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Full Length Research Paper

Prevalence of intestinal parasitoses among patients and staff of an institution for the mentally retarded

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Intestinal parasitoses remain a major problem in developing countries worldwide. Lack of current data on the prevalence of intestinal parasitoses in institutionalized populations in Puerto Rico prompted us to survey which parasites were endemic in an institution for the mentally retarded. Fecal samples obtained from 86 patients and 43 staff members were examined by direct smear, zinc sulfate flotation and Harada-Mori. Soil samples were collected in three playing areas to determine whether any source of infection was present in the institution. Approximately 52.3% of the patients and 13.9% of the staff members harbored parasites. Forty-five percent of the patients were infected with *Trichuris trichiura*, 1.2% - hookworms, 19.8% - *Escherichia coli* 1.2% - *Endolimax nana*, 2.3% - *Giardia lamblia* and 2.3% - *Dientamoeba fragilis.* Nine percent of staff members harbored *T. trichiura* and 7% *E. coli*. Only one soil sample contained one egg of *T. trichiura*. These results indicate that the prevalence of intestinal parasitoses in the institutionalized population examined was much higher than that shown by most recent studies of the general population. Additional studies are required to know the current local prevalence of parasites in the general population and in institutionalized populations of the Island.

Key words: Prevalence, intestinal parasitoses, mentally retarded.

INTRODUCTION

Human parasites remain a major public health concern. Morbidity, mortality and health effects are frequently misconceived and ignored in many developing countries. Among the diverse habitats in the human body, intestinal infections with parasites are the most common globally.

The worldwide prevalence of intestinal parasites is estimated in more than 3.5 billion with around 4.5 million clinical cases (Okyay et al., 2004). Infections may range from asymptomatic to disabling, disfiguring or killing, depending on the nutritional status, hygiene, and socioeconomic level of the patients, among other related factors (Chandrasena et al., 2004; Oberhelman et al., 1998).

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Intestinal parasitoses are common both in the general population and in people residing in institutions in tropical and subtropical regions (Grande et al., 2011; Melo et al., 2010). The conditions required for the transmission and acquisition of intestinal parasitism are favored in institutions where large numbers of people are grouped together for a long period of time and poor sanitary conditions prevail. This is evidenced by studies on the prevalence of intestinal parasites in schools, day care centers and institutions for the handicapped (Souza et al., 2010; Ilechukwu et al., 2010; Okyay et al., 2004; Heidari and Rokni, 2003; Lee et al., 2000; Gatti et al., 2000; Rivero-Rodríguez et al., 2000).

Many studies were conducted in Puerto Rico between 1904 and 1990 to determine the prevalence of intestinal parasitoses in the general population of the Island. Although the prevalence of some helminthes was as high as 100% at the beginning of the 20th century, more recent

Table 1. Patients and staff members infected with helminthes, protozoa or both, as detected by all methods.

Population in the institution	Patients (%)	Staff (%)	Total (%)
	111	97	208
Participating in the study			
Inpatients	75 (87.2)		
Outpatients	11 (12.8)		
Total	86 (77.5)	43 (44.3)	129 (62.0)
Harboring helminthes	26 (30.2)	3 (7.0)	29 (22.5)
Harboring protozoa	6 (7.0)	2 (4.6)	8 (6.2)
Harboring helminthes and protozoa	13 (15.1)	1 (2.3)	14 (10.8)
Total number of persons with parasites	45 (52.3)	6 (13.9)	51 (39.5)

studies suggest that the prevalence of intestinal parasites appears to be decreasing (Ashford et al., 1904; Knight et al., 1973; Bendezú et al., 1982; Rivera-Marrero, 1986; Hillyer et al., 1980). Intestinal parasitoses are often higher in local institutionalized populations; however, no comparable published data is available for institutionalized populations in Puerto Rico.

The objective of this study was to perform an epidemiological survey to determine the prevalence of intestinal parasitoses in patients and personnel in an institution for the mentally retarded, and to examine soil samples from the play areas most frequently used at the institution to determine whether sources of infection were present.

MATERIALS AND METHODS

Collection and examination of fecal samples

An epidemiological study was carried out among 86 patients and 43 staff members at an institution for the mentally retarded between the periods of 1991 to 1992. Prior to the survey, approval was obtained from the Director of the Institute, Board of Directors and Institutional Review Board. In addition, parental consent and consent from staff members who wished to participate in the study were obtained. Fecal samples from the patients and staff were collected in disposable containers. The samples were stored in the refrigerator until the next day when they were picked up and brought to the laboratory at room temperature for examination. Samples were collected daily from Sunday to Thursday; no samples were collected on Friday or Saturday. The collected samples were examined by Direct Smear Examination, Zinc Sulfate Flotation - Concentration Method (Ash and Orihel, 1987a) and by Harada-Mori Culture to detect light hookworm and *Strongyloides* infections (Ash and Orihel, 1987b).

Examination of the soil samples

Soil samples from three of the most frequently used areas of the institution were collected and examined to determine whether any source of infection was present. The soil samples were taken approximately every two meters in a grid pattern, until all of the area was examined. Approximately 1 g samples of surface soil were collected into pre-labeled, pre-numbered containers. Three ml of 10% formalin were then added to each tube to preserve the collected sample. The preserved samples were maintained at room temperature until examined by zinc sulfate flotation technique, modified for formalin-preserved materials (Ash and Orihel, 1987a).

Statistical analyses

The prevalence of parasites among the inpatients and outpatients was analyzed using the Mann-Whitney test available at http://elegans.swmed.edu/~leon/stats/utest.cgi. Statistical significance was considered if $p < 0.05$.

RESULTS

Patients

The patient population consisted of 111 mentally retarded people, of which 86 (77.5%) participated in this study. Seventy-five (87.2%) of the 86 participants were inpatients residing in the institution and 11 (12.8%) were outpatients. Examination by direct smear and zinc sulfate flotation revealed that 45 (52.3%) patients harbored parasites, 26 (30.2%) patients harbored helminthes, 6 (7.0%) patients harbored protozoa and 13 (15.1%) patients harbored both helminthes and protozoa (Table 1).

Forty-four of the 45 infected individuals were inpatients and one was an outpatient. Six species of parasites were detected among the infected inpatients: two helminthes: *Trichuris trichiura* and hookworms, and four protozoa: *Entamoeba coli*, *Endolimax nana*, *Giardia lamblia* and *Dientamoeba fragilis*. *T. trichiura* and *E. coli* had the highest prevalence of 44.2 and 18.6%, respectively. The prevalence of the other parasites was much lower:

Table 2. Comparison of the prevalence of intestinal parasites between the inpatients and outpatients of the institution.

Parasites	Inpatients			Outpatients		
	DS	$ZnSO_4$FC (%)	Total (%)	DS	$ZnSO_4$FC	Total
Trichuris trichiura	29 (33.7%)	37 (43.0)	38 (44.2)	1 (1.2%)	1 (1.2%)	1 (1.2%)
Hookworms	0	1 (1.2)	1 (1.2)	0	0	0
Entamoeba coli	11 (12.8%)	16 (18.6)	16 (18.6)	1 (1.2%)	1 (1.2%)	1 (1.2%)
Endolimax nana	0	1 (1.2)	1 (1.2)	0	0	0
Giardia lamblia	0	2 (2.3)	2 (2.3)	0	0	0
Dientamoeba fragilis	1 (1.2%)	2 (2.3)	2 (2.3)	0	0	0

Legend: DS = Direct Smear, $ZnSO_4$ = Zinc sulfate flotation-concentration method.

Table 3. Parasites harbored by the patients of the institution, as detected by all methods.

Number of patients with single or multiple infections	Parasites harbored by the patients					
	T. trichiura	*E. coli*	*G. lamblia*	*D. fragilis*	Hookworms	*E. nana*
25	X					
3		X				
1			X			
1				X		
12	X	X				
1	X				X	
1		X				X
1	X	X	X	X		

G. lamblia: 2.3%, *D. fragilis*: 2.3%, *E. nana*: 1.2% and hookworm: 1.2%. The infected outpatient harbored a dual infection with *T. trichiura* and *E. coli.* The prevalence of intestinal parasites was significantly higher ($p < 0.0125$) among the inpatients (Table 2).

Thirty of the 45 infected patients harbored only one species of parasite: 25 patients were infected only with *T. trichiura*, 3 with *E. coli*, 1 with *G. lamblia*, and 1 with *D. fragilis*. Polyparasitism was detected in 15 patients: 12 had double infection with *T. trichiura* and *E. coli*, 1 patient harbored *T. trichiura* and hookworms, 1 harbored *E. coli* and *E. nana*, and 1 was infected with *T. trichiura*, *E. coli*, *G. lamblia* and *D. fragilis* (Table 3).

The prevalence of *T. trichiura*, *E. coli* and hookworms was higher among the male patients than among the female patients; 63.3% of males harbored *T. trichiura*, 24.5% *E. coli*, 2.0% hookworms, 2.0% *G. lamblia,* and 2.0% *D. fragilis*. *E. nana*, *G. lamblia* and *D. fragilis* were more prevalent among women; 21.6% of the females harbored *T. trichiura*, 13.5% *E. coli*, 2.7% *E. nana*, 2.7% *G. lamblia* and 2.7% *D. fragilis* (Table 4).

All the infected patients who were 10 years old or less harbored *T. trichiura* and *E. coli.* Fifty percent of the 11 to 20 year old group was infected

Table 4. Prevalence of intestinal parasites among patients and staff members of the institution grouped by sex.

Gender	Patients		Staff		Total	
	M	F	M	F	M	F
Number of patient	**49**	**37**	**6**	**37**	**55**	**74**
Trichuris trichiura	31(63.3%)	8 (21.6%)	1 (16.7%)	3 (8.1%)	32(58.2%)	11(14.9%)
Hookworms	1(2.0%)	0	0	0	1(1.8%)	0
Entamoeba coli	12(24.5%)	5 (13.5%)	0	3 (8.1%)	12(21.8%)	8 (10.8%)
Endolimax nana	0	1 (2.7%)	0	0	0	1(1.4%)
Giardia lamblia	1(2.0%)	1 (2.7%)	0	0	1(1.8%)	1(1.4%)
Dientamoeba fragilis	1(2.0%)	1 (2.7%)	0	0	1(1.8%)	1(1.4%)

Legend: M = male, F = female.

with *T. trichiura*, 22% with *E. coli* and 5.6% with *G. lamblia*. Fifty percent of the patients in their thirties harbored *T. trichiura*, 2.8% hookworms, 19.4% *E. coli* and 2.8% *E. nana*. Thirty-one percent of the patients in their forties harbored *T. trichiura* and 25% *E. coli*. One third of the patients in their fifties had *T. trichiura*, 22% *E. coli*, 11% *G. lamblia* and 22% *D. fragilis.* One half of the patients older than 50 were infected with *T. trichiura.*

All of the Harada-Mori patient cultures were negative for hookworms and *Strongyloides* after 5-10 days of incubation.

Staff

Forty three (44.3%) of 97 staff members participated in the study. Six (13.9%) of them harbored parasites: 3 (7.0%) people harbored helminthes, 2 (4.6%) people protozoa, and 1 (2.3%) person harbored both helminthes and protozoa (Table 1).

The infected staff members harbored only two species of parasites: *T. trichiura* and *E. coli*. The prevalence of these parasites was 8.7% and 6.5%, respectively. Three people were infected with *T. trichiura*, 2 with *E. coli* and 1 had a double infection with *T. trichiura* and *E. coli*.

As observed in the patients, all of the Harada-Mori patient cultures were negative for hookworms and *Strongyloides* after 5 to 10 days of incubation.

Soil

A total of 170 soil samples were collected from the three playing areas most frequently used by the institutionalized populations. Although several free living nematodes were found, only one soil sample contained one egg of *T. trichiura* with a mature larva. The area of approximately 1.3 × 1.9 m, surrounding the site where the positive sample was collected, was re-examined more closely. Sixteen additional samples were collected 30 cm apart from each other, but none of the 16 samples contained eggs or cysts.

DISCUSSION

In this study, the ages of the patients at the institution ranged from ten to sixty-five years, with a mean age of twenty-nine. Most of the infected patients were in their thirties. The subsequent most frequently infected group were the patients in their twenties, followed by patients in their forties. Of the six parasites detected, *T. trichiura,* hookworms and *E. coli* were more prevalent in males than in females. Otherwise, *E. nana*, *G. lamblia* and *D. fragilis* were more prevalent in females than in males. Hookworms were found in only one male, and *E. nana* was harbored only by one female.

Comparing with other surveys done in Puerto Rico, the prevalence of intestinal parasitoses among the institutionalized population was much higher than that reported in a contemporary study on healthy individuals, representative of a specific segment of the general population (Hillyer et al., 1980). We found a higher prevalence of *T. trichiura* and a lower prevalence of hookworms compared to the former study. However, no *Strongyloides stercoralis* was detected. The low prevalence of hookworms and the absence of *Strongyloides* spp. in the institution may be accounted to the fact that most of the institutionalized population came from urban areas, where contact with soil is less frequent, decreasing the probability of acquiring larvae. There was only one patient with hookworm infection, who was toilet-trained, used the sanitary facilities, and did not contaminate the green playing areas of the institution by defecation. These may have precluded the establishment of source of infection within the institution, which could explain why hookworms' larvae were not found in the soil samples examined. However, since the soil samples were representative, but not exhaustive, the existence of such source of infection, although unlikely, cannot be completely

ruled out.

The lack of growth of hookworms and *S. stercoralis* larvae in the Harada-Mori in the patients and staff members was unexpected since both organisms were detected in previous studies conducted in the Island (Knight et al., 1973; Bendezú et al., 1982; Rivera-Marrero, 1986). In those studies, the prevalence for hookworms ranged from 1 to 11%, and that of *S. stercoralis* from 0.6 to 2.4%. The failure of hookworm larvae development in cultures of the samples in which hookworms eggs were detected, by the concentration method, can be attributed to the storage of the sample in the refrigerator before the sample was brought to the laboratory for examination. Development of *Necator americanus* is temperature sensitive, and storage of a sample in a refrigerator for several hours, or longer, may prevent *N. americanus* eggs from embryonating (Hillyer et al., 1980).

The prevalence of *E. coli* in the institutionalized population was higher than that previously detected in local children population (Knight et al., 1973), as well as that of *D. fragilis* (J.F. Maldonado, personal communication). This high prevalence of *E. coli* possibly occurs as a result of an internal transmission of this organism although no source of infection was found. *D. fragilis* had been identified in a previous study only in rare occasions (Young and Felsenfeld, 1948). Because it only exists in trophozoite stage, and because of its minute size, it could easily be overlooked in routine coprological examination using direct smear. Even smears stained with hematoxylin or trichrome stain require careful examination to identify *D. fragilis*.

The prevalence of *E. nana* and *G. lamblia* was lower in the institution than the prevalence reported in a previous study conducted in 1975 (J.F. Maldonado, personal communication), and neither of the organisms was reported in another study performed in 1973 (Knight et al., 1973), whose objective was to survey for *Schistosoma mansoni*. Protozoa were not recorded in any other recent studies since 1975 (J.F. Maldonado, personal communication), probably because most of these studies had as principal objective the detection of helminthes; therefore, the diagnostic methods selected in these studies were not the most appropriate for the detection of protozoa.

Although *E. coli* and *E. nana* are considered nonpathogenic intestinal protozoa, they must be differentiated from pathogenic amebas, such as *E. histolytica*. The recovery of these *harmless* comensals usually is indicative of fecal-oral contamination. Therefore, persons who are found to have these protozoa might have been exposed to intestinal parasites responsible for a variety of clinical symptoms. In general, these results revealed a significant difference, as compared to similar studies in this type of institution in other locations. Gatti found that 23% of the patients in an institution for mentally retarded in Italy harbored intestinal parasitic infections (Gatti et al., 2000). In another study, the overall prevalence of intestinal parasite infections among individuals with mental retardation in New York State was 7.3%, with the two most prevalent infections being *Enterobius vermicularis* (4.5%) and *S. stercoralis* (1.2%) (Schupf et al., 1995). Although neither *Enterobius vermicularis* nor *S. stercoralis* were detected in this study, the overall prevalence of parasites in the patients was 52.3%. This might reflect that we need better facilities and sanitary conditions, as well as, more trained staff to deal with more vulnerable subjects.

Only two organisms were detected in the six infected staff member participants: *T. trichiura* and *E. coli. T. trichiura* was the most common single infection. Five of the six infected persons harbored one parasite and one had a dual infection. The prevalence of *T. trichiura* was higher among the male staff population, while *E. coli* was present only in a women. The ages of the staff members ranged from twenty-one to sixty-eight with a mean age of forty-two. The highest prevalence of parasites among the staff members was found in persons over forty possibly because they had close contact with the patients, or had been working longer in the institution.

Soil samples were examined to determine whether any of the identified infections could have been acquired within the institution. Although only one egg of *T. trichiura* was found in one of the soil samples, its presence is sufficient to suggest that transmission of parasites that can be acquired by direct contact with fecal material could occur in the institution. This finding could be attributed to indiscriminate defecation by some of the patients on the green areas, or by direct dispersion of the infective material by some of the patients, or due to washing of infective material deposited on terraces and sidewalks onto the grass. The low number of eggs detected in the soil, even though a high number of patients were infected, can be explained by the relative small number of soil samples collected, and the relative large grid pattern used. No parasitic larvae were detected, although many larvae of free-living nematodes were found.

The decrease in the prevalence of intestinal parasites in the general population in the 20th century might reflect the improvement in the living conditions, sanitary facilities, and the increasing urbanization in Puerto Rico, including construction of new roads, sidewalks, hospitals, as well as, the implantation of health education and treatment programs. However, these types of improvement do not necessarily apply to all closed environment institutions. Mentally retarded institutionalized patients are not aware of the public health aspects of parasitic infections. Many patients lack the concept of personal hygiene, and in spite of the best

efforts of the staff members, they contaminate the institutional environment, facilitating internal spread of parasites such as *T. trichiura* and *E. coli*.

Conclusion

To the best of our knowledge, this is the only study conducted to determine the prevalence of intestinal parasites in an institutionalized population in Puerto Rico. The prevalence of parasites in the patients and the institution's staff was much higher than that reported in the previous studies conducted on the general population and children residing in the Island. The highest prevalence of intestinal parasitoses among the inpatients, the relatively high levels of infection among staff members and the source of infection detected suggest internal transmission of some of the parasites. Since the last surveys were conducted more than two decade ago, additional studies are required to know the current local prevalence of parasites in both the general population and the institutionalized populations of the Island.

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