

The Prevalence of Intestinal Parasites and Enteropathogenic Bacteria in James Bay Cree Indians, Quebec

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We conducted a survey to identify the intestinal parasites and enteropathogenic bacteria involved in episodes of diarrhea in the James Bay (Quebec) Cree, a previously unsurveyed area of Canada. 382 stool samples obtained from a random sample of the population were examined; 29.3% were positive for at least one parasite and 21 different serotypes of enteropathogenic Escherichia coli (EPEC) were isolated from 6.5% of the stool samples. Stepwise discriminant analysis showed that, in order of importance, age, number of persons per household and the specific village were significantly correlated with parasitic infection. The presence or absence of running water was weakly associated with infection. .

We conclude that overcrowding is an important and potentially reversible causal factor accounting for the high prevalence of intestinal parasites in this population.

Nous avons effectué une étude afin d'identifier les bactéries entériques et les parasites intestinaux responsables de cas de diarrhée dans la population cri de la Baie James. Cette question n'avait jamais été étudiée auparavant au Canada. Nous avons examiné 382 échantillons de selles. De ceux-ci, 29.3% étaient infectés par un parasite au moins; de plus, nous avons isolé 21 sérotypes différents d'Escherichia coli entéropathogène (EPEC) dans 6.5% des échantillons. L'infection parasitaire est reliée aux facteurs suivants (par ordre d'importance) : âge, nombre d'individus par foyer, et village concerné. La présence d'eau courante n'affecte guère les caractéristiques de l'infection..?

Nous concluons que la suroccupation des lieux de résidence est un facteur important, et probablement réversible expliquant la forte prévalence des parasites intestinaux dans la région étudiée.

The 7,300 James Bay Cree live in eight communities; the coasters who pursue their livelihood from the resources along the James Bay coast, and the inlanders with inland hunting territories (Figure 1). Cree families leave each autumn to spend from 3 to 8 months in the wilds where they live by hunting and trapping which is supported by a Cree income security program¹. Over the last twenty years, the Cree have tended to spend less time in the wilds since children have been required by law to attend school. With extended periods of time spent in the settlement, people have become exposed to more infectious diseases².

Few studies of diarrhea have been carried out in northern Canada. However, episodes and epidemics of diarrhea are frequent³. We report the results of a cross-sectional study which identified the intestinal parasites and enteropathogenic bacteria present in asymptomatic persons. Possible associations between infection and age, number of persons per household, presence or absence of running water, and the specific village were also examined.

MATERIALS AND METHODS

During July and August 1982, 50 individuals from each of eight different Cree villages were randomly selected from the band lists. Each person was asked, through an interpreter, to submit a single stool specimen and to respond to a questionnaire which inquired about age, sex, household sanitary facilities and diarrhea symptoms.

A portion of the fresh stool specimen was introduced into a transport medium (Cary and Blair) and shipped for analysis to the Laboratoire de santé publique du Québec. For enteropathogenic bacteria, specimens were streaked directly on MacConkey and Hektoen agar and placed in Hajna

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Figure 1. Geographical distribution of the eight different Cree villages(o). The numbers show the population for each village in 1982.

broth and incubated at 37°C for 48 hours. Enteropathogenic *Escherichia coli* (EPEC) serotypes were identified by sero-agglutination and confirmed biochemically according to the method of Edwards and Ewing⁴. For *Campylobacter* a direct stool examination was performed under a phase contrast microscope. A *Campylobacter* agar was used according to the method of Skirrow⁵. It was streaked and incubated at 42°C with 5% O₂, 10% CO₂ and 85% N₂ for 48 to 72 hours. Another portion of the stool sample was fixed in a 10% formalin solution and examined according to a slightly modified Ritchie's formalin-ether sedimentation concentration technique for parasites^{6,7}.

A stepwise discriminant analysis procedure was used to distinguish between individuals infected and not infected with parasites on the basis of community, age, sanitary facility (presence or absence of indoor piped water and indoor flush toilet), and crowding (the average number of inhabitants per household per community)⁸.

RESULTS

382 of the 400 randomly sampled individuals (96%) responded to the questionnaire and submitted a stool sample. They ranged in age from a few months to 93 years. The age and sex structure of the sample were similar to that of the Cree population. None reported gastrointestinal symptoms.

Bactériologie analysis showed no *Salmonella*, *Shigella*, *Yersinia* or *Campylobacter*. However, 21 different serotypes of EPEC (Table I) were isolated from 6.5% of the stool

TABLE I
Prevalence of Intestinal Parasites and Enteropathogenic *Escherichia coli* (EPEC) by Village, Sex and Age Group from a Survey in James Bay Cree Indians

Village	Persons Examined	Multiple Infections [§]	Percent (%) Positive for Parasites†										Total Percentage Parasites	Percent Positive for EPC‡	
			E.C.	E.N.	E.H.A.	G.L.	E.Hi.	I.B.	C.M.	E.Ho.	M.sp.	EV.			
Eastmain	50	3	10.0	10.0	2.0	0	0	2.0	0	0	0	0	0	18.0	6.0
Chisasibi	47	3	2.1	10.6	4.3	8.5	2.1	0	0	0	0	0	0	19.1	8.5
Waswanipi	41	5	12.2	14.6	9.8	2.4	0	0	0	0	0	0	0	24.4	7.3
Wemindji	49	5	14.3	6.1	8.2	12.2	0	0	0	0	0	0	0	24.5	2.0
Mistassini	52	4	19.2	7.7	7.7	3.8	1.9	0	0	1.9	0	0	0	30.8	1.9
Poste-de-la-Baleine	45	4	15.6	13.3	4.4	4.4	0	2.2	0	0	2.2	0	0	31.1	15.3
Fort-Rupert	48	5	16.7	8.3	10.4	10.4	2.1	4.2	2.1	0	0	0	0	31.2	8.3
Nemiscau	50	5	38.0	6.0	4.0	4.0	6.0	0	2.0	0	0	2.0	0	52.0	6.0
Sex*															
Male	165	11	17.0	8.5	4.8	5.5	0.6	1.2	0.6	0	0	0	0	28.5	6.0
Female	211	23	16.1	10.4	7.6	6.2	2.4	0.9	0.5	0.5	0.5	0.5	0.5	30.3	7.1
Age Group (Years)															
< 1	13	1	7.7	0	0	7.7	0	0	0	0	0	0	0	15.0	0
1-9	117	14	23.1	9.4	8.5	10.3	1.7	1.7	0.9	0.9	0	0	0	56.0	5.0
10-19	53	9	30.2	20.8	5.7	7.5	3.8	0	1.9	0	0	1.9	0	47.1	5.6
20-29	34	3	17.6	8.8	11.8	2.9	0	0	0	0	0	0	0	32.3	8.8
30-39	31	3	9.7	12.9	16.1	3.2	3.2	0	0	0	0	0	0	35.4	12.9
40-49	33	2	6.1	6.1	0.0	9.1	3.0	0	0	0	3.0	0	0	21.2	9.0
50-59	40	2	12.5	5.0	2.5	0	0	2.5	0	0	0	0	0	15.0	5.0
50+	61	0	3.3	4.9	1.6	0	0	1.6	0	0	0	0	0	11.5	6.5
Total:	382	34	16.2	9.4	6.3	5.8	1.6	1.0	0.5	0.3	0.3	0.3	0.3	29.3	6.5

* Sex not available for 6 persons

† E.C., *Entamoeba coli*; E.N., *Endolimax nana*; E.H.A., *Entamoeba hartmanni*; G.L., *Giardia lamblia*; E.Hi., *Entamoeba histolytica*; I.B., *Iodamoeba bütschlii*; C.M., *Chilomastix meslini*; E.Ho., *Enteromonas hominis*; M.sp., *Metorchis* sp.; E.V., *Enterobius vermicularis*. Results not available for 4 persons.

‡ 21 different serotypes of enteropathogenic *Escherichia coli*

§ 2 parasites or more

TABLE II
Stepwise Discriminant Analysis Distinguishing Between
Infected and Non Infected Individuals with Parasites on the
Basis of Age, Crowding and the Respective Community for
the James Bay Cree, Quebec*

Variable	Discriminant Fonction F Coefficient		Significance
Age	.884	17.8	.001
Crowding	.480	10.7	.001
Community	.241	7.5	.001

* Presence of sanitary facilities did not fit the model.

cultures. Prevalence of EPEC infection ranged from 1.9% in the community of Mistassini to 13.3% in Waswanipi. There was only slight variation between age groups.

Ten different species of parasites, 8 protozoan, 2 helminths, were found in 112 of the 382 stool samples (29.3%); 30% had multiple infections, i.e. two or more different parasites. In one particular case, a 12-year-old girl, 6 different parasites were identified. Water- and food-borne protozoa were most frequently found, especially *Entamoeba coli* which was present in 16.2% of the study sample. The helminth *Enterobius vermicularis* cannot be reliably estimated by stool sample analysis, but eggs were found in one individual. *Metorchis sp* was also found in one individual.

Males and females were similarly infected with parasites. Infection rates per community varied substantially; Nemiscau reported the highest level of infection (52%). *E. coli* was the most abundant parasite in 6 of 8 villages, while in the two remaining, *Entamoeba nana* was most prevalent (Table I).

The highest prevalence (56%) was seen in the 1-9 year old group ($p < .001$). The rate of infection decreased by age; the lowest infection rate (11.5%) was observed among the elderly. *Giardia lamblia* and *E. coli* were the most common parasites in the 0-1 and 1-9 age groups.

Stepwise discriminant analysis showed that age, crowding and the community itself were associated with the presence of intestinal parasites. The effect of age was approximately twice as strong as crowding and three times stronger than the community (Table II). The presence of indoor piped water and flush toilets did not enter the model. No correlations for any of these variables were found for EPEC.

DISCUSSION

Although no carriers of *Salmonella*, *Shigella*, *Yersinia* or *Campylobacter* were found, 6.5% of stool samples obtained from asymptomatic persons were positive for EPEC. The finding that currently designated enteropathogenic serotypes of EPEC may not be pathogenic and that other serotypes may be pathogenic, though not labelled as such, has been reported in other populations⁹⁻¹⁰. This problem deserves further study, especially in the North where episodes and epidemics of diarrheal illnesses are relatively frequent.

The lack of correlation with sanitary facilities is surprising. Other than the relatively low prevalence of infection, drinking water practices in the North may account for this negative result. Although all villages now have running water or chlorinated water delivered in large containers, many residents continue to drink water from surrounding lakes, rivers, or springs which have no quality control, primarily because this running water has several undesirable characteristics such as metallic taste, a brownish color, and smells of chlorine. Further studies should question the respondents about the sources of drinking water.

Surveys done in Northern Canada between 1961 and 1975 report prevalence rates of intestinal parasites ranging from 44% to 69.7%¹¹⁻¹⁴. More recent studies done in Labrador in 1979¹⁵ and the N.W.T. between 1969-1978¹⁶ reported prevalence rates of 15% and 31.6% respectively. Prevalence rates in these latter surveys are similar to those found in this study (29.3%). Improved sanitary conditions, as well as improvements in preventive and curative health programs, may be responsible for the declining rates of infection with parasites.

Metorchis sp were found in one woman. This trematode is usually found in the liver of piscivorous mammals such as dogs, cats and raccoons but is found occasionally in humans following ingestion of infected fish¹⁷⁻¹⁸. This parasite has been previously found in natives of Canada and Greenland^{13, 14, 15}.

G. lamblia and *E. histolytica* were the two water- and food-borne protozoa found in this study that can induce diarrhea. The remaining protozoan are generally considered as commensal and non-pathogenic. Among the James Bay Cree Indians, the 1-9 year old age group, as in other similar studies^{13,14,19,20}, showed the highest prevalence of infections with *G. lamblia*. This same age group not only had the highest prevalence of infection with parasites (56%) but may also represent the principal reservoir from which other members of the community become infected, since the major mode of transmission in an endemic situation is from one individual to another¹⁶. Stepwise discriminant analysis confirms this observation by showing that age of the individual and number of persons per household are the two main factors which correlated with the presence of parasites in an individual. In 1982, the average number of persons per dwelling in the study communities ranged from 5.2 to 7.6, compared to the Quebec average of 2.7²¹. This overcrowding probably accounts for higher household transmission of pathogenic organisms.

In each of the study communities (except in Chisasibi), some houses have no sewage System. In certain communities (Poste de la Baleine, Eastmain, Wemindji) most houses lacked sewage facilities. In these cases, the Cree use other waste disposal systems such as outhouses, bucket style toilets and honey bags. Water quality and availability vary considerably from one community to another. In addition the general practice of water chlorination does not control the transmission of *G. lamblia* and *E. histolytica*. Sand filtration of water would remove nearly all cysts and diatomaceous earth filters would remove them completely²². In the absence of such facilities, it is not surprising that the presence of indoor piped water and flushing toilet were found not to be associated with the presence of parasites.

Since the major mode of transmission of the potential pathogens found in this study (EPEC, *G. lamblia*, *E. histolytica*) is the fecal-oral route, specific educational programs should be directed toward the 1-9 age group found to be the major reservoir for contamination. Increased awareness of sanitation in the communities combined with emphasis on the quantity of housing should contribute towards a reduction of the prevalence of intestinal pathogens in the North.

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