Short Communication

High prevalence of enteroparasitosis in urban slums of Belo Horizonte-Brazil. Presence of enteroparasites as a risk factor in the family group

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The present study evaluates the prevalence of enteroparasitosis in the urban slums of Belo Horizonte, Brazil and the risk of transmitting enteroparasites to the family members of infected individuals. Stool samples were collected and examined at clinical laboratories near each slum. Individuals were identified and classified as positive for parasitosis (IP^+), and individuals with negative stool tests were classified as negative for parasitosis (IP^-) and enrolled as control patients. We collected samples from 594 patients, of which 20.2% and 79.8% were classified as IP^+ and IP^-, respectively. In addition, 744 family members (FIPs) effectively participated in the study by providing fecal samples. In total, 1338 participants were evaluated. Of these, 34.6% were tested positive for parasitosis. *Blastocystis* was the most prevalent parasite, infecting 22.4% of individuals. Among FIPs, the overall prevalence was 46.1%. Of these, 50.6% and 44.7% were classified as $FIPs^+$ and $FIPs^-$, respectively. These results showed that IP^+ did not impact the prevalence of infection within the studied communities, not constituting index cases of specific risk behaviors, suggesting that, in fact, these communities are exposed to similar oral–fecal routes of contamination.

Keywords: Enteroparasites, Risk factors, Prevalence

Introduction

Infectious and parasitic diseases deserve special attention in developing countries because they are closely associated with poor sanitary conditions. In such countries, enteroparasites cause adverse consequences for their hosts. It has been estimated that intestinal parasitic infections affect approximately 3.5 billion people worldwide, and parasites such as *Ascaris lumbricoides*, hookworm, and *Trichuris trichiura* globally affect about 1 billion people in over 150 countries.[1,2] Among intestinal protozoa, *Giardia lamblia* annually infects approximately 500 million people in Asia, Africa, and Latin America and *Entamoeba histolytica* infects approximately 50 millions.[3,4]

In addition to the lack of basic sanitation, poor hygienic conditions leave the population exposed to constant contamination by enteroparasites, compromising not only the health of individual persons but also that of the workforce and, therefore, negatively impacting economic development. Knowledge of the routes of transmission and the prevalence of intestinal parasitosis are very useful when implementing preventive and therapeutic strategies as part of public health initiatives.

Brazil has seen a decrease in the prevalence of intestinal parasitic infections over the last 30 years.[5] This is primarily due to investments in sanitation engineering. However, less developed regions, such as the north and the northeast of the country, have infection rates as high as 62.4%.[6,7]

The aim of the present study is to assess the prevalence of enteroparasitosis in the slums and outskirts of Belo Horizonte, Brazil and to confirm the importance of enteroparasites as a risk factor for the infection of family members.

Methods

Characterization of the studied communities

The Municipal Secretary of Health–Belo Horizonte established health services on a territorial basis, which are organized into nine health districts in different

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geographic regions. Four communities were evaluated: Santa Maria (south central) Jardim Felicidade (north), Alto Vera Cruz (east), and Vista Alegre (west). Data were collected in these four communities and analyzed together because these communities are similar in terms of socioeconomic characteristics, demographic density, and health coverage policies.

These four communities have a total population of ~43 232 inhabitants over an area of 2.24 km^2, demonstrating a population density of 19 300 inhabitants/km^2. The elderly population (person > 65 years) comprises 6.1% of residents, while 24.9% are children < 12 years of age. The average income of each household is between US$375.10–542.50. The supply of treated water reaches nearly all residences (99.8%), however household sewage is present in > 92% of homes. Garbage collection in these neighborhoods is well structured, as a whole, but in slum areas collection only reaches 53.9–86.6% of residences.

Sample collection

In this study, all individuals with positive stool samples were diagnosed by clinical laboratory analysis in each community between 2007–2010. A general analysis was performed that focused on the prevalence of parasitosis in two groups of individuals: group 1, individuals with positive stool tests for parasitosis, identified and classified as positive indicators of Parasitosis (IP^+); and group 2, individuals with negative stool tests for parasitosis, identified and classified as negative indicators of Parasitosis (IP^-). Analysis of the overall prevalence of enteroparasitosis among the family members (FIP) of these two groups was also performed to assess the association between IP^+, as carriers of enteroparasitosis, and the prevalence of intestinal parasites in the FIP of those individuals.

IP^+, IP^-, and FIP were invited to take part in this study, and those who refused or had no FIP were excluded. The participants received labeled flasks containing 10% buffered formalin and were requested to collect three stool samples every other day. The samples were examined for the presence of intestinal parasites using the formalin–ethyl acetate concentration method.[8] To diagnose *Cryptosporidium*, 384 samples were randomly selected and processed using the ELISA technique in order to identify coproantigens (Cryptosporidium II Test; Wampole-Alere). Individuals who were positive for intestinal parasites according to their clinical examinations also received specific treatments, as needed.

Experimental design

The necessary sample size (approximately 640 individuals in the four studied communities) was estimated based on previously published studies.[1–7] The average estimated prevalence of intestinal parasitic infection based on these studies was 48%. This value was used to calculate the necessary sample size. Using an absolute accuracy value of 8% and significance level of 5%, the calculated sample size was determined to be 144 individuals per community. After considering patient loss, safety, recruitment problems, and project execution, this number was revised to 160 individuals per community. Individuals who provided stool samples for clinical analysis in each community and agreed to participate were randomly selected (random number table at a 1 : 1 proportion) to participate or not participate in this study.

Statistical analysis

Statistical analyses were performed using the Statistical Package for Social Sciences, IBM (release 20.0). Categorical variables are described as proportions and percentages and continuous variables as means ± standard deviations (SD). When comparing groups, the Mann–Whitney U or student t tests were used to analyze continuous variables and the Chi-square or Fisher exact tests were used to analyze categorical variables. We also used the nonparametric ANOVA and Kruskal–Wallis tests to compare multiple groups, and associations were analyzed using the Dunn test. Differences with $P < 0.05$ are considered statistically significant with a confidence interval of 95%.

Ethical considerations

The study was approved by the ethics committee of the municipality of Belo Horizonte, Brazil. All participants provided written informed consent. In order to perform this study and provide feedback to the communities, educational materials were provided to all participants, in addition to lectures, explaining how parasites are transmitted and ways to prevent infection.

Results

After randomization, 594 patients who provided stool samples were included in this study. Of these, 120 patients (20.2%) were positive for enteroparasitosis and included in the IP^+ group; 474 IP^- patients (79.8%) were also identified. Apart from these 594 IP patients, 744 relatives effectively participated in the study by providing fecal samples and were also included in this study.

The overall prevalence of intestinal parasites found in 1338 (594 IPs + 744 relatives of IPs) samples stratified by age and parasite was 34.6%. The average age of the participants in this study was 29.3 ± 20.2 years, with patients < 12 years accounting for 24.9% of the study population. There were no significant differences in terms of prevalence between age groups, however significant differences were found in terms of the type of infectious parasite. *Blastocystis* was the most common parasite in all three age groups, demonstrating a significantly higher prevalence among elderly patients (≥ 65 years) compared with children (27.4% vs 19.6%, respectively; $P = 0.014$). Following *Blastocystis*, *E. coli* and *G. lamblia* were the most frequently identified parasites in children (Table 1).

In addition to determining the overall prevalence of intestinal parasites in the studied communities, we also evaluated the association between IP^+ and prevalence in FIPs. The overall prevalence of intestinal parasites in FIPs was 46.1%. Of 744 enrolled FIPs, 178 (23.9%) were related to 120 IP^+ patients. Parasitological examination of these 178 FIPs revealed 90 positive samples (50.6%). In total, 566 (76.1%) FIPs were associated with 474 IP^- patients, and of these 253 FIPs (44.7%) were positive (Table 2).

There were no significant differences in terms of the prevalence of most types of parasites between the two groups (FIP^+ vs FIP^-), except *Trichuris trichiura* ($P = 0.003$), *Cryptosporidium* ($P = 0.023$), and *Ascaris lumbricoides* ($P = 0.012$), which were statistically more prevalent in IP^+ patients (Table 3).

Discussion

Enteroparasites are common in many parts of the world, and they are an important cause of diarrhea that may affect over half of the world's population; thus, enteroparasites are considered a serious public health problem in developing countries.[1,2,9]

The present study shows that enteroparasitosis was highly prevalent in samples obtained from individuals (IP^+; 20.2%), as well as the family members of these

Table 1 Distribution of parasites in 1338 fecal samples stratified by age

Parasite	≤ 12 years old	> 12 to 64 years old	≥ 65 years old
Blastocystis sp	54 (19.6)	195 (23.2)	34 (27.4)
Endolimax nana	22 (8.0)	112 (13.3)	14 (11.3)
Entamoeba coli	36 (13.0)	108 (12.8)	15 (12.1)
Entamoeba histolytica	14 (5.1)	29 (3.4)	3 (2.4)
Giardia lamblia	24 (8.7)	16 (1.9)	1 (0.8)
Iodamoeba butschlii	2 (0.7)	9 (1.1)	1 (0.8)
Strongyloides stercoralis	0 (0.0)	7 (0.8)	1 (0.8)
Ascaris lunbricoides	6 (2.2)	6 (0.7)	1 (0.8)
Entamoeba hartmanni	1 (0.4)	3 (0.4)	1 (0.8)
Schistosoma mansoni	0 (0.0)	3 (0.4)	0 (0.0)
Trichuris trichiura	2 (0.7)	2 (0.2)	1 (0.8)
Hookworms	0 (0.0)	2 (0.2)	0 (0.0)
Enterobius vermicularis	0 (0.0)	2 (0.2)	0 (0.0)
Taenia sp	0 (0.0)	1 (0.1)	0 (0.0)
Hymenolepis nana	0 (0.0)	1 (0.1)	0 (0.0)
Cryptosporidium sp	0 (0.0)	1 (0.1)	0 (0.0)

Table 2 Stool examination from families of indictors of parasitosis (FIPs)

IPs	FIPs	Stool tests not done (excluded)	Stool tests done (included)	Positive results	Negative results
IP^+ 120	462	284 (61.5)	178 (38.5)	90 (50.6)	88 (49.4)
IP^- 474	1720	1154 (67.1)	566 (32.9)	253 (44.7)	313 (54.8)
594	2182	1438	744	343 (46.1)	401 (53.9)

Table 3 Prevalence of positive fecal samples in FIPs stratified by enteroparasites

Parasite	FIP^- $N = 178$	FIP^+ $N = 566$	Total $N = 744$	P
Blastocystis sp	186 (25.0)	47 (6.3)	233 (31.3)	0.105
Endolimax nana	80 (10.7)	26 (3.5)	106 (14.2)	0.875
Entamoeba coli	71 (9.5)	32 (4.3)	103 (13.8)	0.067
Entamoeba histolytica	23 (3.1)	10 (1.3)	33 (4.4)	0.380
Giardia lamblia	10 (1.3)	5 (0.7)	15 (2.0)	0.388
Iodamoeba butschlii	7 (0.9)	0	7 (0.9)	0.136
Entamoeba hartmanni	1 (0.1)	1 (0.1)	2 (0.2)	0.388
Trichuris trichiura	1 (0.1)	4 (0.5)	5 (0.6)	0.003
Cryptosporidium sp	0	1 (0.1)	1 (0.1)	0.023
Ascaris lunbricoides	0	2 (0.3)	2 (0.3)	0.012
Strongyloides stercoralis	1 (0.1)	0	1 (0.1)	0.575
Hookworms	0	0	0	–
Taenia sp	0	1 (0.1)	1 (0.1)	0.074
Enterobius vermicularis	0	0	0	–
Hymenolepis nana	0	0	0	–
Schistosoma mansoni	0	0	0	–

individuals (FIP$^+$; 46.1%), in selected communities in Belo Horizonte, Brazil. The prevalence of enteroparasitosis was high in both IPs and FIPs, but FIPs demonstrated a prevalence that was nearly twice as high. Perhaps this is due to the real increase in the number of FIPs who were diagnosed, consequently demonstrating better detection power. Regardless, the findings we obtained by screening these infected communities are interesting, even if the real prevalence is underestimated. In this context, the clinical importance of pathogens and their impact on the quality of life of infected individuals should be considered. Commensal infections warrant extra attention because transmission pathways could be identified by recognizing the behavior patterns (or the social relationships of these communities), that spread other diseases via the same routes of transmission.

Considering that the studied communities benefited from a safe drinking water supply and piped sewage, others routes are probably involved in the transmission of enteroparasites. One possible hypothesis is that the consumption of uncooked food transmits enteroparasites, such as contaminated vegetables and fruit. These foods could come from a common source used by the majority of the population living in the same area. Another possibility is poor personal hygiene, which compromises food quality after processing. *Blastocystis* was the most frequently identified parasite, however human infection is not especially well-known among health professionals. Many laboratories do not know how to identify *Blastocystis*, and many clinicians do not suspect this infection when examining patients. The pathogenic abilities of this parasite are still controversial.[10,11] *Blastocystis* is found throughout the world, varying in prevalence depending on the sanitary conditions.[12] Prevalence ranges between 8–50% in different countries where stool samples that have been submitted for routine testing.[13–16] Many studies on the prevalence of parasites in Brazil also fail to mention *Blastocystis*. Our results corroborate the findings of Amato Neto *et al*,[17] who reported that *Blastocystis* is the most prevalent parasite in Florianópolis, Brazil.

Following *Blastocystis*, *E. nana*, *E. coli*, *E. histolytica/dispar*, and *G. lamblia* were the most frequently diagnosed parasites. *Endolimax nana* and *E. coli* were the most frequent commensal infections.[18–20] *Entamoeba histolytica/dispar* is one of the most prevalent infections in the Amazon region.[21] In the southeast region of Brazil, *E. histolytica/dispar* is also a common protozoan infection, followed by *Giardia,* which is the most prevalent parasite in the region.[22–26]

The identification of helminths in our population was very rare. These results are in disagreement with some studies on parasites in Brazil.[23,27,28] However, these studies evaluated regions with poor sanitary conditions and included mostly children who are the most susceptible to helminth infection.

Nevertheless, the prevalence of helminthiasis in Brazil is changing. It has been reported that helminths are more frequent in the countryside, especially in areas where underdevelopment is still common. Surveys of the outskirts of large cities generally report a low prevalence of helminths.[17,19,21,29–32]

In summary, the initial aim of this study was to evaluate the relationship between the prevalence of intestinal parasites in individuals living in certain slums who provided stool samples for clinical laboratory analysis and the prevalence of these parasites in their family members. However, these samples are considered representative of the prevalence of enteroparasitosis in these communities because all participants were residents of the same areas and exposed to the same risks. Despite the high prevalence of enteroparasitosis among individuals, we were surprised by the higher prevalence among FIPs. Obviously, tests performed at laboratories are more likely to be positive because individual who seek medical attention often present with complaints that are indicative of enteroparasitosis. However, our results did not confirm this notion. Instead, our results demonstrate that prevalence in the studied communities was higher, suggesting that individuals could have common sources of contamination or exhibit similar risky behaviors that favor similar routes of contamination, thus homogenizing prevalence with communities. Therefore, we can say that the IP$^+$ patients are actually only index cases from a community that was equally infected, not index cases of specific risk behaviors. Considering the good sanitation infrastructure that is available in the studied communities, our results show that health education policies are crucial for improving the quality of life of individuals in such populations.

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