Brief Report

Relationship between Intestinal Parasitic Infection in Children and Soil Contamination in an Urban Slum

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Summary

Purpose: Urban slums are well known for their high infant mortality and morbidity rates, and parasitic infections seem to be a common problem among these children. The aim of the present study was to determine protozoa and nematodes prevalence among children of a selected community located in São Paulo, Brazil, and access the relation between soil and children infection.

Methods: Soil contamination samples from 15 strategic locations in the slum area as well as stool samples (examined for protozoa and nematodes through five different methods) from 120 children aged 2–14 years (49% M: 51% F, mean ± SD = 7.9 ± 3.8 years) were assessed in a cross-sectional study. Children’s domicile locations were determined, and a comparative analysis was undertaken to correlate children and soil infection.

Results: Overall infection rate was 30.8% (n = 37), without difference between genders. The most frequent intestinal protozoa were Endolimax nana (20.8%), Entamoeba coli (15.8%) and Giardia lamblia (16.7%). Frequencies of Ascaris lumbricoides and Enterobius vermicularis in stool samples were 2.5 and 1.7%, respectively. No cases of hookworms, Schistosoma mansoni or Trichuris trichiura were identified. Polyparasitism occurred in 10.8% of the children, while 69.2% were free of parasitic infections. Out of the 15 soil samples analyzed, Ascaris sp. eggs were found in 20% and hookworm eggs in 6.7%.

Conclusion: Helminth infection is not as prevalent as previously reported in urban slums in São Paulo, neither as clinical disease nor in soil samples. Protozoa intestinal infection, however, is still frequent in some marginalized populations in São Paulo. Improvement in living standards, mostly sanitation might decrease the prevalence of these diseases.

Key words: Brazil, ascaris, child, soil, protozoa, ancylostoma, soil-transmitted helminth, parasitology.

Introduction

Infection by soil-transmitted protozoa and nematodes (including Ascaris lumbricoides—roundworms, Trichuris trichiura—whipworms, Ancylostoma duodenale and Necator americanus—hookworms), remain among the most common diseases in humans, affecting up to 25% of the world’s population.

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Study site

The study was conducted at ‘Porto Seguro’, an urban slum area of São Paulo, SP, Brazil.
(Porto Seguro community). The place was selected, as it is an undeveloped and relatively limited area. The total population was 876 in 2000, with 290 children (2–14 years) and 44 children with <2 years. This population was distributed in 215 domiciles. The soil in this area is dominantly red clay and the terrain comprises an irregular surface, within unstable contaminated lateritic soil in constant ground collapse. Despite being in the middle of an urban area, the community has serious problems with water supply and waste disposal.

**Study design**

All children from the Porto Seguro community were invited to participate in this cross-sectional study, and were registered only after the objectives of the study had been explained to them and to their parents, and full informed consent obtained. Stool samples were obtained from children aged 2–14 years. Soil samples were obtained from 15 strategic places in the slum area. Children’s domicile places were determined, and a comparative analysis was undertaken to correlate children and soil infection.

**Soil analysis**

Quantification of total nematode egg load in soil samples from 15 study localities was performed. Places were chosen to evaluate most uniformly the area, emphasizing places with higher population density. Two 200 g soil samples were collected from each local, using a spade to scoop soil from the surface (0–50 mm depth). Each 200 g soil sample was transferred to a separate jar. They were then taken to the laboratory and nematodes eggs were recovered.

**Collection of stool samples and parasitological examination**

Stool samples were collected at children’s domiciles, kept cool prior preparation and analysis, transported to a laboratory and examined within 12 h. Every fecal sample was examined for protozoa and nematodes through five different techniques: (i) Direct exam; (ii) Kato-Katz technique [7]; (iii) Spontaneous sedimentation method (Lutz-Hoffman) [8, 9]; (iv) Thermal migration method (Rugai, Mattos and Brisola) [10] and (v) Zinc sulfate flotation (Faust method) [11].

**Ethics and statistical analysis**

Before the study onset, information meetings were held with the community leaders and parents. At these meetings, informed consent was obtained from the parents. The institutional ethics review board of the Medical School of Santa Casa of São Paulo approved the present study.

Quantitative data reflecting parasite abundance within hosts are shown as arithmetic mean values. Chi-square test was used for comparison between boys and girls.

**Treatment**

At the end of the study all children with positive exams were appropriately treated, without any expenses to their parents.

**Results**

Of a total of 290 children who lived in the community, 120 collected appropriate stool samples, owing to an overall compliance of 41.4% (49% M: 51% F, mean ± SD = 7.9 ± 3.8 years, range 2–14 years). However the distribution of the sample included most of the areas of the slum.

**Parasitic infection**

Overall infection rate was 30.8% (n = 37), without difference between genders. The most frequent intestinal protozoa were *E. Nana* (20.8%), *E. coli* (15.8%) and *G. lamblia* (16.7%). Frequencies of *A. lumbricoides* and *E. vermicularis* in stool samples were 2.5 and 1.7%, respectively. No cases of hookworms, *S. mansoni* or *T. trichiura* were identified.

**Table 1**

<table>
<thead>
<tr>
<th>Parasite, % (n)</th>
<th>Total (n = 120)</th>
<th>Sex</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Females (n = 61)</td>
<td>Males (n = 58)</td>
<td>X²</td>
<td>P</td>
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<tr>
<td><strong>Soil-transmitted helminths</strong></td>
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<tr>
<td><em>A. lumbricoides</em></td>
<td>2.5% (3)</td>
<td>1.6% (1)</td>
<td>3.4% (2)</td>
<td>0.37</td>
<td>0.37</td>
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<tr>
<td><em>E. vermicularis</em></td>
<td>1.7% (2)</td>
<td>1.6% (1)</td>
<td>1.7% (1)</td>
<td>0.00</td>
<td>0.50</td>
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<tr>
<td><strong>Intestinal protozoa</strong></td>
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<tr>
<td><em>E. coli</em></td>
<td>15.8% (19)</td>
<td>18.0% (11)</td>
<td>13.8% (8)</td>
<td>0.45</td>
<td>0.16</td>
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<tr>
<td><em>E. histolytica</em></td>
<td>0.8% (1)</td>
<td>0</td>
<td>1.7% (1)</td>
<td>1.55</td>
<td>0.49</td>
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<tr>
<td><em>E. nana</em></td>
<td>20.8% (25)</td>
<td>23.0% (14)</td>
<td>19.0% (11)</td>
<td>0.34</td>
<td>0.15</td>
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<tr>
<td><em>G. lamblia</em></td>
<td>16.7% (20)</td>
<td>21.3% (13)</td>
<td>12.1% (7)</td>
<td>1.92</td>
<td>0.08</td>
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<tr>
<td><em>C. mesnili</em></td>
<td>0.8% (1)</td>
<td>0</td>
<td>1.7% (1)</td>
<td>1.55</td>
<td>0.49</td>
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</table>
when compared to older children (28.6% versus 51.8%, \( p = 0.009 \)). Polyparasitism occurred in 10.8% of the children, while in 69.2% no parasites were identified.

**Soil contamination**

Of the 15 soil samples analyzed, *Ascaris* sp. eggs were found in 3 (20%) and hookworm eggs in 1 (6.7%). Two of the *Ascaris* containing samples were collected close to a waste disposal area, while the hookworm eggs were found in the only area with sandy soil. Map 1 correlates soil contamination and children infection.

**Discussion**

Urban slums have serious sanitary problems regarding water supply, waste disposal and proper sewage drainage. In such scenery, digestive-tract diseases arising from poor sanitation and pollution of drinking water are expected to be major concerns, mainly amongst children [5].

Our study has some important findings. First, the overall prevalence of intestinal-helminth infections among children of the Porto Seguro community was very low. This finding correlates to the recently observed trend of decreasing soil-helminths infection in São Paulo [12]. This can be mostly attributed to the urbanization process with improvement of sanitation [12–14]. Although children who live in urban slums have poor sanitary conditions, the low contamination of the surrounding area might be a protective factor. Another important issue is the soil-protective effect. Clay soil has been previously associated with lower-nematodes infection [3], as they usually retain more water than sandy soils, and air space is hence reduced. None of the children had hookworm infection. This finding contrasts to previously reported rates as high as 15% in São Paulo [15]. Hookworms are known to be the helminths most affected by urbanization process, and are likely to disappear in urban areas [12–14]. As hookworm’s larvae are obligatory aerobes, when clay soils become less aerated, it restricts the movement of these nematodes [3]. Hookworm eggs were observed in soil in the upper part of the Porto Seguro hill, the only place with sandy soil in the area. The soil-protective effect might be responsible for the low infection rate in our study. Additionally, as urbanization progresses, paved soil might also help to eradicate these helminths. *Ascaris* eggs, however, were mostly found in the lower places of the hill, where clay soil is present. However, density of children infection was not affected by the presence of eggs in soil samples. (Map 1)

Second, we have not observed a strong association between children and soil infection. In only one area with contaminated soil we have also observed children infection (Map 1). However, this finding should be evaluated carefully. As the slum has a limited area, children go from house to house. Therefore, their homes might not be the place where they stay most of the time. Also, infection rate was higher in areas with higher demographic density. For instance, the peripheral areas where ascaris and hookworm eggs were found in soil samples had a very low-demographic density. On the contrary, the central areas had the highest demographic density. This bias was not considered in study design, but must be herein stated.

Five intestinal protozoa were identified in the study population: *E. nana*, *E. coli*, *C. mesnili*, *G. lamblia* and *E. histolytica*. Children younger than 8 years had a significant lower prevalence of protozoa infection when compared to older children, as it generally occurs (28.6% versus 51.8%, \( p = 0.009 \)). However, the most frequent observed protozoa were not pathogenic (*E. nana*, *E. Coli*, *C. mesnili*). *G. lamblia* and *E. histolytica* were observed in 16.7 and 0.8% of the children, respectively. For these protozoa, there was a similar infection rate for children younger versus older than 8 years (\( p = 0.24 \)). Since these pathogenic parasites are mostly transmitted through poor-hygiene practices, they could be grossly extinguished by simple sanitary improvements [16]. In spite of the high prevalence of protozoa among these children,
it was much lower than previously found in children from developing countries, with infection rates as high as 78% [17–20].

This study has certain limitations, inherent to the representativeness of the selected sample and type of analysis. Compliance rate was not as high as expected, but the distribution of the sample included most of the areas of the slum. Also, only one stool analysis was possible for each child. However, overall infection rate was assessed by five different methods in order to reduce the misdiagnosis, and therefore infection frequencies could be evaluated.

In conclusion, helminth infection in urban slums in São Paulo is not as common as in the past decades [15], neither as a clinical disease nor as soil contaminants. Protozoa intestinal infection, however, is still frequent. Efforts to reach the most disadvantaged segments of populations and to urgently improve access to clean water, sanitation and behavioral education will certainly have significant effect in decreasing even more parasitic diseases.

References