
FACTORS ASSOCIATED WITH THE OCCURRENCE OF INTESTINAL PARASITES IN CHILDREN LIVING IN THE FEDERAL DISTRICT OF BRAZIL.

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ABSTRACT

This study aimed to describe factors associated with the occurrence of intestinal parasites in children living in the Federal District of Brazil (FD). Between 2012 and 2013 fecal samples from 193 children of Riacho Fundo II (RF, n=73) and Ceilândia (CE, n=120) were examined using Rugai and Lutz's methods. Socioeconomic and health variables were obtained through interviews with the children's parents. The association between these variables and the occurrence of parasites was analyzed by chi-squared or Fisher's exact tests. The occurrence of parasites in RF (79%) was higher than in CE (54%). The most frequent parasites were *Giardia intestinalis* (RF=15%, CE=9%), *Hymenolepis nana* (RF=44%, CE=0%) and *Ascaris lumbricoides* (RF=30%, CE=2%). In CE, a higher frequency of parasites was found in children living in crowded houses and also in houses with domestic animals present. In RF, a higher frequency of parasites was found in children whose families did not wash fruit and vegetables hygienically. A relevant occurrence of intestinal parasites in children was found in the FD, where there is a treated water supply and sewage system. We concluded that poor hygiene habits are the key factors in the transmission of intestinal parasites in FD.

KEYWORDS: Intestinal parasites; children; socioeconomic factors; Federal District.

RESUMO

Fatores associados à ocorrência de enteroparasitos em crianças no Distrito Federal, Brasil

O objetivo do estudo foi descrever fatores associados à ocorrência de enteroparasitos em crianças no Distrito Federal (DF). Entre 2012 e 2013, foram examinadas amostras de fezes de 193 crianças das regiões administrativas de Riacho Fundo II (RF, n=73) e Ceilândia (CE, n=120) pelos métodos Rugai

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e Lutz. As variáveis socioeconômicas e sanitárias foram obtidas por meio de questionários aplicados às famílias e a associação com a ocorrência de enteroparasitos foi analisada pelo teste qui-quadrado. A ocorrência de enteroparasitos em RF (79%) foi maior que em CE (54%) e os mais frequentes foram: *Giardia intestinalis* (RF=15%, CE=9%), *Hymenolepis nana* (RF=44%, CE=0%) e *Ascaris lumbricoides* (RF=30%, CE=2%). Verificou-se frequência mais elevada de parasitos entre crianças de CE que viviam em casas com maior número de moradores e nas quais havia a presença de animais domésticos. Também foi encontrada frequência mais elevada de parasitos entre crianças de RF cujas famílias não higienizavam frutas e verduras. Uma relevante ocorrência de parasitos intestinais em crianças foi constatada no DF onde existem boas condições de saneamento básico. Conclui-se que, precários hábitos de higiene são fatores fundamentais para a transmissão de enteroparasitos no DF.

DESCRITORES: Enteroparasitos; crianças; fatores socioeconômicos; Distrito Federal.

INTRODUCTION

Infections with intestinal parasites pose a serious public health problem, especially in underdeveloped countries (Quihui et al., 2006). It is estimated that over one billion people worldwide harbor intestinal parasites and such infections are present in almost all tropical and subtropical areas of the world (Hotez et al., 2005; Fonseca et al., 2010). In Brazil, intestinal parasites are still widespread, resulting in high morbidity and mortality (Roque et al., 2005).

School-age children are the most susceptible to infection by intestinal parasites, which may compromise their physical and intellectual development and affect school performance (Muniz-Junqueira & Queiroz 2002; Silva et al., 2011). These parasitic infections have great importance in the etiology of anemia, intestinal obstruction, malnutrition, chronic diarrhea and weight loss (Macedo, 2005; Rey, 2008; Silva et al., 2011).

Most cases of parasitic infections occur in populations with lower socioeconomic status and poor sanitary conditions (Andrade et al., 2010; Barreto et al., 1991, 2010). Several factors are associated with the occurrence of intestinal parasites, such as deficiencies in sanitation and health education (Castro et al., 2004; Ferreira & Andrade 2005; Silva et al., 2008), poor housing conditions (Andrade et al., 2010), poor hygiene (Raso et al., 2006), and population behavioral habits (Okay et al., 2004; Andrade et al., 2010). Interventions such as treatment of infected individuals and the development of sanitation and health education programs have been shown to decrease the prevalence of intestinal parasites (Fonseca et al., 2010).

Some studies have indicated the occurrence of parasitic infections in the population of the Federal District of Brazil (FD), such as cysticercosis (Vianna et al., 1992), toxocariasis (Campos Júnior et al., 2003), strongyloidiasis (Veloso et al., 2008), diphyllbothriasis (Llaguno et al., 2008), among others (Mello et al., 1995). In a study conducted in an administrative region of the FD a parasite prevalence of 75.5% was found in children (Muniz-Junqueira & Queiroz, 2002), further indicating a clear association between malnutrition and parasite infection. Additionally, basic sanitation, personal hygiene and other socioeconomic factors

should influence the occurrence of parasites in FD. Thus, the aim of this study was to describe factors associated with the occurrence of intestinal parasites in children in two administrative regions of FD.

MATERIAL AND METHODS

A cross-sectional quantitative study was conducted in public schools located in two administrative regions of FD, Ceilândia (CE) and Riacho Fundo II (RF), from March 2012 to April 2013. The research project was approved by the Ethics Committee of the Faculdade Anhanguera de Brasília (FAB), No. 042342/2012, and by the Department of Education of FD.

Children aged between 4 and 14 years old participated in the present study after parental consent. Only children who delivered the three fecal samples requested and whose parents answered a questionnaire on socioeconomic and health status were included. In total, 193 children were included in the study, 73 from RF and 120 from CE. Fecal samples were collected in previously identified 50g vials, without preservative, with a collection interval of four to five days. Fecal samples were delivered in school by children or guardians, stored in coolers with ice, and sent to the Laboratório de Parasitologia of FAB and Laboratório de Parasitologia Médica e Biologia de Vetores of Universidade de Brasília for processing. Diagnosis followed biosafety standards.

The parasitological diagnosis was performed using two methods (Hoffman et al., 1934; Rugai et al., 1954). Once processed, the samples were stored in 10% formol. For each sample, eight microscope slides were stained with Lugol and examined using an optical microscope at 400x magnification for visualization and identification of parasites. The procedures for the preparation of the microscope slides and diagnosis were performed as described in the literature (Machado & Costa-Cruz, 1998).

Questionnaires concerning socioeconomic and health factors such as family income, housing conditions, water supply, sewage system, presence of pets, hygiene habits and referred symptoms in recent months were given to the children's parents. The data were organized into spreadsheets using Microsoft Excel software and the results were presented as percentages.

The frequency of intestinal parasites in children of RF and CE was compared using the chi-squared test. The proportions and confidence intervals (lower and upper) of children infected by parasites in RF and CE were also estimated, using the method described by Agresti & Coull (1998). The association between the occurrence of intestinal parasites and socioeconomic variables was analyzed by chi-squared or Fisher's exact tests. The tests were applied using the program Statistica® and considering $p < 0.05$ as statistically significant. The results of parasitological examinations were given to the parents or guardians of children and they were referred to medical health centers, where they received specific treatment.

RESULTS

Among the 193 children examined, 123 (63.7%) were infected (Table 1). There was a difference in the proportion of children infected between the two areas analyzed (chi-square = 17.4, $p < 0.01$); the occurrence of parasites in RF (79%) was higher than in CE (54%) (Figure 1).

Table 1. Frequency of intestinal parasites in children according to the gender and age in Riacho Fundo II (n=73) and Ceilândia (n=120), Federal District, Brazil, 2012-2013.

Age (years)	Females			Males		
	N	N positive	% positive	N	N positive	% positive
Riacho Fundo II						
4 - 7	22	21	95	20	16	80
8 - 11	8	6	75	10	7	70
12 - 14	7	3	43	6	5	83
Total	37	30	81	36	28	78
Ceilândia						
4 - 7	29	13	45	44	25	57
8 - 11	30	20	67	16	6	38
12 - 14	0	0	0	1	1	100
Total	59	33	56	61	32	52

N: number of children; %: percentage

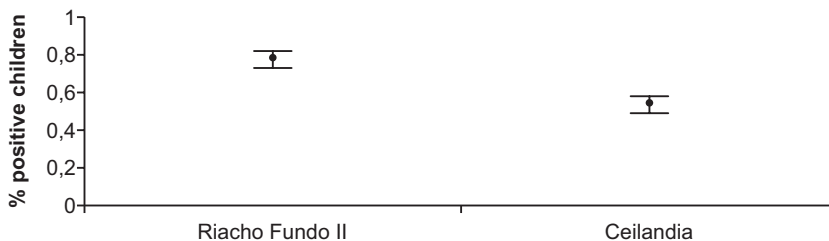


Figure 1. Estimated proportions and 95% confidence intervals (lower and upper) of children infected with protozoa and helminths in Riacho Fundo II and Ceilândia, Federal District of Brazil, between 2012 and 2013.

All families reported that their homes had a sewage system, treated water supply, and electricity. In CE, a higher frequency of parasites was found in children living in crowded houses and also in houses with domestic animals. In RF, a higher frequency of parasites was found in children who did not use footwear regularly and whose families did not wash fruits and vegetables properly (Table 2). The symptoms of intestinal parasite infections reported by parents were vomiting (30%), irritability (30%), itching in the anus or in the vagina (29%), diarrhea (25%), weight loss (25%), skin spots (22%) and weakness (15%). The presence of any symptoms

reported by parents was not a factor associated with the occurrence of intestinal parasites in RF (chi-square=1.45, p=0.23) and in CE (chi-square=0.09, p=0.75).

Table 2. Frequency of intestinal parasites in children according to socioeconomic and health factors in Riacho Fundo II (n=73) and Ceilândia (n=120), Federal District, Brazil, 2012-2013.

Factors		Frequency of intestinal parasites in children					
		Riacho Fundo II			Ceilândia		
		N	%	p*	N	%	p*
Family income (number of minimum salaries)	>1	20	27	0.50	46	38	0.39
	≤1	35	48		17	14	
Number of people per household	>5	50	68	0.24	38	32	0.02
	≤5	10	14		26	21	
The residence has backyard without cement floor	Yes	57	78	0.70	30	25	0.66
	No	3	4		34	28	
Presence of pets in the residence	Yes	24	33	0.90	24	20	<0.01
	No	32	44		40	33	
The family usually cleans fruit and vegetables with soap, vinegar or bleach	Yes	7	9	<0.01	23	19	0.35
	No	54	74		42	35	
The child usually walks barefoot	Yes	42	57	<0.01	43	36	0.46
	No	15	21		21	17	
The child usually keeps their nails short and clean	Yes	7	10	0.11	53	44	0.31
	No	52	71		11	9	
The child usually washes their hands after using the toilet	Yes	19	26	0.21	55	46	0.41
	No	42	57		9	7	

N: number of children; %: percentage; *: p-value after chi-square or exact Fisher's tests.

Giardia intestinalis, *Ascaris lumbricoides* and *Hymenolepis nana* were the most common parasites, the latter being more frequent in RF (Table 3). No helminth larva was detected by the Rugai method.

Table 3. Frequency of intestinal protozoa and helminths detected in fecal samples of children examined in Riacho Fundo II (n=73) and Ceilândia (n=120), Federal District, Brazil, 2012-2013.

Species	Riacho Fundo II		Ceilândia		
	N	%	N	%	
Helminths	<i>Hymenolepis nana</i>	32	44	0	0
	<i>Ascaris lumbricoides</i>	22	30	02	02
	<i>Trichuris trichiura</i>	03	04	0	0
	Ancylostomidae	04	05	02	02
	<i>Enterobius vermicularis</i>	0	0	01	01
	<i>Taenia</i> sp.	0	0	01	01
Protozoans	<i>Giardia intestinalis</i>	11	15	11	09
	<i>Entamoeba histolytica/dispar</i>	05	07	03	03
	<i>Entamoeba coli</i>	20	27	28	23
	<i>Endolimax nana</i>	02	03	23	19
	<i>Entamoeba hartmanni</i>	0	0	04	03
	<i>Iodamoeba butschlii</i>	01	01	0	0

N: number; %: percentage

DISCUSSION

The frequency of intestinal protozoa and helminths found in school-age children in FD was as high as those observed in other regions of Brazil (Araújo & Fernandez, 2005; Batista et al., 2009; Basso et al., 2008; Barbosa et al., 2012; Castro et al., 2004; Cantuária et al., 2011; Freitas & Junior, 2013; Gurgel et al., 2005; Machado & Costa-Cruz, 1998; Morrone et al., 2004; Mascarini & Cordeiro, 2007; Prado et al., 2001; Quadros et al., 2004; Silva et al., 2008; Silva et al., 2011; Santos et al., 2010; Uchôa et al., 2001; Vasconcelos et al., 2011).

Another study conducted in FD showed a high prevalence of intestinal parasites in children living in the administrative region of Paranoá where *A. lumbricoides* (47%) had the highest occurrence, followed by *G. lamblia* (30.4%) and *H. nana* (20.6%) (Muniz-Junqueira & Queiroz, 2002). These parasites were also the most frequent in the present study, with frequencies ranging from 15% to 44%. These results indicate the persistence of intestinal parasites in children in FD, where there is a treated water supply and sewage system. These results also indicate that other factors must favor the occurrence of parasites in children in FD.

Poor hygiene conditions can also be associated with infection and reinfection with intestinal parasites (Silva et al., 2008; Raso et al., 2006; Okyay et al., 2004). The difference in the occurrence of children parasitized in RF and CE could be associated with different socioeconomic and hygiene conditions existing in these areas. The RF families had more crowded houses, more pets and even dirtier backyards. These factors can increase the chances of parasite transmission.

Hygiene habits, such as wearing shoes, keeping fingernails clean, washing fruit and vegetables, and washing hands after defecation and before meals are very important in preventing and reducing the risk of infection by parasites, especially among children (Raso et al., 2006; Andrade et al., 2010; Castro et al., 2004). In the state of Maranhão, Silva et al. (2011) detected a high frequency of geohelminths in children who did not wear shoes often. The present study also showed a higher frequency of parasites in RF children who did not wear shoes regularly. However, the most frequently occurring parasites in children from RF are not transmitted by the penetration of larvae through the feet. One hypothesis to explain this result is that the children who do not use shoes are also those who have low personal hygiene, which would be related to the mechanisms of transmission of *G. intestinalis*, *A. lumbricoides* and *H. nana*. It was expected that we would find the highest frequency of protozoa or helminths in children of families who do not properly wash fruit and vegetables because of the high rates of vegetable contamination found in Brazil (Guilherme et al., 1999; Gregorio et al., 2012). Another variable related to the occurrence of intestinal parasites was the presence of pets in the residences. These animals can carry helminth eggs and protozoan cysts and oocysts (Rey, 2008), which could facilitate their transmission to children in FD.

Weight loss, skin spots and diarrhea were symptoms frequently cited by parents of children who were examined in this study. These symptoms are often observed in children infected with intestinal parasites (Rey, 2008; Andrade et al., 2010). In the present study no association was found between the occurrence of parasites and the symptoms reported by parents. This may have been the result of a reporting bias, common in studies involving interviews with the population. Future studies including detailed clinical examinations of children could be performed to overcome the limitation of the present work.

The present study revealed a high occurrence of intestinal parasites in the two administrative regions of FD, areas with a good sewage system and supplied with treated water. In this scenario, the results indicate that poor hygiene habits are the key factors related to the transmission of intestinal parasites in FD. Thus, we emphasize the need for a health policy to combat these infections, targeting government and community engagement in order to develop health education programs focused on children, who play an important role in the maintenance of intestinal parasites due to their higher susceptibility and poor hygiene habits that facilitate transmission.

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