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

PAUL BRASSARD, M.Sc.,[1] **JOHN HOEY,** M.D.,[13] **JOHANNE ISMAIL, B.Sc.,[2] FLORIAN GOSSELIN,** M.Sc.2

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 differents d'Esçherichia 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 program[1]. 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 diseases[2].

Few studies of diarrhea have been carried out in northern Canada. However, episodes and epidemics of diarrhea are fréquent[3]. 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 (Carry 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

1. Department of Community Health, The Montréal General Hospital, Î597 Fine Avenue West, Montréal (Québec) H3G 1 B3
2. Laboratoire de santé publique du Québec, Sainte-Anne dé Bellevue. Québec
3. Correspondance and reprint requests should be addressed GRANT SUPPORT: ministère des affaires sociales, Québec

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 Ewing[4]. For *Campylobacter* a direct stool examination was performed under a phase contrast microscope. A *Campylobacter* agar was used according to the method of Skirrow[5]. It was streaked and incubated at 42°C with 5% 0_2, 10% CO_2 and 85% N_2 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 Escher*ichia coli* (EPEC) by Village, Sex and Age Group from a Survey in James Bay Cree Indians

	Persons Examined	Multiple Infections§	Percent (%) Positive for Parasites†										Total Percentage Parasites	Percent Positive for EPC‡
			E.C.	E.N.	E.HA.	G.L.	E.Hi.	I.B.	C.M.	E.Ho.	M.sp.	EV.		
Village														
Eastmain	50	3	10.0	10.0	2.0	0	0	2.0	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	19.1	8.5
Waswanipi	41	5	12.2	14.6	9.8	2.4	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	24.5	2.0
Mistassini	52	4	19.2	7.7	7.7	3.8	1.9	0	0	1.9	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	31.1	13.3
Fort-Rupert	48	5	16.7	8.3	10.4	10.4	2.1	4.2	2.1	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	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	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	30.3	7.1
Age Group (Years)														
< 1	13	1	7.7	0	0	7.7	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	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	47.1	5.6
20-29	34	3	17.6	8.8	11.8	2.9	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	35.4	12.9
40-49	33	2	6.1	6.1	0.0	9.1	3.0	0	0	0	3.0	0	21.2	9.0
50-59	40	2	12.5	5.0	2.5	0	0	2.5	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	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	29.3	6.5

* Sex not available for 6 persons

† E.C., Entamoeba coli; E.N., Endolimax nana; E.HA., ENtamoeba hartmanni;G.L., Giardia lamblia; E.Hi., Entamoeba histolytica; I.B., Iodomoeba bütschlii; C.M., Chilomastix mesnili; 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 Coefficient	F	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 populations[9-10]. 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 1979[15] and the N.W.T. between 1969-1978[16] 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 fish[17-18]. 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 another[16]. 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 2.7[21]. 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 geneal practice of water chlorination does not control the transmission of *G. lamblia* and *E. histolvtica.* Sand filtration of water would remove nearly all cysts and diatomaceous earth filters would remove them completely[22]. 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. histo-lytica)* 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.

Acknowledgement

We lhank S. loannou and L. Francoeur, the nurses in the respective dispensaries, and the interpreters, and the Laboratoire de santé publique du Québec.

REFERENCES

1. La Rusic IE. Income security for subsistence hunters. Department of Indian and Northern Affairs. Canada, 1982.
2. Dept. of National Health and Welfare Canada, Medical Branch. Indian health — a discussion paper (draft). Ottawa, 1979.
3. Pekeles G. An epidemic of infantile gastroenteritis in the Hudson Bay and James Bay regions. A description with recommendations to the Ministère des Affaires Sociales, M.Sc. Thesis, McGill University, Montréal, Canada, 1981.
4. Edwards RR, Ewing WH. Identification of Enterobacteriaceae, 3rd éd. Burgess Publishing Co., Minneapolis, Minn. 1972.
5. Skirrow MB. Campylobacter enteritis: A "new" disease. Br Med J 1977; 2: 9-11.
6. Léger N, Notteghem MJ. Guide de parasitologie pratique. Soc d'id d'eneignement. Paris 1970: 26-27.
7. Melvin DM, Brooke MM. Laboratory procedures for the diagnosis of intestinal parasites. U.S. Dept. of Health and Human Services. Public Health Service, CDC, Atlanta, 1980.
8. Kleinbaum DG, Kupper LL. Applies regression analysis and other multivariable methods. Duxbury Press, Mass. VVadsworth Pub Comp. 1978.
9. Woodward WE. Hirschhorn N. Sack RB, Cash RA; Brownlee L. Chickadonz GH, Evans LK, Shepard RN, Woodward RC. Acute diarrhea on an Apache Indian reservation. Am J Epidemiol 1974; 99: 281-290.
10. Gangarosa EJ, Merson MH. Epidemiologic assessment of the relevance of the so-called enteropathogenic serogroups of *Escherichia coli* in diarrhea. N Engl J Med 1977; 296: 1210-1213.
11. Freeman RS, Jamieson J. Parasites of Eskimos at Igloolik and Hall Beach, Northwest territories. In: Shephard RJ, Itoh S, eds. Proc 3rd Internat. Symp. Circumpolar Health. Yellowknife, Northwest territories: University of Toronto Press, 1976: 306-315.
12. Laird M, Meerovitch E. Parasites from Northern Canada I. Entozoa of Fort Chimo Eskimos. Can J Zool 1961; 39: 63-67.
13. Meerovitch E, Eaton RDP. Outbreak of amebiasis among Indians in North Western Saskatchewan. Canada. Ain J Trop Med Hyg 1965; 14: 719-723.
14. WatsonTG, Freeman RS, Staszak M. Parasites in native peoples of the Sioux lookout zone Northwestern Ontario. Can J Public Health 1979: 70: 179-182.
15. SoleTD, Croll N. Intestinal parasites in man in Labrador. Canada. Am J Trop Med Hyg 1980; 29(3): 364-368.
16. Eaton RDP. *Giardia inleslinalis, Enlamoeba hiflolylica* and *Diphyl-lobotrium spp,* in central and northern Canada. Can Dis Wkly Rep 1981; 7-26: 129-131.
17. Eaton RDP. Metorchiasis — A Canadian Zoonosis. Epidemiological Bulletin 1975; 19(5): 62-68.
18. Cameron TWM. The morphology, taxonomy and life history of *Metorchis conjunctus* (Cobbold 1860). Can J Res 1944; 22: 6-16."
19. Babbott FL Jr. Frye WW, Fordon JE. Intestinal parasites of man in Arctic Greenland. A m J Trop Med Hyg 1961; 10: 185-190.

20. Eaton RDP. Endémie giardiasis in Northern Canada. Can Dis Wkly Rep 1976; 2-32: 125-126.
21. Statistics Canada, 1981 census, Catalog No E-575, Minister of Supply and Services, Canada 1983.
22. Control of communicable diseases in man. A.S. Benenson éd., 12thed. 1975. American Public Health Association Report.

Received: October 9, 1984 Accepted: March 4, 1985

FIRST NATIONAL CONFERENCE ON

HEALTH PROMOTION AND AGING

Sponsored by the Gerontology Division of the Canadian Public Health Association

May 1-2, 1986

The Royal Connaught Hôtel— Hamilton, Ontario

This two-day inaugural Conference will receive approaches to health promotion for the aging population in Canada. It will provide the first nation-wide opportunity to share current aspects and new advances in research, public policy, care-provider services and community-based promotion.

Whether you are based in the community or in an institution, are involved in the development of policy or research, or are concerned with the political aspects of this issue, you will benefit from participation in this Conference.

The World Health Organization (WHO) Expert Committee on the Effectiveness of Health Promotion for the Elderly will have just completed a three-day meeting in Hamilton. They will both participate in the CPHA Conference and report on their recommendations. This offers a unique opportunity for Canadians to benefit from the international experience.

A large focus of the Conference will be on audience participation. During the panel discussions, delegates will be encouraged to share their experiences and opinions.

For More Information Please Contact:

First National Conference on Health Promotion and Aging
Canadian Public Health Association
1335 Carling Avenue, Suite 210
Ottawa, Ontario K1Z 8N8

(613) 725-3769 TELEX 53-3841