

**ORIGINAL ARTICLE**

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**INTESTINAL PARASITE PREVALENCE IN  
SCHOOLCHILDREN FROM NORTHWESTERN RIO  
GRANDE DO SUL STATE, BRAZIL**

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**ABSTRACT**

Parasites are often a public health hazard, especially among schoolchildren. The transmission of these parasites is associated with poor hygiene and sanitation, as well as close contact between people. This study aimed to evaluate the occurrence of intestinal parasitic infections in schoolchildren from the rural and urban areas of the Palmeira das Missões county, a major town in northwestern Rio Grande do Sul State. Fecal samples from 209 schoolchildren aged three to fourteen were analyzed. The Hoffman, Pons and Janer, Faust, Ritchie, and Kinyoun's stain for coccidia parasite detection techniques were applied. 59.3% of the patients were positive for pathogenic or commensal parasites. The most common parasites were *Ascaris lumbricoides*, *Entamoeba coli*, *Giardia duodenalis* and *Cryptosporidium* spp., respectively. There were no significant differences in positivity among schoolchildren from rural and urban areas. Low family income and the mothers' schooling (up to 8 years of education) were statistically significant for the presence of parasites. This is the first parasite study carried out in the Palmeira das Missões county.

**KEY WORDS:** *Ascaris lumbricoides*; *Giardia duodenalis*; *Cryptosporidium*; enteroparasites.

**INTRODUCTION**

Intestinal parasitism is a major public health hazard in developing countries, where millions of children host considerable loads of enteroparasites (Pullan et al., 2014). According to Macedo (2005), these infections occur more often in the lower class which presents little if any schooling, a fact which is corroborated by several studies that show the occurrence of parasites transmitted through soil, especially in poor countries (WHO, 2017; Pham-Duc et al., 2013; Shobha et al., 2013).

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In Brazil, significant social inequalities, together with haphazard urban planning, still force some social groups to live under precarious conditions (Fonseca et al., 2010). According to the IBGE (Brazilian Institute of Geography and Statistics), only 1,569 (28.2%) municipalities in the country presented Basic Sanitation Policies in 2011. For this reason, intestinal parasites should be prioritized in public health actions, not only because of the harm they can cause to individuals, but also because of the cost to the State in regard to treatment. In addition, these parasitic infections can eventually demand emergency surgery (Andrade et al., 2015).

Schoolchildren are the most seriously affected by helminths and protozoa in the digestive system because of their poor hygiene habits. In addition, their immune system is not yet fully effective in eliminating these parasites, which can lead to, or enhance, malnutrition, diarrhea and anemia, as well as impair physical and cognitive development (Carvalho-Costa et al., 2007; Labeaud et al., 2015).

Data for the State of Rio Grande do Sul (RS), Brazil, have indicated an enteroparasite prevalence ranging from 26 to 62% for *Ascaris lumbricoides*, 8.6 to 58% for *Trichuris trichiura* and 12 to 27% for *Giardia duodenalis* (De Carli & Tasca, 2001; Becker et al., 2002; Mylius et al., 2003; Roque et al., 2005). In a study with schoolchildren in the Caxias do Sul county in northeastern RS by Basso et al. (2008), the prevalent parasites were: *A. lumbricoides* (47%), *T. trichiura* (36%), *G. duodenalis* (24%) and *Enterobius vermicularis* (8%). Another study at a childcare center in the city of Rio Grande, southern RS, evaluated 165 children, 106 of whom (64.2%) were parasite positive, notably *G. duodenalis* (30.3%), *T. trichiura* (24.2%) and *Ascaris lumbricoides* (22.4%). In addition, the authors highlighted the occurrence of coccidia *Cryptosporidium* spp. (2.4%) and *Cystoisospora belli* (0.6%), highlighting the importance of using specific techniques for diagnosing these protozoa (Berne et al., 2012).

In addition to the information available in the literature, regarding the municipalities, being relatively scarce, little is known on major and contributing risk factors to the maintenance and increase of intestinal parasites in each region, especially when considering the highly different climatic and socio-cultural conditions in Brazil. The aim of this study was to investigate the occurrence of intestinal parasites in schoolchildren from the rural and urban areas of the Palmeira das Missões County in northwestern Rio Grande do Sul State, an area where data on soil-transmitted helminths (STH) and protozoa in children were still nonexistent.

## MATERIAL AND METHODS

The county of Palmeira das Missões, located in northwestern Rio Grande do Sul State, has an estimated population of 34,328 inhabitants, 29,831 of whom live in the urban area and 4,497 in the rural area. The Human Development Index (HDI) is 0.737 (IBGE, 2011). Meetings were initially held with the administrative staff of five municipal schools, three of which located in the rural area and two in the urban area. After informing these officials of the purpose of the research, a meeting with parents (or guardians), schoolchildren and teachers was scheduled, when all the children were invited to attend a lecture on the importance of the control, diagnosis and prevention of intestinal parasites. Parents or guardians were requested to sign a free and informed consent document so that their children could participate in the study. All subjects were given an information leaflet prepared by the research team listing major enteroparasites that have been diagnosed in Brazilian children. The study was sanctioned by the Research Ethics Committee of the Federal University of Pelotas (UFPel) under n.13672413.2.0000.5317.

Meetings were also held with the staff members of five Basic Health Units (BHU) closest to each of the five schools so as to ensure that the positive children were referred to a BHU for free treatment and medication.

In order to obtain epidemiological data from each child, parents or guardians were asked to answer a questionnaire to verify the family's socioeconomic profile. Different aspects of the children's evaluation included age, sex, address, type and size of dwelling, number of inhabitants, family income, mothers' schooling and access to public sanitation (sewage system, clean drinking water, and garbage collection availability).

To collect student fecal samples, the schools in Palmeira das Missões were visited one at a time on a monthly basis. Samples were collected in triplicate on alternate days, identified and stored in sterile collection containers added with MIF preservative solution and kept under refrigeration at about 4 °C to then be taken to the Human Parasitology Laboratory of the Federal University of Pelotas (UFPel) for analysis. The samples were processed by Hoffman, Pons and Janer (HPJ, or spontaneous sedimentation), Ritchie (formalin-ether centrifugal sedimentation), Faust (zinc sulfate centrifugal flotation), and Kinyoun staining techniques. Three slides were prepared for each technique for microscopic analysis.

A descriptive comparison of the two study groups (infected schoolchildren - positive group; uninfected schoolchildren - negative group) for each variable was developed, expressing values in frequency (observed value - n), and percentage (%). Statistical comparison between groups was performed using the qui-square test ( $p \leq 0.05$ ), and odds ratio evaluation (Odds ratio).

## RESULTS

Two-hundred and nine students (122 boys and 87 girls) participated in the study, 124 of whom (59.3%) were positive for at least one parasite. Of these, 86 (69.4%) presented monoparasitism and 38 (30.6%), polyparasitism (Table 1). Considering the general occurrence of parasites and commensals (monoparasitism and polyparasitism cases), *Ascaris lumbricoides* was the most prevalent parasite, diagnosed in 69 students (55.6%), followed by *Entamoeba coli* (43/34.7%), *Giardia duodenalis* (32/25.8%), *Cryptosporidium* spp. (15/12.1%), *Strongyloides stercoralis* (12/9.7%), *Taenia* spp. (5/4.0%), *Trichuris trichiura* (3/2.4%) and *Hymenolepis nana* (2/1.6%).

Table 1. Occurrence of monoparasitism and Polyparasitism in schoolchildren from Palmeiras das Missões County, Rio Grande do Sul State, Brazil.

Monoparasitism	N	%
<i>Ascaris lumbricoides</i>	40	46.5
<i>Strongyloides stercoralis</i>	04	4.6
<i>Trichuris trichiura</i>	01	1.2
<i>Taenia</i> sp	01	1.2
<i>Entamoeba coli</i>	24	27.9
<i>Giardia duodenalis</i>	16	18.6
Total	86	100
Polyparasitism		
<i>A.lumbricoides</i> + <i>E.coli</i>	11	28.9
<i>A.lumbricoides</i> + <i>G. duodenalis</i> + <i>Cryptosporidium</i> spp.	08	21.1
<i>A.lumbricoides</i> + <i>S.stercoralis</i>	04	10.6
<i>A.lumbricoides</i> + <i>Taenia</i> sp.	03	7.9
<i>A.lumbricoides</i> + <i>T.trichiura</i>	01	2.6
<i>A.lumbricoides</i> + <i>G.duodenalis</i> + <i>S.stercoralis</i>	01	2.6
<i>A.lumbricoides</i> + <i>H.nana</i> + <i>G.duodenalis</i> + <i>E.coli</i>	01	2.6
<i>G.duodenalis</i> + <i>E.coli</i> + <i>Cryptosporidium</i> spp.	04	10.6
<i>G.duodenalis</i> + <i>S.stercoralis</i> + <i>Cryptosporidium</i> spp.	02	5.3
<i>T.trichiura</i> + <i>E. coli</i>	01	2.6
<i>S.stercoralis</i> + <i>E. coli</i>	01	2.6
<i>H.nana</i> + <i>Taenia</i> spp + <i>E.coli</i> + <i>Cryptosporidium</i> spp.	01	2.6
Total	38	100

The statistically significant risk factors found were family income (up to a minimum wage) and mothers' schooling (up to 8 years of schooling), which were significantly associated with parasitological stool exam positivity (Table 2). There were no statistically significant differences for the variables age, sex, or child origin (rural or urban area) ( $p \geq 0,05$ ).

*Table 2.* Socioeconomic factors in schoolchildren from Palmeira das Missões County, Rio Grande do Sul State, Brazil, associated with the presence of intestinal parasites.

Variables	N %	% Positives	p	Odds Ratio (IC)
<b>Age</b>				
03-06 years old	105 (50.2 %)	55 (52.4)	0.29	
≥07 years old	104 (49.7 %)	69 (66.3)		
<b>Sex</b>				
Female	87 (41.6 %)	48 (55.1)	0.18	
Male	122 (58.4 %)	76 (62.3)		
<b>Place of residence</b>				
Rural area	126 (60.3 %)	76 (60.3)	0.41	
Urban area	83 (39.7 %)	48 (57.8)		
<b>Family income</b>				
Up to 01*	120 (57.4 %)	86 (71.7)	0.0001	3.4 (1.9045-6.0509)
≥01*	89 (42.6 %)	38 (42.7)		
<b>Residents</b>				
Up to 4	121 (57.9 %)	71 (58.7)	0.46	-
≥4	88 (42.1 %)	53 (60.2)		
<b>Company water</b>				
Yes	164 (78.5%)	99 (60.4)	0.33	
No	45 (21.5%)	25 (55.6)		
<b>Garbage collection</b>				
Yes	152 (72.7%)	87 (57.2)	0.19	
No	57 (27.3%)	37 (64.9)		
<b>Bathroom</b>				
Yes	197 (94.3%)	115 (58.4)	0.20	
No	12 (5.7%)	09 (75.0)		
<b>Mother's schooling</b>				
Up to 08 years of studies	141 (67.5%)	96 (68.1)	0.0003	3.1 (1.6745 - 5.5467)
09 or more years	68 (32.5%)	28 (41.1)		

\* Brazilian minimum wage = R\$ 880,00 (about U\$: 240 – April, 2016)

## DISCUSSION

This study found that the majority (59.3%) of the schoolchildren was enteroparasite or commensal positive, revealing that parasitism is common in children living in Palmeira das Missões, RS. The results obtained were similar to those of another study also done in Rio Grande do Sul State in the city of Caxias do Sul by Basso et al. (2008), who evaluated a 35 year period and found a 58% positivity rate in school children aged 6 to 14 years of age. In agreement with the present study, Filho et al. (2011), evaluated schoolchildren in the city of Osasco in the State of São Paulo, southeastern Brazil, and found a 60.7% positive rate; Santos et al. (2010) detected an even greater positivity (83%) in children of riverside communities of Coari, Amazonas State, northern Brazil, where monoparasitism also prevailed.

The high prevalence of *A. lumbricoides*, present in 33% of positive schoolchildren, is consistent with other studies carried out in Brazil (Biscegli, et al., 2009; Labeaud et al., 2015; Abdi, et al., 2016). Since this parasite is cosmopolitan and is relevant in poor or developing countries, a similar prevalence has also been recently found in school children from Ethiopia (29.9%) (Abdi et al., 2016) and Kenya (23.2%) (Nikolay et al., 2015). One of the reasons for the increase in the prevalence of this helminth is its biology, as *Ascaris lumbricoides* eggs are resistant and adhere easily to surfaces, presenting an important transmission factor, these eggs are not easily removed by washing and may be resistant to different temperatures, humidity and pH (Maya et al., 2012). It is also known that *A. lumbricoides* eggs, as well as those of other STH, are frequently found in the soil of public squares and parks in Rio Grande do Sul State (Moura et al., 2012; Prestes et al., 2015), thus enabling child infection.

With regard to the prevalence of *Giardia duodenalis* (25.8%), similar results were found by Machado et al. (2008), who detected a 27.5% prevalence of this protozoan in children living on the outskirts of the city of Uberlândia in the State of Minas Gerais. Similarly, *G. duodenalis* was found to be the most frequent parasite at schools in Catanduva County, São Paulo State, affecting 74% of the population analyzed (Biscegli et al., 2009). In our study, this prevalence was also similar to that found by Al-Mekhlafi et al. (2013), who examined 7 to 12 year-old children in rural areas in Malaysia, with a 22.2% *G. duodenalis* prevalence. This parasite is associated with poor hygiene; also, there is often a significant association between the protozoan, the nutritional status of children, low income, in addition to the intake of unfiltered and/or unboiled water (Carvalho-Costa et al., 2007).

The schoolchildren positivity for *Cryptosporidium* spp. (7.2%) is also noteworthy. Among protozoa of increased relevance in recent decades, *Cryptosporidium* spp. is the most frequent and most pathogenic; in addition, this parasite is found both in humans and animals, thus enhancing the risk

of zoonosis (Lallo & Bondan, 2006). Its occurrence in the human population has increased considerably, even in developed countries (Yoder et al., 2012). Although specific staining for *Cryptosporidium* spp. is not usually included in laboratory stool test routines, Berne et al., (2012) found a 2.4% rate in children from day care centers in the municipality of Rio Grande, RS; thus evidencing the need for the implementation of specific tests for the diagnosis of intestinal coccidia, since its prevalence has been underestimated, a fact also emphasized by this study. Further research on this protozoan which includes the use of molecular characterization techniques is important and will certainly help clarify its zoonotic potential, modes of transmission and the prevailing species in southern Brazil, similarly to what is being done in different countries (Do Nascimento et al., 2009; Cardona et al., 2011; Helmy et al., 2013; Sharma et al., 2013; Osman et al., 2016).

As for family income and mothers' schooling, an association between these variables and intestinal parasites was detected. Our findings are in agreement with those by Fonseca et al. (2010), who found a 36.5% prevalence in children living in municipalities in the North and Northeast of Brazil and reported that children living in households with a total income equal to or lower than one minimum wage, whose mothers had little schooling showed the highest infection rates. Mascarini & Donalísio (2006) also reported a relationship between family income and the mothers' low education level with intestinal parasites in children from day care centers in Botucatu, State of São Paulo.

The presence of these endemic diseases may also be related to lack of information regarding health education, since the implementation of educational practices that allow people to learn about parasitosis enables individuals to act in the prevention and reduction of the parasitic load. Moreover, understanding the reality of where educational action is to be undertaken is important. This is performed by exploring the sociocultural context and identifying social inequalities caused by poverty (Bóia et al., 2006). To this end, 250 educational leaflets on the main parasites found in this study were distributed among schoolchildren, their parents and/or guardians and teachers alike. Positive children received specific medical treatment at Basic Health Units.

This study revealed a high prevalence of enteroparasites and comensals in students from Palmeira das Missões, especially *A. lumbricoides*, *E. coli*, *G. duodenalis* and *Cryptosporidium* spp. Educational activities should be developed at schools, as prophylaxis for most parasitic infections can be achieved with the adoption of simple measures which, if well run, often have lasting effects. Likewise, it is important to promote epidemiological surveys to study the occurrence of different parasites with a view to offering proper treatment and taking preventive action.

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