

# Disease patterns among Canadian aboriginal children

## *Study in a remote rural setting*

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### ABSTRACT

**OBJECTIVE** To describe disease patterns among children in an isolated aboriginal community, and to compare them with patterns found among other aboriginal and non-aboriginal Canadian children.

**DESIGN** Retrospective review of logbooks and patient charts extracted from nursing station records for all visits to the community's nursing station between April 1, 1990, and March 31, 1991.

**SETTING** An isolated aboriginal community located in northwestern Ontario.

**PARTICIPANTS** All aboriginal children younger than 5 years.

**MAIN OUTCOME MEASURES** Disease-specific incidence per 100 person-years by age, sex, and season.

**RESULTS** Upper and lower respiratory tract infections, skin conditions, otitis media, and chickenpox were the leading causes of illness. Except for chickenpox, these illnesses occurred at a significantly higher rate among infants than among children 1 to 4 years old. No important differences were found by sex for any condition, except asthma where boys predominated. Autumn and winter seasonal patterns were most evident for respiratory tract infections. The rate of illness for most conditions was higher than that reported among other aboriginal and non-aboriginal Canadian children.

**CONCLUSIONS** The illnesses most frequently seen in these children are respiratory tract infections and skin conditions. Etiologic factors are likely to be related to multiple interacting forces (both environmental and genetic) and require further investigation.

### RÉSUMÉ

**OBJECTIF** Décrire le profil de la morbidité chez les enfants d'une collectivité autochtone éloignée et la comparer à celle observée chez d'autres enfants canadiens autochtones et non autochtones.

**CONCEPTION** Une étude rétrospective des registres et des dossiers des patients, tirés des archives du poste infirmier, pour toutes les visites à ce dispensaire de la collectivité, entre le 1<sup>er</sup> avril 1990 et le 31 mars 1991.

**CONTEXTE** Une collectivité autochtone isolée, située dans le Nord-Ouest de l'Ontario.

**PARTICIPANTS** Tous les enfants autochtones de moins de cinq ans.

**PRINCIPALES MESURES DES RÉSULTATS** L'incidence annuelle de maladies précises par 100 personnes, en fonction de l'âge, du sexe et de la saison.

**RÉSULTATS** Les infections des voies respiratoires inférieures et supérieures, les problèmes dermatologiques, l'otite moyenne et la varicelle constituaient les principales causes de maladie. À l'exception de la varicelle, ces maladies survenaient beaucoup plus fréquemment chez les nourrissons que chez les enfants âgés de un à quatre ans. Des distinctions importantes selon le sexe n'ont pas été constatées pour les différentes maladies, sauf pour l'asthme dont l'incidence était plus élevée chez les garçons. La fréquence saisonnière des infections des voies respiratoires était plus évidente durant l'automne et l'hiver. L'incidence de la plupart des états pathologiques était beaucoup plus élevée que celle observée chez les autres enfants canadiens, autochtones et non autochtones.

**CONCLUSIONS** Les maladies les plus fréquentes observées chez ces enfants étaient les infections des voies respiratoires et les problèmes dermatologiques. L'étiologie est probablement associée à des facteurs multiples interdépendants (d'ordre environnemental et génétique) et exige une analyse plus exhaustive.

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**I**t is generally acknowledged that Canadian aboriginal children's health is poor compared with that of their non-aboriginal counterparts. Despite a pronounced decline in aboriginal infant mortality over the past several decades, neonatal mortality rates remain 38% to 80% higher and postneonatal mortality rates 400% to 500% higher than in the Canadian non-aboriginal population.<sup>1,4</sup> The leading causes of aboriginal infant mortality include diseases of the respiratory system, sudden infant death syndrome, infective and parasitic diseases, injuries, and poisonings.

Since causes of mortality sometimes correlate poorly with causes of morbidity, the health profile of a given population can be better described when data on morbidity are also available. To date, morbidity data are very limited for Canadian aboriginal children. Elevated rates of hospitalization have been found for aboriginal children in British Columbia,<sup>5</sup> Saskatchewan,<sup>6</sup> northwestern Ontario,<sup>7</sup> and southwestern Ontario.<sup>8,9</sup> Case series documenting severe or recurrent pneumonia or episodes with complications among hospitalized aboriginal children have been reported from Edmonton,<sup>10</sup> Saskatoon,<sup>6,11,12</sup> and Winnipeg.<sup>13-15</sup> Data derived from hospital-based studies are dependent on the patterns of referral and admitting practices in each setting.

A population-based study of aboriginal infants and young children in southwestern Ontario demonstrated high risks of iron deficiency anemia, otitis media, pneumonia, and other lower respiratory tract infections compared with non-aboriginal infants and young children.<sup>8,9</sup> Overall, respiratory tract infection was the main cause of illness and had the highest relative risk compared with non-aboriginal children. Southern aboriginal populations, however, often have better infrastructure and socioeconomic environments than those in northern and remote locations. Aboriginal groups tend to be heterogeneous with respect to language, culture, and health-related practices. We therefore cannot presume that heterogeneous and

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geographically distinct populations necessarily share the same health profile. To date, no information has been available on population-based morbidity rates among aboriginal children in northern or remote settings in Canada.

This paper reports on the health status of children in a remote aboriginal community in the Sioux Lookout Zone (SLZ) in northwestern Ontario. We were interested in determining the leading causes and patterns of morbidity in this population and to compare these findings with findings in other aboriginal and non-aboriginal Canadian children.

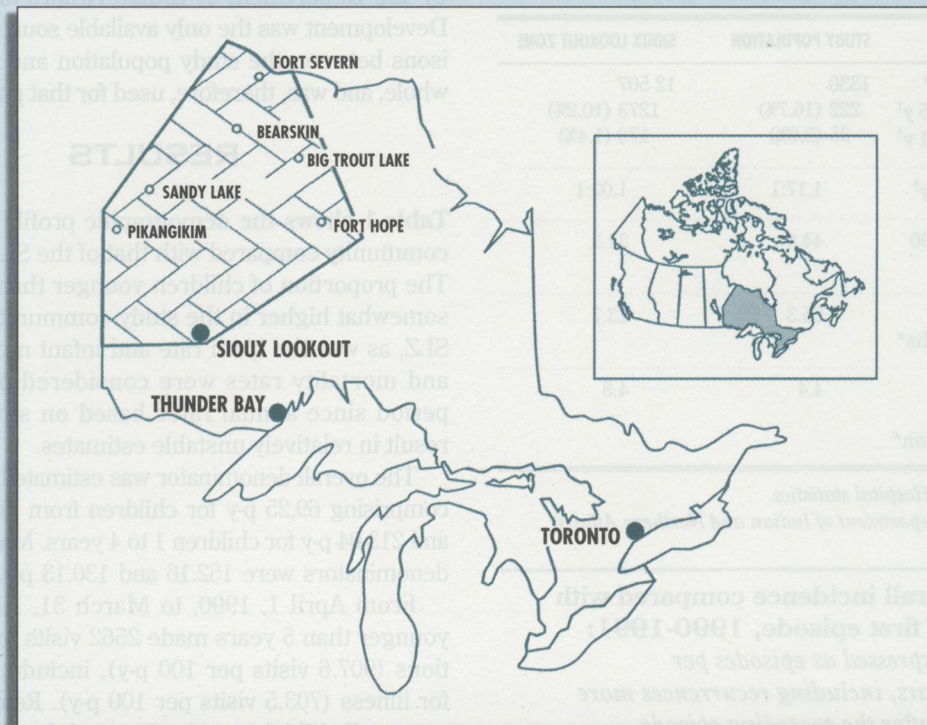
## METHODS

Health care delivery to the study community is organized at the level of the SLZ, as defined by Health Canada's Medical Services Branch. The SLZ is a 385 000-km<sup>2</sup> region in northwestern Ontario with an aboriginal population (Northern Ojibwa and Swampy Cree bands<sup>16</sup>) of about 14 000 people and a total population of about 18 000 (**Figure 1**). Health care for the 28 small, isolated, aboriginal communities dispersed throughout the SLZ is organized into a hierarchy of health stations, nursing stations, and a zone hospital located in the town of Sioux Lookout.<sup>4,17,18</sup> Physicians provide less than 10% of the health care in the region.<sup>17,18</sup>

Economically the region is poor; most work is seasonal or temporary. Unemployment frequently exceeds 80%, and government jobs or benefits are important sources of income.<sup>19</sup> At the time of this study, housing and infrastructure was substandard: virtually no homes had running water, and most communities lacked any form of sewage treatment.<sup>20</sup>

The community selected for this study is an isolated reserve of approximately 1300 people in the western region of the SLZ. It is one of two communities in the SLZ large enough to generate the rates required for this study, and in general, it resembles the socioeconomic and demographic profile of the SLZ. A physician visits this community for approximately 1 week each month, but most health care is delivered by out-post nurses, nurses' aids, and community health workers. Travel is limited and is possible only by air for most of the year; the nursing station is the only place people can bring health concerns to a health worker with formal training.

Logbooks kept at each nursing station in the SLZ contain records of all medical and nursing visits. Entries include patients' age, sex, band number, main reasons for each visit, and disposition. Logbook records of children in the study community younger

**Figure 1. Map of Ontario showing Sioux Lookout Zone**

than 5 years old at the time of presentation were entered into Epi Info 5.0<sup>21</sup> for the year ending March 31, 1991. Pertinent demographic information was determined from these logbooks and from medical records in the nursing station. Data on visits to the nursing station and to outpost nurses and visiting physicians were then exported to Statistical Analysis System (SAS)<sup>22</sup> and analyzed by diagnostic category.

Up to four separate diagnoses for each nursing station visit were recorded in the logbook. Each was treated as an independent visit in our analysis. Diagnoses were classified according to the International Classification of Health Problems in Primary Care.<sup>23</sup> An episode of illness was defined as a visit for illness. All subsequent visits within the following 14 days for the same illness were considered as the same episode: presentation, treatment, and follow-up visits for the same diagnosed illness within 2 weeks were treated as one episode, regardless of the number of visits during that period. Incidence was expressed as number of episodes of illness per 100 person-years (p-y) and included multiple episodes for the same

child.<sup>24</sup> Incidence of first episode was expressed as number of first episodes of an illness per 100 p-y.

Disease-specific incidence rates were found to conform to the Poisson distribution. Since the distribution of two Poisson variates conditional on their sum is binomial, the  $\chi^2$  statistic was used in analyzing incidence by age and sex.<sup>25</sup> To allow for the effect of multiple comparisons, *P* values of <.01 were required for statistical significance and 99% confidence limits were used.<sup>26</sup> To compare our results with rates found among aboriginal and non-aboriginal children in southwestern Ontario, we generated 95% confidence intervals using the Poisson distribution.<sup>26</sup>

Determining a population denominator was difficult, as no official census data were available for the community. The number of children residing in the community was determined from birth records maintained at the nursing station. Denominators were generated from records of births, deaths, and migration and were calculated monthly using information reported by local informants. For example, children born halfway through the year contributed 0.5 person years, as did

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**Table 1. Study population compared with  
Sioux Lookout Zone population, 1991:**  
*Mortality rates are averaged over 5 years, 1987-1991*

CHARACTERISTIC	STUDY POPULATION	SIoux LOOKOUT ZONE
Total population*	1330	12 507
• Population <5 y <sup>†</sup>	222 (16.7%)	1273 (10.2%)
• Population <1 y <sup>†</sup>	35 (2.6%)	178 (1.4%)
Boy-girl ratio <5 y <sup>†</sup>	1.17:1	1.02:1
Birth rate per 1000 population*	44.8	31.3
Infant mortality per 1000 live births*	25.3	13.7
Crude mortality (all ages) per 1000 population*	4.4	4.8

\*Data from SLZ Hospital statistics.

<sup>†</sup>Data from the Department of Indian and Northern Affairs.

**Table 2. Overall incidence compared with  
incidence of first episode, 1990-1991:**  
*Incidence is expressed as episodes per  
100 person-years, including recurrences more  
than 14 days after the preceding episode*

ILLNESS	OVERALL INCIDENCE	INCIDENCE OF FIRST EPISODE
Upper respiratory tract infections	111.9	61.6
Skin conditions	98.1	54.6
Lower respiratory tract infections	94.1	46.1
Otitis media	88.2	48.5
Chickenpox	28.6	28.6
Gastroenteritis	25.9	19.5
Asthma	25.2	12.4
Fever, unspecified	24.8	20.2
Injuries	24.8	21.6
Otitis externa	20.2	16.3
Pneumonia	17.0	13.8
Other respiratory diseases	12.4	11.0
Eye diseases	12.0	9.9
Other gastrointestinal diseases	11.7	10.6
Genitourinary conditions	8.5	6.0
Neurologic conditions	6.4	3.9
Musculoskeletal conditions	5.7	5.3
Other conditions	56.7	41.1

those who turned 5 halfway through the year. For this reason, the total number of children is different from the total number of p-y. Band list information provided by the Department of Indian Affairs and Northern Development was the only available source for comparisons between the study population and the SLZ as a whole, and was, therefore, used for that purpose.

## RESULTS

**Table 1** shows the demographic profile of the study community compared with that of the SLZ as a whole. The proportion of children younger than 5 years was somewhat higher in the study community than in the SLZ, as was the birth rate and infant mortality. Birth and mortality rates were considered over a 5-year period since annual rates based on small numbers result in relatively unstable estimates.

The overall denominator was estimated at 282.29 p-y, comprising 69.25 p-y for children from birth to 1 year and 213.04 p-y for children 1 to 4 years. Male and female denominators were 152.16 and 130.13 p-y, respectively.

From April 1, 1990, to March 31, 1991, children younger than 5 years made 2562 visits to nursing stations (907.6 visits per 100 p-y), including 1986 visits for illness (703.5 visits per 100 p-y). Remaining visits were well child, immunization, and dental visits.

Incidence of illness and incidence of first episode are shown in **Table 2**. Infectious diseases accounted for almost two thirds of all episodes of illness, and respiratory infections alone accounted for close to half. High rates of recurrence were found for respiratory and skin conditions; low rates were observed for chickenpox, injuries, and musculoskeletal conditions. As shown in **Table 3**, disease-specific incidence declined significantly with age in 12 of 18 illness categories. Highest risk ratios for infants were found for eye diseases, other gastrointestinal conditions, fever, lower and upper respiratory tract infections, and other conditions. Injuries increased with age ( $P < .01$ ), and there was a trend (although not statistically significant) for increased incidence of genitourinary conditions with age. Minor differences by sex were found for most conditions, but a significant difference was found only for asthma, which occurred three times more frequently among boys.

Most illness episodes followed an expected seasonal pattern, with gastroenteritis occurring in the summer months. **Figure 2** highlights the pattern for respiratory illnesses and demonstrates clearly a trend to increased frequency in February and, less distinctly, in September. Asthma, fever, injuries, and skin conditions showed little or no seasonal variation.

**Table 3. Incidence of first episode of various illnesses by age, 1990-1991: Incidence is expressed as episodes per 100 person-years, including recurrences more than 14 days after the preceding episode**

ILLNESS	BIRTH TO 1 YEAR	1 YEAR TO 4 YEARS	RISK RATIO FOR BIRTH TO 1 YEAR COMPARED WITH FROM 1 YEAR TO 4 YEARS	95% CI (P VALUE)
Upper respiratory tract infections	216.6	77.9	2.8	2.1-3.7 (<.001)
Skin conditions	157.4	78.9	2.0	1.4-2.7 (<.001)
Lower respiratory tract infections (except pneumonia)	164.6	52.6	3.2	2.2-4.5 (<.001)
Otitis media	161.7	64.3	2.5	1.8-3.5 (<.001)
Chickenpox	30.3	28.2	1.1	0.5-1.9 (<.9)
Gastroenteritis	31.8	23.9	1.3	0.6-2.4 (<.5)
Asthma	26.0	24.9	1.1	0.4-2.0 (<1.0)
Fever	53.4	15.5	3.5	1.9-6.7 (<.001)
Injuries	11.6	29.1	0.4	0.1-0.8 (<.1)
Otitis externa	37.5	14.6	2.6	1.2-5.1 (<.1)
Pneumonia	31.8	12.2	2.5	1.1-5.4 (<.1)
Other respiratory diseases	24.5	8.4	2.7	1.1-6.8 (<.1)
Eye diseases	34.7	4.7	7.8	3.3-31.8 (<.001)
Other gastrointestinal diseases	30.3	5.6	5.5	2.3-18.0 (<.001)
Genitourinary conditions	4.3	9.9	0.4	0.0-1.3 (<.3)
Neurologic conditions	10.1	5.2	2.2	0.4-7.6 (<.4)
Musculoskeletal conditions	10.1	4.2	2.3	0.4-9.3 (<.3)
Other conditions	109.7	39.4	2.8	1.8-4.2 (<.001)

Various studies have reported incidence as either number of annual episodes per 100 children, including recurrent episodes in the same child, or as first annual episode per 100 children. **Table 2** shows that incidence is significantly higher than incidence of the first episode for many conditions. We have chosen to report both proportions, but have limited age, sex, and seasonal analyses to incidence per 100 children, including recurrent episodes in the same child, to facilitate comparison with studies of other aboriginal children employing this measure.<sup>8,9,27</sup>

**Figure 3**<sup>8,9</sup> shows rates of illness among infants in the study community compared with those in aboriginal and non-aboriginal infants in southwestern Ontario.<sup>8</sup> Although this paper did not include confidence intervals, we used the Poisson distribution to determine 95% confidence intervals to facilitate further comparison of infants in the study community with those in southwestern Ontario. Skin conditions, otitis media, and lower respiratory tract infections

were more frequent in the SLZ. Only gastroenteritis rates were higher in the southwestern Ontario aboriginal population. Rates of all conditions were significantly higher in the study children than in non-aboriginal children in southwestern Ontario.

## DISCUSSION

Little has been published on the morbidity patterns of aboriginal children on reserves. This study attempts to describe the disease patterns of aboriginal children living in an isolated community by using diagnoses recorded in nursing station logbooks.

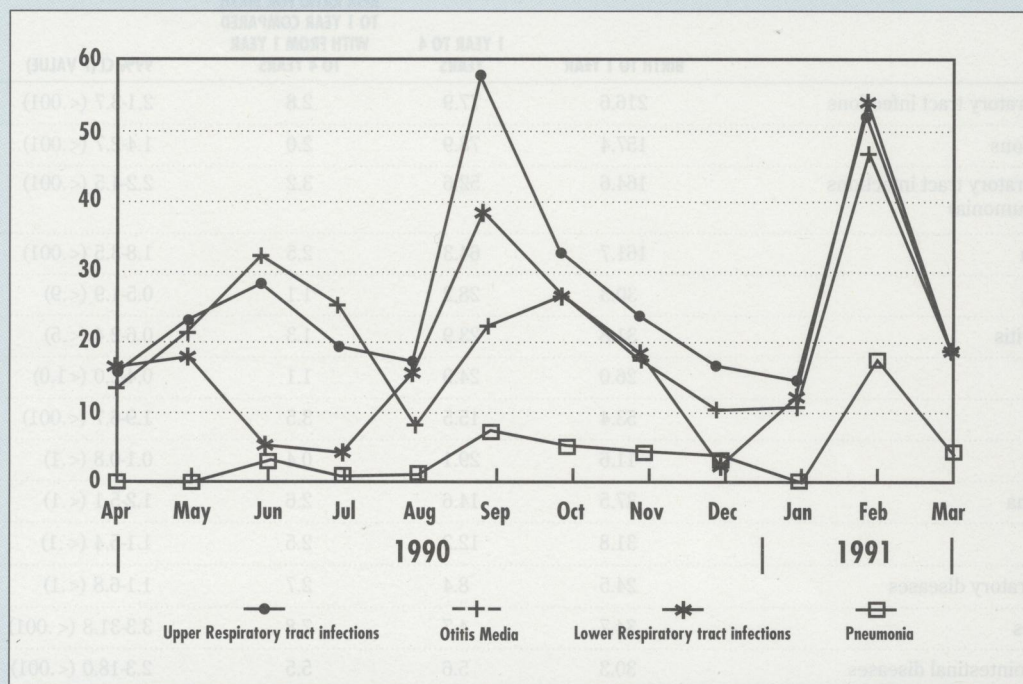
### Limitations

Several limitations could be associated with this study. First, the logbook diagnoses from which disease-specific rates were derived were largely made by outpost nurses rather than by physicians. The pattern of nurses' diagnoses in the SLZ, however, has

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Figure 2. Seasonal pattern of respiratory infections



been shown to be similar to that of physicians,<sup>18</sup> with differences mostly related to the mix of patients seen. Second, the definition of an episode of illness varies among studies. We have chosen to represent an episode of illness by all visits for the same diagnosis within 14 days of the initial visit so as to facilitate comparison with other published results. This definition has been employed by others.<sup>27</sup> The initial and all subsequent visits involving assessment and treatment of a specific health condition have been used also to define an episode.<sup>8,9</sup> Episodes have also been defined by using varying periods for various conditions<sup>17</sup> and by using the complete period of illness from onset to resolution.<sup>28</sup>

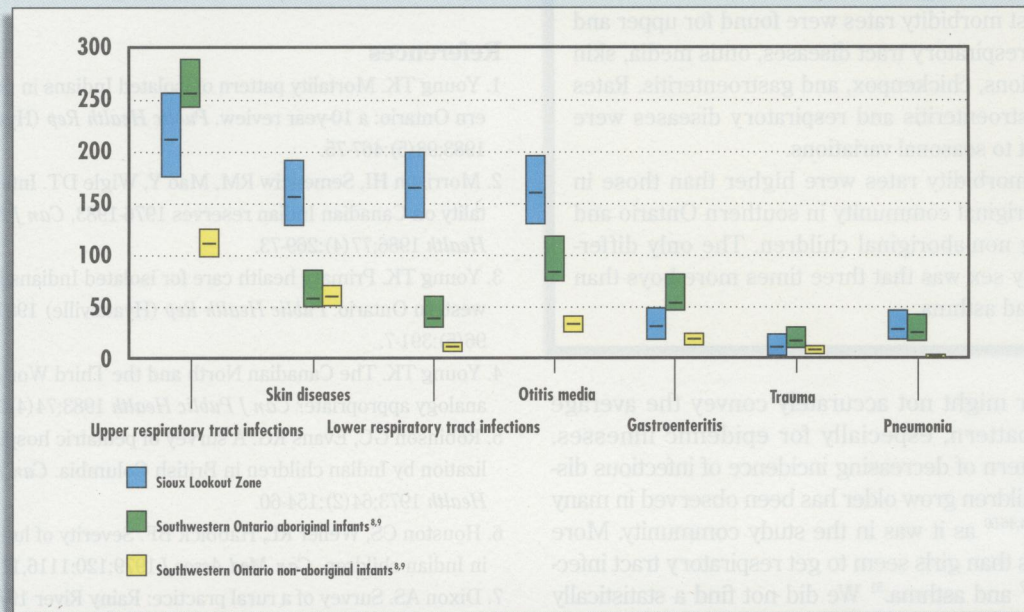
Health care use is an imperfect proxy for population-based morbidity, since it is affected by coverage of health services, care-seeking behaviour, and provider behaviour (in eliciting follow-up visits), as well as actual health status. In the study community, the nursing station was the only accessible medical clinic, and travel to other communities was extremely limited due to geographic isolation. Anecdotal reports by local nurses indicate that visits for trivial reasons tend to be rare and that many families seek health care and adhere to follow-up instructions only when illnesses are

considered severe. The results presented in this study, therefore, are considered representative for this community. The overall rate of health care use by children younger than 5 years is similar to that reported in other aboriginal<sup>18,9,29,30</sup> and non-aboriginal<sup>8,9,31-34</sup> settings. Of note, the rate of health care use in the study community for infants' upper respiratory tract infections, which are mostly minor self-limiting conditions, is very similar to that reported from southwestern Ontario,<sup>8</sup> suggesting roughly comparable levels of health care use in these two communities (Figure 3<sup>8,9</sup>). Given the factors noted above and that some ill children would probably not be brought to see a health worker, health care use in this setting likely underestimates morbidity, especially morbidity due to minor conditions.

#### Findings

Even with the limitations described above, several interesting patterns in morbidity rates can be discerned. The relatively higher rates of skin conditions in the SLZ could reflect the virtual absence of running water in homes in the study community. The SLZ children frequently had more lower respiratory tract infections and otitis media. Wood-burning stoves are the

**Figure 3.** Rates of illness in the first year of life: Comparing the SLZ with aboriginal and non-aboriginal communities in southwestern Ontario (95% CI)



main source of heating and cooking in the study community, a factor linked to lower respiratory tract infections among Navajo children and to otitis media among non-aboriginal children.<sup>35,36</sup> The prevalence of wood-burning stoves in southwestern Ontario has not been reported, but is likely to be lower. Additional potential risk factors for respiratory morbidity, which cannot easily be compared between these sites, include socioeconomic status, household ventilation, cigarette smoking, crowding, immunization levels (including pertussis and measles), and genetic predisposition.

For aboriginal children, breastfeeding has been shown to be strongly protective against otitis media,<sup>37</sup> upper respiratory tract infection, gastroenteritis, and lower respiratory tract infection, including pneumonia.<sup>38</sup> Unfortunately, infant feeding practices have not been reported from the aboriginal population in southwestern Ontario or from the SLZ. High rates of anemia in infancy have been reported from both communities<sup>39,40</sup> and from other Canadian aboriginal populations,<sup>41</sup> possibly contributing to increased susceptibility to infectious diseases. These risk factors might also contribute to the very large differences in infectious disease rates between aboriginal and non-aboriginal Canadian children.

Seasonal patterns for respiratory tract infections are strikingly similar, with increased frequency in both February and September, consistent with the typical epidemiologic pattern of elevated rates of viral respiratory infections in autumn and winter months. That this seasonal pattern is shared by several different respiratory tract infections is not surprising, since they share many of the same viral pathogens. A combination of domestic overcrowding, prolonged continuous indoor living and working, indoor air pollution, and extremely dry air in the cold winter months might promote transmission of viruses and susceptibility to respiratory infection. Similar seasonal patterns of respiratory tract infections have been reported among aboriginal children in the US southwest<sup>42</sup> and non-aboriginal children in North Carolina<sup>43,44</sup> and Seattle.<sup>45,46</sup> In the study community, gastroenteritis also demonstrated seasonal variation with a winter peak. This finding could have been due to an increased incidence of gastroenteritis or to the fact that children have more contact with health services during these months for other reasons, chiefly respiratory tract infections. During the study year, chickenpox presented as a typical epidemic, its peak occurring in June. These data are limited in that a

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#### Key points

- This is the first population-based study of morbidity rates among aboriginal children in a remote, northern setting in Canada.
- Highest morbidity rates were found for upper and lower respiratory tract diseases, otitis media, skin conditions, chickenpox, and gastroenteritis. Rates for gastroenteritis and respiratory diseases were subject to seasonal variations.
- Most morbidity rates were higher than those in an aboriginal community in southern Ontario and among non-aboriginal children. The only difference by sex was that three times more boys than girls had asthma.

single year might not accurately convey the average seasonal pattern, especially for epidemic illnesses.

The pattern of decreasing incidence of infectious diseases as children grow older has been observed in many settings,<sup>43,44,46-50</sup> as it was in the study community. More young boys than girls seem to get respiratory tract infections<sup>28,43,44,47</sup> and asthma.<sup>51</sup> We did not find a statistically significant difference between boys and girls for these conditions in the study community (Table 3).

#### Conclusion

These data are the first to document patterns of morbidity among a population of Canadian aboriginal children in a northern, remote area. Infectious diseases, especially respiratory tract infections, are the leading cause of morbidity. Conditions associated with potentially serious sequelae, such as acute lower respiratory tract infections, otitis media, gastroenteritis, and pneumonia, appear to occur more frequently among SLZ children than among more urbanized aboriginal populations in Canada and particularly among non-aboriginal Canadians. Further research is needed to better characterize the burden of illness, to understand more fully the causes, and to evaluate the effectiveness and cost-effectiveness of interventions to improve aboriginal children's health. Current knowledge is sufficient, however, to warrant urgent action to ameliorate the life circumstances and living conditions of young aboriginal children and to intensify other activities to promote their health. ♦

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