Intestinal protozoan infections and environment conditions among rural schoolchildren in Western Brazilian Amazon

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Research note

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Abstract

Objective

This study sought to analyse the occurrence of intestinal parasites in schoolchildren from rural areas in Rio Branco, State of Acre, Western Brazilian Amazon.

Results

The proportion of children tested positive for intestinal parasites in this study was 91.48%, of which all of them had protozoan infections. About 65.96% of the students were characterised by a polyparasitism state. Among the parasites found, *Endolimax nana*, *Blastocystis* sp., and *Giardia duodenalis* were the most prevalent in the positive samples. The proportions observed between sociodemographic and environment conditions data and positive diagnosis did not show significant statistical.

Introduction

To the present day, intestinal parasitic infections represent an important public health problem worldwide, mainly in underdeveloped and developing countries. In this context, Brazil stands out, given the lack of public policies for better coverage of basic sanitation in this country [1, 2]. In addition, it is known that both the transmission and growing number of cases are also related to eating habits, as well as cultural and educational behaviours, as parasitic infections are more prevalent in populations of low socioeconomic status [3–5].

Intestinal parasites can be responsible for cases of chronic diarrhoea and malnutrition, compromising physical and intellectual development, especially in younger age groups of the population, with several surveys of intestinal parasites showing a high prevalence in these population groups in several regions of the world across different social and environmental contexts [3, 4].

In children, the intestinal parasites can be an important factor bond to comorbidities and deficiencies such as intestinal obstruction, anaemia, sub nutrition, growth retardation and mental health damages. In school environment, these conditions could develop poor academic performance, absenteeism and cognitive impairments [6, 7]. Furthermore, in this setting, children constantly parasitized, without a basic sanitation conditions and access to health services, live in a constant cycle of infection and reinfection between them.

Although the importance of research evaluating the prevalence of these enteroparasites is known, few studies are available in relation to the northern region of the country [4], the State of Acre in particular. In view of the above, the present study aimed to verify the proportion of intestinal parasites in schoolchildren from a rural area in the Western Amazon.

Material And Methods

Study area

The municipality of Rio Branco, capital of the State of Acre, in the northern region of Brazil, borders on the states of Amazonas and Rondônia, and shares international borders with Bolivia and Peru (Fig. 1). The regional climate is humid equatorial and the average annual temperature is 24.5 °C, with annual rainfalls above 2000 mm. According to the census published by the Brazilian Institute of Geography and Statistics in 2019 [8], an estimated population of 407.319 people is distributed among 155 neighbourhoods, districts, and localities. This study was carried out at the Rural State School Ruy Azevedo, and is located in the Praia do Amapá neighbourhood in the rural area of Rio Branco. The last IBGE census identified the respective neighbourhood as a subnormal agglomeration in which residents are precariously assisted by the services offered by the government, such as garbage collection, water supply, and sewage. In addition, the same area was identified to have a complex land problem that culminates in extensive areas of invasion.

Data collection and parasitological analysis

A cross-sectional study was conducted between May and June 2019. Each family received a bottle containing Merthiolate-Iodo-Formol (MIF) per child to collect a single stool sample. Parents or legal guardians received verbal and written instructions on how to proceed with the collection. Sample selection was non-probabilistic and largely determined by voluntary participation. The study included individuals of both sexes aged between five and twelve years.

Stool samples were analysed at the Laboratory of Clinical and Parasitological Analysis of the Teaching and Research Unit in Veterinary Medicine at the Federal University of Acre (UFAC) in Rio Branco. Coproparasitological tests were performed using formol-ether concentration technique [9], and two slides per sample were analysed. A sample was considered positive when at least one parasite species was detected.

A questionnaire was completed voluntarily by the legal guardian of each participant in order to obtain sociodemographic characteristics. The information collected included age, sex, number of residents, parental education level of the parents, monthly family income, sanitary facilities, origin of drinking water, location of the bathroom, use of antiparasitic drugs, and symptoms of gastrointestinal disorders suggestive of enteroparasitosis.

Data analysis

Sociodemographic characteristics and parasitic proportions were analysed by chi-square or Fisher's exact test using the Stata 13.0 program [10] to identify differences in frequencies between participants at the 5% level of significance.

Results

A total of 58 children participated in the survey, of which of them only 47 delivered the stool sample. Of these, 57.45% were male, while 42.55% were female. The children examined were aged between five and twelve years, with an average of approximately eight years of age.

The proportion of enteroparasites in this study came to around nine out of ten children (91.48%). Protozoan infections were more frequent than helminth infections; these results are shown in Table 1. Monoparasitism was identified in 25.53% of children, while 65.96% had polyparasitism with up to six parasite species.

Table 1
Distribution of intestinal parasites, polyparasitism and monoparasitism in schoolchildren from Rural School Ruy Azevedo, Acre State, Brazilian Western Amazon, 2019 (n = 47).

Parasites	**Male (n)**	**%**	**Female (n)**	**%**	**Total (n)**	**%**
Blastocystis sp.	12	44.44	5	25.00	17	36.17
Endolimax nana	21	77.77	11	55.00	33	70.21
Entamoeba coli	5	18.51	5	25.00	10	21.27
Entamoeba histolytica/dispar	8	29.62	6	30.00	14	29.78
Giardia duodenalis	8	29.62	9	45.00	17	36.17
Iodamoeba sp.	11	40.74	6	30.00	17	36.17
Ancylostoma sp.	-	-	1	5.00	1	2.12
Ascaris lumbricoides	-	-	1	5.00	1	2.12
Taenia sp.	1	3.70	-	-	1	2.12
Polyparasitism	19	70.37	12	60.00	31	65.96
Monoparasitism	5	18.51	7	35.00	12	25.53
Negative cases	4	14.81	-	-	4	8.51

The socioeconomics and demographic data are presented in Table 2. Other information according to the collected data were; the per capita monthly income was calculated as R$191.41 reais, corresponding to $1.25 per capita per day. Only 15.52% of households had running water, while 84.48% used water from simple wells. About 20.69% of the families reported cultivating a vegetable garden for their own consumption.

Table 2
Socioeconomics, demographic and environment characteristics of schoolchildren from Rural School Ruy Azevedo, Acre State, Brazilian Western Amazon (n = 58)

Characteristics	Frequency (n)	Percentage (%)
Residence area		
Rural	55	95.83
Urban	3	5.17
Parents' school level		
Complete / incomplete elementary school	15	25.86
Complete / incomplete high school	31	53.45
Complete/incomplete higher education	11	18.97
Illiterate	1	1.72
House structure		
Wooden house	15	25.86
Brick's house	12	20.69
Mixed (bricks and wooden)	29	50.00
Unknown	2	3.45
Type of drinking water		
From the tap	26	44.83
Boiled	5	8.62
Filtered	11	18.97
Mineral water	10	17.24
Unknown	6	10.34
Bathroom indoors		
Yes	32	55.17
No	24	41.38
Unknown	2	3.45
Own vegetable garden at home		
Yes	12	20.69
No	43	74.14

Characteristics	Frequency (n)	Percentage (%)
Unknown	3	5.17
Family monthly income (R$)		
39–99	7	12.07
100–500	16	27.58
501–1000	17	29.31
1001–2000	12	20.70
>2001	3	5.17
Unknown	3	5.17

Regarding the signs and symptoms caused by infections with enteroparasites, 18.97% of children were symptomatic, of which 17.24% and 13.79% reported to have diarrhoea and emesis, respectively. It was identified that 27.58% never had a parasitological examination of their faeces, 44.82% had an examination more than a year ago, 20.69% less than a year ago, and 6.89% did not respond. Of these children, 82.76% were dewormed, either within the last six months (31.25%), the last year (22.91%), or the last five years (25%).

The proportions observed between sociodemographic data, clinical aspects and positive diagnosis did not show significant statistical differences at the 5% level.

Discussion

In our study, we verified the high proportion of intestinal protozoa among the enteroparasitic agents identified. These results corroborate with findings made in some regions of Brazil [11, 12], and even globally [3, 13–15]. The authors of those studies agree that most of these infections occur because these populations live in precarious conditions of basic sanitation. The highest prevalence being observed in tropical countries is due to the fact that they have the environmental conditions of tropical areas, temperature, and humidity, which are predisposing factors for renewing the parasites' life cycles [16].

In addition, risk factors for the development of enteroparasitosis include contact with residues of different natures and water contaminated with human faeces, inadequate housing conditions, poor hygiene practices, low education, and family income [3, 5]. Continued exposure to these factors is important for maximizing the parasitic burden and, therefore, the development of intestinal parasites. It is worth noting that the very same conditions are predisposing factors of polyparasitism [3, 5, 17], as observed in our study.

According to our diagnoses, helminth infections accounted for a minor proportion of enterparasitic infections, which corroborates with the findings of Panti-May et al. [15] in Yucatan children in Mexico and

with Dessie et al. [3] in schoolchildren in Ethiopia. Although enteroparasitosis affects individuals of all ages, the most vulnerable group is the one with the lowest age, coupled with the fact that children have greater contact with the soil through recreational activities. It is also noteworthy that the finding of a case of *Taenia* sp., such as *Taenia solium*, may precede cases of cysticercosis and causing co-infections [18].

Among the intestinal parasitoses with the highest prevalence worldwide are amoebiasis, hookworm infections, ascariasis, giardiasis, and tricuriasis [2, 19]. In Brazil, the scarcity of statistical data that account for the real prevalence of these parasites makes it difficult to understand the current situation in the country, and these data are only available partially and in specific settings. The World Health Organization, in its most recent report about helminths transmitted by the soil from 2018, reported that in Brazil, the number of children of preschool and school age who require preventive chemotherapy was more than nine million. Of these, about 80% had preventive chemotherapy coverage. However, this coverage was only applied to schoolchildren aged five to fifteen years [20]. In our study, the children were between five and twelve years of age; yet, we still revealed a high proportion of positive cases due to low sanitary conditions to which these children are exposed, and difficulties in accessing health services in the region.

In this study, no statistically significant association was found between the variables studied. It is likely that this is due to the level of exposure to pathogens, various forms of infection, and the homogeneity of the samples studied. Despite this, it is worth emphasising the importance of the study with regard to the high prevalence of parasites found.

Conclusion

We conclude that in the region studied, there is a high prevalence of intestinal protozoan infections, accompanied by frequent cases of polyparasitism. These data point to a continued faecal-oral transmission to which these populations are exposed, reflecting the need to expand basic sanitation services, and implement health and environmental education programs.

Limitations

Our limitations in this study are: the low n because of low adherence of the chlidren's parents in participate of this research, that could might describe better the prevalence of the infections at the locality. Due to lack better conditions of laboratory equipments and supplies to perform other parasitological tests, as for oportunist parasites, and molecular techniques to discriminate *E. histolytica* from *E. dispar*.

Abbreviations

MIF: Merthiolate-Iodo-Formol; IBGE:Instituto Brasileiro de Geografia e Estatística.

Declarations

Availability of data and materials

All data generated or analyzed during this study are included in this article.

Ethics approval and consent to participate

The study was conducted after approval of the project by the Ethics and Research Committee from Federal University of Acre, under number opinion CAAE 02873118.2.0000.5010, and fulfilled the requirements posed by Resolution 196/96 of the National Health Council. All participants who agreed to participate in the study signed informed consent (parents or guardians and schoolchildren). Children positive for intestinal parasitic infection received a free medical consultation and treatment. A brief health education was given for all schoolchildren, parents and school staff.

Consent for publication

This manuscript does not contain any person's data, or any photographs/videos were not taken.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

All the authors actively participated on the conception of the research, data collection, analysis and interpretation, and writing various parts of the paper. LFB, LAKM, FLJ and AFB: designed the study and supervised the Project and write the first version of the manuscript. BESF, LAKM and FLJ organized and analised the socioeconomic and environment data. LBF, AAF, GVC, GHS, LLSS, RCRM and AFB collected the samples and performed the laboratory analysis, All authors read and approved the final manuscript.

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