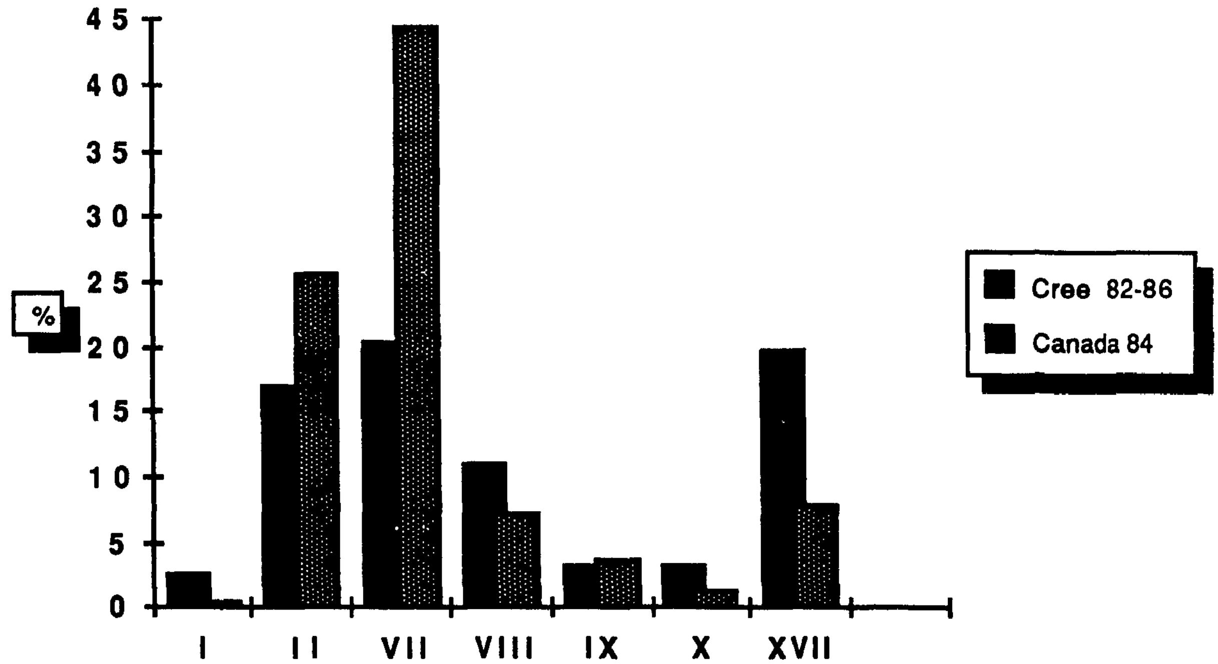
Proportional mortality, by ICD-9 Categories, Cree 1982-1986



In Figure 11, we show a comparison of the observed proportions of all deaths for selected ICD-9 categories, in the Cree 1982-1986 versus Canada in 1984. A total of 175,480 Canadians died that year, 45% from cardiovascular diseases and 26% from cancer. These leading causes of death were not as prominent in the Cree, but on the other hand deaths from injuries, violence and poisonings represented almost one fifth of total Cree deaths, versus only 8% in Canada. These patterns will tend to persist after statistical procedures such as age standardization, as we will see in section 6.9.

Figure 11

Comparison of proportions of deaths by selected ICD-9 categories, Cree 1982-1986 and Canada 1984.



6.8 Standardized mortality ratios

The standardized mortality ratios obtained for each of the seventeen ICD categories of death are shown in Table 5. They have been obtained by performing indirect age and sex standardization to the reference population of Canada in 1984. Standardization was performed systematically for age and sex, because using an overall SMR can sometimes mask sex-specific differences in mortality. These differences can be particularly interesting if different pathologies are involved (e.g. neoplasms).

The 95% confidence intervals on these ratios have been calculated by using standard statistical tables[58] for the numerator (Observed), assumed to be distributed as a Poisson variable. When the observed count exceeded 50, an approximation of the normal distribution was used to calculate confidence intervals. The denominator (Expected) is assumed to be exact, since it is calculated on the relatively large population of Canada in 1984. The width of the confidence interval on the SMRs is therefore inversely proportional to the size of the numerator. In other words, SMRs are more precise in our study for death categories which account for greater proportions of the total number of deaths.

Table 5

Proportional distribution of deaths in the Cree population, period 1982-1986, standardized mortality ratios to the reference population of Canada in 1984, and 95% confidence intervals.

ICD - 9 Category	Number	%	SMR	95 % CI
I. Infections	5	2.8	4.98*	1.59 - 11.65
II. Tumors	31	17.1	0.80	0.54 - 1.13
III. Endocrinology	6	3.2	1.58	0.58 - 3.45
IV. Haematology	1	0.6	1.63	0.16 - 9.14
V. Mental	1	0.6	0.89	0.09 - 4.99
VI. Nervous	7	3.9	2.40	0.96 - 4.93
VII. Circulatory	37	20.4	0.60*	0.42 - 0.82
VIII. Respiratory	20	11.1	1.83*	1.12 - 2.82
IX. Digestive	6	3.3	1.08	0.40 - 2.37
X. Genito-urinary	6	3.3	3.12*	1.14 - 6.81

Table 5 (continued)

ICD - 9 Category	Number	%	SMR	95% CI
XII. Skin	1	0.6	8.37	0.84 - 46.86
XIV. Congenital	3	1.7	0.85	0.17 - 2.50
XV. Perinatal	2	1.1	0.50	0.05 - 1.80
XVI. SIDS Unknown	5 14	2.8 7.6	3.97*	1.27 - 9.28
XVII. Injuries	36	19.9	2.01*	1.40 - 2.78
TOTAL (All Causes)	181	100.0	1.15	0.98 - 1.31
Males	96	53.0	0.95	0.76-1.14
Females	85	47.0	1.49*	1.17-1.81

* significant

In the next section, we will use each of these SMRs to estimate and discuss the relative burden of each disease category to the Cree population, and to gain insight on sex differences, patterns, and trends regarding the various disease entities responsible for deaths within each ICD-9 category for which the findings are conclusive. Meaningful cause-specific SMRs will be reported, and comparisons with other Indian populations will be established.

6.9 Potential Years of Life Lost

This indicator can be calculated in different ways, as we have seen in the section on methods. To allow for comparisons with recently published data on the Canadian population, we used two versions of the indicator, both of which include years lost in the first year of life : PYLL from birth to 75, and PYLL from birth to 65. The data used in the calculations of these two variants is included for reference in Appendix 8.

The first variant of the indicator (0-75) allows comparisons with data recently published by McCann[59] for Canadian males and females, by province, for the same period 1982-1986. Figure 12 shows that Cree females experience premature death at a greater degree than the female population of Canada, Quebec, Yukon and the Northwest Territories. By contrast, Cree males fare better than males in the Canadian Territories, and show only slight excesses when compared to the Canadian and Quebec male populations (Figure 13). These figures are striking and dramatize the premature mortality pattern of Cree females in the period under study.

Figure 12

PYLL rate per 100 000, all causes ; Cree, Canada, Quebec and Territories, 1982 to 1986, females under 75.

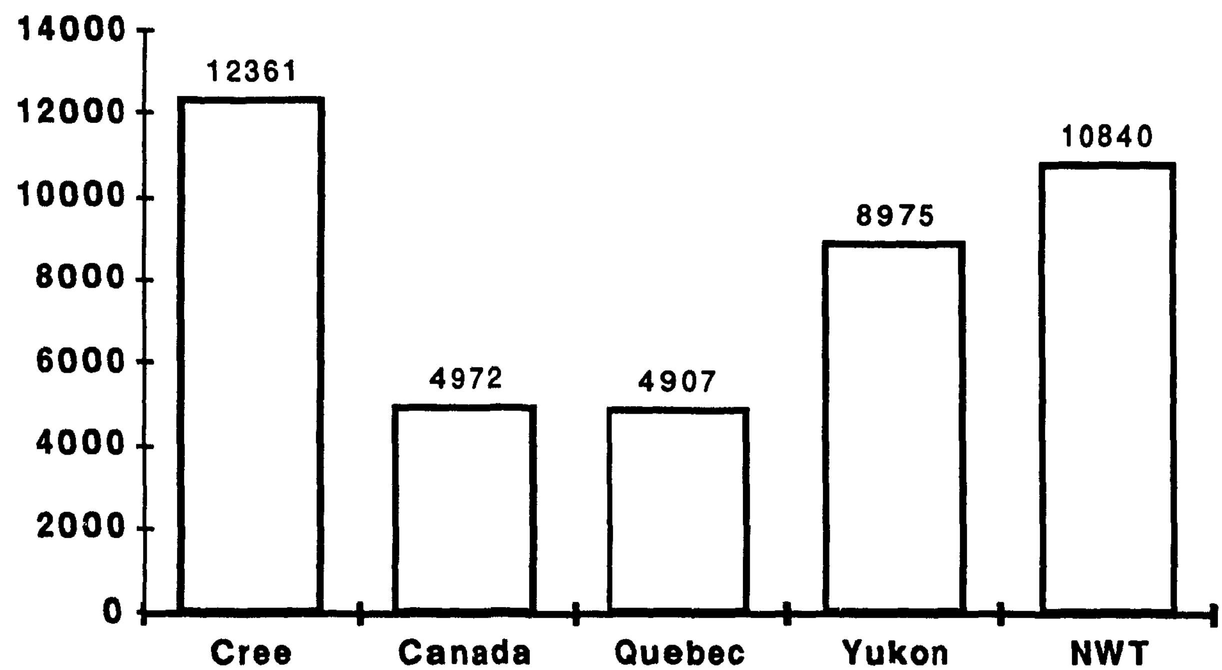
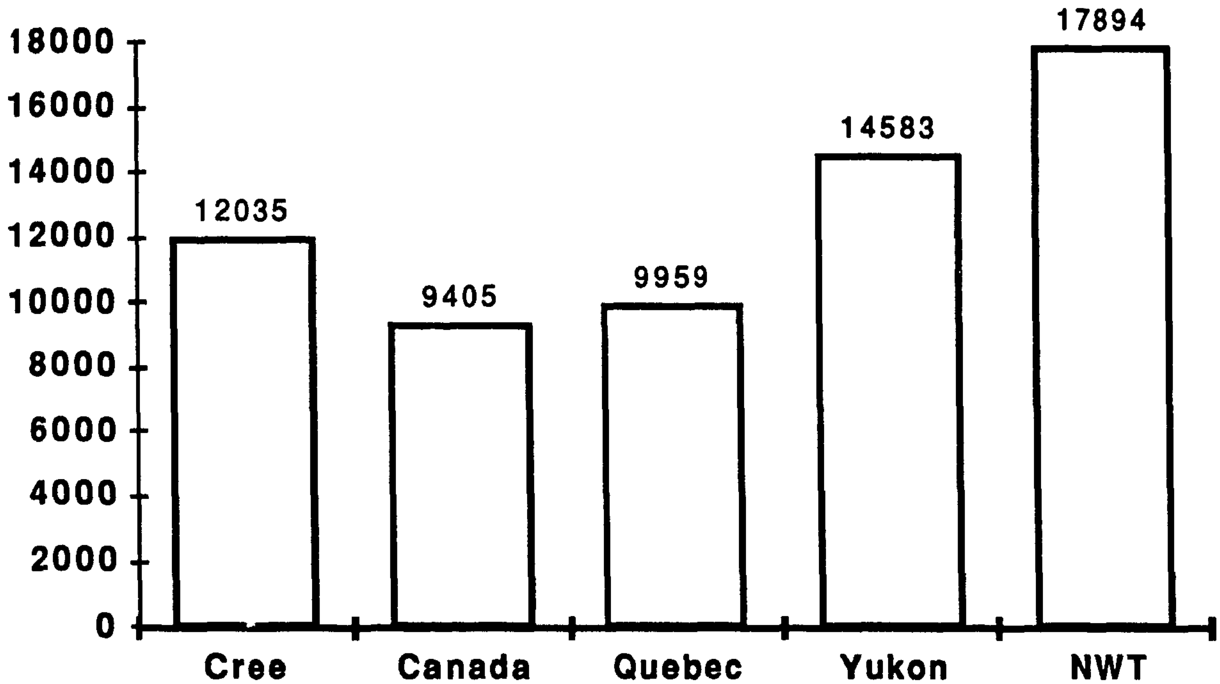


Figure 13

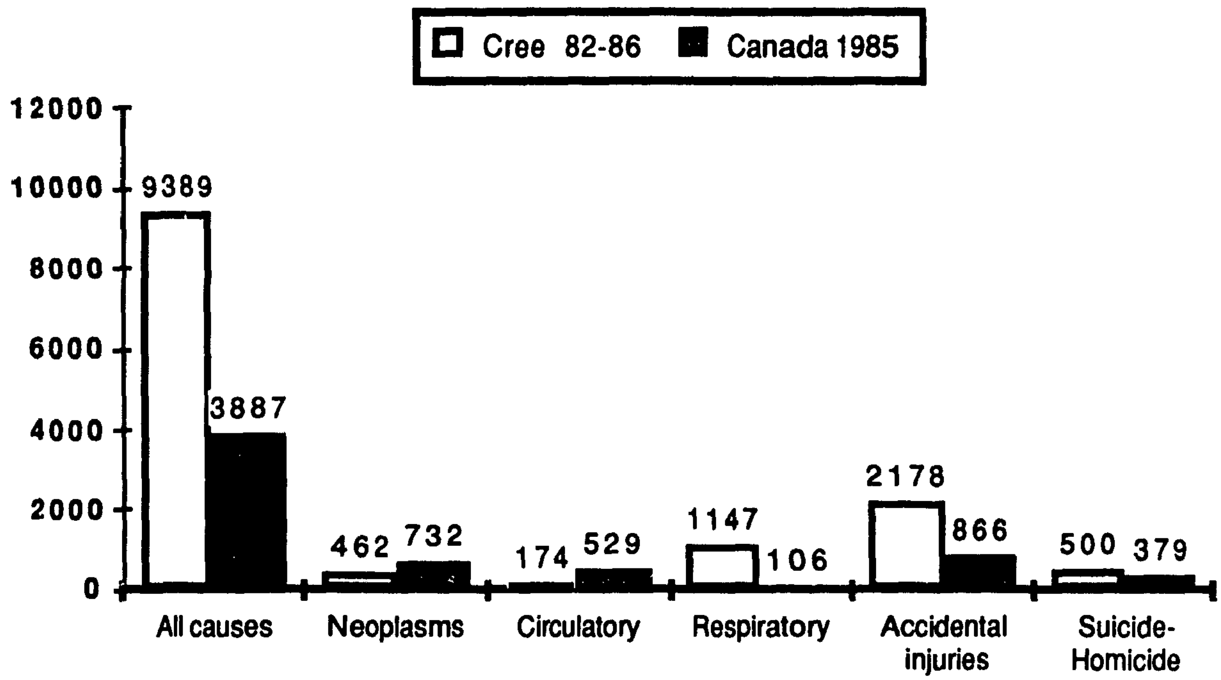
PYLL rate per 100 000, all causes ; Cree, Canada, Quebec and Territories, 1982 to 1986, males under 75.



In Figure 14, we use another variant of the indicator (0-65), and compare the Cree in the 1982-1986 period to the Canadian experience in 1985[60], in terms of all-cause mortality, and for various disease conditions. The extent of prematurity of Cree deaths is striking, with a ratio of almost 2.5 times more years lost from all causes by the Cree, per 100,000 population. These rates are not standardized, and they reflect the actual extent of premature mortality experienced by the Cree. Large relative excesses in potential years of life lost were due to respiratory diseases (ICD, VIII) and unintentional injuries (E800-E949), while the Cree experienced less premature mortality by neoplasms (ICD, II) and circulatory diseases (ICD, VII). On the other hand, suicide & homicide (E950-E969) were responsible for slight excesses in years lost. These findings confirm and somewhat amplify the mortality pattern revealed by the standardized mortality ratios.

Figure 14

PYLL rate per 100 000, ages 0-65. Comparison between the average rates of years lost in the Cree of northern Quebec for the period 1982-1986, and the rates in the Canadian population in 1985, for deaths from all causes, neoplasms, circulatory diseases, respiratory diseases, unintentional injuries, and suicide & homicide.

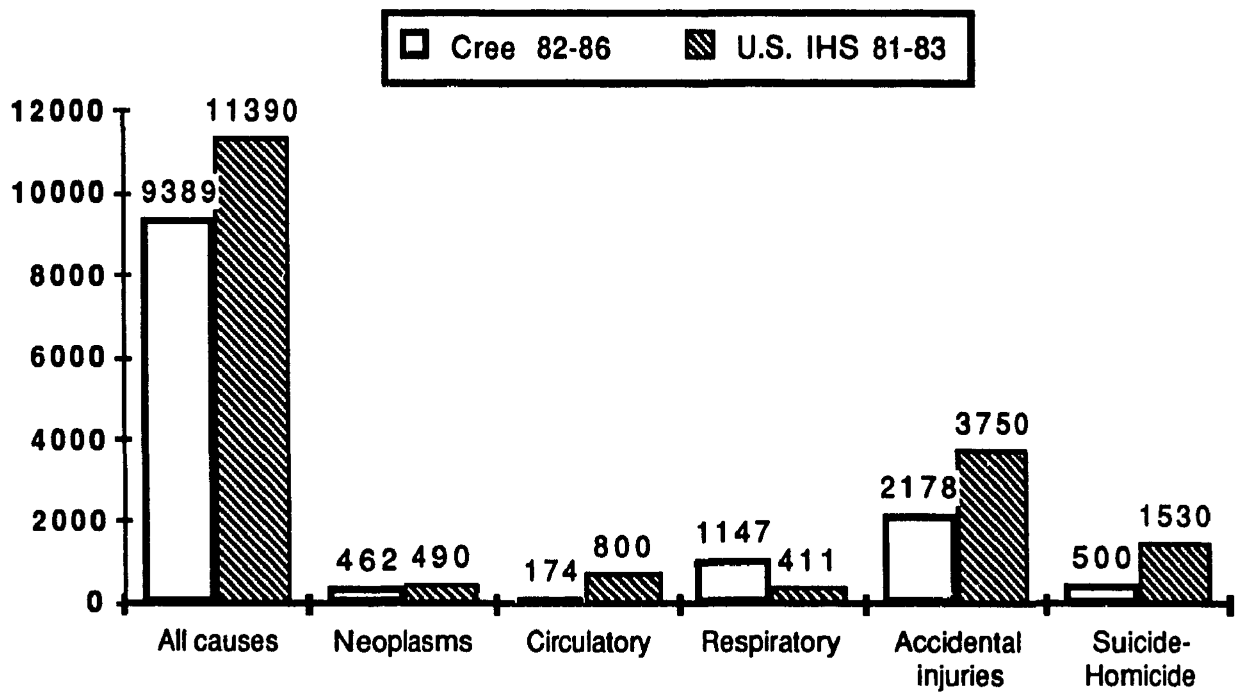


Although we did not insist until now on comparisons between the Cree and other Indian groups across Canada and the U.S., we will introduce various elements of data from native populations for discussion in the following section. At this point, let us repeat the exercise of comparing the Cree in terms of potential years of life lost from birth to age 65, this time to the American Indian population under the responsibility of the Indian Health Service. The data recently published[61] refers to various geographic areas scattered across the United States, and is based on the analysis of 5207 deaths during the three year period 1981-1983. Figure 15 provides a graphic comparison identical to the previous one, where the Cree seem to fare better than the American

Indians, except for diseases of the respiratory system. Although these findings must be interpreted with caution because they refer to different time periods, they are interesting and the age distribution of the two groups are similar.

Figure 15

PYLL rate, per 100 000, ages 0-65. Comparison between the average rates of years lost in the Cree of northern Quebec during the period 1982-1986, and the rates in the American Indian population under the responsibility of the Indian Health Service from 1981 to 1983, for deaths from all causes, neoplasms, circulatory diseases, respiratory diseases, unintentional injuries, and suicide & homicide.



6.10 Inland and coastal mortality rates

The five coastal communities of Wemindji, Waskaganish, Chisasibi, Eastmain and Whapmagoostui are relatively isolated (as well as the small inland community of Nemaska), and share a pattern of health services dependent on local nursing stations, air evacuation, and medical care in hospitals in Chisasibi and Val D'Or. By contrast, the two largest inland communities, Mistassini and Waswanipi, are accessible by road and relatively close to Chibougamau, where most hospital-based services are provided. In these last two communities, exposure to motor vehicles is greater, and the availability of various goods and services has had a longer influence on the traditional Cree way of life. For all these reasons, health data has traditionally been presented separately for inland and coastal communities, and has lead to various interpretations related to demographic, social and economic factors.

Traditionally, the coastal communities performed better in terms health indicators. For the period 1982-1986, the data relative to live births, stillbirths, infant deaths and total deaths, in the inland versus the coastal communities, is summarized in Appendix 9. Mortality rates in the first year of life are presented in Table 6. They show that the inland communities have neonatal and postneonatal mortality rates that double those of the communities on the coast, while perinatal death rates are strikingly similar.

Table 6

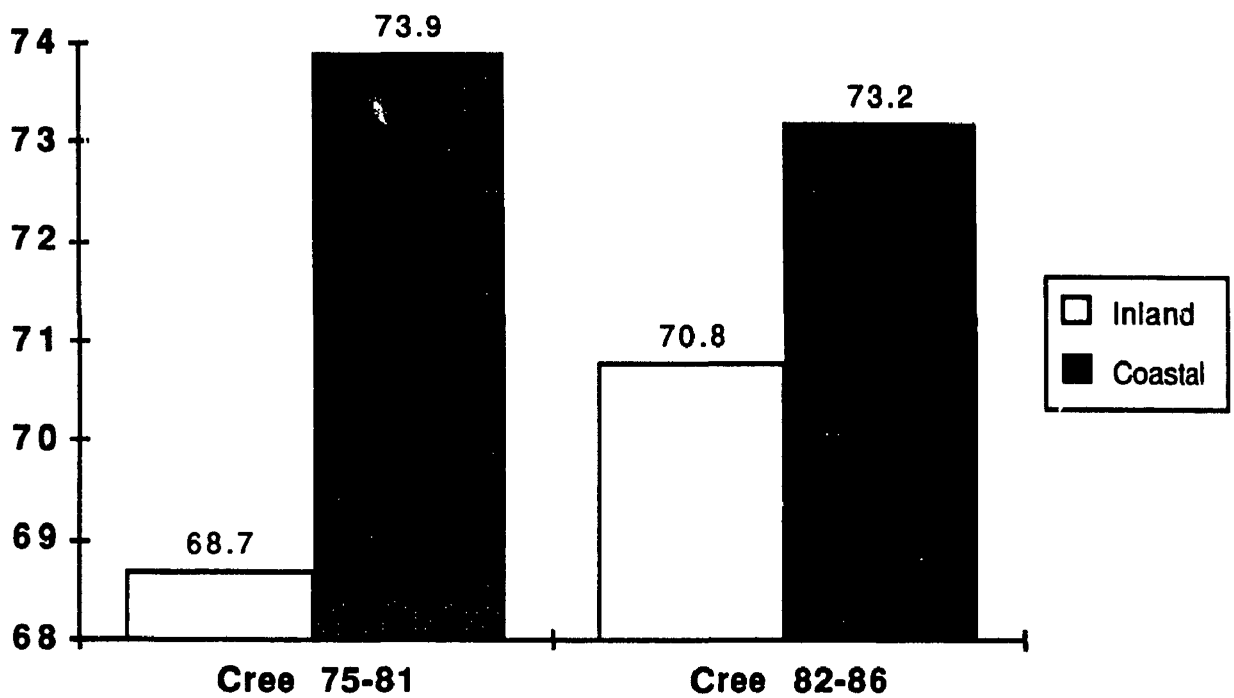
Comparison of inland vs coastal Cree communities : perinatal, neonatal, postneonatal and infant mortality rates, with 95% confidence intervals, 1982-1986.

Mortality rates	Inland (95% CI)	Coastal (95% CI)
Perinatal	6.6 (1.3-19.5)	6.9 (2.2-16.3)
Neonatal	4.4 (0.44-16.0)	1.4 (0.1-7.8)
Postneonatal	20.0 (8.9-38.0)	11.0 (4.8-22.1)
Infant	24.4 (12.0-43.7)	12.6 (5.6-24.0)

The same tendency is observed in terms of life expectancy at birth, which is higher in the coastal communities, as shown in Figure 16. However, life expectancy has dropped slightly in the five coastal communities between the periods 1975-1981 and 1982-1986, and the differences between the two regions seem to be narrowing, with the three inland communities of Waswanipi, Mistassini, and Nemaska experiencing an increase of two years in life expectancy at birth between the two periods. At age one, the residents of these communities can expect to live 71.1 more years, while residents on the coast live on average 73.1 more.

Figure 16

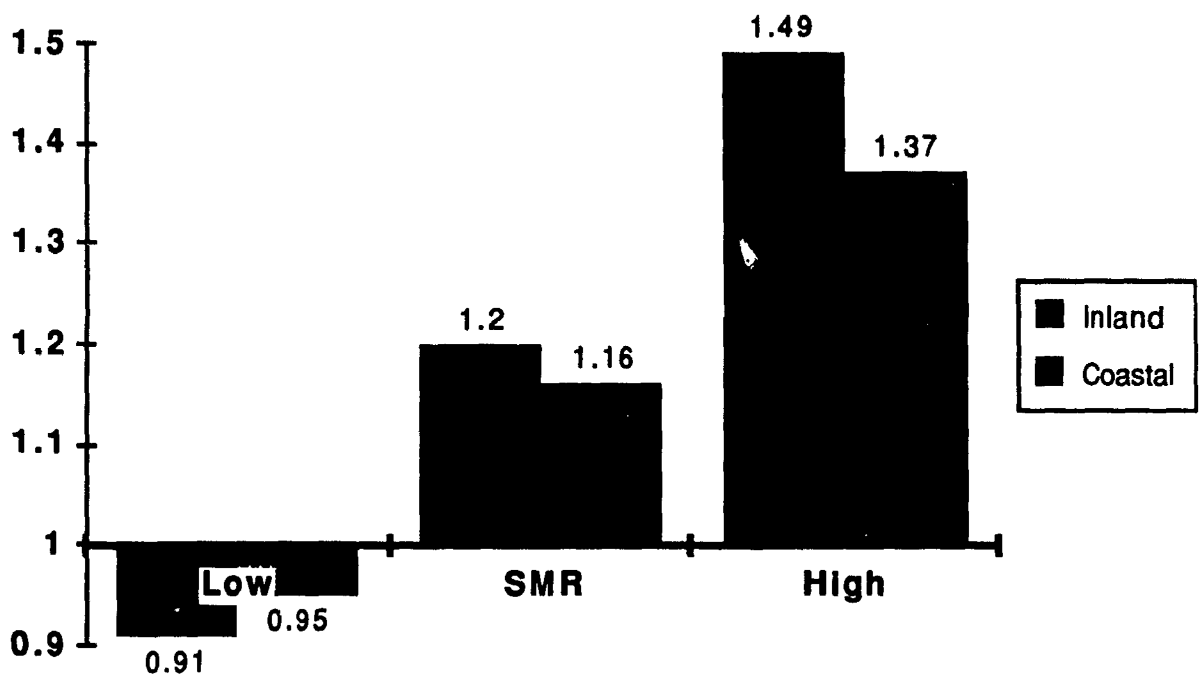
Comparison of life expectancy at birth, in years, for inland vs coastal Cree communities, 1975-1981 and 1982-1986.



We calculated standardized mortality ratios for all causes of death combined, in inland and coastal communities. Figure 17 shows that the SMRs are almost identical, suggesting that the large excesses in infant mortality experienced by the inland communities are compensated by lower death rates after age one.

Figure 17

Standardized mortality ratios to the Canadian population in 1984, all-cause mortality and 95% confidence intervals (Low-High), comparison of inland and coastal Cree communities, 1982-1986



In addition to the analysis of differences between inland and coastal communities, we provide in Appendix 10 a complete breakdown of deaths and stillbirths by community, as coded by ICD-9 categories, by age groups and by gender. This may be of interest to local residents, leaders and providers, as an overview of the mortality experienced in their own community.

7. Discussion

7.1 Preliminary considerations

This study is intended to provide a comprehensive review of the mortality experienced by the Cree Indians of James Bay in the five year period 1982-1986. The rationale behind such a study is to identify patterns, causes of death, or specific age groups for which prevention of unacceptable, untimely or premature deaths is feasible, and to gain insight on priorities for action.

The limitations of the present study can be largely accounted for at a first level by the use of data from death certificates, registries, and census output to conduct mortality surveillance; and at a second level, by the inherent limitations of the interpretations that can be made concerning the health of a population solely from mortality statistics.

Important health problems may be overlooked by an analysis of mortality statistics : a classic example is alcohol abuse. Rhoades (op.cit.) states that alcohol is the leading and perhaps the most costly risk factor among Indians. Alcohol misuse underlies many major causes of Indian deaths in American reservations and contributes to an array of physical conditions treated by the Indian Health Service. An estimated 75% of all traumatic deaths and suicides among American Indians involve alcohol, and deaths from chronic liver disease and cirrhosis represent 5% of all deaths. Alcohol was mentionned specifically in relation with only six deaths from the data sources used in the present study. Alcohol intoxication was mentioned as the underlying cause of one death, and as a contributing cause in two accidental deaths and one suicide. Chronic alcoholism was mentionned in relation with only two deaths, one by cirrhosis of the liver and the other from myocardial infarction. There seems to be a discrepancy between perceptions of the importance of alcohol-related deaths in the Cree, and their actual reporting. This is true of most socially inacceptable behaviors, and the burden of suicide, mental illness, child abuse and neglect, and substance abuse in general, are not adequately reflected by death certification.

In this section, we will discuss the general mortality patterns which emerge from four main estimates of risk : life expectancy, age-specific mortality rates, standardized mortality ratios, and potential years of life lost. Infant mortality and mortality among Cree children will be discussed separately, and finally we will review selected specific causes of death delineated by the Ninth International Classification of Diseases. This pathway should allow us to cover all the conclusive findings from this study, and to establish links with pertinent data available from other native and non-native populations.

7.2 Life expectancy

Values of life expectancy at birth calculated for Cree males and females, and for the Cree population as a whole, are comparable to those of industrialized countries such as Italy, Poland and Portugal, and greater than those observed in any country in South America[62]. Life expectancy at birth remains lower than that observed in Canada and Quebec as a whole, and is now similar to that of residents of the poorest districts of Montreal (Hoey et al., op. cit.). Cree life expectancy at birth is similar to that of Canadian Indian reserve residents[63], and is much greater than in the Quebec Inuit population[64]. Gaps between Quebec statistics and findings for Cree males and females have increased between the periods 1975-1981 and 1982-1986, with Cree men loosing 1.3 year and females 3.3 extra years of expected life to their Quebec counterparts. The difference between Cree males and females has decreased from 3.4 to 2.1 years, in accord with Canadian trends since 1975.

Life expectancy at birth for the Cree population as a whole was 71.9 years for the study period, while life expectancy at age one stood at 72.2 years, illustrating the continuing burden of infant mortality to this population. It is striking that Cree female infants account for this tendency alone, males living shorter lives on average at age one than at birth. Trends in Canadian statistics show that life expectancy at birth exceeds life expectancy at age one in both sexes since 1975, and that the difference is increasing[65]. The life expectancy at age 20 in the Cree, for both sexes combined, was of 50 years compared to 57.5 for Canada, at age 40, the Cree lived on average 31.7 more years, and Canadians 38.4. This indicates that the Cree continue to experience decreased longevity even after childhood and adolescence.

7.3 Age-specific mortality rates

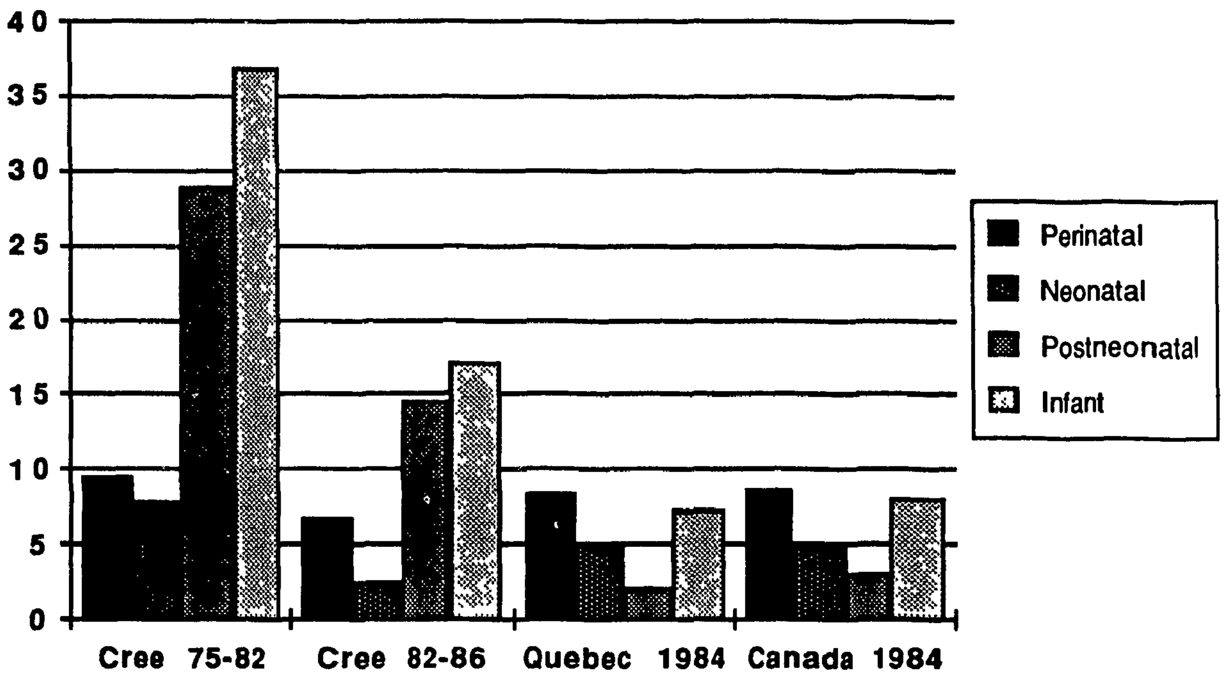
You will recall, from the data presented in figure 7, that the Cree experienced excesses in age-specific mortality rates in all the age groups, except over 65 years of age (this is called the "healthy survivor effect"). These findings are coherent with other studies which compared age-specific death rates among North American Natives to non-native reference populations, but important differences also exist. A review of program statistics published by the American Indian Health Service in 1983[66] shows that during the period 1977 to 1979, Indians and Alaska Natives generally experienced higher age-specific death rates than Americans as a whole, and that the greatest relative excesses were in the age groups 25-34, 15-24, and 35-44 respectively. Among residents of Canadian Indian reserves the picture reported by Mao (op.cit.) is similar, with Indian rates exceeding Canadian rates in all age groups under 60, and largest relative excesses being found in young adults, male and female.

In the Cree, the relative burden is shifted towards the younger age groups. In terms of relative risk, the Cree were twice as likely to die in their first year of life than other Canadians, almost nine times as likely to die from ages 1 to 4, and more than twice as likely from 5 to 14. Cree infants and children also experienced the largest absolute excesses, and probably represent the age groups where public health gains are the most desirable in terms of prevention of untimely deaths. For this reason, we will discuss the causes of mortality in these age groups specifically, before reviewing the various causes of death in the whole population.

7.4 Infant mortality

The medical litterature on Indian infant mortality in Canada generally describes a pattern of elevated mortality in comparison with white infants, and differences are most often attributable to excess deaths in the postneonatal period (Last, Morrison, op. cit.). In the U.S. the overall infant mortality rate is no longer higher for the Indian Health Service (IHS) than for the general population, but this has been achieved despite high postneonatal rates, at the expense of lower perinatal and neonatal death rates (Rhoades, op.cit.). A similar picture is emerging in the Cree population, but excesses in postneonatal mortality are much more important, and infant mortality still stands at about twice Quebec and Canada levels. Figure 18 provides a graphic illustration of patterns in rates observed in the Cree, and in the provincial and national populations.

Figure 18 : Illustration of perinatal death rates and mortality rates in the first year of life, for the Cree of northern Quebec 1975-1981 and 1982-1986, and the populations of Quebec and Canada in 1984.



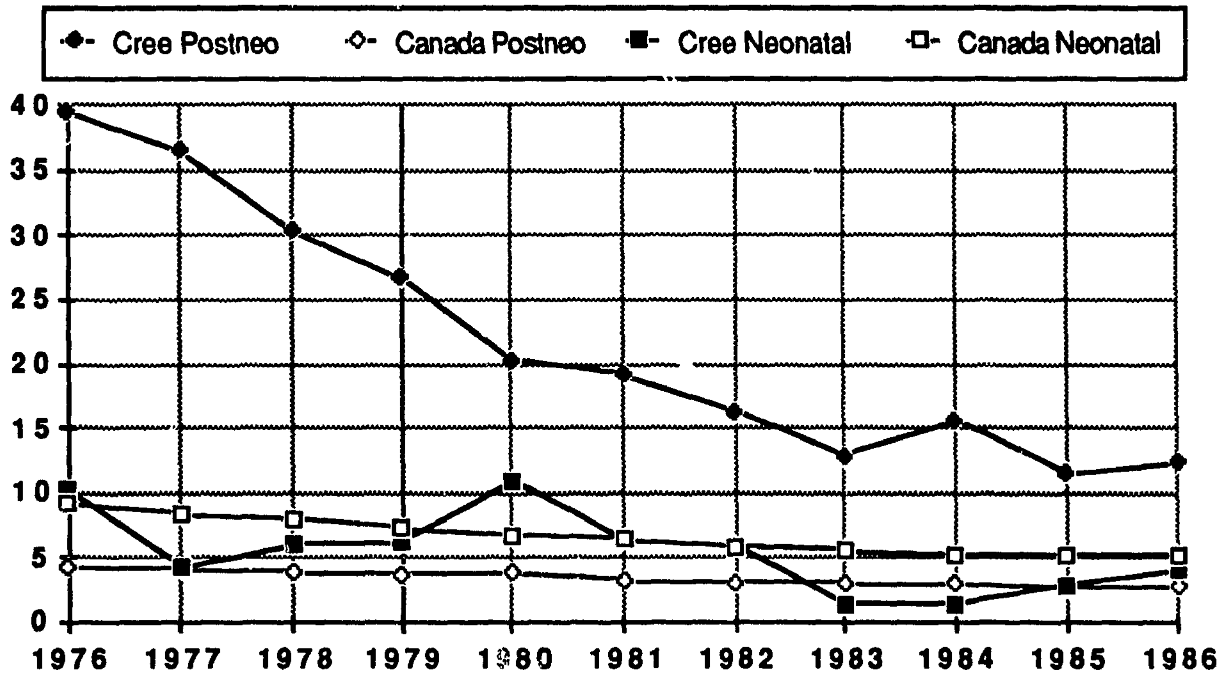
In the perspective of reviewing policies relative to obstetrical practices in the Cree coastal communities, Robinson conducted a study in 1986 to review perinatal mortality in the 1975-1984 period.[67] Despite the relative lack of sophisticated neonatal or obstetrical services in these communities, and despite experience suggesting high prevalence of maternal risk factors, low perinatal rates were the rule. Our study confirms these findings, and suggests that perinatal death rates are low in the inland communities as well. Could we be missing some stillbirths or neonatal deaths? Live births are unlikely to go unrecorded, since clinics are staffed with nurses in every village, and prenatal care is provided to all women, with very few exceptions. Any death of a resident of the village is known, and funeral services are held. However, it is theoretically possible that in families spending extended periods in the bush, the early death of a premature child or a stillbirth could go unrecorded.

There was perfect concordance between official stillbirth certification in the first four years of our study period, and reports by the nursing clinics. Certificates for 1986 were not available at the time our work was undertaken. Robinson suggests that "part of the explanation (for the low perinatal death rates) may be that evolution has favoured natural selection of women who deliver easily and have large, healthy babies". Mean birthweight is high, and low birthweight rate is only 2%, versus 5.25% in Canada and 5.82% in Quebec in 1984 (Statistics Canada, 1984).

Both the average neonatal and postneonatal mortality rates have improved dramatically between 1975-1981 and 1982-1986, and the average neonatal rates for the latter period are now lower than Quebec and Canadian rates. There is no reason to believe that this is due to a lack of reliability in the data, and the factors which favor survival of Cree babies in the first days of life probably have an incidence on all the neonatal period. Cree babies fare better from birth to 28 days than their IHS counterparts (5 deaths per 1000, 1981-1983) and than other Canadian Indian babies (6 deaths per 1000 in 1983). Trends indicate that while postneonatal rates have been improving rapidly, three-year average neonatal rates have remained fairly stable in the Cree since 1977 (Figure 19), and may have reached an irreducible minimum.

Figure 19

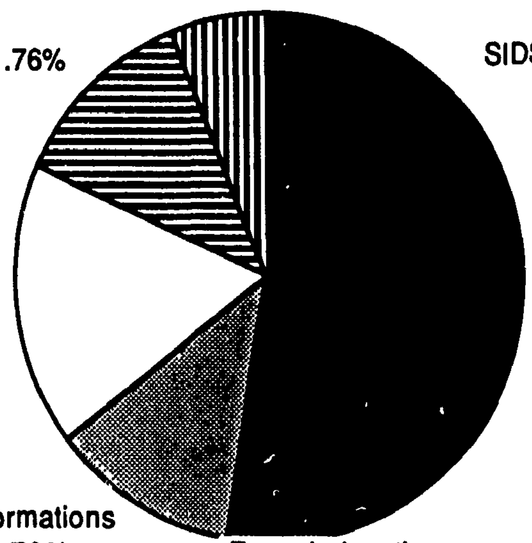
A comparison of trends in neonatal and postneonatal mortality, between Cree three year running average rates and Canadian rates, for the period 1976 to 1986.



The disproportionate number of infant deaths occurring in the postneonatal period for the Cree population suggests that their postneonatal experience in some way lessens their chance of survival after they complete the neonatal period. This may not be entirely true. While neonatal deaths in our study, in accord with general patterns, have been caused by prematurity, malformations and birth trauma, the leading causes of postneonatal mortality in the North American population are related to sudden infant death syndrome (SIDS), acute medical diseases, and accidents. These causes were important in the Cree, but they also experienced dramatic mortality from congenital malformations and genetic diseases (as illustrated in Figure 20), and these causes originate from the perinatal period, rather than from specific socioeconomic or environmental conditions prevailing in the postneonatal period.

Figure 20

Summary of the distribution of the causes of death (%) observed during the postneonatal period in the James Bay Cree of northern Quebec, 1982-1986



Causes of genetic origin accounted for 7 of the 17 deaths observed during the postneonatal period. They almost all occured in tertiary care hospitals. Three deaths were attributed to Cree Familial Leukodystrophy, two deaths were due to unspecified encephalopathies (present since birth), and two more to congenital malformations.

Cree Familial Leukodystrophy (ICD-9 code 3300) death rates probably remained stable around 2.5 per 1000 live births between the periods 1975-1981 and 1982-1986. Assuming that the two other deaths coded as "encephalopathy" (code 3483) represented the same disease entity, the rate could be as high as 4.3 per 1000 in this study. The genetic pattern for this disease has been recently described by Dr. Deborah Black[68] among Cree families in Chisasibi, but migrations may extend the burden of this disease to other Cree communities. Two types have been described; death generally occurs before the end of the first year of life in Type I, and during childhood in

Type II. The overall rate of all nervous system and sense organ diseases in the postneonatal period in Canada was .07 per 1000 live births in 1984. Had this rate been observed in the Cree, their postneonatal mortality rate would have been a more acceptable 10.3 per 1000. Furthermore, since four of these five deaths occured on the coast, these communities would have experienced a postneonatal death rate of only 5.6 per 1000, representing the proportion we usually associate with socioeconomic and environmental conditions.

The preventability of these genetic conditions affecting the central nervous system is highly uncertain, and requires sufficient knowledge for efficacious genetic screening and counceling. More research will be needed and many practical and ethical considerations will have to be addressed before these diseases are eliminated from the Cree genetic background.

Two deaths in the postneonatal period were attributable to congenital anomalies, for a rate of 1.7 per 1000 live births, compared to 0.66 for Canada in 1984. Three deaths were due to infections. Two were coded as infections of the respiratory system, and one as a skin infection (ICD category XII). The latter death occured as a systemic infection, with meningitis and pneumonia. Two of the three deaths from infectious diseases occured during transportation from the residence to the hospital or the nursing station, suggesting delays in referral. The postneonatal death rate from respiratory tract infections in our study was 1.7 per 1000, over 10 times the Canadian rate.

Two deaths by unintentional injuries occured during the study period, and both involved transportation in motor vehicles. One death was caused by multiple trauma in a motor vehicle accident, and the other by suffocation (currently the leading cause of accidental deaths in Canadian infants), on a sled pulled by a snowmobile. A lot of accent has been placed on prevention of these types of infant deaths in North America in recent years, with emphasis on parent education and passive restraint measures. Unintentional injury rates in Cree infants were about ten times Canadian rates.

The sudden infant death syndrome is now the largest single cause of infant mortality in the western world[69], striking one or two of every 1000 infants before their first birthday. It is the first cause of postneonatal mortality in Canada, with rates ranging from 1.1 to 1.3 per 1000 live births in the mid-1980s. In Ontario, rates seem to be declining, falling below one per 1000 in 1985, but this may be a matter of terminology. The rate observed in our study was 3.43 per 1000, which is lower than the rates in the order of 5 or 6 per 1000 reported in American Indians and Alaskan Natives. The increase in Cree rates from the period 1975-1981 is probably due to an increase in reporting, and this may account for the observed decrease in deaths of unknown origin.

SIDS rates are systematically higher in males in studies conducted in Canada, in the U.S., and in American Indians. The male to female ratio is usually from 1.5 to 2.0, in contrast with the 0.33 ratio we observed. It is interesting to note that one death attributed to SIDS (code 7980) also occured in a 13 month old Cree boy, and that only four deaths were labeled SIDS after one year of age in Canada in 1984 ! The diagnostic criteria for the condition are vague, and although at least one of the Cree infants in our study had an autopsy, SIDS remains a diagnosis of exclusion. Preventability of this condition is still illusory, and various interventions involving intensive surveillance of infants at high-risk have not yet been proved efficacious.

Of the 20 infant deaths reported in our study, 14 occured in females. Again, this finding contrasts with our expectations, since there is no biological reason to explain such a difference in incidence between males and females. In fact, all the causes of death affecting Cree infants are usually more common in males, and the overall male to female ratio for infant mortality was 1.23 in 1984 in Canada. What is the probability of a 6:14 split, or of an even more extreme split occurring by chance only? A simple computation based on the properties of the binomial distribution[70], assuming a 50-50 risk in each sex in the long run, sets this probability at .0577. The excess female risk persists through childhood : the male-female split is 4:6 in the 1-4 age group, and 2:5 in the 5-14 group.

These findings are difficult to explain, and they have an important incidence on the calculation of sex-specific indicators in this study. Infant mortality accounted for 43% of all potential years of life lost from 0 to 75 in females, versus only 19% in males. The high mortality rate in female infants also had an incidence on standardized mortality ratios and life expectancy at birth calculated for Cree females, and this has to be kept in mind. For example, had the sex ratio for deaths been 1 : 1 in the first year of life, the PYLL 0-75 in females would have been reduced to 10,843, or approximately the level experienced by females in the Northwest Territories (See figure 12). Also, given that the number of years lost from 0 to 75 for males and females is similar, it is important to notice that Cree women live much longer on average than Cree men after they survive through childhood. At age 20, women live on average till 77 years old, and Cree men live on average till 73.

7.5 Mortality in Cree children (age groups 1-4 and 5-14)

You will recall that Cree children are more than eight times more likely to die than Canadians between ages one and five, and 2.5 times as likely between 5 and 15. The causes of death implicated are detailed in the two first tables of Appendix 6.

Although only one death was formally coded as such (the two others were assigned the codes of complicating infections), the Cree Leukodystrophy syndrome was responsible for three deaths among Cree children. Other systemic diseases present since birth were contributive to at least two of the deaths by infections in the 1-4 age group. Overall, infections were the immediate cause of death in at least seven of the 17 deaths in Cree children between ages 1 and 15. Accidental drownings, suffocation, respiratory obstruction by food, and homicide claimed 6 lives, for an overall rate of 215 per 100,000 population in this age group. The corresponding Canadian rate for all injuries and poisonings (ICD category XVII) was only 15 per 100,000 in 1984...

A review of the causes of death experienced by the Cree in childhood and in their young teens, illustrates similarities between mortality patterns in children and adults. Risk reduction strategies are required by these excess deaths from infectious diseases, accidents, and violence. They include safer environments, enhanced immunity by better nutrition and adequate immunization, and prudent health care[71]. Sensible behavior, including the use of child safety seats in cars and of life jackets in boats, the avoidance of alcohol when driving motor vehicles, and better awareness of the risks of suffocation in infants and young children, are susceptible of preventing the majority of accidental deaths in this age group.

7.6 All-cause standardized mortality ratio and potential years of life lost

Let us now consider how we can analyze the information given by these two indicators regarding the general mortality pattern of the Cree population for the period 1982-1986. You will recall that the age and sex-standardized all-cause mortality ratio stands at 1.15, and that this excess is barely significant (95% confidence interval = 0.98 - 1.31). This means that there is a 15% excess in the **number** of deaths that was observed (181), as compared with the number of deaths that would be expected (158) if the relatively young Cree population had experienced Canadian age and sex-specific death rates. Indirect standardization does not take into account the extent of prematurity of the deaths in the smaller population, but only the total number in all age groups. The 15% excess in observed counts are not as impressive as the 142% excess in potential years of life lost by the Cree from birth to 65 years old. We already know that much of this excess originates from mortality in the younger age groups, and we will further analyze what are the contributions of specific ICD-9 categories of causes to the total years lost.

It is important to note that the potential years of life lost rates reported in this study are not age-standardized. Standardization can be achieved by using the expected number of deaths calculated from the age structure of the reference population, to adjust the observed number of years lost observed. We did not perform age standardization, because our goal was to demonstrate the actual experience of the Cree population in terms of premature mortality. A striking example of the effect of the Cree age structure is the rate for circulatory diseases. It appears lower than it should in the Cree versus Canada as a whole, because the incidence rates for ischaemic heart disease are highest at middle or older ages. Nevertheless, in absolute terms the indicator shows that circulatory diseases (or cancer) are not important contributors to premature mortality in the Cree population...

The all-cause standardized mortality ratio computed for the present study period indicates an improvement from the SMR of 1.4 reported in Robinson's study. In strict terms however, these ratios are not directly comparable, since they are not standardized to the same reference population. In practice, the relative age and sex structure of the Canadian population has not changed enough between 1978 and 1984 to significantly invalidate this comparison. It must also be noted that Cree women experience greater excess mortality than men in terms of total number of deaths (SMR = 1.49), yet they live longer.

7.7 Infectious diseases

The first ICD-9 category does not include some deaths from infectious diseases that are attributable to a specific organ system, such as pneumonia, meningitis, or gastroenteritis. Beyond this artificial classification, infectious and parasitic diseases have traditionnally been deadly in the Cree and in other native populations. The conditions for this are no longer present in many Cree communities, namely overcrowding of houses, absence of proper sewage systems, running water, and refrigeration, and inadequate immunization. However, to a certain extent, Cree adults and children are still exposed to a high-risk environment in bush camps and fishing camps, where up 50% of the population may spend most of their time. For example, outbreaks of gastroenteritis still occur despite modern facilities, and symptoms of gastrointestinal infections are known to be prevalent in bush camps.[72]

Nevertheless, the number and severity of infectious and parasitic diseases seem to be declining in the Cree. The SMR for deaths coded in category I of the Ninth International classification still stands around five, with a confidence interval that does not include one. Category I included 4.8% of deaths in Robinson's study, down to 2.8% from 1982 to 1986.

Tuberculosis is no longer a problem that is apparent in terms of mortality, although it remains a burden to the Cree, requiring special activities such as BCG vaccination of infants. In the younger age groups, infections often precipitate death in immunocompromised or abnormal children, and the underlying condition is often not preventable.

Many deaths are probably due to the increased distance from health care when families are in the bush. However, we found that some deaths by infections, especially respiratory, are probably preventable by increased awareness and earlier referral by parents, as the availability of health care in local nursing stations is probably adequate in all the villages. Primary care nurses and physicians working in the communities should be aware of the high mortality rates from respiratory tract infections in Cree infants and children, and increase their threshold for aggressive surveillance or therapy accordingly.

7.8 Neoplasms

North American Indians are considered to be a population at low risk for cancer, and this is specially true of the cancers that are the most lethal in the Canadian population, namely breast, lung and colon cancer. In the 1975-1981 study, the SMR for cancer was 0.72, but the incidence of cancer was assumed to be rising, in accord with the gradual modification of nutritional habits, increases in cigarette smoking, and environmental changes. The latency period of most cancers is very long however, and excess in cancer mortality may not show up before the next decade. The following Table summarizes the data relative to Cree deaths due to malignant tumors during the period 1982-1986.

Table 7

Summary of deaths due to cancer in the James Bay Cree of northern Quebec, 1982 - 1986.

Tumor site	Number
Digestive tract general	2
liver	3
pancreas	3
oesophagus	1
colon	1
rectum	1
Trachea, bronchus & lung	8
Lips, oral cavity & pharynx	1
Leukemia	1
Kidney	2
Prostate	1
Breast	2
Undetermined	5
TOTAL	31

Table 7 (continued)

Cree population	SMR	95% CI
Males	0.75	0.44 - 1.18
Females	0.87	0.46 - 1.50
Both sexes	0.80*	0.54 - 1.13

* Age and sex-standardized

Tumor site	SMR	95% CI
Digestive tract	1.05	0.51 - 1.87
Pancreas	1.71	0.34 - 5.01
Trachea, bronchus, lung	0.61	0.26 - 1.21
Kidney	1.22	0.12 - 4.40
Female breast	0.66	0.07 - 2.39

In terms of statistical significance, the present study did not reveal any difference between Cree cancer rates in general, and Canadian rates. Nevertheless, point-estimates of the standardized mortality ratios obtained for males, females, and both sexes combined, are consistently below the national average. Cree females had a higher incidence of death by cancer than males, and this is contrary to observations made on Canadian reserves (Beauvais, op. cit.). Cree females died mainly from digestive tract cancers, rather than from cancers specific to their gender. Cancer of the cervix was not an important contributor to deaths by neoplasms in our study, and breast cancer mortality in Cree women seemed to be relatively rare.

Lung cancer mortality is high on Canadian reserves (SMRs in the order of two to three), but appears to be lower than Canada's as a whole in our study. This may be explained by the fact that the Cree smokers who are now in the age groups at risk for lung cancer tended to smoke less than Canadian smokers of their age.

Kidney cancer is of special interest, since exposure to methylmercury is known to cause kidney parenchymal cancers in mice, and has been proved to be a important contaminant of fish eaten in the Cree communities.[73] We were not able to demonstrate a statistically significant increase in kidney cancer in our study, but of course the observed numbers are quite small, and again the latency period from the beginning of heavy exposure to death may not yet be over at this time.

All three cases of liver cancer in our study were coded as "either primary or secondary". Although metastatic liver cancer is much more common than primary liver cancer in general, the possibility of an increased incidence of malignant transformation resulting from chronic active hepatitis B must be kept in mind in this population.

7.9 Endocrine diseases

The main question concerning this disease category is whether diabetes is now a significant lethal condition in the Cree, as the prevalence of this condition is thought to be increasing, mainly because of changes in diet and a more settled way of life. Diabetes was not a significant underlying cause of death during the study period (only 2 deaths), but it did show up as a contributor in seven of the 37 deaths from circulatory diseases. This is consistent with the fact that diabetes-related deaths are underestimated by simple coding of the underlying cause of death, and appear more often in a multiple-cause-of-death approach. In order to describe diabetes-related deaths more accurately as prevalence and reporting increase, future studies in the Cree will have to use this approach.

7.10 Circulatory diseases

Previous studies on American Indians have consistently shown low levels of coronary heart disease, and equal or higher rates of cerebrovascular disease than the general population. Although genetic factors may explain the relatively low levels of coronary artery disease among certain Indians[74], it is considered more likely that American Indians have a lower accumulated exposure to extrinsic risk factors. In Canada, the prevalence among Indians of risk factors such as obesity, diabetes, high blood lipids, hypertension, and smoking, is high and thought to be increasing. This translates in rates of cerebrovascular diseases that are already 2-3 times higher in residents of Canadian Indian reserves, while rates of deaths from coronary heart disease specifically are equal to those observed in the corresponding county population (Beauvais, op.cit.). Age-standardized mortality ratios for coronary heart disease and cerebrovascular disease have been shown by Mao (op. cit.) to be higher in women than in men on Canadian reserves.

Blood cholesterol levels in the Cree of northern Quebec are lower than the levels observed in Quebec, but smoking and obesity are more common and increasing.[75] The traditional Cree diet consisted of game, fish, berries, and plant teas, and included the organs and viscera.[76] The diet was high in protein, provided the necessary nutrients, and may have protected people from heart disease, cancer, and dental cavities.[77]

Although longitudinal data on the prevalence of cardiovascular risk factors in the Cree are still scarce, we assume that changes in the traditional way of life which have taken place since the early 1970s will eventually produce rising death rates from circulatory disorders, and from ischemic heart disease in particular. The present study does not yet reveal such a tendency in cardiovascular mortality.

Standardized mortality ratios for circulatory diseases as a whole are low in the two periods 1975-1981 (SMR=0.77) and 1982-1986 (SMR=0.60), and in the latter case at least the standardized rate is significantly lower than Canada's. The interpretation of these findings is challenging because we expected the rates of arteriosclerotic cardiovascular diseases, which account for most of deaths in category VII, to be increasing while the Cree accumulate exposure to higher levels of risk factors. The changes in nutritional, lifestyle, and smoking habits are probably too recent to have a significant effect on mortality from ischaemic heart disease. The observed decrease is not statistically significant (the confidence intervals overlap), and could be artifactual (for example related to coding "fashion"). The findings from the present study indicate that cardiovascular diseases are a problem which is relatively less important in the Cree population than it is in Quebec or Canada, and that this appreciation is even more true in terms of premature mortality (see Figure 14).

The detailed causes of death within category VII which accounted for the 37 deaths observed during the study period are shown in Table 8. Also shown are the standardized mortality ratios obtained for men, women, both sexes, and for various groups of circulatory causes of death. Cree women are relatively more at risk than Cree men when compared to Canadian standards in terms of mortality from circulatory diseases. Rates are significantly lower in Cree men than in Canada as a whole, and rates for Cree women are similar to those of Canadian women. However, in many cases, deaths in women occured at advanced ages, and were often described as resulting from chronic conditions (e.g. heart failure) rather than from acute events.

Table 8 : Summary of deaths by circulatory diseases among the James Bay Cree of northern Quebec, period 1982 - 1986

Condition	ICD-9 Code	Number
ISCHEMIC, HEART	410 - 414	19
OTHER, HEART	420 - 429	
Dysrythmia		3
Aortic valve disorder		1
Heart failure		7
Endocarditis		2

Table 8 (continued)

Condition	ICD-9 Code	Number
CEREBROVASCULAR	430 - 438	4
Pulmonary embolism	415.1	1

CONDITION	CODE	SMR	95% CI
All category VII	390 - 459	0.60*	0.42 - 0.82
Ischemic, heart	410 - 414	0.52*	0.31 - 0.80
Other forms, heart	420 - 429	2.21*	1.17 - 3.78
Cerebrovascular	430 - 438	0.38*	0.10 - 0.97
Males		0.41*	0.24 - 0.66
Females		0.93	0.58 - 1.42

* significant

The age-standardized rates of ischemic heart disease in the Cree are about half those observed in the Canadian population. This makes the Cree a very-low-risk group even among Canadian Indians. Rates of cerebrovascular diseases, which share many of their risk factors with ischemic heart disease, are only 38% of Canada's. However, the causes regrouped under the sub-category "other forms of heart disease" are in significant excess. Some of these causes (heart failure, dysrythmia) are closely related to ischemic heart disease, and their inclusion in the latter category would have increased the SMR for ischemic heart disease to 0.79 (0.53-1.13). This demonstrates the relative instability of indices drawn from ICD sub-categories in a small population. Coding patterns can emerge from certain characteristics of the deceased : for example, if deaths from heart disease tend to occur in older individuals than in the Canadian population, they may be more likely to be labeled as "heart failure". In any case, it seems that rates of ischemic heart disease have not increased since 1975, and this alone is contrary to our expectations.

7.11 Respiratory diseases

This disease category includes two groups of conditions which have different implications for public health planning : infections, including pneumonia and influenza, and chronic pulmonary diseases. Most of the deaths from the latter are caused by respiratory insufficiency resulting from cigarette-induced chronic obstructive pulmonary disease in adults. The mortality from respiratory diseases experienced by the Cree during the study period is summarized in Table 9.

Table 9

Summary of deaths related to respiratory diseases in the James Bay Cree of northern Quebec during the period 1982 - 1986.

Condition	ICD-9 Code	Number
Pneumonia and Influenza	480-487	11
COPD and Allied Conditions	490-496	5
Undetermined, Other	510-519	4
TOTAL	460-519	20

CONDITION	SMR	95% CI
All category VIII	1.83*	1.12 - 2.82
Pneumonia etc.	2.63*	1.29 - 4.72
COPD etc.	1.08	0.34 - 2.52
Males	1.31	0.62 - 2.41
Females	3.03*	1.43 - 5.58

* significant

As we observed for cardiovascular mortality and lung cancer, the respiratory causes of death closely related to tobacco were not found to be "excessive" in the Cree during the study period. Of course, this "excess" is appreciated relativelv to Canadian data, and we must keep in mind that smoking is considered a prominent public health problem in Canada. The low rates of deaths from COPD in the Cree may indicate a delay until accumulated years of exposure to smoking have an effect on mortality.

Excess respiratory deaths were due to infections, and we already saw that many of these occured in infancy and childhood, more often in females. Consequently, females were at higher risk of dying from any respiratory disease, and in both sexes combined there was a significant excess in mortality in comparison with Canada as a whole. These findings are consistent with the low rates of COPD and the high rates of lethal respiratory infections observed among residents of Canadian Indian reserves.

There seems to be an improvement from the previous period 1975-1981, when the SMR stood at 2.6, and much of the improvement may be attributable to a reduction in deaths from infections during the first year of life (11 in 1975-1981 vs 2). Respiratory infections remain an important cause of mortality in the Cree, and almost half of these deaths occur early in life and carry a heavy social burden. The other half accounts for deaths in elderly individuals, when pneumonia or influenza can be seen as complications of old age or multi-organ failure, but could be prevented in part by pneumococcal and influenza vaccines. Deaths from chronic pulmonary obstructive diseases do not seem to be a major problem in the Cree population, but a follow-up of trends in this death category will be interesting : childhood asthma as well a chronic bronchitis and emphysema may become fast-growing killers as cigarette smoke starts pervading the closed home environments of the North.

A survey conducted in 1983-1984 by Dr. Peter Foggin (op. cit.) revealed that 66% of Cree were current smokers, compared to 37% of Canadians, but also suggested that the proportion of heavy smokers was lower in this population. A more recent study indicates that prevalence of smoking is very high among Cree teenagers, reaching around 100% in females at the end of high school.[78] Given that the price of cigarettes is relatively low on Indian reserves in Canada, smoking is likely to become a major threat to the health of these populations and we can expect increasing rates of lung cancer and cardiovascular diseases over the next decades.

7.12 Genito-urinary diseases

Deaths in this disease category are relatively infrequent in general. We observed an excess in deaths from genito-u·inary causes in the Cree, measured by a statistically significant SMR of 3.12. All deaths occured in old people and were due to chronic renal failure, which may be secondary to chronic glomerulonephritis or pyelonephritis, among various conditions. The main cause of chronic renal failure in Canada is diabetes mellitus, and renal failure is relatively more frequent among diabetic American Indians than among diabetic Americans[79]. Diabetes was not mentionned on any of the death certificates or registrations coded as "chronic renal failure", but this may be due to underdiagnosis of the condition in elderly individuals who presumably died of multi-organ failure and did not see a doctor before the onset of their terminal illness.

7.13 Accidents, poisonings, and violence

The high mortality rate from accidents, poisonings, and violence among Canadian Indians does not appear to result from the hazards of a rural and remote lifestyle, which includes common use of firearms for hunting, increased exposure to large bodies of water for fishing, the frequent use of snowmobiles and off-road motor vehicles, a..d poorer access to medical facilities. The mortality rates for accidents, poisonings, and violence for many northern mining communities are only 50% to 100% higher than the national figures, while rates in Indian reserve residents were found to be 3 times higher (Beauvais, op. cit.). Excess deaths are especially evident for fires, drownings, suicides, and homicides but not for motor vehicle accidents or accidental falls. This pattern is consistent across several studies (Mao, Jarvis, op.cit.).

Robinson had found a 2.0 SMR for APV in the Cree for the period 1975-1981, and had insisted on the fact that Cree rates were relatively low when compared to those experienced by most other North American Indian groups. It is striking that the situation has remained virtually unchanged in the present study period, and while APV rates have been decreasing among North American Indians in general, the Cree still experience lower rates than registered Indians in Ontario, Alberta, and British Columbia.[80] Table 10 summarizes the Cree experience in terms of deaths by accidents, poisonings, and violence for the period 1982-1986. The data is presented separately for coastal and inland communities, and illustrates that deaths by motor vehicle accidents occur much more frequently in the inland communities, and that other APV deaths are equally distributed between the two regions.

Table 10

Summary of deaths from accidents, poisonings, and violence; James Bay Cree of northern Quebec, period 1982 - 1986

Injury type	Inland	Coastal	TOTAL
Drowning	9	8	17
Motor vehicle accident	7	2	9
Homicide	1	1	2
Suicide, firearms	1	1	2
Suicide, INH poisoning		1	1
Suffocation	2		2
Aspiration, alcohol-related	1		1
Firearm accident		1	1
Fire		1	1
TOTAL	21	15	36

Table 10 (continued)

CONDITION	CODE	SMR	95% CI
All Category XVII	800 - 999	2.01*	1.40 - 2.78
Drowning	830,832,910	9.49*	5.53 - 15.19
Motor vehicle	810 - 825	1.46	0.65 - 2.78
Suicide	950 -959	0.71	0.14 - 2.07
Males		2.11*	1.40 - 3.04
Females		1.72	0.73 - 3.40

* significant

Drownings had been found to be 12 times more frequent in the Cree than in Canada as a whole in 1975-1981. Drownings still represent almost 10% of all deaths in the period 1982-1986, and still occur almost 10 times more frequently than among Canadians, and more often in adults. We were conservative in estimating the SMR for drownings in the Cree, by including in the Canadian reference count all drownings related to water transport accidents (830, 832) or to other mechanisms of submersion (910).

Epidemiologic studies in the United States suggest that important differences exist in drowning epidemiology between children and adults and that preventing drowning may be more problematic in adults than in children. Studies in the United States have also emphasized the role of alcohol as a contributive factor in half of the adult cases reported.[81] The epidemiology of drowning in the Cree may not be related to swimming activities as such, but more often to fishing or hunting activities that imply transportation over large bodies of water. There is anecdotal evidence suggesting that such accidents often occur in the spring, and are frequently caused by the collapse of a motor vehicle through thawing ice. The risk for this type of accident may be increased by the variations in water levels of the rivers and reservoirs, as a consequence of dams built for hydro-electric projects.

A detailed analysis of motor vehicle accidents would have to consider traffic and non traffic vehicles separately. We could not validly separate these specific causes, but we estimate that accidents involving snowmobiles, motorcycles, and other off-road vehicles accounted for at least one third of all deaths from motor vehicle accidents. Motor vehicle accident rates were not higher than in Canada, and these accidents were concentrated in the inland communities, probably reflecting increased risk and exposure.

A recent study by Hasselback et al.[82] highlights the Canadian Native population as a high-risk group for suicide in a large ecological study linking suicide rates from 1981 to 1986 and sociodemographic indicators from the 1981 Canadian Census. Robinson had not found an elevated suicide rate in the 1975-1981 study, and had discussed this finding as reflecting possible underreporting of this cause of death. When Claudette Lavallée of the Northern Quebec Module investigated the deaths reported from the nursing clinics, she uncovered at least one probable suicide death which had been reported in 1987 as an accidental drowning by the physician who completed the death certificate. For the period 1982-1986 however, all three deaths by suicide she identified from the clinics' reports were officially certified.

The present study is consistent with Robinson's in failing to demonstrate an elevated suicide rate in the Cree for the period 1982-1986. Residents of Indian reserves in Quebec did not exhibit differences in suicide rates either when compared to their respective county populations in 1978-1984 (Beauvais, op.cit.), but many other Indian groups across Canada and the U.S. experience rates that are many times superior.[83] Overall differences between groups of registered Indians across Canada suggest the important influence of local factors (Beauvais, op. cit.).

Firearms were involved in two successful suicide attempts as well as in two homicides and one accidental death. One death was caused by a volontary overdose of INH, a potent drug used in the treatment of tuberculosis.

The overall picture suggested by this review of accidental and violent deaths in the Cree for the study period, is that of an important public health problem. Its severity is stable since the previous period, with APV deaths still accounting for about 20% of all deaths. Rates of drownings have remained unchanged as well, and motor vehicle accidents and suicides seem to occur at age-standardized rates that are similar to those observed in the Canadian population. Cree males are more accident- and violence-prone compared to Canadian males, while females are not significantly at higher risk. In terms of prematurity of accidental and violent deaths, the observed PYLL rates for the Cree are higher than Canadian rates, but lower than rates observed on U.S. IHS reserves.

Improved medical care might decrease the number of deaths resulting from accidents, poisonings, and violence. However, Young (op. cit.) found that 92% of deaths from injuries and poisonings in the Sioux Lookout Zone occured before the medical care system could be involved. There is no reason to believe that the situation is very different in the Cree, with half of the population involved in traditional activities, sometimes very far away from the main communities.

A formal review of the nature, mechanism and severity of the injuries suffered could demonstrate the need for primary prevention strategies vs. sophisticated evacuation facilities. We also need to know more about the the circumstances surrounding deaths by drownings, suffocation, and motor vehicle accidents, to implement effective preventive interventions and optimize the motivation of the communities to adopt and promote them. The information we need is not readily available from mortality surveillance data, and should be collected specifically in a prospective study of accidental and violent deaths in the Cree of northern Quebec.

8. Ethics and confidentiality

Although the present study did not include any experimental intervention, it did imply ethical issues. Approval of the Cree Board of Health and Social Services was obtained through the Northern Quebec Module prior to consultation of the data from clinic registries, the List of Beneficiaries, and from death certificates.

All nominal information related to deceased individuals was treated in the spirit of the objectives of the research. Copies of the death certificates which were obtained from the Registre de la Population were protected according to the conditions specified in the application we submitted to the Commission d'Accès à l'Information in December 1987, and have been destroyed in December 1988. Any publication, document, or thesis related to the present study will have to be approved by the Cree Board of Health and will not contain any nominal information. The protocol of the present study was submitted and approved by the Ethics Comittee of the Montreal General DSC in February 1988.

9. Future work

Small populations are usually more homogenous in character than large ones, and therefore make it easier to establish the relationship between socio-demographic characteristics and mortality data. A number of problems arise, however, in small populations : the potentially low number of events points to the need for aggregation over a number of years, and the use of a census or a registry as a data base for determination of the denominator can be the source of substantial errors in estimation, mainly because of the lack of migration data at this level. For logistic reasons, it may be illusory to try to establish general mortality surveillance in the Cree on a yearly basis. Five-year intervals for detailed analyses are probably ideal, with the possible exception of perinatal and infant mortality, which are evaluated in relation to births, and can be easily updated every year as three-year running averages.

It has always been rather vague as to whether death and other surveillance are a part of research or not. Because they are ongoing, they tend to be taken for granted and are not included in lists of research priorities and activities. In fact, surveillance of deaths in the James Bay Cree population still poses important problems in methodology and data collection and validation, and does not yet fit the term "inbuilt " surveillance.

A detailed plan on how to verify, analyze and present deaths in the Cree, on a yearly and 5-yearly basis, needs to be made. The experience and specific findings of the present study may lead to specific actions both locally and at the provincial level, to improve the quality and accuracy of data sources for the ascertainment of mortality events in region 10B. As previously mentioned, obtaining a reliable assessment of denominators for these events is not straightforward, and one of the possible solutions would be to expand the role of the List of Beneficiaries to that of a demographic registry, with continuous systematic input concerning births, deaths and migrations in the Cree population.

The completeness and accuracy of the Registry of deaths established by the Montreal General DSC to achieve surveillance within the communities have been confirmed by the validation process undertaken for this study. The need for procedures to improve reporting in certain communities and under specific conditions (migrations, referrals to specialized health care centers, deaths in remote areas, etc.) has been illustrated by the data collection process that was conducted by Claudette Lavallée, and by her recommendations[84]. The "improved" Registry was much more complete than official death certification pathways, and in the future a valid coding of the underlying causes could easily be performed routinely by a consultant nosologist.

Detailed analyses of the causes of deaths, which are not performed systematically by the MSSS, will remain as an important feature of regional mortality surveillance. Reliance on an autonomous registry of deaths increases the "responsiveness" of the surveillance system to changes in mortality patterns or to clusters in time or space.

The present study may lead to the development of hypotheses about the etiology of underlying causes of death in terms of socio-economic or demographic characteristics, and to the establishment of general relationships which may provide a model for health service delivery based on relevant characteristics of the population. Of course, it is a study which considers mortality as the sole outcome, and therefore will underestimate the burden to health of conditions which are typically non-fatal, underreported or underdiagnosed on death certificates. Notorious examples of these in all modern societies are alcohol and drug abuse, obesity, diabetes, and mental health problems in general.

Formal epidemiologic studies of the Cree population of the James Bay area are rare, and the data available for determinations of patterns and trends in the distribution of health-related phenomena in this population are scarce. It is our hope that the present analysis of mortality causes will provide meaningful information for future comparisons. In the tracks of Robinson's study completed in 1981, we now have valid and detailed death statistics on the Cree of northern Quebec since the signing of the James Bay Agreement.

The findings and conclusions of the present study will be presented to the Cree Board of Health and Social Services, which is ultimately responsible for its translation into public health strategies and planning. This autodetermination of actions must be emphasized, since future mortality trends will eventually reflect the choice of a way of life by the Cree population. In this context, causes of death which are unacceptable to us and stand out as priorities may be more acceptable to the Cree, if they constitute a "normal" risk associated with exposure to traditional living conditions and activities they have chosen to preserve.

In this perspective, the leaders of each of the eight Cree communities will be presented with a summary of the deaths that have occurred among their population of residents during the study period, specifying the age and gender of the deceased, and the underlying cause of death. Paradoxically, there may be more interest locally for this type of crude reporting than for the analyses and the interpretations of the data for the whole Cree population.

10. Summary

This study reviewed the causes of death experienced by the population of about 8000 Cree living in northern Quebec along the coast of James Bay, during the five year period extending from 1982 to 1986. Since the period 1975-1981, the Cree have reduced the gaps between their mortality rates and those experienced in Canada as a whole, in many ways. The Cree perinatal and neonatal mortality rates are now lower than Canadian rates, infant mortality has been reduced by 50%, and the age-standardized death rate has decreased by almost 20% and is now comparable to the national average.

On the other hand, a substantial proportion of Cree deaths are premature and carry a heavy social burden. The Cree experience postneonatal mortality rates which are among the highest in any Indian population in North America. Cree children are still at high risk of dying from infections and accidents, and Cree adolescents and young adults are at higher risk than young Canadians for accidental or violent deaths. Drownings remain about ten times more frequent than in Canada, and may be related to specific epidemiologic features. However, overall death rates from accidents, poisonings, and violence have remained stable over the last ten years, and are still lower than in other native groups.

The Cree of northern Quebec still have lower rates of the chronic diseases which plague most developed countries. Cardiovascular diseases, cancer, and chronic respiratory diseases have not yet emerged as growing problems, although this may be due to low accumulated exposure.

This study has identified areas where interventions are the most desirable in terms of prevention of unnecessary and untimely deaths, but it must not serve as a justification to do nothing in other areas. The inherent limitations of using mortality data to conduct an evaluation of the health of a population must be kept in mind, and the need for a coherent multifactorial approach to health cannot be overemphasized. With the development of healthier physical and social environments through community development and participation, and with increasing access to specialized health care, it is now obvious that the James Bay Cree of northern Quebec can aspire to the mortality levels of the most developed countries in the world.

Appendix 1

Denominator for the study of the mortality among the James Bay Cree of northern Quebec, period 1982 - 1986 : Count of residents of the 8 cree communities, by sex and by age groups.

Source : List of Beneficiaries of the James Bay Agreement, 1985-03-25

Age group	Men	Women	Total
0-1	119	114	233
1-4	254	246	500
5-14	1152	1135	2287
15-24	919	910	1829
25-44	889	952	1841
45-64	421	397	818
65-74	143	130	273
75+	68	67	135
Total	3965	3951	7916

Appendix 2

Data sources used in the estimation of the number of deaths among the James Bay Cree of northern Quebec, for the period 1982 -1986.

YEAR	MNQ Registry	Death Certificates	List of Beneficiaries	Final List
1982	39	29	1	40
1983	33	22	1	34
1984	27	23	0	27
1985	33	29	1	34
1986	44	---	2	46
TOTAL	176	103	5	181

Appendix 3

Proportions (%) of total deaths occurring in each age group, comparison of Cree 1975-1981, Cree 1982-1986, and Canada 1984.

Age	Cree 1975-1981		Cree 1982-1986		Canada 84
	Number	%	Number	%	%
0 - 1	65	21.0	20	11.1	1.74
1 - 4	20	6.5	10	5.5	0.38
5 - 14	16	5.2	7	3.9	0.52
15 - 24	23	7.4	14	7.7	2.06
25 - 44	27	8.7	15	8.3	5.16
45 - 64	48	15.4	34	18.8	20.51
65 +	111	35.8	81	44.7	69.53
TOTAL	310	100.0	181	100.0	100.0

Appendix 4

Complete Life Tables for the James Bay Cree of northern Quebec ; both sexes combined, males, and females, period 1982 - 1986

Legend

x	Age
Dx	Observed deaths in age interval
Px	Observed population in age interval
Mx	Death rate
Qx	Death probability
Sx	Survivors
dx	Deaths
fx	Fraction
Ax	Years lived
Tx	Cumulated years
ex	Life expectancy

All

x	Dx	Px	Mx	Qx	Sx	dx	fx	Ax	Tx	ex
0	20	233	.0172	.0171	100000	1710	0.2	98632	7193447	71.93
1	10	500	.0040	.0159	98290	1563	2.0	390034	7094815	72.18
5	2	1045	.0004	.0020	96727	193	2.5	483152	6704781	69.32
10	5	1242	.0008	.0040	96534	386	2.5	481705	6221629	64.45
15	4	1000	.0008	.0040	96148	385	2.5	479778	5739924	59.70
20	10	829	.0024	.0119	95763	1140	2.5	475965	5260146	54.93
25	4	639	.0013	.0065	94623	615	2.5	471578	4784181	50.56
30	3	460	.0013	.0065	94008	611	2.5	468513	4312603	45.87
35	6	419	.0029	.0144	93397	1345	2.5	463623	3844090	41.16
40	2	323	.0012	.0060	92052	552	2.5	458880	3380467	36.72
45	4	269	.0030	.0149	91500	1363	2.5	454093	2921587	31.93
50	10	199	.0101	.0493	90137	4444	2.5	439575	2467494	27.37
55	11	172	.0128	.0620	85693	5313	2.5	415183	2027919	23.66
60	9	178	.0101	.0493	80380	3969	2.5	391993	1612736	20.06
65	9	146	.0123	.0597	76417	4562	2.5	370680	1220743	15.97
70	15	127	.0236	.1114	71855	8005	2.5	339263	850063	11.83
75	57	135	.0844	1.000	63850	63850	8.0	510800	510800	8.00

Appendix 4 (continued)

Males

x	Dx	Px	Mx	Qx	Sx	dx	fx	Ax	Tx	ex
0	6	119	.0101	.0100	100000	1000	0.2	99200	7093489	70.93
1	4	254	.0031	.0123	99000	1218	2.0	393564	6994289	70.65
5	0	524	.0000	.0000	97782	0	2.5	488910	6600725	67.50
10	2	628	.0006	.0030	97782	391	2.5	487933	6111815	62.50
15	2	524	.0008	.0040	97391	390	2.5	485980	5623882	57.75
20	8	395	.0041	.0203	97001	1969	2.5	480083	5137902	52.97
25	2	313	.0013	.0065	95032	618	2.5	473615	4657819	49.01
30	2	225	.0018	.0090	94414	850	2.5	469945	4184204	44.32
35	5	203	.0049	.0242	93564	2264	2.5	462160	3714259	39.70
40	1	148	.0014	.0070	91300	639	2.5	454903	3252099	35.62
45	3	133	.0045	.0222	90661	2013	2.5	448273	2797196	30.85
50	8	108	.0148	.0714	88648	6329	2.5	427418	2348923	26.50
55	5	89	.0112	.0545	82319	4486	2.5	400380	1921505	23.34
60	4	91	.0088	.0431	77833	3355	2.5	380778	1521125	19.54
65	7	72	.0194	.0925	74478	6889	2.5	355163	1140347	15.31
70	10	71	.0282	.1317	67588	8901	2.5	315688	785184	11.62
75	26	68	.0765	1.000	58687	58687	8.0	469496	469496	8.00

Females

x	Dx	Px	Mx	Qx	Sx	dx	fx	Ax	Tx	ex
0	14	114	.0246	.0243	100000	2430	0.2	98056	7336715	73.01
1	6	246	.0049	.0194	97570	1893	2.0	386494	7238659	73.82
5	2	521	.0008	.0040	95677	383	2.5	477428	6852165	71.24
10	3	614	.0010	.0050	95294	476	2.5	475280	6338782	66.52
15	2	476	.0008	.0040	94818	379	2.5	473143	5863502	61.84
20	2	434	.0009	.0045	94439	425	2.5	471133	5390359	57.08
25	2	326	.0012	.0060	94014	564	2.5	468668	4919226	52.32
30	1	235	.0009	.0045	93450	421	2.5	466198	4450558	47.63
35	1	216	.0009	.0045	93029	419	2.5	464098	3984360	42.83
40	1	175	.0011	.0055	92610	509	2.5	461778	3520262	38.01
45	1	136	.0015	.0075	92101	691	2.5	458778	3058484	33.21
50	2	91	.0044	.0218	91410	1993	2.5	452068	2599706	28.44
55	6	83	.0145	.0700	89417	6259	2.5	431438	2147638	24.02
60	5	87	.0115	.0559	83158	4649	2.5	404167	1716200	20.64
65	2	74	.0054	.0266	78509	2088	2.5	387,325	1312033	16.71
70	5	56	.0179	.0857	76421	6549	2.5	365732	924708	12.10
75	31	67	.0925	1.000	69872	69872	8.0	558976	558976	8.00

Appendix 5

Cree infant mortality 1982-1986 : Summary of the data used in calculation of period rates, three year running average rates and 95% confidence intervals.

Stillbirths, Cree 1982-1986		
Community	Number	Year
Eastmain	1	1982
Whapmagoostui	1	1983
Chisasibi	2	1984
Waswanipi	1	1985

Live births and deaths in the first year of life, Cree 1982-1986, by year						
Event	1982	1983	1984	1985	1986	1987
Live births	218	254	227	224	242	260
Deaths 0-6 days	0	1	0	0	2	0
Deaths 7-28 days	0	0	0	0	0	1
Deaths 29-365 d.	4	5	0	6	2	1
TOTAL deaths	4	6	0	6	4	2

Appendix 5 (continued)

Total number of births, Cree 1982-1986, by 3 year periods

Period	1982-1984	1983-1985	1984-1986	1985-1987
Total births (3 years)	699	705	693	726

Infant, neonatal and postneonatal mortality rates, James Bay Cree 1982-1986

Three year running averages and 95% CI

Rate per 1000 live births	1983	1984	1985	1986
Neonatal	1.4	1.4	2.9	4.1
95% CI	0.1-8.0	0.1-7.9	0.3-10.4	0.8-12.1
Postneonatal	12.9	15.6	11.5	12.4
95% CI	5.7-24.5	7.7-27.9	4.9-22.8	5.5-23.6
Infant	14.3	17.0	14.4	16.5
95% CI	6.7-26.3	8.8-29.8	6.8-26.6	7.4-27.1

Appendix 6

Distribution of Cree deaths, period 1982-1986, across age groups and across ICD-9 categories

ICD	0-1	1-4	5-14	15-24	25-44	45-64	65 +
I			1	1			3
II				1	2	11	17
III		1				2	3
IV							1
V							1
VI	5	1					1
VII					1	6	30
VIII	2	3	1	1		3	10
IX		1	1			2	2
X						1	5
XII	1						
XIV	3						
XV	2						
SIDS	4	1					
?	1		1	2	3	2	5
XVII	2	3	3	9	9	7	3
TOT	20	10	7	14	15	34	81

Appendix 7

Outline of detailed causes of death in the James Bay Cree of northern Quebec, period 1982-1986, for each age group of the population.

Age group 1 - 4 years	
Cause of death	**Number**
Leukodystrophy	3
Pneumonia	2
Gastroenteritis	1
SIDS	1
Drowning	2
Accidental suffocation	1
TOTAL	10
Age group 5 - 14 years	
Meningococcemia	1
COPD	1
Gastroenteritis	1
Respiratory obstruction by food	1
Drowning	1
Homicide (Shotgun)	1
Unknown	1
TOTAL	7

Age group 15 - 24 years	
Acute hepatitis	1
Cancer, primary site unspecified	1
Pneumonia	1
Drowning	5
Motor vehicle traffic accident	1
Snow vehicle accident	1
Fire	1
Suicide by poisoning	1
Unknown	2
TOTAL	14

Age group 25 - 44 years	
Cancer, testicle and unspecified	2
Myocardial infarction	1
Motor vehicle traffic accident	2
Snow vehicle accident	1
Drowning	2
Suicide by firearms	2
Homicide	1
External cause, unspecified	1
Unknown	3
TOTAL	15

Age group 45 - 64 years	
Cause of death	Number
Cancer, unspecified site	1
Cancer, lung and brochus	4
Cancer, digestive tract	5
Cancer, breast	1
Diabetes and obesity	2
Myocardial infarction	2
Cardiac dysrhythmia	1
Aortic valve disorder	1
Heart failure	1
Bacterial endocarditis	1
COPD	2
Pneumonia	1
Abdominal surgical conditions	2
Chronic renal failure	1
Drowning	3
Motor vehicle nontraffic accident	2
Accident - Hunting rifle	1
Accident - laceration and hemorrhage	1
Unknown	2
TOTAL	34

Age group 65 years +	
Cause of death	Number
Blastomycosis	1
Septic peritonitis	1
Septicemia	1
Cancer, unspecified	1
Cancer, oesophagus	1
Cancer, bronchus and lung	5
Leukaemia	1
Cancer, liver	2
Cancer, breast	2
Cancer, colon	1
Cancer, pancreas	1
Cancer, brain	1
Cancer, oral cavity	1
Cancer, prostate	1
Fluid and electrolyte balance	2
Diabetes	1
Anemia	1
Alcohol abuse	1
Senile dementia	1
Heart failure	6

Age group 65 years + (continued)	
Cause of death	**Number**
Ischaemic heart disease	16
Cardiac dysrythmia	2
Pulmonary embolism	1
Acute cerebrovascular disease	4
Endocarditis	1
COPD	3
Pneumonia	6
Pulmonary fibrosis	1
Chronic passive congestion of liver	1
Gastrointestinai bleed	1
Renal failure	4
G-U unspecified	1
Drowning	2
Accident, unspecified	1
Unknown	5
TOTAL	81

Appendix 8

Summary of the data used in the calculations of the two variants of the indicator Potential Years of Life Lost; study of the mortality among the Cree Indians of James Bay, Quebec, period 1982 - 1986

Indicator	#	Years lost 1982-1986	Average one year	Standardized per 100 000
0-75 Males	68	2,386	477.2	12,035
0-75 Females	55	2,442	488.4	12,361
0-75 All	123	4,828	965.6	12,198
0-65 Males	52	1,787	357.4	9,014
0-65 Females	48	1,929	385.8	9,765
0-65 All	100	3,716	743.2	9,389
0-65 II	30	183	36.6	462
0-65 VII	37	69	13.8	174
0-65 VIII	20	454	90.8	1,147
0-65 Accidents	27	862	172.4	2,178
0-65 Violence	5	198	39.6	500

Appendix 9

Comparison of inland vs coastal Cree communities : population, births, stillbirths, infant deaths and total deaths, 1982-1986

Indicator	Inland	Coastal
Population	3241	4675
Live births	451	714
Stillbirths	1	4
Early neonatal deaths (0-7 days)	2	1
Late neonatal deaths (7-28 days)	0	0
Postneonatal deaths (28-365 days)	9	8
Total deaths in first year of life	11	9
Deaths after the first year of life*	55	103
TOTAL deaths	66	112

* does not include 3 deaths from unknown communities

Appendix 10

Summary of deaths in the period 1982-1986, presented for each Cree community, by age groups, gender, and ICD-9 categories.

Waswanipi 9980								
ICD-9	0-1	1-4	5-14	15-24	25-44	45-64	65+	TOTAL
I			M 1					M 1
II						M 1	M 1 F 1	M 2 F 1
III		F 1						F 1
VII							M 2 F 2	M 2 F 2
VIII		F 1						F 1
X							M 1	M 1
SIDS	F 1							F 1
XVII	F 1	F 1	F 1	M 2	M 1 F 1	M 2		M 5 F 4
?					F 1			F 1
TOTAL	F 2	F 3	M 1 F 1	M 2	M 1 F 2	M 3	M 4 F 3	M 11 F 11 S 1

S = Stillbirth

Mistassini 9981								
ICD - 9	0-1	1-4	5-14	15-24	25-44	45-64	65+	TOTAL
II						F 2	M 2	M 2 F 2
III						M 1 F 1	M 1	M 2 F 1
VI	M 1							M 1
VII					F 1		M 3 F 3	M 3 F 4
VIII	F 2	M 1		M 1			M 1	M 3 F 2
X						M 1		M 1
XIV	F 2							F 2
SIDS	F 1							F 1
XVII		F 1	M 1	M 1	M 3	M 2	M 2	M 9 F 1
?				F 1		M 1	F 1	M 1 F 2
TOTAL	M 1 F 5	M 1 F 1	M 1	M 2 F 1	M 3 F 1	M 5 F 3	M 9 F 4	M 22 F 15

Eastmain 9983								
ICD - 9	0-1	1-4	5-14	15-24	25-44	45-64	65+	TOTAL
II							M 1 F 1	M 1 F 1
V							M 1	M 1
VII						M 1		M 1
VIII						M 1	M 1	M 2
IX						M 1		M 1
SIDS	M 1							M 1
XVII				M 1	M 1			M 2
?							F 1	F 1
TOTAL	M 1			M 1	M 1	M 3	M 3 F 2	M 9 F 2 S 1

S = Stillbirth

Wemindji 9984								
ICD - 9	0-1	1-4	5-14	15-24	25-44	45-64	65+	TOTAL
I							M 1	M 1
II						F 1	F 1	F 2
VII						F 1	M 2 F 3	M 2 F 4
VIII			F 1				M 2 F 1	M 2 F 2
IX		F 1					M 2	M 2 F 1
X							F 1	F1
?			F 1				F 1	F 2
TOTAL		F 1	F 2			F 2	M 7 F 7	M 7 F 12

Waskaganish 9985								
ICD - 9	0-1	1-4	5-14	15-24	25-44	45-64	65+	TOTAL
I				F 1			M 1	M 1 F 1
II						M 1	M 1	M 2
VII						F 2	M 2 F 6	M 2 F 8
VIII							M 1	M 1
IX						F 1		F 1
X							F 1	F 1
XII	F 1							F 1
XIV	F 1							F 1
XVII			F 1	M 1		M 1		M 2 F 1
TOTAL	F 2		F 1	M 1 F 1		M 2 F 3	M 5 F 7	M 8 F 14

Chisasibi 9986								
ICD - 9	0-1	1-4	5-14	15-24	25-44	45-64	65+	TOTAL
I							F 1	F 1
II						M 1 F 4	M 6 F 1	M 7 F 5
III							M 2	M 2
IV							F 1	F 1
VI	M 2 F 1	M 1					F 1	M 3 F 2
VII						M 1	M 4 F 3	M 5 F 3
VIII		F 1				M 2	F 3	M 2 F 4
IX			F 1					F 1
X							M 1 F 1	M 1 F 1
XV	F 1							F 1
SIDS	F 1							F 1
XVII		M 1		M 3 F 1	M 2	M 1 F 1	M 1	M 8 F 2
?				F 1	F 1		M 1 F 1	M 1 F 3

Chisasibi 9986 (continued)								
ICD - 9	0-1	1-4	5-14	15-24	25-44	45-64	65+	TOTAL
TOTAL S 2	M 2 F 3	M 2 F 1	F 1	M 3 F 2	M 2 F 1	M 5 F 5	M 15 F 12	M 29 F 25

Nemaska 9987								
ICD - 9	0-1	1-4	5-14	15-24	25-44	45-64	65+	TOTAL
II				M 1		M 1		M 2
XV	M 1							M 1
XVII	M 1				M 1			M 2
?	F 1				F 1			F 2
TOTAL	M 2 F 1			M 1	M 1 F 1	M 1		M 5 F 2

Whapmagoostui 9988								
ICD - 9	0-1	1-4	5-14	15-24	25-44	45-64	65+	TOTAL
II							M 1 F 1	M 1 F 1
VI	F 1							F 1
VII						M 1		M 1
VIII							F 1	F 1
?						F 1		F 1
TOTAL S 1	F 1					M 1 F 1	M 1 F 2	M 2 F 4

S = Stillbirth

Village : unknown			
3 deaths	M	SIDS	1-4 years
	M	ICD-2	25-44 years
	F	ICD-2	25-44 years

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