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Prevalence of enteroparasitosis in children in a city in the north of Paraná and the associated factors

Prevalência de enteroparasitoses em crianças de uma cidade do norte do Paraná e fatores associados

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Abstract

The objective of this study was to investigate the prevalence of enteroparasitosis and the factors involved in their transmission in children between the ages of 0 and 15 in the city of São Jerônimo da Serra, Paraná. The study was carried out from July 2014 to June 2017. 362 samples were analyzed using the methods of Hoffman, Pons and Janer, Faust and collaborators, and Kato-Katz modified. Associations between the socioeconomic variables, as it relates to the habits and environment of the children, and enteroparasitosis were verified by logistic regression, considering a level of significance of 5%. We encountered a high prevalence of enteroparasites (36.5%), a high frequency of polyparasitism (43.9%) and a higher frequency of protozoa (34.5%) in relation to helminths (3.9%). The pathogenic parasites found were *Giardia lamblia* (8.0%), *Entamoeba histolytica/dispar* (3.6%), *Hymenolepis nana* (2.5%), *Enterobius vermicularis* (2.2%), *Ascaris lumbricoides* (1.1%), hookworms (0.8%) and *Trichuris trichiura* (0.3%). *Endolimax nana* was the most frequent (19.3%); even though it is a commensal amoeba, its detection is concerning since the transmission mechanism (fecal-oral) is equal to pathogenic microorganisms. We observed an association between the presence of enteroparasitosis and age group, household income, education level of parents/guardians, living in rural area, consumption of untreated water, inadequate garbage disposal, contact with sand or dirt and presence of a household pet. Hygienic habits, sanitary, socioeconomic and socio-demographic conditions are directly related to infection by intestinal parasites and must be improved to avoid dissemination in the population.

Keywords: Enteroparasitosis. Associated factors. Children.

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Resumo

O objetivo deste estudo foi investigar a prevalência de enteroparasitoses e os fatores envolvidos na transmissão de enteroparasitoses em crianças de 0 a 15 anos de idade do município de São Jerônimo da Serra, Paraná. O trabalho foi desenvolvido no período de julho de 2014 a junho 2017. Analisou-se 362 amostras pelos métodos de Hoffman, Pons e Janer e Faust e cols. As associações entre variáveis socioeconômicas, referentes aos hábitos das crianças e ao ambiente em que vivem e enteroparasitoses foram verificadas por meio de regressão logística, considerado nível de significância de 5%. Encontrou-se alta prevalência de parasitismo (36,5%), uma alta frequência de poliparasitismo (43,9%) e uma freqüência maior de protozoários (34,5%) em relação aos helmintos (3,9%). Os enteroparasitas patogênicos encontrados foram *Giardia lamblia* (8,0%), *Entamoeba histolytica/dispar* (3,6%), *Hymenolepis nana* (2,5%), *Enterobius vermicularis* (2,2%), *Ascaris lumbricoides* (1,1%), ancilostomídeos (0,8%) e *Trichuris trichiura* (0,3%). *Endolimax nana* foi o mais frequentemente encontrado (19,3%). Mesmo sendo comensal, sua detecção é preocupante uma vez que o mecanismo de transmissão (fecal-oral) é igual dos microrganismos patogênicos. Observou-se associação entre a presença de enteroparasitoses e faixa etária, renda familiar, escolaridade dos responsáveis, morar em zona rural, consumo de água não tratada, destino inadequado do lixo, contato com areia ou terra e presença de um animal de estimação. Hábitos de higiene, condições sanitárias, socioeconômicas e sociodemográficas estão diretamente relacionados às infecções por parasitos intestinais e devem ser melhoradas para evitar disseminação na população.

Palavras chaves: Enteroparasitoses. Fatores associados. Crianças.

Introduction

Intestinal parasitic infections (IPIs), some of which are classified as neglected tropical diseases by the World Health Organization (WHO), are a major health concern worldwide, especially in low-income, developing countries of tropical and subtropical regions.[1] Infection is commonly associated with poverty, unhealthy hygienic habits, inadequate sanitation and poor nutrition.[2] Children of preschool and school age are susceptible to IPIs, which are capable of causing complications such as bowel obstruction, malnutrition due to reduced intestinal absorption or consumption of nutrients by the pathogen, anorexia, anemia and diarrhea.[3]

It is estimated that 2 billion individuals are infected by soil-transmitted helminths, of which, the most common is *Ascaris lumbricoides, Ancylostoma/Necator* spp and *Trichuris trichiura*.[1] According to Lobo et al.,[4] of the protozoans, 50 million were infected by *Entamoeba histolytica* and 2.8 million by *Giardia duodenalis. Cryptosporidium* spp and *Enterocytozoon bieneusi* are also of concern, capable of causing intestinal infections and disseminated pathology depending on the species involved. Even though there is a wide occurrence reported, giardiasis, schistosomiasis, soil-transmitted helminths and cryptosporidiosis are considered as neglected diseases due to lack of studies in low-income countries.[1, 5]

Transmission of the infective agents responsible for IPIs is typically through ingestion of contaminated food or water, contact with infected individuals or, depending on the organism, contact with the habitat.

Clinical diagnosis of IPIs, while possible, is difficult as the symptoms of each IPIs are largely similar making laboratory methods such as microscopy, immunology or molecular biology necessary to identify the causative agent. The most commonly used methods are known for being simple and cost-effective. These include spontaneous sedimentation,[6] which is used to detect the presence of eggs and larvae of helminths as well as protozoan cysts; the Faust method,[7] which is used to diagnose helminth (eggs and larvae) and protozoan (cysts) infections; and the Kato-Katz[8] method to detect

the presence of intestinal helminthic infestations caused by *A. lumbricoides*, *T. trichiura*, hookworm and especially *Schistosoma* spp.[9]

Parasitological survey studies are done in centralized regions, thus not portraying the general situation in Brazil. Paraná is located in the southeast region of Brazil with an estimated population of 11,242,720 individuals.[10] In a study done by Lopes et al.[11] in the city of Jataizinho, the prevalence of IPIs in children was found to be 68.2%. The results of a study by Pittner et al.[12] in Guarapuava was similar, 60.5%. Both cities are classified as rural, and the prevalence encountered is high, especially in comparison to the urban city, Cambé, which has a prevalence of 23.2%.[13]

It is known that adequate infrastructure and sanitation in Brazil are unequal; better conditions are found in urbanized regions and these available improvements contribute to reducing the risk of parasitic infections.[14] São Jerônimo da Serra has a reported human development index (HDI) of 0.637, which is classified as medium development. The objective of this study was to determine the prevalence of enteroparasitoses in children between the ages of 0 and 15 and to investigate the risk factors involved in their transmission.

Material and Methods

This study was conducted in São Jerônimo da Serra, a city located in northern Paraná, Brazil from July 2014 to June 2017. This city has an area of 825 km^2 and an estimated population of 11.337 individuals and is ranked three hundred and seventy-fourth (374th) among the other cities in Parana, in terms of development. Children between the ages of 0 and 15 make up 27% of this population.[10, 15]

With informed consent from parents and/or guardians, fecal samples of children, ages 0 to 15, were collected by a team from the Secretary of Health of São Jerônimo da Serra and submitted to parasitological exams as described by Hoffman, Pons and Janer (1934);[6] Faust and collaborators (1939);[7] and Kato and Katz (2000)[8] in the Protozoologia Laboratory at the State University of Londrina (UEL). The results were sent to the parents and/or guardians by means of the Secretary of Health so that infected children could be treated adequately.

Parents or guardians were asked to respond to a standard questionnaire which evaluated different aspects of the child's life. Demographic, socioeconomic variables related to the habits of the children and the environment in which they live were considered independent while presenting a positive result for at least one of the enteroparasitoses was considered as a dependent. The associations were verified by means of logistic regression, with the presentation of the Odds Ratio and its respective 95% confidence interval, in addition to p values, with a considered level of significance of 5%.

The data obtained in this study were organized with EPIINFO 3.5.2 (CDC, Atlanta, Georgia, USA) and analyzed using the Statistical Package for Social Sciences (SPSS), version 19.0. This project was approved by the UEL Ethics Committee (CEP-UEL 179/10).

Results

A total of 362 fecal samples were analyzed of which 132 (36.5%) were positive for intestinal parasites. 34.5% of the samples were positive for protozoans and 3.9% for helminths. Of the 132 positive samples, 56.1% samples demonstrated mono-parasitism and 43.9% polyparasitism. The protozoan with the highest occurrence was *Endolimax nana* (19.3%) followed by *Entamoeba coli* (17.7%) while the highest occurring helminths were *Hymenolepis nana* (2.5%) and *Enterobius vermicularis* (2.2%) (Table 1). All samples were negative for *Balantidium coli*, *Hymenolepis diminuta*, *Schistosoma mansoni*, *Strongyloides stercoralis* e *Taenia* sp.

Table 1- Intestinal parasitic infections occurring in children of the city São Jerônimo da Serra, Paraná Brazil, 2014-2017.

Intestinal Parasite	(n)	%
Protozoan	125	34.5
Endolimax nana	70	19.3
Entamoeba coli	64	17.7
Giardia lamblia	29	8.0
Entamoeba histolytica/dispar	13	3.6
Iodamoeba butschlii	11	3.0
Helminths	14	3.9
Hymenolepis nana	9	2.5
Enterobius vermicularis	8	2.2
Ascaris lumbricoides	4	1.1
Hookworms	3	0.8
Trichuris trichiura	1	0.3

Fonte: Autores.

Socioeconomic and sociodemographic factors associated with parasitic infections which were found to be significant were age, specifically ages six to ten years (OR 1.80, 95% CI 1.11-2.96), and ages eleven to fifteen years (OR 2.86, 95% CI 1.50-5.41); a family income less than or equal to minimum wage (OR 3.04, 95% CI 1.56-5.94); years of schooling of the parents or guardians less than four years (OR 2.15, 95% CI 1.17-3.95), and between five and eight years (OR 1.97, 95% CI, 1.10-3.41). The sex of the child was not a significant risk factor even though the prevalence of intestinal parasites was higher in female children (Table 2).

Table 2- Analysis of the socio-demographic and socioeconomic factors associated with the occurrence of intestinal parasitic infections in children of the city of São Jerônimo da Serra, Paraná, Brazil, 2014-2017.

Variables	Total		Positive		OR (CI 95%)*	p
	n	%	n	%		
Age						
0 – 5 years	146	40.6	39	26.7	1	
6-10 years	159	44.2	63	39.6	1.80 (1.11-2.96)	**0.018**
11-15 years	55	15.3	28	50.9	2.86 (1.50-5.41)	**0.001**
Sex						
Female	187	51.7	71	38.0	1	0.539
Male	175	48.3	61	34.9	0.87 (0.57-1.34)	
Income**						
≤ 1 minimum wage	282	81.3	115	40.8	3.04 (1.56-5.94)	**<0.001**
> 1 minimum wage	65	18.7	12	18.5	1	
Years of schooling of parent/guardian						
0 – 4 years	92	28,1	39	42,4	2.15 (1.17-3.95)	**0.013**
5 – 8 years	133	40,7	53	39,8	1.97 (1.10-3.41)	**0.022**
≥ 9 years	102	31,2	26	25,5	1	

*OR: Odds Ratio, CI: Confidence interval; **Minimum monthly income in Brazil from 2015-2017= R$832.25.
Fonte: Autores.

Hygienic habits of the children and other variables related to the environment, and associated with parasitic infections were home located in a rural area (OR 3.51; IC 95% 2.06-6.01), use of untreated water (OR 1.92; IC 95% 1.24-2.98), inadequate garbage disposal (OR 2.11; IC 95% 1.34-3.34), the child plays in dirt or sand (OR 1.82; IC 95% 1.03-3.24) and the presence of a dog (OR 1.93; IC 95% 1.04-3.55) or cat (OR 1.89; IC 95% 1.21-2.98) in the household. Although not significantly associated, the absence of a bathroom with a toilet and walking around barefooted showed p values very close to 0.05 (Table 3).

Table 3- Analysis of the factors associated with the presence of intestinal parasitic infections in children of the city of São Jerônimo da Serra, Paraná, Brazil, 2014-2017.

Variables	Total		Positive		OR (CI 95%)*	p
	n	%	n	%		
Home location						
Rural	244	68.2	108	44.3	3.51 (2.06- 6.01)	**<0.001**
Urban	114	31.8	21	18.4	1	
Stream, river or dam close to home						
Yes	140	39.8	55	39.3	1.26 (0.81-1.96)	0.309
No	212	60.2	72	34.0	1	
Possesses treated water						
Yes	190	53.7	55	28.9	1	
No	164	46.3	72	43.9	1.92 (1.24-2.98)	**0.004**
Possesses a bathroom with a toilet						
Yes	325	93.1	111	34.2	1	
No	24	6.9	13	54.2	2.28 (0.99-5.25)	0.053
Adequate disposal of garbage						
Yes	152	42.9	40	26.3	1	
No	202	57.1	87	43.1	2.12 (1.34-3.34)	**0.001**
Possesses a vegetable garden						
Yes	189	54.0	72	38.1	1.19 (0.77-1.84)	0.446
No	161	46.0	55	34.2	1	
Eats fruits and raw vegetables						
Yes	306	87.7	115	37.6	1.55 (0.77-3.15)	0.220
No	43	12.3	12	27.9	1	
Washes fruits and vegetables						
Yes	337	96.6	123	36.5	1	
No	12	3.4	3	25.0	0.58 (0.15-2.18)	0.420
Washes hands before eating						
Yes	330	93.8	118	35.8	1	
No	22	6.3	9	40.9	1.24 (0.52-2.99)	0.627
Walks around barefoot						
Yes	257	73.2	100	38.9	1.67 (0.99-2.79)	0.053
No	94	26.8	26	27.7	1	
Plays in dirt or sand						
Yes	277	78.9	107	38.6	1.82 (1.03-3.24)	**0.041**
No	74	21.1	19	25.7	1	
Possesses a dog						
Yes	285	81.4	110	38.6	1.93 (1.04-3.55)	**0.036**
No	65	18.6	16	24.6	1	
Possesses a cat						
Yes	193	55.1	82	42.5	1.89 (1.21-2.98)	**0.005**
No	157	44.9	44	34.9	1	

*OR: Odds Ratio, CI: Confidence interval.
Fonte: Autor.

Discussion

Enteroparasitoses are a serious problem in public health. An estimated 25% of the world's population is affected by enteroparasitoses and, with the advent of HIV, there is an increase in the prevalence of emerging protozoa. Although intestinal parasitism is relevant in epidemiology and public health, in Brazil there are insufficient studies regarding its prevalence and the associated risk factors.

This study aimed to discover the prevalence and factors associated with transmission of enteroparasitoses in the city of São Jerônimo da Serra, which has an HDI of 0.637. A high prevalence of intestinal parasites was encountered (36.5%) in this city. Few studies have been conducted in the state of Paraná in order to know the prevalence of enteroparasites, but studies such as those developed by Costa-Macedo et al.[16] in Jacarezinho (16%.); Lopes-Mori et al.[13] in Cambé (23.3%); Lopes et al.[11] in Jataizinho (68.2%) and Pittner et al.[12] in Guarapuava (60.5%) demonstrate a high prevalence of enteroparasitoses. Matsuchita et al.[17] found a similarly high prevalence (41%) in São Jerônimo da Serra in a study conducted between the years 2010 to 2012. These differences demonstrate that each region has its own epidemiological profile or lifestyle particularities whether they are socioeconomic and demographic conditions or hygienic habits.

The results of this study point not only to the elevated levels of intestinal parasitism but also to the frequent occurrence of polyparasitism. An analysis of the frequency of mono- and polyparasitism showed that 56.1% of the children were parasitized by only one species and 43.9% were parasitized by more than one species of intestinal parasite. A higher frequency of mono-parasitism appears to be the more common pattern in the population as demonstrated by various works.[12, 13, 18] However, according to Rocha et al.,[19] precarious conditions of basic sanitation expose the population to the acquisition of different enteroparasites, making cases of polyparasitism frequent, a fact observed in the population studied.

The percentage of protozoan infections (34.5%) was higher than helminthiasis (3.9%). This pattern has been observed in Brazil; as reported by some authors, it is considered to be related to the increased use of chemotherapy effective against helminths and other intestinal worms (ineffective against protozoan) as well as improvements in public health, education and housing. [20, 21]

E. nana was the most frequent protozoan (19.3%) in the samples evaluated and this prevalence corroborates with the data observed by Poulsen et al.[22] The authors estimated the overall prevalence in healthy individuals to be 13.9%. This protozoan is considered commensal; its presence, however, is cause for concern as it has the same transmission mechanism as other pathogenic species (fecal-oral), serving as an important indicator of the hygienic-sanitary conditions of the population. According to one systematic review,[22] the protozoan *Endolimax* is also transmitted by contaminated food and water,[23] by raw consumed vegetables[24] and by banknotes,[25] justifying the higher prevalence of this parasite in the samples tested.

The most frequent pathogenic protozoan in this study was *G. lamblia* (8.0%). Giardiasis frequency in Brazil varies between 9 and 50 percent and this huge variation in the percentage can be attributed to the scarcity of research on this subject in the country.[26] In relation to the reported occurrence of this parasite in Brazil, we detected a low frequency of this protozoan. According to Zajac et al.,[27] simple techniques such as zinc sulfate flotation and centrifugation maybe be applied to better detect this parasite. Although this method was employed in this study, the analysis of only one fecal sample per child and the intermittent pattern of excretion of *G. lamblia* may have caused an underestimation of the frequency. The prevalence of giardiasis found in this study is worrisome since it points to poor hygienic habits or poor sanitary conditions in the studied population. Recognizing its link to poverty and the significant burden of disease in developing countries, WHO included giardiasis in the "Neglected Disease" initiative in 2004.[28]

In relation to the analysis of the sociodemographic and socioeconomic factors associated with the occurrence of IPIs, this study's results showed that children older than six years had a higher chance of being parasitized. According to Santos and Merlini,[29] until nine years of age, children are more prone to acquiring intestinal parasites, a fact which is related to the degree of immunity, acquired hygienic habits as well as a higher frequency of contact with geo-helminths due to more external leisure activities; with increasing age, such activities are conducted in closed environments.

Furthermore, household income and the education level of the parent or guardian were also observed to be important factors. It is known that low-income families are more prone to IPIs due to home location and subsequently homes that lack proper sanitation, adequate sewerage or treated water. Parents who are not conscious of the proper care that should be taken in regard to food preparation and personal hygiene may not enforce such rules with their children, thereby, increasing the risk of contact with intestinal parasites.[30] This study is in accordance with Bencke et al.[31] in which the authors stated that populational studies of different regions in Brazil have different enteroparasitoses depending on the sanitation conditions as observed in the studied population of São Jerônimo da Serra.

The results clearly demonstrated that there was a higher chance of the child being parasitized when they consumed untreated water, had intimate contact with dirt or sand, did not have access to adequate waste disposal, had household pets and lived in a rural area. However, humans most commonly become infected with parasites through consumption of infected food or water or via direct fecal-oral contamination.[32] Okhuysen and White[33] demonstrated in their study that the spread of protozoa in developing countries was due to fecal contamination as a result of poor sewage management. Food and water-borne outbreaks have been known to occur especially since the infectious cyst form of these protozoa is relatively resistant to chlorine. Our study indicates that the population investigated does not practice adequate hygienic habits, propagating the dissemination of intestinal parasites. In addition, adequate measures of basic sanitation should be implemented to reduce, and in the long-term, prevent enteroparasitary infections.

We must also consider that the close relationship between domestic animals and humans can facilitate the transmission of some parasites. In this study, we verified a correlation between enteroparasitoses and the presence of dogs or cats in the household similar to Silveira[34] who encountered a prevalence of 59% of intestinal parasites in children who had household pets. Xavier[35] verified that 20.8% of the dogs which had contact with children were infected with enteroparasites. More recently, Tůmová et al. were the first to report a true zoonotic transmission between chinchilla and humans.[36]

Due to the high prevalence of IPIs and frequency of polyparasitism found in São Jerônimo da Serra, it can be concluded that, from an epidemiological perspective, basic sanitation, socioeconomic and sociodemographic conditions are enabling factors of intestinal parasites and must be improved so dissemination can be reduced and, eventually, eliminated.

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