INTESTINAL PARASITOSES AMONG WAYAMPI INDIANS FROM FRENCH GUIANA

CARME B.*, MOTARD A.*, BAU P.**, DAY C.*, AZNAR C.* & MOREAU B.***

Summary :

Intestinal parasitism and its epidemiological characteristics were studied in an isolated Amerindian population from Upper Oyapock (French Guiana) that has retained its traditional social and cultural specificities. This population consisted of 138 Wayampi Indians, 68 adults and 70 children (below the age of 15 years), with a sex ratio (M/F) of 0.86, spread over the four villages of the community of Trois Sauts, corresponding to more than two thirds of the population recorded as inhabiting the sector in the last census (375 inhabitants). Fecal examination combined the direct examination of fresh feces with the quantitative techniques of Kato-Katz method, Baermann and MIF staining. Overall, 92 % of the subjects were found to have intestinal parasites, 85 % if only direct examination of fresh stools was taken into account. Fourteen species of human parasite were identified: seven protozoa and seven helminths. We observed in particular 1) a high frequency of hookworm infection due to *Necator americanus*. Over 50 % of subjects were affected, with a range of 25 % to 75 % according to the village, but with only moderate parasite loads; 2) a high level of parasitism by *E. histolytica/E. dispar* (17 %), *Stongyloides stercoralis* (16 %) and *Hymenolepis nana* (18%); 3) a lower level of parasitism by *Ascaris lumbricoides* and very low levels (almost absent) of *Trichiuris trichiura*; 4) the absence of *Schistosoma* and fluke eggs. With the exception of *H. nana*, which was more frequent in children than in adults, there was no significant difference in the level of parasitism according to sex and age.

Although the Wayampi of French Guiana are French citizens and consequently have quite high incomes and ready access to clinics and medicines, intestinal parasites are far from under control in this population. A lack of fecal hygiene and the habit of walking barefoot are widespread in the unchanging Amazonian environment and contribute to this phenomenon.

KEY WORDS : intestinal parasites, epidemiology, Amerindians, French Guiana.

Résumé : PARASITOSES INTESTINALES CHEZ LES WAYAMPI DE GUYANE

Le parasitisme intestinal avec ses caractéristiques épidémiologiques est étudié au sein d'une population amérindienne isolée du Haut Oyapock (Guyane Française) ayant gardé un fort particularisme socioculturel. Cent trente huit indiens Wayampi, 68 adultes et 70 enfants (< 15 ans), sexe ratio (H/F) 0,86, répartis sur les quatre villages de la commune de Trois Sauts, soit plus du tiers de la population recensée dans le secteur (375 habitants), ont été concernés. Le bilan coprologique réalisé sur le terrain associe un examen direct à frais et les techniques de Kato quantitative, Baerman et MIF coloration. Le pourcentage global de sujets parasités est de 92 %, 85 % si l'on ne tient compte que du seul examen direct. Quatorze espèces différentes sont identifiées : sept protozoaires et sept helminthes. On relève principalement : 1- une grande fréquence de l'ankylostomiase à Necator americanus *: globalement 50 %, variant de 25 à 75 % selon les villages, mais avec des charges parasitaires modérées; 2- un taux relativement élevé de parasitisme par* E. histolytica/E. dispar *(17 %),* Strongyloides stercoralis *(16 %),* Hymenolepis nana *(18 %); 3- un taux plus faible d'*Ascaris lumbricoides *et la quasi-absence de* Trichiuris trichiura*; 4- l'absence d'œufs de schistosomes et de douves. À l'exception d'*H.nana *plus fréquent chez les enfants, il n'existe pas de différence notable du taux de parasitisme selon le sexe et l'âge. Ainsi, malgré des revenus relativement conséquents liés au statut de citoyen français, la présence d'un dispensaire largement accessible, une bonne disponibilité des médicaments, le parasitisme intestinal est loin d'être maîtrisé chez les Wayampi de Guyane. L'absence d'hygiène fécale et la marche pieds nus généralisée dans un environnement amazonien non modifié rendent compte de ce phénomène*

MOTS CLÉS : *parasites intestinaux, épidémiologie, Amérindiens, Guyane Française.*

INTRODUCTION

At the end of the 1990s, due to improvements in living conditions, hygiene and treatment, intestinal parasitoses are no longer an important public health problem in the two French West Indies départements: Martinique (Gardien *et al.*, 1997; Magnaval, 1998) and Guadeloupe (Nicolas M. *et al.*, 3ème Congrès de Neurologie Tropicale, 1998; Fort-de-France). The situation appeared to be similar for the urban zones of French Guiana, the only French département located on the American continent itself, at least for the coastal zone where 90 % of the population lives. This conclusion was based on data from biological laboratories, particular those of the Hospitals of

* Laboratoire hospitalo-universitaire de Parasitologie-Mycologie, Equipe JE 2188, UFR de Médecine, Université Antilles-Guyane et Centre Hospitalier de Cayenne, BP 6006, F-97306 Cayenne (French Guiana).

** Centre de santé de Camopi, Centre Hospitalier de Cayenne.

*** Laboratoire de Biologie polyvalente, Centre Hospitalier de Cayenne.

Ethique : - Enquête présentée et approuvé par la CCPPRB (Comité Concultatif de Protection des Personnes dans la Recherche Biomédicale) de la Région Antilles-Guyane (Octobre 1999, Pr E. Janky, Centre Hospitalier Universitaire de Pointe-à-Pitre, F-97 110 (Guadeloupe). Tél. : 0590 89 13 80 – Fax : 0590 89 13 88.

Correspondence : Pr Bernard Carme,
Tél./Fax : 0594 29 62 50/0594 39 53 09 – E-mail : b.carme@nplus.gf

Cayenne and Saint-Laurent-du-Maroni. In contrast, a different situation was predicted for the Amerindian and Bush Negro communities living in the regions of the interior. These populations, particularly those living in the protected zone, have conserved their specific sociocultural structures and their ancestral way of life, largely due to regulated access. This conservatism, which is desired by cultural leaders and accepted by the French administrative authorities, may be an indirect cause of the persistence of infectious diseases, particularly intestinal parasitoses, which are controlled elsewhere in French Guiana. The lack of reliable epidemiological data on this subject for more than 20 years (Eutrope & Juminer, 1978) led us to propose a study program on intestinal parasitoses in the ethnic minorities living in the interior of French Guiana. The medium-term objective was to propose measures that are adapted to local situations, combining efficiency and the respect for local customs and traditions as far as possible. This pilot study was carried out among the Wayampi of Upper Oyapock in October 2000 with this aim in mind.

ENVIRONMENT, PATIENTS, MATERIALS AND METHODS

THE ENVIRONMENT AND POPULATION STUDIED

French Guiana, the only French-speaking country in South America, is the largest French administrative region or département, covering 91,000 km^2, one sixth of the national territory (Fig. 1). GNP per capita is the highest of any country in South America, US $11,000 in 1995. As for all French citizens, a minimum income is guaranteed by the state, in the form of the RMI (*revenu minimum d'insertion*, welfare support, ~ US$ 5,000 a year), as is open access to health care (CMU: *couverture maladie universelle*, universal health cover).

French Guiana is separated from Brazil in the east by the river Oyapock, and from Suriname in the west by the river Maroni. It is a country of plains and low hills covered by primary Amazon forest with the exception of a region of coastal savanna a few kilometers wide located behind the coastal mangrove swamp. The river system and airplanes are the only ways of reaching the interior of the country. The road network connects only the urban zones of the coastal area and the near interior. The population was only ~ 73,000 in 1982. In the last twenty years, considerable population growth has been observed in French Guiana: 115,000 to 130,000 in 1991 and the population was close to 200,000 at the end of the 1990s. The rural communities account for 20 % of the total population, with those of the interior accounting for about 10 %. It is in these rural communities that most of the members of the two oldest ethnic communities of French Guiana are found. The Amerindians have always lived in this region and the Bush Negroes, the direct descendants of former African slaves, arrived from Suriname in the 18th Century and took refuge in the interior of the country on the banks of the Maroni and its tributaries. The 4,000 Amerindians belong to six different ethnic groups. Three of these groups are coastal Indians more integrated into modern society in French Guiana. The other three groups correspond to Indians from the interior, established in regions with regulated access designed to "protect" these populations who wish to retain their traditions in a preserved environment: the Wayana of the upper course of the Maroni (about 500 individuals), the Wayampi of the upper course of the Oyapock (about 800 individuals) and the Emerillon (about 230 individuals), who occupy a zone between the other two groups.

Fig. 1. – French Guiana with the localisation of the four villages of the communauty of Trois sauts

This study was carried out in October 2000 at Trois Sauts (latitude 2.5° north, longitude 5° west), a community located in the upper reaches of the Oyapock. The right bank of the river, part of the Brazilian state of Amapa, is inhabited in this zone. The 370 inhabitants are all Wayampi except for five teachers and a nurse posted to this area. The inhabitants live in four villages in close proximity along the river. These villages are Yawapa (30 inhabitants), Pina (40 inhabitants), Zidock (225 inhabitants) and Roger (75 inhabitants).

DATA COLLECTION, SAMPLE SIZE AND ETHNIC ASPECTS

We carried out a descriptive cross-sectional study of the population over four days, with random sampling for adults. A map of the villages was made, the dwellings counted and a list of inhabitants produced. Adults and children who did not attend school were selected by drawing lots, in two stages. The first stage concerned selection of the dwelling and the second, selection of the occupant. For children at school, the first 70 volunteers who brought stool samples to school in the morning were included in the sample for analysis, provided that their parents gave consent. For each subject, surname, first names, age, sex and the number of the dwelling were recorded. The inclusion criteria were as follows: permanent residence in one of the four villages, at least six months old and, for those older than two years, resident in the village for more than one year. Seventy-four of the 138 individuals included were female and 64 were male (sex ratio M/F = 0.86) and the proportions of adults and of children below the age of 15 years were identical. The sample population corresponded to two thirds of the inhabitants of Roger, half the population of Yawapa and Pina and a quarter of the population of Zidock.

We analyzed the register of the clinic to determine the reasons for consultation and the frequency and type of prescription of antiparasitic agents. We were able to relate these nominative data to the individuals studied. However, the absence of complementary examinations on-site, except for malaria testing, and the absence of a permanent doctor prevented the use of these diagnostic data in combination with our parasitological data.

For the description of the villages and assessment of fecal hygiene conditions and shoe wearing, the six members of the team recorded their observations on standardized forms and then compared them. Conclusions were drawn with the help of the nurse and the teachers (Table I), thereby avoiding the need to consult cultural leaders and the inhabitants for delicate observations and interpretations.

Table I. – Total population, study population and characteristics of the four villages of Trois Sauts.

Villages (1)	**Yawapa**	**Pina**	**Zidock**	**Roger**
Ethnic group	Wayampi	Wayampi	Wayampi	Wayampi
Number of inhabitants	30	40	225	75
Number of dwellings (carbet)	4	6	24	12
Number of coprological Assessments carried out				
- Total	15	24	54	45
- Female/Male	8/7	14/10	24/30	29/16
- Chlidren[2]/Adults	8/7	13/11	29/25	19/26
Situation	River bank	River bank	River bank	River bank
Access to the river (3)	Banks with rocks	Banks with rocks	Landing stage and beach	Beach
Type of dwelling	Open and semi open (50-50 %)	Open (100 %)	Semi-open (100 %)	Semi-open (100 %)
Clinic	No	No	Yes	No
Duration of journey to village clinic (motorized canoe)	20/30 minutes	10/15 minutes	0 3/5	minutes
School	Yes	No School attendance at Yawapa	Yes	No School attendance at Zidock
Electric generator	Yes	No	Yes	No
Treated water (4)	Yes regular chlorination	No	Yes (in theory) but chlorination irregular	Yes (in theory) but chlorination irregular
Barefoot	~ 50 %	~ adults: 50 % children ~100 %	~ 50 %	~ 50 %
Light sandals	~ 50 %	~ 50 %	~ 50 %	~ 50 %
Defecation site				
- Latrines	No	No	No	No
- River	Yes ++	Yes ++	Yes ++	Yes ++
- Slope	Yes	Yes	Yes	Yes
Beach	/	/	Yes +-	Yes +-
- Nearby forest	Yes	Yes	Yes	Yes

(1) From the furthest downstream to the furthest upstream along the Oyapock; (2) Child if aged < 15 years; (3) Zone of landing and disembarkation; (4) Treated water available at the fountains, but water also taken from the river.

This study was authorized by the Regional Consultative Committee for the Protection of People involved in Biomedical Research. In all cases, samples were taken and information sought only after obtaining informed consent from the subject or his legal representative. The complete results of coprological examinations for each individual were supplied to the doctor of the sector within 10 days of the end of the mission, accompanied by comments and suggestions for treatment.

Stool specimens and coprological techniques

Each participant gave only one stool specimen in a hermetically sealed plastic container that was delivered to his or her home in the evening and taken to the clinic in the morning. A second sample was requested if the first was insufficient. The feces were examined immediately.

The parasitological techniques used involved the direct examination of the stools after dispersion in normal saline, the Kato-Katz quantitative technique (volume of 40 mg of stools, with assessment of the entire spread), Baermann's technique for the detection of *Strongyloides* larvae, using a technique adapted for use in the field and MIF (merthiolate iodine formol) staining for the identification of amebas and flagellated organisms. Ten stool cultures were set up on filter paper, from stools testing positive for hookworm infection, to facilitate identification of the species responsible.

For direct examination and the Kato-Katz method, microscopy was carried out on-site. We added formol to the incubation medium for Baermann's technique after 24 hours, and to stool culture medium after 48 hours. For these examinations, the centrifugation pellets were analyzed differently, at the Laboratory of Cayenne, after returning from the mission. MIF staining analysis was also carried out at Cayenne. The feces were frequently liquid or semi-liquid in consistency, making it impossible to use them for the tests of Kato-Katz and Baermann. It was also difficult to obtain sufficiently large samples. Thus, we were not able to carry out all the intended coprological tests for all the subjects.

Analysis of the results

Univariate analyses as a function of sex, age, family composition and village were carried out using the Chi square test, Fisher's exact test, Student's t test and Mann and Whitney tests. Stratification was used in multivariate analysis, but logistic regression analysis was not used.

RESULTS

Overall, 92 % of the subjects tested were found to have intestinal parasites, 85 % if only direct examination of fresh feces was taken into account. Sample size and prevalence according to sex, age, village of residence and coprological technique are presented in Tables II and III, differentiating between data for direct examination only (n = 138) and the most appropriate technique: Kato-Katz method (n = 112) for nematode and cestode eggs, technique of Baermann (n = 92) for Strongyloides larvae and MIF staining (n = 102) with direct examination for flagellated organisms and amebas.

Table II. – Prevalence (%) of intestinal parasites: total, according to sex and age.

	Total	**Male**	**Female**	**Adult**	**Children**
Nematodes					
Hookworm eggs	57.1	56.6	57.6	55.9	58.5
S. stercoralis	16.3	15.6	17	8.9	23.4
A. lumbricoides	13.4	15.1	11.9	8.5	18.9
T. trichiura	1.8	1.9	1.7	0	3.8
E. vermicularis	2.7	4.8	0	1.7	3.8
"False parasitism" (eggs in transit)					
Capillaria hepatica	6.3	5.7	6.8	8.5	3.8
Cestodes					
H. nana	17.9	18.9	15.3	**8.5**	**26.4**
Protozoa	DE + MIF	DE + MIF	DE + MIF	DE + MIF	DE + MIF
E. histolytica/E. dispar	16.7	15.6	16.2	20.6	11.4
G. intestinalis	14.5	10.9	16.2	11.8	15.7
C. mesnili	27.5	28.1	27	27.9	27.1
E. coli	58	51.6	62.1	54.4	60

Results were given for appropriate concentration technique: Kato-Katz method for parasite screening at the egg stage (n = 112), Baermann for strongyloidiosis (n = 92). For protozoa, the only result given was obtained by direct examination checked by MIF (Merthioloate Iode Formol coloration technique) staining (n = 103).
Results in bold: significant difference between adults and children, $p < 0.05$.

Table III. – Prevalence of hookworm and *Ascaris lumbricoides* infection according to village.

	Yawapa	Pina	Zidock	Roger	Statistique
Subjects examined	15	24	54	45	
Hookworm eggs	3 (20 %)	7 (29 %)	32 (59 %)	30 (67 %)	X^2 p = 0.001
A. lumbricoides	2 (13 %)	2 (8 %)	12 (22 %)	3 (7 %)	X^2 p = 0.10
	Zidock (12/54) *vs* others villages (7/84) RR = 2.67 (CI 95 % 1.12-6.35)				

Results were given for appropriate concentration technique: Kato-Katz method for parasite screening at the egg stage (n = 112), Baermann for strongyloidiosis (n = 92). For protozoa, the only result given was obtained by direct examination checked by MIF (Merthioloate Iode Formol coloration technique) staining (n = 103).
Results in bold: significant difference between adults and children, $p < 0.05$.

Fourteen different human parasite species were identified: seven protozoa (*Entamoeba histolytica, Giardia lamblia, Endolimax nanus, Chilomastix meslini, Enteromonas and Retortamonas* sp.) and seven helminths (*Necator americanus, Ascaris lumbricoides, Strongyloides stercoralis, Enterobius vermicularis, Trichiuris trichiura, Hymenolepis nana* and *Capillaria hepatica*). For *C. hepatica* eggs were detected in the feces. The eggs of two other species were also present, probably *Ternidens* and *Heterodera* sp.

The prevalence of hookworm infection was high in individuals infested with helminths (57 %), with lower prevalences of strongyloidiasis (16 %) and teniasis due to *Hymenolepis nana* (18 %). In contrast, whip worms were very rare. In cases of oxyuriasis, we were unable to draw any firm conclusions in the absence of the anal scotch test.

Eggs of *Capillaria hepatica* were found in the stools of the inhabitants of two dwellings who had shared a game animal, the liver of which must have been parasitized. The animal concerned belonged to the species Tayassu pecari, known locally as *cochon bois* (wood pig). The presence of this nematode in the livers of these hoofed animals has since been confirmed (two infected animals of eight examined).

No trematode or cestode eggs were found other than those of *Hymenolepis nana*. The specific culture of nematode larvae from stools was informative in 10 cases of hookworm infection. In each case, the species responsible was *Necator americanus*. For the 64 cases testing positive with the Kato-Katz method, median parasite load per g of feces was 165 and the extreme values for parasite load were 25 and 68,750. No significant difference in parasite load was observed as a function of age, sex or village of residence. Parasite loads of more than 2,000 and 5,000 eggs accounted for 8 and 5 % respectively of the carriers of *Necator* nematodes and 2.7 and 4.5 % respectively of the 112 subjects who underwent examinations by the Kato-Katz technique. The level of infection with *Ascaris lumbricoides* was also moderate.

The prevalences of *Entamoeba histolytica/E. dispar* and *Giardia lamblia*, currently the most common pathogenic protozoa, were high, at 17 and 20 % respectively. Higher prevalences were recorded for *Chilomastix mesnili* (27 %), and particularly for *Entamoeba coli* (58 %). We did not look for *Cryptosporidium* oocytes as no suitable technique was available.

The prevalences of infection with *Strongyloides* and *Ascaris* were higher in children than in adults but these differences were not stastically significant. The only significant difference concerned *Hymenolepis nana*, which affected children more frequently than adults. This made it possible to compare villages without having to use stratification. Two differences were identified (Table III): the frequency of hookworm infection was higher in Roger and Zidock (67 % and 59 % positive *vs* 20 % and 29 % for Yawapa and Pina) and the frequency of ascariasis was higher at Zidock (22 % *vs* less than 10 % in the other three villages).

Anthelminthic drugs (albendazole or Zentel^R and pyrantel palmoate in the form of Helmintox^R) were prescribed in the six months preceding the study for 17 patients and a treatment against protozoa (metronidazole or Flagyl^R and tinidazole or Fasigyne^R) was prescribed in twenty cases, according to clinic registers. Only ascariasis and hookworm infection were less frequently detected in the treated patients (Table IV). Although we were unable to obtain precise quantitative data, the observations made on-site clearly indicate a lack of fecal hygiene. There were no latrines and the inhabitants of the villages defecated freely in the river in particular, but also on its banks and at the edge of the forest, close to clearings.

DISCUSSION

Analysis of the descriptive forms showed no marked difference in the design and organization of the villages or in their populations. The population was homogeneous (Wayampi Indians), with similar behavior and activities in each village. However, it should be noticed that there was no treatment of the water at Pina and no beach at Yawapa

Table IV. – Prevalence according to whether or not antiparasitic agents had been taken during the previous six months.

	Specific treatment Zentel^{R}/Helmintox^{R}	**No treatment**	**Statistic**
Number of patients	17	120	
Parasites (%)			
Hookworms eggs	29.4	53.3	RR: 0.55 (0.26-1.17) p = 0.06°/p = 0.11*
Ascaris lumbricoides	0	15.8	Fisher exact p = 0.07
Strongyloides stercoralis	11.8	15.8	NS
Hymenolepis nana	17.6	19.2	NS
	Flagyl^{R}/Fasigyne^{R}		
Number of patients	20	117	
Parasites (%)			
Entamoeba histolytica	20	15.4	NS
Giardia lamblia	15	13.7	NS

° according to X^2 Mantel-Haenszel test; * according corrected X^2 Yates test
Zentel^{R} = Albendazole; Helmintox^{R} = Pamoate de Pyrantel, Flagyl^{R} = Metronidazole
Fasigyne^{R} = Tinidazole
NS: not significant

and Pina, where the landing of canoes and domestic activities took place on the rocks. The banks of the river are the site of domestic activities (washing, washing up and bathing). The clearings – zones deforested for the growing of food crops – are visited, particularly by adults.

No significant differences in the prevalence of intestinal nematode infestations were found between adults and children, which is unusual in a tropical zone. We observed that the sites of activity and practices were similar for women and men, except for hunting. In contrast, teniasis due to *H. nana* was more frequent in children than in adults. This may be due to the gradual acquisition of protective immunity and, above all, to defects in individual oral-fecal hygiene, more frequent in children, leading to autoinfestation.

The lack of fecal hygiene and the practice of going barefoot (about 50 %) or wearing non-protective light sandals (also about 50 %) results in a high frequency of transcutaneous transmission of nematode infestations: hookworm infection in particular, and strongyloidiasis. However, the rate of infestation with *S. stercoralis* seemed to be no more than 5.8 % (eight positive results in 138 direct examinations) in the absence of a specific detection technique. We detected no *Schistosoma mansoni*. The rare cases observed in French Guiana are imported from Brazil or the French West Indies, where there is a long-standing history of contamination. Twenty-five years ago, *Biomphalaria glabrata* was discovered at Cayenne, certain specimens of which were experimentally infected with a Puerto Rican strain of *S. mansoni* (Léger *et al.*, 1976). However, the risk of local establishment of the cycle of this parasite has since been considered to be low (Lalande & Picot, 1987).

Hookworm infection was less frequent in two of the villages. This may be because these villages have no beach, with rocks providing the only access to the river. Indeed, sandy soils are known to favor the survival of hookworm larvae (Lilley *et al.*, 1997). The severity of the anemia caused by parasitism depends not only on the species involved, but also on the duration and severity of parasitism, the age and sex of the subject parasitized, the state of their reserves and the iron content of their diet (Roche & Layrisse, 1966). Up to 5 % of the subjects had at least 2,000 eggs per gram of stools and up to 3 % had at least 5,000 eggs per gram of stools. For strongyloidiasis, the longevity of the parasite, the maintenance of a cycle of autoinfestation and the resistance of the parasite to treatment result in a more homogeneous situation, despite the mode of transmission being identical to that for hookworm infection.

The high prevalence of ascariasis at Zidock may be due to the higher density of humans in this village and to water treatment being less effective, although it is equally deficient at Roger and completely absent at Pina.

The high level of parasitism by potentially hematophagic amebas is probably partly reflected in the high frequency of bloody diarrhea recorded at the clinic. The cases of hepatic amebiasis diagnosed at Cayenne Hospital concerned mostly Amerindians from the interior.

In terms of treatment, the frequency and type of traditional herbal treatments is unknown at Trois Sauts but the usage of these treatments is similar to that for all the Indian populations of Amazonia. The medicines used in the villages, including, in particular, the products used against intestinal parasites, were exclusively

those prescribed and distributed free of charge by the nurse and the health care agents of the clinic at Zidock. For the anthelminthic agents, we observed that the most effective prescriptions were those for the treatment of *Ascaris lumbricoides*; low levels of efficacy were observed against strongyloidiasis and *Hymenolepis nana* was found to be refractive to the treatment used. These observations are consistent with classical results. For antiprotozoan treatments, prescriptions during the six months preceding the study had no effect on the observed prevalences. Metronidazole and related products were of only limited contact action effect against ameba. Oral contamination is probably frequent.

Capillaria hepatica was detected in the environment in epidemiological conditions compatible with the occurrence of human hepatic capillariasis. Three cases observed in Brazil have recently been published (Sawamura *et al.*, 1999).

Three recent studies on the Indians of Brazilian Amazonia (Ferrari *et al.*, 1992; Miranda *et al.*, 1999) and central Brazil (Santos *et al.*, 1995) reported frequencies of parasitism lower than those reported here, except for *Ascaris lumbricoides*. This nematode, and *Entamoeba histolytica* and *Giardia lamblia*, all of which are transmitted via the oral route, are also more frequent among the Parakana Indians of the state of Para, whereas nematodes transmitted cutaneously are less frequent (Miranda *et al.*, 1998). In the Mato Grosso, a level of parasitism similar to that observed at Trois Sauts has been reported for the Iaualapiti Indians. In addition, the same two specific features were reported: very low levels (almost zero) of *Trichiuris trichiura* and frequent low parasite loads (Ferreira *et al.*, 1991). For this last observation, as in other recent Brazilian surveys (Eve *et al.*, 1998), the following were put forward as possible explanations: low population density, geographical isolation, sanitation of a moderate standard and the use of indigenous or manufactured anthelminthic agents.

Whatever the reasons, and despite the relatively high incomes and ready access to clinics and medicines in French Guiana, intestinal parasitism is far from being controlled in this population. The lack of fecal hygiene and the custom of going barefoot contribute to this observation, which is somewhat disconcerting at the start of the Third Millennium, in French communities living close to the Space Center at Kourou, at the forefront of high technology and the "space port" of Europe. Indeed, this situation is probably not unique to this community because the environment and living conditions are similar in other parts of the interior of the country. However, suggestions on ways to control parasitism in this particular context must await the findings and conclusions of other planned studies on intestinal parasitoses in the ethnic minorities living in the interior of French Guiana

ACKNOWLEDGEMENTS

We would like to thank local and regional administrative authorities for helping us in our survey, and *le Ministère Français de l'Aménagement du Territoire et de l'Environnement* et l'INSERM (Grant: "*Programme environnement et Santé 2000*", and SmithKline Beecham Inc for their financial support; and Ruth Mathar-Héraud* and Régis Bettinger for technical collaboration.

REFERENCES

EUTROPE R. & JUMINER B. Les parasitoses intestinales chez l'enfant en Guyane. Bilan de quatre années d'exploration systématique au CH de Cayenne. *Bulletin de la Société de Pathologie Exotique*, 1978, *71*, 275-279.

EVE E., FERRAZ E & THATCHER V.E. Parasitic infections in villagers from three districts of the Brazilian Amazon. *Annals of Tropical Medicine and Parasitology*, 1998, *92*, 79-87.

FERRARI J.O., FERREIRA M.U., CAMARGP L.M. & FERREIRA C.S. Intestinal parasites among Karitiana Indians from Rondonia State, Brazil. *Revista do Instituto de Medicina Tropical de Sao Paulo*, 1992, *34*, 223-225.

FERREIRA C.S., CAMARGO L.M., MOITINHO M.L. & DE AZEVEDO R.A. Intestinal parasites in Iaualapiti Indians from Xingu Park, Mato Grosso, Brazil. *Memorias do Instituto Oswaldo Cruz*, 1991, *86*, 441-442.

GARDIEN E. Prévalence des parasitoses intestinales dans les laboratoires publics de Martinique. *Bulletin de la Société de Pathologie Exotique*, 1997, *90*, 169-171.

LALANDE G. & PICOT H. Les risques actuels de l'introduction de la schistosomiase en Guyane francaise. *Bulletin de la Société de Pathologie Exotique*, 1987, *80*, 202-210.

LEGER N., FORGET E. & NOTTEGHEM M.J. Guyane et bilharziose. *Bulletin de la Société de Pathologie Exotique*, 1976, *69*, 332-335.

LILLEY B., LAMMIE P., DICKERSON J. & EBERHARD M. An increase in hookworm infection temporally associated with ecologic change. *Emerging Infectious Disease*, 1997, *3*, 391-393.

MAGNAVAL J.F. Données complémentaires sur l'évolution de la prévalence des parasitoses intestinales à la Martinique. *Bulletin de la Société de Pathologie Exotique*, 1998, *91*, 224-225.

MIRANDA R.A., XAVIER F.B., NASCIMENTO J.R. & DEMENEZES R.C. Prevalencia de parasitismo intestinal nas aldeias indigenas da tribo Tembe, Amazonia Oriental Brasileira. *Revista do Sociedad Brasiliana de Medicina Tropical*, 1999, *32*, 389-393.

MIRANDA R.A., XAVIER F.B. & MENEZES R.C. Parasitismo intestinal em uma aldeia indigena Parakana, sudested do Estado do Para, Brasil. *Cad Saude Publica*, 1998, *14*, 507-511.

ROCHE M. & LAYRISSE M. The nature and cause of hookworm anemia. *American Journal of Tropical Medicine and Hygiene*, 1966, *15*, 1030-1102.

SANTOSO R.V., COIMBRA JUNIOR C.E., FLOWERS N.M. & SILVA J.P. Intestinal parasitism in the Xavante Indians, central Brazil. *Revista do Instituto de Medicina Tropical de Sao Paulo*, 1995, *37*, 145-148.

SAWAMURA R. & MACHADO FERNANDEZ M.I. Hepatic capillariasis in children: Report of 3 cases in Brazil. *American Journal of Tropical Medicine and Hygiene*, 1999, *61*, 642-647.

Reçu le 20 août 2001
Accepté le 13 novembre 2001