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Prevalence of intestinal parasites in children from public preschool in the Triple Border Brazil, Argentina, and Paraguay

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ABSTRACT

Introduction: The prevalence of parasitosis in children from Brazilian border cities is unknown. **Objective:** To identify the prevalence of intestinal parasites in children from public pre-school on the Brazilian border and their socioeconomic and health profile. **Methods:** Fecal samples were obtained from 178 children from public early childhood educational center (CMEI) in Brazilian border municipalities in Foz do Iguaçu, Brazil. Samples were processed by Hoffman sedimentation and zinc sulfate centrifugation and flotation methods. A questionnaire was administered to children´s parents or guardians regarding parasitic diseases, socioeconomic status, and sanitary habits. **Results:** The prevalence of intestinal parasites was 26.9% (n=48). A high prevalence of *Giardia duodenalis* was found (16.3%), followed by *Endolimax nana* (8.4%), *Enterobius vermiculares* (1.7%), *Ascaris lumbricoides,* and *Entamoeba coli* (0.5%). Forty-seven children (26.4%) presented monoparasitism. The percentage of parasitosis was significantly higher among male children (33.7% - p<0.036) who exhibited weight loss (50.0%), were from low-income families (35.4% - p=0.05), and had mothers with a low education (54.0% - p=0.0001). The highest percentage of *Giardia* was in children who exhibited weight loss (42.9% - p<0.05) and had mothers with low education (35.0% - p=0.0001). Multivariate analysis indicated that in the variable gender (male gender), weight loss and low maternal education contributed to the variability of parasitosis in children from the surveyed MCEC. **Conclusion:** The higher prevalence of *Giardia* was due to child and family variables. The detection of *Enterobius vermiculares* and *Ascaris lumbricoides*, despite the low frequency, indicates the need for better basic sanitation policies.

Keywords: child; parasites; prevalence; border areas; giardiasis.

INTRODUCTION

Intestinal parasitic diseases caused by parasites have a wide geographical distribution, with variations depending on the environment and species of parasite involved[1-3]. Parasites can cause digestive disorders, generating severe repercussions such as developmental deficits[4], chronic diarrhea[5], anthropometric deviations[4], malnutrition[6] short stature, anemia, and zinc deficiency[7].

Intestinal parasites affect the entire population, especially those with low socioeconomic status, whose basic sanitation, hygiene, and housing conditions are precarious, mainly affecting children aged between six months and seven years[8,9].

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Declaration of interests: nothing to declare

The frequency rates of intestinal parasites are high in Latin American countries, where, according to coproscopic tests, at least one type of parasite affects the audited population[1-3,5,10-13].

In Brazil, rates vary from 15.1% to 97.8% of children in public daycare centers[1,5,8,9,14-17]. In neighboring countries, in Ciudad del Este (Paraguay), 94.2% of children with intestinal parasites were found, aged between seven and nine years[12]. In Puerto Iguazu (Argentina), 58.8% of children under the age of 15[11].

However, among the intestinal parasites, the *Giardia* protozoan is widely distributed worldwide. In Brazil, in the last five years, its prevalence has varied from 18.4% to 58.4%, depending on the region and the age group studied, with the majority being preschool children up to seven years of age[1,5,8,14,16]. In Paraguay, the percentage observed was 67.0% of children with positivity[12] followed by Argentina with 29.0%[11].

Helminths have also been observed in children in daycare centers up to six years old, with varying prevalence: *Ascaris lumbricoides* (14.8%) in Itapuranga, Goiânia[18], *Ascaris lumbricoides,* and *Enterobius vermicularis* (2.0%) in Campinápolis, Mato Grosso[19], and *Enterobius vermicularis* (1.8%) in Florianópolis, Santa Catarina[20]. In Paraguay, 1.0% of children positive for *Ascaris lumbricoides* and *Enterobius vermicularis*[12], and in Argentina, 23.0% positive for Enterobius vermicular[11].

The different percentages observed above indicate that the epidemiological study of intestinal parasites is complex since, among the different contributing factors, socioeconomic, environmental, and hygienic factors, they are closely linked to the prevalence of pathogens[1,8,9,11].

Given this aspect, the municipality of Foz do Iguaçu, Paraná, Brazil, located in a triple border region Brazil, Argentina, and Paraguay receives more than 5 million tourists per year[21]. Currently, it has 81 ethnic groups, and among the foreigners, Paraguayans are found in greater number, followed by the Lebanese, Chinese and Argentine community[22]. They are associated with a wide cultural diversity, contributing to differences in hygienic habits, resulting in certain contexts, in precarious sanitary conditions[23], implying concerns for the Iguaçu population's health.

Given the increase in the number of women inserted in the labor market, public preschools (*Centros Municipais de Educação Infantil* - CMEI) have become a place where many children spend most of their time, becoming effective contamination site[9].

These institutions have a fundamental role in the integral development of the child, mainly in the intellectual, physical, social, and psychological aspects. However, children who attend CMEI are more susceptible to infections than those who are kept in their homes[24], which can be explained by the great interpersonal contact provided by collective environments[8].

Given the above, the analysis of the presence of intestinal parasites in the Brazilian border child population, in CMEI, is necessary for the epidemiological, socioeconomic, environmental, and hygienic characterization of the sampled population[8,9,17] so that, later, can be instituted the correct drug treatment, avoiding the risk of self-medication, as well as control and prevention measures[17], contributing to improving the health of the population surveyed in other border regions.

Thus, the objective was to identify the prevalence of intestinal parasites in children enrolled in CMEI in Foz do Iguaçu and the possible relationship with the socioeconomic, environmental, and hygienic scenario of these children and their parents or guardians were analyzed.

METHODS

It is a cross-sectional, descriptive, and quantitative approach. The research was carried out in four public CMEI preschools representing different regions of the city of Foz do Iguaçu, Paraná, Brazil, including regions of lower and higher socioeconomic status. The CMEI were designated A, B, C, and D. The choice of the CMEI was based on three criteria: 1) assistance to children from families with different nationalities; 2) CMEI that serve families with homogeneous socioeconomic characteristics, as registered in the Institutional Political Projects and 3) accepted to participate in the research.

The studied population consisted of a convenience sample of children of pre-school age (3 to 5 years), who were enrolled in CMEI A with a total of 320, CMEI B, 146, CMEI C (total of 216), and CMEI D (total of 160), and whose parents or guardians signed the Free and Informed Consent Form (ICF). The final sample totaled 178 children, including two Paraguayan nationals at CMEI B and one at CMEI D.

It was used as inclusion criteria for the age between 3 to 5 years, to be duly registered in CMEI of the city of Foz do Iguaçu-Paraná and that the parents or guardians signed the IC. The exclusion criterion was the failure to collect the fecal sample from the children and the inability to answer the questionnaire due to some physical or cognitive limitation.

For data collection, a structured questionnaire with objective questions of easy understanding was used, adapted from Cavagnolli et al.[17] according to the objective of this study, which contained 19 questions regarding the following variables: educational level of parents or guardians of children, socioeconomic conditions, basic sanitation conditions, water supply, hygiene habits, child health conditions, fecal aspect (liquid, pasty, formed or dry) and food handling by the guardians of the investigated children.

After contacting the management of each CMEI involved in the research to present the project and the approval opinion by the Human Research Ethics Committee of Unioeste, a date was set to explain to the parents or guardians of the children the purpose of

the research, deliver and collect the ICF, and deliver the questionnaires and bottles to be taken to the home and complete the questionnaire and collect the fecal material from the children.

The vials were labeled and identified with the child's full name, the name of the school where he is enrolled, and the date of collection in order to facilitate the delivery of parasitological results. Fecal material analyzes were performed at the Laboratório Ambiental da Usina Hidrelétrica de Itaipu Binacional in Foz do Iguaçu.

The parents or guardians of the children were instructed to collect the material for the Parasitological Examination of Stools (EPF). If the child was not wearing diapers, let him defecate in a container or on a sheet of paper, cardboard, or clear plastic, and then put some feces in the jar. In the case of the child using a diaper, the collection could be made by removing some of the feces from the diaper itself. Do not collect feces directly from the toilet to avoid water interference.

Parents and/or guardians were asked to send the bottles to the CMEI immediately after collection. If it was not possible, they put it in a plastic bag and keep it in the refrigerator to be sent the next day.

It was agreed that the samples should be delivered in the early morning or early afternoon, since the researcher would spend every day at the CMEI, in the given period, to collect the EPF samples and, immediately afterward, process the material at the Environmental Laboratory, according to the term of the science of the person responsible for the field of study. The flasks containing the fecal samples did not contain preservatives and were transported in a thermal box to the Environmental Laboratory.

In the parasitological examination, fecal samples were processed by the spontaneous sedimentation methods of Hoffman, Pons and Janer by the Centrifugation and Fluctuation method in Zinc Sulphate[25,26]. Both provide investigation of protozoan cysts and helminth eggs and/or larvae in fresh or preserved feces.

Three slides from each sample were read for each method to ensure methodological reliability. The reading was carried out by two professionals experienced in the subject, supervised by the technical responsible of the Environmental Laboratory. Thus, a photonic microscope (Nikon Eclipse E200, Tokyo, Japan) was used, with a magnification of 100 and 400 times.

Excel® software (Microsoft Office 2013, Microsoft Corporation, USA) was used to tabulate the data. Descriptive statistics (absolute numbers, percentages, and averages) and inferential statistics were performed using the Minitab® program (version 18.1, 2017), considering a significance level of $\alpha<0.05$. The association between the parasitized state (dependent variable) and the independent variables was assessed using Pearson's chi-square test (X^2). Predictor variables were determined by multivariate logistic regression[27] (stepwise forward method, logit function, 95% confidence interval, α <0.05). The variables that obtained $p\leq0.20$ in the multivariate model were included for testing in the multivariate model. Chi-square analysis: Through this analysis, a model with the predictive independent variables and the value of the determination coefficient (R^2) and the adjusted determination coefficient ($R^2_{adjusted}$) was determined according to the number of predictors in the model in relation to the number of observations. Both R^2 and $R^2_{adjusted}$ indicate the percentage of variation in the response explained by the model, in this case, the variability of the dependent variable, i.e., the condition of being parasitized or having *Giardia duodenalis*.

This research was approved by the Ethics and Research Committee of the Universidade Estadual do Oeste do Paraná - UNIOESTE, according to the process number 1,363,820 of December 2015 and CAAE 50934215.0.0000.0107.

The parents or guardians of all children who had a positive diagnosis of EPF received a drug prescription for antiparasitic drugs (metronidazole and albendazole), along with the drugs, for specific treatment. In addition, guidelines were given through educational lectures in order to prevent the emergence of new cases. These guidelines were carried out involving parents or guardians, considering all children enrolled in these CMEI.

RESULTS

Of the total of 178 children surveyed, the prevalence of intestinal parasites was 26.9% (48 children), and among children with positive tests for intestinal parasites, only one child (2.1%) had biparasitism, the others had monoparasitism (97.9%). No cases of polyparasitism were identified. Among the parasites identified, *Giardia duodenalis* was the most frequent, followed by *Endolimax nana*, *Enterobius vermiculares*, *Ascaris lumbricoides,* and *Entamoeba coli* (Table 1). Among the 48 parasitized children, none had Paraguayan nationality.

Regarding the gender variable, it was observed in relation to the parasitized state higher percentages among boys (33.7%) in relation to girls (19.8%) ($p<0.036$). Regarding income, children from low-income families (<1 minimum wage) had a higher prevalence of parasites than those from higher-income families (>1 minimum wage) ($p=0.05$) (Table 2).

Table 1: Number and prevalence (%) of intestinal parasites found in CMEI preschool children, according to the total number of participants (n=176). Foz do Iguaçu, Paraná, Brazil, 2016.

Types of parasite	n	Prevalence (%)
Protozoa		
Giardia duodenalis	29.0	16.3
Endolimax nana	15.0	8.4
Entamoeba coli	1.0	0.5
Helminths		
Enterobius vermiculares	3.0	1.7
Ascaris lumbricoides	1.0	0.5
Total parasitized children	48.0	26.9
Total children	178	100.0

Regarding the educational level of parents and/or guardians, a higher prevalence of parasites was observed in children from families whose mothers had low education (up to elementary school) when compared to children whose mothers had higher education (incomplete high school education) (p=0.0001). The same was not observed in relation to the father's education (Table 2).

As for the hygiene habits analyzed by the children, it was found that the majority (37.0%) did not have the habit of hand hygiene before meals, and 32.0% did not have the habit of washing their hands after using the toilet. Regarding the hygiene habits of parents/guardians, it was found that the form of hygiene of food (fruits, vegetables, and vegetables) was found that the majority performed it only with water (27.9%) and only 26.4% of those responsible by the children reported performing hand hygiene after changing diapers (Table 2).

As for the residential structure of the children surveyed and their families, it was found that the highest percentage did not have running water (50.0%), did not treat the water with chlorine (32.0%), and lived in homes with no sewage system (33.3%) (p>0.05 - Table 3).

When investigating the child's health care, it was observed that 29.4% of the parasitized children had never undergone parasitological examination of feces, and, of these, 31.0% had already experienced abdominal pain, nausea, and vomiting. In 50.0%,

Table 2: Characteristics of the profile of children and their guardians, hygiene habits of children and parents and/or guardians, and the parasitic state and state with *Giardia* (giardiasis) of children from public CMEI preschool. Foz do Iguaçu, Paraná, Brazil, 2016.

Characteristics	Without parasite N (%)	With parasite N (%)	*p*	Without *G. duodenalis* N (%)	With *G. duodenalis* N (%)	*p*
Children's profile						
Gender						
Male	61 (66.3)	31 (33.7)	0.036	73 (79.3)	19 (20.7)	0.103
Female	69 (80.2)	17 (19.8)		76 (88.3)	10 (11.7)	
Profile of parents or guardians						
Family income						
Up to 01 minimum wage	42 (64.6)	23 (35.4)	0.050	51 (78.5)	14 (21.5)	0.174
Above 01 minimum wage	86 (78.2)	24 (21.8)		95 (86.4)	15 (13.6)	
Not informed	2 (66.7)	1 (33.3)		3 (100.0)	0 (0.0)	
Mother's education						
Up to complete elementary	23 (46.0)	17 (54.0)	0.0001	26 (65.0)	14 (35.0)	0.0001
Incomplete high school to higher education	105 (77.8)	30 (22.2)		120 (88.9)	15 (11.1)	
Not informed	2 (66.7)	1 (33.3)		3 (100.0)	0 (0.0)	
Father's education						
Up to complete elementary	32 (66.7)	16 (33.3)	0.165	37 (77.0)	11 (23.0)	0.096
Incomplete high school to higher education	97 (77.0)	29 (23.0)		110 (87.3)	16 (12.7)	
Not informed	1 (25.0)	3 (75.0)		2 (50.0)	2 (50.0)	
Children's habits						
Wash hands before eating						
No	17 (63.0)	10 (37.0)	0.226	22 (81.5)	5 (18.5)	0.814
Yes	107 (74.3)	37 (25.7)		120 (83.3)	24 (16.7)	
Not informed	6 (85.7)	1 (14.3)		7 (100.0)	0 (0.0)	
Wash hands after using the toilet						
No	17 (68.0)	8 (32.0)	0.570	20 (80.0)	5 (20.0)	0.650
Yes	108 (73.5)	39 (26.5)		123 (83.7)	24 (16.3)	
Not informed	5 (83.3)	1 (16.7)		6 (100.0)	0 (0.0)	
Hand washing way						
Only water	21 (72.4)	8 (27.6)	0.972	23 (79.3)	6 (20.7)	0.546
Water + soap	104 (72.7)	39 (27.3)		120 (83.9)	23 (16.1)	
Not informed	5 (83.3)	1 (16.7)		6	0 (0.0)	
Habits of parents or guardians						
Raw food washing						
Only water	106 (72.1)	41 (27.9)	0.372	120 (81.6)	27 (18.4)	0.115
Water, soap and chlorine	24 (80.0)	6 (20.0)		28 (93.3)	2 (6.7)	
Not informed	0 (0.0)	1 (100.0)		1 (100.0)	0 (0.0)	
Wash hands after changing diapers						
No	7 (77.8)	2 (22.2)	0.784	8 (88.9)	1 (11.1)	>0.999
Yes	109 (73.7)	39 (26.4)		123 (83.1)	25 (16.9)	
Not informed	14 (66.7)	7 (33.3)		18 (85.7)	3 (14.3)	

weight loss has already occurred, in addition to the feces being liquid and pasty (37.0%). In relation to these variables of the child's health conditions, the variable 'weight loss' was significant in relation to the prevalence of intestinal parasites (p=0.042) and *Giardia* (p=0.006), where children with weight loss showed a greater prevalence of both conditions (Table 3). Children with 'liquid or pasty' stools had a tendency (p=0.051) to have a higher prevalence of giardiasis when compared to children with 'formed/dry' stools (Table 3).

Then, a multivariate analysis was performed. Among the independent variables analyzed, three variables remained in the final model (Table 4) mother's education (Odd Ratio [OR]: 3.05), gender (OR 2.57), and weight loss (OR 3.12). In addition, the R^2 was 9.61%, and the adjusted R^2 was 6.77%, indicating the percentage of variability that these variables explain in relation to the phenomenon of parasites in the children surveyed, indicating that

Table 4: Multivariate logistic regression of the independent variables that predict the parasitic state of children from public CMEI preschools. Foz do Iguaçu, Paraná, Brazil, 2016.

Independent variable	Coefficient	Odds Ratio (*Parasite*) 95% CI	*p*
Mother's education			
Up to complete elementary	1.118	3.05 (1.09–8.55)	0.033
Incomplete high school to higher education		1	
Gender			
Male	0.944	2.57 (0.96-6.88)	0.060
Female		1	
Weight loss			
Yes	1.139	3.12 (0.73–13.37)	0.125
No		1	

R^2=9.61%; $R^2_{adjusted}$=6.77%

Table 3: Characteristics of residential structure and health conditions of children, and the parasitized state and state with *Giardia* (giardiasis) of children of public preschool CMEI. Foz do Iguaçu, Paraná, Brazil, 2016.

Characteristics	Without parasite N (%)	With parasite N (%)	*p*	Without *G. duodenalis* N (%)	With *G. duodenalis* N (%)	*p*
Residential structure						
Obtaining water						
Not piped	3 (50.0)	3 (50.0)		4 (66.7)	2 (33.3)	
Piped	126 (74.1)	44 (25.9)	0.189	143 (84.1)	27 (15.9)	0.257
Not informed	1 (50.0)	1 (50.0)		2 (100.0)	0 (0.0)	
Water treatment						
Not treated	17 (68.0)	8 (32.0)		4 (66.7)	2 (33.3)	
Treated	104 (73.2)	38 (26.8)	0.589	143 (84.1)	27 (15.9)	0.489
Not informed	9 (81.8)	2 (18.2)		2 (100.0)	0 (0.0)	
Waste elimination						
Absence of sewage system	36 (66.7)	18 (33.3)		42 (77.8)	12 (22.2)	
Presence of sewage network	85 (74.6)	29 (25.4)	0.287	97 (85.1)	17 (14.9)	0.242
Not informed	9 (90.0)	1 (10.0)		10 (100.0)	0 (0.0)	
Presence of vegetable garden						
No	121 (73.8)	43 (26.2)		135 (82.3)	29 (17.7)	
Yes	9 (75.0)	3 (25.0)	>0.999	12 (100.0)	0 (0.0)	0.220
Not informed	0 (0)	2 (100.0)		2 (100.0)	0 (0.0)	
Child health conditions						
Stool examination						
No	48 (70.6)	20 (29.4)		53 (78.0)	15 (22.0)	
Yes	80 (74.8)	27 (25.2)	0.543	93 (87.0)	14 (13.0)	0.120
Not informed	2 (66.7)	1 (33.3)		3 (100.0)	0 (0.0)	
Abdominal pain, nausea and vomiting						
No	110 (74.3)	38 (25.7)		125 (84.4)	23 (15.6)	
Yes	20 (69.0)	9 (31.0)	0.550	23 (79.3)	6 (20.7)	0.493
Not informed	0 (0)	1 (100.0)		1 (100.0)	0 (0.0)	
Weight loss						
No	121 (75.2)	40 (24.8)		138 (85.7)	23 (14.3)	
Yes	7 (50.0)	7 (50.0)	0.042	8 (57.1)	6 (42.9)	0.006
Not informed	2 (66.7)	1 (33.3)		3 (100.0)	0 (0.0)	
Consistency of feces						
Liquid/pasty	17 (63.0)	10 (37.0)		19 (70.3)	8 (29.7)	
Formed/dried	110 (75.3)	36 (24.7)	0.181	125 (85.6)	21 (14.4)	0.051
Not informed	3 (60.0)	2 (40.0)		5 (100.0)	0 (0.0)	

being male, with loss of weight and mothers with low education, reflect part of the variability of the parasitized condition. Still, the male gender, weight loss, and having a mother with low schooling reflect part of the variability of the parasitized condition in the surveyed children in the CMEI.

Multivariate analysis was performed in relation to the presence of Giardia. Among the independent variables analyzed, two variables remained in the final model (Table 5) mother's education (OR 2.98) and gender (OR 2.15). In addition, the R^2 was 6.82%, and the adjusted R^2 was 4.65%, in relation to the phenomenon of the presence of Giardia in the children surveyed, indicating that the male gender and having mothers with low education reflect part of the variability of this condition in the surveyed children at CMEI (Tables 3 and 4).

DISCUSSION

Despite advances in the health area[28] and the availability of a wide variety of antiparasitic drugs[28], intestinal parasites still have a high prevalence, especially in the child population[1,14-16]. In this scenario, CMEI are one of the establishments in which children are more susceptible to parasitic diseases intestinal diseases due to the longer stay in these institutions[9] and the great interpersonal contact provided by this collective environments[8].

In addition, the wide cultural and ethnic diversity presented by the border population studied contributes to the divergence of hygienic habits, resulting in poor sanitary conditions[22,23], causing concerns for the health of the Brazilian Iguassu population.

The prevalence of parasitism shown in the present study (26.9%) was lower than that observed in other studies in compared to the neighboring borders. In Puerto Iguazu, Argentina, 58.8% of children under 15 years of age living in public school areas were parasitized[11]. In Ciudad del Este, Paraguay, 94.2% of children enrolled in the first cycle of basic education in public schools, aged seven to nine years, were parasitic[12]. The higher percentages found in neighboring countries may be due to the age difference of the evaluated public, the different investigation methods used (parasitological stool examination), direct to fresh and direct smear with Lugol's solution and Sheather's fluctuation[11], and the investigation site[29].

Table 5: Multivariate logistic regression of the independent variables that predict the presence of *Giardia* (giardiasis) in children of public CMEI preschool. Foz do Iguaçu, Paraná, 2016.

Independent variable	Coefficient	Odds Ratio (*Giardia*) 95% CI	*p*
Mother's education			
Up to complete elementary	1.092	2.98 (1.04–8.52)	0.042
Incomplete high school to higher education		1	
Gender			
Male	0.765	2.15 (0.75–6.14)	0.153
Female		1	

R^2=6.82%; $R^2_{adjusted}$=4.65%

Regarding the degree of parasitism, in the present study, monoparasitism (97.9%), followed by biparasitism (2.1%) observed ($p<0.05$), differed from that found by Riveiro et al.[11], in Puerto Iguazu (Argentina), where they found monoparasitism in 68.8% of cases and 34.1% of biparasitism. Such investigation is necessary since the medication and the dosage of the antiparasitic depend on the species detected[30].

Considering that in the present study, the species *Giardia duodenalis* was the most found (16.3%), the discussion will be more directed to this species. Higher frequencies were observed by Riveiro et al.[11], in Puerto Iguazu (Argentina) with 29.0%, and by Ocampos et al.[12], in Ciudad del Este (Paraguay) with 67.0%, pointing to an uneven dispersion of this etiological agent. between the different border countries.

The predominance of *Giardia duodenalis* may be related to the fact that the cysts of the protozoan species are resistant to the treatment of water with chlorine and due to interpersonal transmission among children[8,31,32]. The presence of this protozoan (8.3%) in treated waters by companies that provide this service shows the importance of better monitoring by companies that provide water treatment services in relation to the health of the population[33].

Entamoeba coli and *Endolimax nana* are not pathogenic, being commensal in the human intestine. Nevertheless, its notification is relevant since this is a parameter to measure the degree of fecal contamination to which individuals are exposed, having the same mechanism of transmission of pathogenic parasites[34].

The low frequencies of *Enterobius vermiculares* and *Ascaris lumbricoides* observed in this study, 1.7% and 0.5%, respectively, are similar to those found in children in daycare centers up to six years old from other studies: Campinápolis, Minas Gerais state, 2.0 % for both parasites[22]; Florianópolis, Santa Catarina state, 1.8% for *Enterobius vermiculares* [20]. In Paraguay, this frequency in children between seven and nine years of age, for both parasites, was 1.0%[12].

According to Fonseca et al.[1], the low frequency of these helminths indicates their low circulation in the community, possibly due to the better conditions of basic sanitation.

As for gender and age group, it was noticed that the number of parasitized children was higher in males (p=0.036), among children aged 3 to 4 years compared to the age group of 5 years. These data corroborate the findings of another study[35], which also found a higher prevalence of parasitic

infections in male children, however, aged between 3 and 5 years. The higher prevalence of parasites in male children is because boys are more exposed to the home environment during leisure activities, they play more with land and water when compared to girls[20].

Regarding the socioeconomic factor and the education of the parents or guardians of the children, the variables 'low family income' (up to 1 minimum wage) (p=0.05) and 'low education level of the mother' (up to complete elementary school) (p=0.0001), were statistically associated with a higher percentage of parasites in children, and 'low maternal education' was also associated with a higher percentage of giardiasis (p=0.0001). Regarding income, similar data was observed by Riveiro et al.[11], in Puerto Iguazu (Argentina), indicating that low family income favors the emergence of parasites. Carvalho and Gomes[36] observed in their work that the socioeconomic condition index is quite significant to recognize the effects of parasite prevalence, agreeing with the relationship between lower family incomes and high rates of parasites.

Vasconcelos et al.[37] observed a significant influence of maternal education, indicating that mothers with better education have more access to information on child development and can promote better physical and emotional conditions for their child's development.

Regarding children's hygiene habits, the lack of the habit of washing hands before eating and after using the toilet did not influence the existence of parasitosis in the children surveyed (p>0.05), which differs from what was observed by Abreu et al.[8]. When they investigated the epidemiological aspect of enteroparasitosis in children from two daycare centers in Marialva, Paraná, and in one of them, the existence of intestinal parasites was higher (p<0.05) in children who did not wash their hands or sometimes washed before meals or after using the bathroom.

Regarding the hygiene habits of parents or guardians in relation to food hygiene (fruits, vegetables, and legumes), although not significant, the fact that this practice occurs only with water can trigger cyst contamination. It is known that there is a need to sanitize food with soap and water since only in this way does the egg or cyst of the food parasite detach[8,12].

Regarding housing, the fact that most of the research participants live in a masonry house, have access to the sewage network, use piped water, and make use of filtered water may justify the low frequency of parasites, which will against other studies[1,3,6].

In the study by Riveiro et al.[11], in Puerto Iguazu (Argentina), the majority of parasitized children (88.6%) lived in households with unsatisfactory basic needs, absence of peri-household hygiene (65.4%), drinking water and garbage/waste disposal was unsafe in about 40.0% of households. The findings by Riveiro et al.[11], are supported by Fonseca et al.[38] and Magalhães et al.[39], and these authors found a significant correlation between parasitic infection and waste elimination.

Regarding the characteristics of children's health care, it was clear that the majority had already carried out parasitological examinations of feces, did not show signs and symptoms, nausea, vomiting, and the stool had formed consistency, which differs from other studies[5,40]. However, they presented weight loss, which contributed to the prevalence of parasitosis (p=0.042), mainly of giardiasis (p=0.006). Riveiro et al.[11], in their study, also found a significant influence of weight loss in parasitized children.

The multivariate analysis carried out in this study showed that the variables "mothers with low education" and "male children", both for the parasitized condition and the giardiasis condition, despite the determination coefficients (adjusted R^2 and R^2) have been may explain part of the variability of these conditions in the surveyed children in the CMEI, going against what was observed by Riveiro et al.[11], who, when analyzing the predictive variables of the parasitized state in children investigated in Puerto Iguazu (Argentina), identified that the presence of parasites was also determined by the mother's literacy.

In this study, there was low adherence by the parents or guardians of the children attending the CMEI surveyed. Of the total number of parents or guardians of 466 children enrolled in the established age group, only 178 children joined the survey. This low adherence was unexpected since when presenting the study proposal to those responsible for these children in the first contact, great interest was observed, which was not proven in practice.

In conclusion, the presence of a higher prevalence of giardiasis observed resulted in the child and family variables, and the detection of *Enterobius vermiculares* and *Ascaris lumbricoides*, despite the low frequency, indicates the need for better basic sanitation and health policies.

The investigation of multilevel determinants increases understanding for the spread and maintenance of intestinal parasites in the border population studied and provides useful reference information to prioritize and clarify the direction of targeted interventions. This study is expected to contribute to the control of the emergence and prevention of intestinal parasitic diseases in other border regions with ethnic and cultural characteristics similar to this study.

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