

Cancer Surveillance in a Remote Indian Population in Northwestern Ontario

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Abstract: The incidence and mortality rates of malignant neoplasms in an isolated Indian population in northwestern Ontario, Canada during the period 1972–81 were determined and age-adjusted comparisons with the Canadian national population computed. Indian men were at half the risk of developing and dying from cancer compared to Canadian men, while among women the risks were similar. The most outstanding feature was the high mortality and incidence rates of kidney cancer in both sexes (relative risks for mortality and incidence 7 to 13 times that for Canadians). Gallbladder cancer was of importance in females, similar to observations in other Amerindian groups.

Low-risk sites among Indians included: lung in men, breast in women, and skin in both sexes. Other sites such as colon and prostate were common in both populations. Establishing baseline incidence and mortality data and continuing surveillance over a period of time in a well-defined, geographically isolated Native population undergoing rapid social change is of interest both epidemiologically and from the health service perspective. Further studies may elucidate risk factors, of which diet appears most responsible for the peculiar pattern observed. (*Am J Public Health* 1983; 73:515–520.)

Introduction

As the importance of infectious disease mortality and morbidity declines in the Canadian Native population, the role of chronic diseases becomes increasingly of interest to epidemiologists, health planners, and service providers. In the published literature, most of the studies to date have dealt with Native groups in the United States, especially those from the Southwest and Alaska.^{1–3} A few reports examined the epidemiological and clinical features of cancer among Canadian Inuit (Eskimos),^{4,5} while data on Canadian Indians are similarly scarce.^{6–8}

The Sioux Lookout Zone in northwestern Ontario, Canada provides an excellent opportunity for establishing baseline incidence and mortality data as well as longitudinal observations. As a health service area of the Medical Services Branch, Department of National Health and Welfare, the Zone serves a well-defined, geographically isolated, and socially homogeneous population. About 10,000 Cree and

Ojibwa Indians inhabit 30-odd remote settlements scattered in the subarctic boreal forest.‡ An accurate population census is available annually from the Department of Indian and Northern Affairs. A full description of the organization of health services and the changing health status of the people has been published elsewhere.^{9,10}

Methods

During the years 1972–1981, all known cases of malignant neoplasms (International Classification of Diseases (ICD), 9th revision, codes 140–208) were collected in a cancer registry. Diagnoses of carcinoma-in-situ were excluded from consideration. There were several sources of data:

- All Indian deaths in the Zone were reviewed regularly by the medical staff and the causes established, coded and recorded;
- Selected information on all patients discharged from the Sioux Lookout Zone Hospital was recorded on file cards from 1970–1974, and from 1975, the Hospital Medical Records Institute (HMRI) computerized printouts replaced the cards;
- Since 1978, certain data from all clinical encounters with health aides, outpost nurses, and field physicians in the communities were recorded in logs and stored on magnetic tapes;

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Editor's Note: See also related editorial p 485 this issue.

‡The Ojibwa is also called Chippewa in the US. The closely related Crees and Ojibwas belong to the Algonkian family of languages and the eastern subarctic culture area.

● Consultants' letters and pathology reports on patients who received care in medical institutions outside the Zone system were regularly received by the Zone Hospital's medical records department.

The names of all patients who had the appropriate ICD diagnostic codes were obtained from all these sources, and the relevant clinical information abstracted from their files. Since the Zone health service is the major source of health care for the area's Indians and maintains up-to-date records on those who utilized other agencies, it is unlikely that any cancer case receiving care would escape ascertainment.

In this study, national Canadian cancer statistics for 1976-1978 as reported by Statistics Canada are used for comparison. Age standardization is necessary due to the different age structures of the Zone Indian and Canadian national populations. As can be seen from the 1977 population data in Table 1, the Sioux Lookout Zone has a wide-based pyramid typical of developing countries, with over 65 per cent of the population under the age of 25. This population, counted in the middle of the 1972-81 study period, was used as the index population in all standardization calculations. The age classes chosen were those used in Statistics Canada annual cancer publications.¹¹

The method of indirect standardization was used in order to avoid the large sampling error of age-specific rates in this small study population. Unless otherwise stated, the arithmetic mean of the 1976, 1977, and 1978 Canadian rates for each age class was used as the standard population rate in the calculation. In this way, the substantial year-to-year fluctuation in age-specific rates for uncommon sites of cancer, which is seen even at the national level, is reduced. The contribution to the variance of the standardized mortality ratio (SMR) or standardized incidence ratio (SIR) by the expected number of events in the denominator can be assumed to be negligible. The SMR or SIR variance can then be taken to be that of the numerator, a small number of observed events, which follows a Poisson distribution. Significance levels for SMRs and SIRs in this paper are based on the tables for Poisson-distributed variables published by Bailar and Ederer.¹² In general, the p value quoted indicates whether the SMR or SIR is significantly greater or less than unity, reflecting either an excess or deficit, respectively, of

TABLE 1—Age-Sex Structure of Sioux Lookout Zone Indian Population, 1977

Age Group	No. Males	No. Females
0-24	2771	2816
25-34	564	539
35-44	417	375
45-54	241	209
55-64	170	170
65-74	106	96
75-84	50	35
85+	6	18
TOTAL	4325	4258

Source: Department of Indian and Northern Affairs Treaty Indian Population by Band, District and Region, 1977.

TABLE 2—Cancer Deaths in the Sioux Lookout Zone 1972-1981: Age-Sex Distribution and Relative Risks

Age Group	Male		Female	
	No. Deaths	RR‡	No. Deaths	RR‡
0-24	1	0.5	1	0.7
25-34	0	—	1	1.6
35-44	0	—	6	2.9*
45-54	2	1.5	4	1.2
55-64	6	0.7	6	1.0
65-74	10	0.9	10	1.8
75-84	5	0.5	5	1.5
85+	1	0.7	3	1.2
TOTAL	26	0.67*	36	1.44

‡RR = relative risk = no. deaths observed in age class in Sioux Lookout Zone/no. deaths expected if Canadian age-sex-specific rate applied.
*p less than 0.05.

observed cases in the Sioux Lookout Zone compared to expected cases from the Canadian population.‡‡

No attempt was made in this study to determine if the cases were "full-blooded" Indians or not. In Canada such designations are not commonly used. The determination of "Treaty Indian status" is legalistic and complex, a discussion of which is beyond the scope of this paper. The Hudson Bay Company has been in the region since the late seventeenth century and intermarriage has occurred over the years of contact. However, a serological study of several genetic markers in 1970 in one community in the Zone indicated very little evidence of Caucasian admixture.¹³ As far as the authors can ascertain, the cases in this study were not the progeny of Indian-Caucasian intermarriages.

Results

Mortality

Within the ten-year study period, 62 deaths from malignant neoplasms were registered. The mean annual crude mortality rate was 58/100,000 (95 per cent confidence interval 45 to 75) for all sites and both sexes. By comparison, the Canadian (mean 1974-1977) rate was 152/100,000. Age-standardized mortality ratios (SMRs) were computed for each sex: in males the SMR was 0.67,* and in females 1.44 NS. (In this paper, a single asterisk * means p less than 0.05, double asterisk ** means p less than 0.01, and NS is not significant at the 0.05 level.)

The age-sex distribution of cancer deaths is given in Table 2. Over half of the cases were over 65 years of age. Age-specific analysis of cancer mortality in the Zone is made statistically unreliable by the small number of cases occur-

‡‡Note, however, that, in the absence of a specific prior hypothesis when comparing multiple pairs of rates in two populations, p-values such as those cited in this paper do not accurately reflect the probability of Type I error. These values are cited merely as an indication of sampling variation due to the small number of events observed.

TABLE 3—Comparative Ranking and Age Standardized Mortality Ratios of Selected Primary Cancer Sites: Sioux Lookout Zone 1972–81 vs Canada 1976–78

ICD-9 Code and Site	Sioux Lookout Zone			Canada
	No. Deaths	%	SMR	Rank
Males				
189.0 Kidney	5	19.2	6.9**	9th
162 Trachea/Bronchus/Lung	3	11.5	0.26**	1st
205 Myeloid leukemia	3	11.5	4.0	below 10th
185 Prostate	3	11.5	0.93	2nd
156 Gallbladder/bile ducts	2	7.7	5.9	below 10th
157 Pancreas	1	3.9	0.49	5th
153 Colon	1	3.9	0.29	3rd
151 Stomach	0	0	0	4th
Other	8	30.8	—	—
All Sites	26	100.0	0.67*	—
Females				
153 Colon	5	13.8	1.7	2nd
174 Breast	4	11.1	0.77	1st
189.0 Kidney	4	11.1	13.1 **	below 10th
156 Gallbladder/bile ducts	3	8.3	6.8*	below 10th
157 Pancreas	3	8.3	1.6	5th
162 Trachea/Bronchus/Lung	2	5.6	0.88	3rd
183.0 Ovary	2	5.6	1.3	4th
151 Stomach	0	0	0	6th
180 Cervix uteri	0	0	0	9th
Other	13	36.2	—	—
All Sites	36	100.0	1.44	—

*p less than 0.05.
**p less than 0.01.

ring in each age-class. The overall pattern for males is of generally decreased relative risks of death from cancer. Among females, the highest relative risk (2.9*) is observed among the 35–44 age group.

Within the decade, the crude mortality rate for cancer appeared to rise toward the end of the period, but the increase is not statistically significant. The mean 1977–81 rate was 67 (95 per cent confidence interval 47–93), compared to a mean 1972–76 rate of 49/100,000 (95 per cent confidence interval 31–73). In the late 1960s, according to Zone annual reports, the mean rate was 47/100,000. Accurate data earlier than the mid-1960s are not available.

Nationally, a cancer registry for Indians does not exist. From departmental annual reports and a study on demographic trends,¹⁴ there appears to have been very little change in Indian cancer mortality nationally since the mid-1950s. The crude mortality rate varied between 50 and 55/100,000 and cancer accounted for between 5 and 8 per cent of all deaths.

Table 3 shows the SMRs for each sex for the several cancer sites ranking highest in the Sioux Lookout Zone and in Canada. The most unusual feature is the predominance of kidney cancer in both sexes. Overall it accounted for 15 per cent of cancer deaths in the Sioux Lookout Zone, compared to only 2 per cent in the Canadian population, indicating a large excess in kidney cancer mortality among Indians in the Sioux Lookout Zone. All cases reported had typical radiological and/or histological features of renal cell carcinoma (hypernephroma). No cases of Wilm's tumor or cancer of the renal pelvis and ureter were reported.

Among males, lung and prostate cancer (12 per cent each) in the Sioux Lookout Zone also ranked very high in Canada. The SMR for prostate cancer (0.93) did not show any significant excess or deficit, but the risk of death from lung cancer in the Sioux Lookout Zone was only one-fourth that of Canada. Of note was the absence of stomach cancer among the Sioux Lookout Zone Indians whereas, among Canadian males, it contributed to 7 per cent of all cancer deaths and ranked fourth. This apparent deficit, however, was not statistically significant.†††

Among females, colon and breast cancer were important causes of cancer deaths in both populations. Gallbladder cancer ranked fourth in the Sioux Lookout Zone, contributing to 8 per cent of the deaths, but was of little importance nationally. The SMR of 6.8* showed a clear excess in mortality in the Sioux Lookout Zone for this type of cancer.

The increasing contribution of cancer to general mortality over the last decade is evident from Table 4. An almost linear increase from 6 per cent in 1972 to over 20 per cent in 1981 can be seen. As injuries and poisonings were major causes of deaths in the Zone (accounting for over one-third of all deaths), the proportion of cancer deaths among non-violent deaths was also examined and showed a similar trend. Cancer as a proportion of elderly deaths, however, showed no clear trend over the period, suggesting that most

†††Where the number of observed cases for a site equals zero, the upper 95 per cent limit can be estimated by using $n = 3$ as the upper limit, as described by Haenszel, *et al.*¹⁵

TABLE 4—Contribution of Cancer to General Mortality: Sioux Lookout Zone, 1972–1981

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	Total
Total Deaths											
All Causes	66	72	84	65	83	50	62	66	61	59	667
Cancer Deaths	4	5	5	4	6	4	6	8	8	12	61
% of Total Deaths	6.1	6.9	6.0	6.2	7.2	8.0	9.7	12.1	13.1	20.3	9.2
% of Non-violent Deaths	10.8	10.9	10.2	10.5	12.8	11.4	15.0	18.2	20.0	30.0	14.7
Total Deaths aged 65+	15	14	17	19	24	15	20	22	17	22	184
% Due to Cancer	6.7	28.6	11.8	15.8	12.5	20.0	20.0	18.2	23.5	31.8	18.5

of the increasing proportionate mortality due to cancer occurred among those under 65 years of age.

Incidence

Eighty-eight new cancer cases (40 male and 48 female) were diagnosed between 1972 and 1981 among Indians in the Sioux Lookout Zone. The mean annual incidence rate for the first five years was 77/100,000 (95 per cent confidence interval 55–105), not significantly different from that of the second five-year period which was 89/100,000 (95 per cent confidence interval 66–118). For Canadians, the mean 1974–77 rate was 305/100,000. The standardized incidence ratios

(SIR) for all types of cancer in the Sioux Lookout Zone were 0.51** and 0.77(NS) for males and females, respectively.

Table 5 provides the number of new cancer cases as well as SIRs for selected sites which ranked high in the two populations. No patient had more than one new primary site.

Kidney cancer ranked highest in both males and females, and together constituted 17 per cent of all new cancer cases in the Sioux Lookout Zone. The male-to-female ratio was 2:1, similar to that reported for the general population. The SIRs for both males and females were about 7**.

Among males, the other leading cancers—lung, prostate, and colon—could be found within the five highest

TABLE 5—Comparative Ranking and Age Standardized Incidence Ratios of Selected Primary Cancer Sites: Sioux Lookout Zone 1972–81 vs Canada 1976–78

ICD-9 Code and Site	Sioux Lookout Zone			Canada
	No. New Cases	%	SIR	Rank
Males				
189.0 Kidney	10	25.0	7.1**	below 10th
185 Prostate	6	15.0	0.65	3rd
153 Colon	3	7.5	0.58	4th
162 Trachea/Bronchus/Lung	3	7.5	0.25**	2nd
205 Myeloid leukemia	3	7.5	3.7	below 10th
156 Gallbladder/bile ducts	2	5.0	5.4	below 10th
191 Brain	2	5.0	1.3	below 10th
173 Skin	1	2.5	0.06**	1st
188 Bladder	0	0	0*	5th
151 Stomach	0	0	0*	8th
Other	10	25.0	—	—
All sites	40	100.0	0.51*	—
Females				
189.0 Kidney	5	10.4	7.7**	below 10th
153 Colon	4	8.3	0.85	3rd
156 Gallbladder/bile ducts	4	8.3	9.0**	below 10th
174 Breast	4	8.3	0.27**	1st
157 Pancreas	3	6.3	3.0	below 10th
173 Skin	3	6.3	0.28*	2nd
182 Body of uterus	3	6.3	0.77	4th
162 Trachea/Bronchus/Lung	2	4.2	0.78	5th
180 Cervix uteri	2	4.2	0.65	6th
183.0 Ovary	2	4.2	0.82	8th
188 Bladder	0	0	0	9th
151 Stomach	0	0	0	10th
Other	16	33.3	—	—
All Sites	48	100.0	0.77	—

ranking sites in both populations. However, among the Sioux Lookout Zone Indians, the risk of developing lung cancer was much lower than in the Canadian population (SIR 0.25**). Skin cancer, very common in Canada (highest ranking site among males, 20% per cent of cases), was relatively rare in the Sioux Lookout Zone, accounting for only 2.5 per cent of new cases. No bladder or stomach cancer was diagnosed in the Zone in ten years, although these cancers were 5th and 8th ranking in Canada.

Among females, breast, skin, and colon cancers ranked high in both populations, although the risks for developing breast and skin cancers in the Sioux Lookout Zone were much lower, with SIRs of 0.27** and 0.28** respectively. Gallbladder cancer showed a high incidence in the Zone, ranking second with 8 per cent of new cases, compared to less than 1 per cent in Canada. An Indian woman in the Sioux Lookout Zone was almost at 9 times greater risk of developing this cancer than a Canadian woman. Again, no cases of bladder or stomach cancer were reported in the Zone. Due to the much lower incidence of cancers of these two sites among Canadian women compared to Canadian men, the Sioux Lookout Zone female deficits did not reach statistical significance.

Discussion

Cree-Ojibwa men in the Sioux Lookout Zone were at approximately half the risk of developing and dying from cancer compared to Canadian men nationally, yet the risk of cancer among women in the Sioux Lookout Zone was as great as in Canada. A similar discrepancy between male and female age-standardized mortality ratios was also reported by Gallagher and Elwood in their study of Indians in British Columbia.⁷

There may well be methodological bias toward underestimating the true number of cancer cases. Many deaths occur at home and, in the past decade, 9% of all deaths were classified as "ill-defined" or unknown. On the other hand, access to health care facilities has certainly improved in the last decade or so and may have been responsible for more cancer cases coming to medical attention. In any case, the excess relative risks described above for some sites—particularly kidney in both sexes and gallbladder in females—were of such a magnitude that they cannot readily be explained as reporting artifacts.

The high mortality and incidence rates of kidney disease in the Sioux Lookout Zone were not found in studies from British Columbia⁷ or Alberta⁸ nor among US Indians.¹ On the other hand, in Northwest Territories Inuit in Canada, a high percentage of kidney cancers in both sexes was found, although the importance of this neoplasm in proportion to other sites appeared to have declined in more recent years.⁴

The etiology of cancer of the kidney is poorly understood. Various risk factors have been suggested in the literature: a high meat diet,¹⁶ high cholesterol diet and obesity,¹⁷ the trace element cadmium,¹⁸ smoking,¹⁹ and coffee.²⁰

The smoking prevalence among Indians in the Sioux Lookout Zone, as determined in a community health survey in the early 1970s, is high compared to Canadians. It was found that 48 per cent of the survey respondents over age 15 were smokers, compared to 38 per cent in the Canadian population. The same difference was present in both sexes and all age groups.²¹

It would be difficult to explain both the high risk for kidney cancer and low risk for lung cancer if one were to link the former to a high smoking prevalence in the population. There is long history of "low dose" smoking in the region, as tobacco was one of the trade goods in the fur trading era, but widespread heavy smoking of packaged cigarettes, especially among the young, has probably been a more recent phenomenon since World War II.

Dietary information is fragmentary in the Sioux Lookout Zone but historical and ethnographic data, for example those from Roger's study of the Round Lake Ojibwa,²² indicate that the traditional diet was one with a very high meat content. Coffee is not a popular beverage among the Indians in the Zone, while tea is drunk in very large quantities and has a long history dating back to early fur trading days. Obesity is a serious problem among Indians in Canada, more so among women than men, according to data from the Nutrition Canada survey during the early 1970s.²³

No data are available on cadmium levels in the environment. Water samples obtained from the community reporting the highest number of kidney cancers were therefore sent to the public health laboratory for chemical analysis. These showed acceptable cadmium levels.

There have been reports in the literature on familial renal cell carcinoma associated with chromosomal abnormalities.²⁴ Of the 15 cases of kidney cancer in this study no significant community or family clusters were detected.

The importance of gallbladder cancer, especially among females, was also evident among British Columbia Indians,⁷ Alaska Natives,²⁵ and Indians in the southwestern USA.^{26,27} A very high rate of cholelithiasis and altered bile chemistry has been documented among the Indians and implicated as a probable risk factor for the development of biliary tract neoplasms in later life.²⁸⁻³⁰ A high prevalence of gallstones and gallbladder disease has been demonstrated in a survey of Micmac Indians in Eastern Canada.³¹ In the Sioux Lookout Zone, a proper epidemiological study of gallbladder disease has yet to be attempted, but personal observation suggests a similarly high rate of cholelithiasis. The same risk factor which predisposes to gallbladder disease and gallbladder cancer—obesity—is also prevalent among women in the Sioux Lookout Zone.

In the Alberta study,⁸ the proportionate incidence rates for cancer of the colon, lungs, and prostate among males were quite similar to those observed in the Sioux Lookout Zone. However, skin cancer constituted 12 per cent of new cases among Alberta Indians but was of low incidence in the Sioux Lookout Zone. Among females, kidney cancer was very rare in Alberta whereas breast and cervix constituted 20 per cent of all invasive cancers. One may postulate that Alberta Indians, with a much stronger urban influence and a history of more intensive acculturation, show a pattern of

neoplastic disease which the Sioux Lookout Zone Indians may eventually develop.

Schaefer has suggested that the epidemiological pattern of cancer among Native Peoples in Canada is changing, probably related to major life-style and environmental changes over the past three decades.⁴ This paper has attempted to provide baseline incidence and mortality data on one Canadian Indian group. The availability of an accurate population census and the reasonably complete ascertainment of cases make this study of isolated Indians in one region of particular interest. Continuing surveillance over the next decade can provide valuable information on evolving trends. Repeating the study among other Cree-Ojibwa groups with similar geographical, linguistic, and cultural characteristics in contiguous regions, such as northeastern Manitoba and the James Bay coastal area, would also be useful to determine if the pattern found in Northwestern Ontario is merely a local phenomenon. Further case-control studies of kidney and gallbladder cancer may provide useful insights into local risk factors and ultimately may suggest preventive strategies. From a public health perspective, adequate cancer surveillance data are prerequisites to the planning of appropriate preventive, curative, and palliative services.

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ACKNOWLEDGMENTS

The authors wish to thank Dr. C. P. Shah, Department of Preventive Medicine and Biostatistics, Dr. A. B. Miller and Dr. G. Howe, National Cancer Institute of Canada Epidemiology Unit, all of the University of Toronto, for their useful suggestions during the preparation of this manuscript.