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ORIGINAL ARTICLE

INTESTINAL PARASITES IN CHILDREN WITH NEUROLOGICAL DISORDERS TREATED AT A REHABILITATION INSTITUTION IN NITERÓI, RIO DE JANEIRO, BRAZIL

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ABSTRACT

Enteroparasitosis presents high prevalence in developing countries, and is frequent among children, and those with disabilities present even higher susceptibility. The present study evaluated 156 children with neurological disorders to whose parents or guardians an epidemiological questionnaire was applied with a view to identifying risk factors. Stool samples were processed using Ritchie modified by Young, Faust et al., Lutz and Baermann-Moraes techniques. Thirteen samples (8.3%) were positive, being *Blastocystis* sp. the most frequent parasite (46.2%). Higher positivity was observed for protozoa, especially non-pathogenic. A statistically significant association was only found between the educational level of the mother and positivity for enteroparasites. Among positive children, the habit of placing their hands and objects in their mouths and the consumption of raw vegetables was more frequent. The results show the existence of care and sanitation minimizing the acquisition of intestinal parasite diseases. It is important to alert parents and caregivers about personal hygiene, water and food quality, as well as the environment, considering that transmission of these parasites occurs via the fecal-oral route, in association with multiple factors.

KEY WORDS: Neurodevelopmental disorders; parasites, *Blastocystis* sp.; factors; frequency.

INTRODUCTION

Intestinal parasites are the most common diseases worldwide (OPAS/OMS, 2016) and children are the most susceptible to these parasites (Batista et al., 2009; Boeira et al., 2012).

The prevalence of intestinal parasitic diseases in Brazil is high among children, especially within the 3 to 12 age group, although this ratio depends

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on the region and town. It is correlated with basic sanitation and dwelling conditions, and with socioeconomic levels (Frei et al., 2008; Menezes et al., 2008). There are only a few studies on the occurrence of enteroparasitosis among individuals with disabilities, although data from the World Health Organization show that approximately 11% of the Brazilian population presents some type of disability (Silva et al., 2010).

Disabled children present either temporarily or permanently, a differentiated chronic physical, developmental, behavioral or emotional condition. They need healthcare services that go beyond the regular procedures recommended for children of the same age (Neves et al., 2013). Garcia et al. (2004) suggested that mental disability can directly influence hygiene habits and, consequently, favor the acquisition of enteroparasites.

The present study, aimed, therefore, to identify the frequency and risk factors associated with intestinal parasitic diseases among children with neurological disorders, thereby aiding the understanding of the epidemiology of these parasites in this group and increasing information on the subject as well as promoting interventions to improve the quality of life of this community. These children were seen at the outpatient care unit of the Fluminense Rehabilitation Association, in Niterói, RJ.

MATERIAL AND METHODS

A cross-sectional study was conducted at the Fluminense Rehabilitation Association, which is located in the Icaraí district of the municipality of Niterói. The Association provides care for 2,000 patients, of whom 700 are children, 400 of which present neurological disorders.

The study sample consisted of 400 children treated by the Fluminense Rehabilitation Association within the age group of 0-13years, who presented neurological disorders. The project was submitted to and subsequently approved by the Research Ethics Committee of the Fluminense Federal University (UFF), under registration number 1,002,869. Participation in the study was authorized by the children's parents and/or guardians from May 18 to October 3, 2016, by signing a free and informed consent statement.

Fecal samples were collected in accordance with the guidance provided and following the schedule established in conjunction with the parents and/or guardians. These comprised two samples with Railliet & Henry preservative, as recommended by Goulart & Leite (1978) and one without preservative.

After collection, the samples were forwarded to the Parasitology Laboratory of the Biomedical Institute of UFF. The samples with preservative were processed using the Ritchie (as modified by Young et al., 1979), Faust et al. (1938) and Lutz (1919) techniques. Those without preservative were processed using the Baermann technique (1917) & Moraes (1948).

The risk factors were analyzed through counting the epidemiological questionnaire responses. The following factors were evaluated: basic sanitary conditions, including the type of water supply and the sewage disposal system; type of housing; parents' educational level; use of filters for drinking water; attitudes that favor infection, such as the habit of placing hands and objects in their mouths, direct contact with the floor, presence of a caregiver, type of bowel movement, implementation of anti-parasite treatment, consumption of unpeeled fruit and raw vegetables, and parents' knowledge about parasites.

The statistical analysis relating each risk factor and positivity for intestinal parasites was performed through Fisher's exact test with the SPSS version 11.7, 1999 program (SPSS Inc., Chicago, IL), and also for each variable, comparing it with the total of other associated categories with a trust interval of 5%. In analyzing the percentage of participation and positive results, it was considered as excellent rate between 90-100%, as very good rate between 70 to 89.9 %, good from 50 to 69.9%, moderate in between 30-49.9% lower from 10 to 29.9%, and very low being 0.1 to 9.9%.

RESULTS

Of the 400 children with special health requirements, 277 (69.3%) took part in the study. Among these, 156 (56.3%) handed in fecal samples, of which 13 (8.3%) were positive. Nine of them (69.2%) presented monoparasitism and four (30.8%), polyparasitism.

All the positive samples had evolutive forms of protozoa, which were mostly non-pathogenic. In one sample, there was an association with the helminth *Trichuris trichiura*. *Blastocystis* sp. was the most frequent parasite. The species of parasites found among the children are presented in Table 1.

Table 1. Results regarding positivity for intestinal parasites in fecal samples from 13 children treated at the Fluminense Rehabilitation Association, Niterói, RJ, Brazil, using parasitological techniques performed between May and October 2015.

Intestinal Parasites	Children
Endolimax nana	1 (7.7%)
Trichuris trichiura	1 (7.7%)
Giardia intestinalis	3 (23.1%)
Complex *Entamoeba histolytica/Entamoeba dispar*	4 (30.8%)
Entamoeba coli	5 (38.4%)
Blastocystis sp.	6 (46.1%)

Of the 156 children who participated, 27 (20.9%) were diagnosed with cerebral palsy, 30 (19.2%) were diagnosed with autism, 22 (14.1%) did not have a definite diagnosis, 21(13.5%) were diagnosed with Down syndrome and 56 (35.9%) presented other diagnoses such as: West syndrome, microcephaly, hydrocephalus, Turner syndrome, head trauma, holoprosencephaly, Edwards syndrome, Lennox-Gastaut syndrome, Pallister-Killian syndrome, CHARGE syndrome, various levels of mental disability, hemiparesis, hypotonia, cerebellar atrophy, Dyggve-Melchior-Clausen syndrome, Costello syndrome and learning difficulties.

Table 2 presents the relationship between positivity among the children at the Fluminense Rehabilitation Association and their respective neurological diagnoses. There was no significant association between the type of disorder and positivity for parasites.

Table 2. Relationship between the type of mental disorder and positivity of the parasitological result among 156 children attended at the Fluminense Rehabilitation Association, Niterói, RJ, Brazil, who participated in the study between May and October 2015.

Type of mental disorder	Children		TOTAL	p value
	Positive	Negative		
Down syndrome	2 (15.4%)	19 (13.3%)	21 (13.5%)	0.6880
Autism	4 (30.7%)	26 (18.1%)	30 (19.2%)	0.2772
Cerebral palsy	1 (7.7%)	26 (18.1%)	27 (17.3%)	0.4689
Without diagnosis	3 (23.1%)	19 (13.3%)	22 (14.1%)	0.3972
Others	3 (23.1%)	53 (37.2%)	56 (35.9%)	0.3802
Total	13	143	156	

Fisher's exact test $p < 0.05$

One hundred of the participating children were male and 56 were female. Of these, eight boys and five girls were positive for enteroparasites ($p = 1.0$). The mean age among the participating children was 4.9 ± 3.35 years and among the positive children, 6.5 ± 3.96 years. The age group ranged from 2 to 13 years of age.

The results regarding risk factors are presented in Tables 3a, 3b e 3c. Regarding the type of home, four children lived in houses without backyard; four, in houses with non-treated non-cemented backyard, and five, in houses with non-treated non-cemented backyard with a garden.

Table 3a. Result from the analysis on the risk determinants among children with neurological disorders treated at the Fluminense Rehabilitation Association, Niterói, RJ, Brazil, who participated in the study between May and October 2015.

	Children		
Type of home	Total (n=156)	Positive (n=13)	P
House without backyard	48 (30.7%)	4 (30.8%)	1.0000
House with non-treated non-cemented backyard	12 (7.7%)	2 (15.4%)	0.2625
House with non-treated non-cemented backyard and garden	17 (10.9%)	2 (15.4%)	0.6361
House with cemented backyard and garden	41 (26.3%)	5 (38.5%)	0.3285
House with cemented backyard and without garden	36 (23.1%)	0 (0%)	
House with cemented/covered floor	2 (1.3%)	0 (0%)	
Father's educational level			
Illiterate	1 (0.6%)	0(0%)	
Incomplete elementary school	1 (0.6%)	0 (0%)	
Completed elementary school	9 (5.7%)8	1 (7.7%)	0.5337
Incomplete secondary school	14 (9.1%)	3 (23.1%)	0.0961
Completed secondary school	8 (5.1%)	0 (0%)	
Incomplete high school	10 (6.4%)	0 (0%)	
Completed high school	61 (39.1%)	6 (46.1)	0.7677
Incomplete higher education	12 (7.7%)	0 (0%)	
Completed higher education	25 (16.1%)	0 (0%)	
I do not know	15 (9.6%)	3 (23.1%)	0.1141
Mother's educational level			
Illiterate	3 (1.9%)	1 (7.7%)	0.2311
Incomplete elementary school	2 (1.3%)	1 (7.7%)	0.1602
Completed elementary school	6 (3.8%)	1 (7.7%)	0.4120
Incomplete secondary school	11 (7.1%)	2 (15.4%)	0.2295
Completed secondary school	9 (5.7%)	0 (0%)	
Incomplete high school	13 (8.3%)	0 (0%)	
Completed high school	68 (43.6%)	2 (15.4%)	0.0406*
Incomplete higher education	14 (9.1%)	1 (7.7%)	1.0000
Completed higher education	27 (17.3%)	5 (38.4%)	0.0509
I do not know	3 (1.9%)	0 (0%)	

Fisher's exact test $P<0.05$ *significant

Table 3b. Result from the analysis on the risk determinants among children with neurological disorders attended at the Fluminense Rehabilitation Association, Niterói, RJ, Brazil, who participated in the study between May and October 2015 (continued)

	Children		
Family Income	Total (n=156)	Positive (n=13)	P
Lower than R$ 300.00	11 (7.1%)	1 (7.7%)	1.0000
From R$ 300.00 to 600.00	7 (4.5%)	1 (7.7%)	0.4630
From R$ 600.00 to 1,000.00	47 (30.1%)	4 (30.75%)	1.0000
From R$1,000.00 to 2,000.00	42 (26.9%)	3 (23.1%)	1.0000
Higher than R$ 2,000.00	49 (31.4%)	4 (30.75%)	1.0000
Type of water supply			
Supply network from a central water tank	2 (1.3%)	0 (0%)	
Public supply network (piped)	139 (89.1%)	13 (100%)	0.3632
Shallow well	2 (1.3%)	0 (0%)	
Artesian well	13 (8.3%)	0 (0%)	
Type of drinking water			
Domestic water filter	97 (62.2%)	8 (61.5%)	1.0000
Mineral water	34 (21.8%)	2 (15.4%)	0.7351
Tap water	14 (9.0%)	2 (15.4%)	0.3291
Boiled water	2 (1.3%)	1 (7.7%)	0.1602
Boiled and filtered water	6 (3.9%)	0 (0%)	
Boiled and tap water	1 (0.6%)	0 (0%)	
Filtered and mineral water	1 (0.6%)	0 (0%)	
Boiled and mineral water	1 (0.6%)	0 (0%)	
Type of sanitation			
Septic tank with bathroom outside the house	3 (1.9%)	0 (0%)	
General sanitation network	130 (83.3%)	13 (100%)	0.1276
Pipes discharging the sewage in river, lake or sea	7 (4.5%)	0 (0%)	
Ditch	2 (1.3%)	0 (0%)	
Masonry tank with several compartments	9 (5.8%)	0 (0%)	
I do not know	5 (3.2%)	0 (0%)	
Pet			
Yes	80 (51.3%)	7 (53.4%)	0.779
No	76 (48.7%)	6 (46.2%)	

Fisher's exact test $p<0.05$

Table 3c. Result from the analysis on the risk determinants among children with neurological disorders attended at the Fluminense Rehabilitation Association, Niterói, RJ, Brazil, who participated in the study between May and October 2015 (continued)

	Children		
Consumption of raw vegetables	Total (n=156)	Positive (n=13)	p
Yes	111(64.1%)	11 (84.6%)	0.3499
No	45 (35.9%)	2 (15.4%)	
Consumption of fruit			
Yes	125 (80.1%)	11 (84.6%)	1.0000
No	31 (19.9%)	2 (15.4%)	
Children's habits			
Hand in the mouth	119 (76.3%)	10 (76.9%)	
Objects in the mouth	91 (58.3%)	7 (53.9%)	
Direct contact with the floor	113 (72.4%)	8 (61.5%)	
Caregiver	66 (42.3%)	5 (38.5%)	
No	11 (7.05%)	3 (23.1%)	0.371
Intestinal alterations			
Yes	99 (63.5%)	5 (38.5%)	0.0702
No	57 (36.5%)	8 (61.5%)	
Treatment against parasitic diseases			
Self-administered every 6 months	13 (8.3%)	2 (15.4%)	0.2958
Under doctor's prescription	53 (33.9%)	6 (46.1%)	0.3672
Uses natural products when presenting symptoms	1 (0.64%)	0 (0%)	
Has not undergone any for over a year	52 (33.3%)	5 (38.5%)	0.3245
Has never use any	21 (13.5%)	0 (0%)	
Self-administered and also under doctor's prescription	2 (1.3%)	0 (0%)	
Under doctor's prescription but without treatment for over a year	14 (9.06%)	0 (0%)	
Parents or guardians knowledge about intestinal parasitic diseases			
Yes	91 (58.4%)	7 (53.9%)	0.7745
No	65 (41.6%)	6 (46.1%)	

Fisher's exact test $P<0.05$ * significant

Regarding the father's educational level, most presented incomplete secondary education (i.e. Brazilian elementary school phase II) or had finished high school. In turn, among the mothers, considering the positive children, eight had finished high school or had higher education, four presented incomplete secondary school or a lower educational level, and one was illiterate.

In relation with income, most of them declared having an income between R$ 600.00 and R$ 1,000.00 or higher than R$ 2,000.00.

Regarding the water supply in the home, all of them said that they received water from the public water supply network. One informant said that artesian well water was also used. Regarding drinking water, eight said that they consumed water filtered through an activated carbon filter. Regarding sewage treatment, all indicated that their homes had access to the public sewage treatment network.

According to the information provided, eleven children were consuming raw green vegetables. Five children had not undergone parasitological treatment for over a year. The parents of two children said that they were providing treatment themselves.

Ten children (76.9%), were reported having the habit of placing their hands in their mouths, this was also associated with placing objects in their mouths and having direct contact with the floor in the case of six children (46.1%).

Regarding the information about parasitic diseases among the parents and guardians, six knew nothing about the subject.

A statistically significant difference was noted regarding the mother's educational level, when these had finished secondary school (Table 3a).

DISCUSSION

There was a 69.3% participation rate in the study through parents' or guardians' signing the free and informed consent statement, among children at the Fluminense Rehabilitation Association and 56.3% of the participants handed in fecal samples. From informal conversations with parents and guardians, this low proportion of samples handed in was associated with the daily challenges of dealing with disabled children and with difficulty in getting to the institution. A few studies about intestinal parasites in children with neurological disorders have been recovered, most of which addressed special patients without evaluation of the results by age group.

The frequency of positive findings regarding intestinal parasites was 8.3% (13/156). This result was lower than that obtained by Tappeh et al. (2010) with 20.5% (46/225); Rhongbutsri et al. (2010) with 38.5% (20/52); Veloso et al. (2011) who observed a positivity rate of 65% (49/75); Slongo et al. (2011) with 34.6% (36/104); and Montero et al. (2014) with 80.4% (45/56). The low result in the present study was associated with the presence of adequate basic sanitation in

the children's homes, which means a protection factor against intestinal parasitic diseases by reducing the risk of acquiring new parasitic diseases, although no statistically significant difference was obtained.

The high rate of negative results (91.7%) was not expected, although it was considered satisfactory. Sharif et al. (2010) also reported low positivity for intestinal parasites in children with mental disabilities in Iran, with negative results in 73.8%. This result was also not expected by the authors. Omar Soufi and Al- Amari (1992) also found a high rate of negative results in 86% of children with neurological disorders in a center in Saudi Arabia. Despite the report by Silva et al. (2010) stating that behavior favoring this infection existed, the low positivity result found here may have been related to the care that the disabled children were receiving, which would minimize the risk of acquiring new parasitic diseases. Pinto et al. (2014) reported that mothers of disabled children were the main providers regarding their children's health in single parent situations. It is possible that this perception assured the reduction of exposure to intestinal parasitism seen in the present study. This result was also not expected by the authors.

Protozoa were found in all the positive samples. One sample presented an association with *Trichuris trichiura* species of helminth. These results were not in accordance with the findings of Omar Soufi and Al- Amari (1992) and Rhongbutsri et al. (2010), who found one positive sample only for helminth in their studies with disabled children, without association with protozoa. The present study also disagreed with the findings of Lee et al, 2000, Slongo et al. (2011) and Shokri et al. (2012) in special patients, who found protozoan cysts and helminth eggs more often than found here.

A number of researchers have indicated an increase in the frequency of protozoan infection with reduction in infections caused by helminths, as also shown in the present study (Zaiden et al., 2008; Belo et al., 2012; Abrahão & Solpesa, 2013; Santos et al., 2014). This finding can be correlated with the periodic treatment for helminths that half of the participating children underwent, as well as anthropic alterations to the urban environment that particularly prevents the life cycles of geohelminths.

In the present study, no statistical significance was noted between the type of child neurological disorder and enteroparasite positivity, similar to the study by Silva et al. (2012) in which the authors found no association between the presence of intestinal parasites and different diseases in patients in a psychiatric hospital in Presidente Prudente/SP - Brazil. The lack of association in this study may be due to the low number of fecal samples from children in the institution studied.

The high frequency of *Blastocystis* sp. found here was not reported in previous studies in patients with special requirements (Veloso et al., 2011; Slongo et al., 2011). However, it has been a frequent finding among children without disabilities (Silva, 2006; Macedo et al., 2010; Leite et al., 2014).

Santos et al (2014) found that the prevalence of *Blastocystis* sp. among children between 2-6 years of age was 40.4%, along with a high rate of protozoa. The higher frequency of findings of *Blastocystis* sp. in coproparasitological studies, as well as among the participants of this study, can be correlated with better trained microscopists in performing this type of diagnosis. It also represents greater circulation of this protozoan between susceptible hosts, including humans.

Regarding gender, among the 13 parasitized children, 8 (61.5%) were male and 5 (38.5%), female. Ponciano et al. (2012) observed that out of 171 samples analyzed, 87(23%) were male and 84 (13.1%), female. Males presented a positivity of 23%, while females presented 13.1%. This was also observed in other studies (Ferreira & Marçal-Júnior, 1997; Monteiro et al., 2009; Santos et al., 2014). On the other hand, Zaiden et al. (2008 - 22.8%) and Reuter et al. (2015 - 60%) showed higher positivity among females. In the present study, no significant difference was noted regarding gender, possibly due to the limited means of exploring the living environment of disabled children

Regarding the questionnaire in the present study, most of the children lived in houses with dirt backyards and houses with gardens. Only one child was parasitized by a geohelminth, and this child lived in a house with a cemented backyard and garden. Although contact with soil was limited to the garden for this child, direct contact with the soil was indicated as a risk factor by Ribeiro and Marçal-Júnior (2003) for geohelminth acquisition. Despite this, it is important to bear in mind that acquisition of *Trichuris trichiura* can also occur through ingestion of contaminated food, especially raw vegetables.

Machado et al. (1999) and Dias et al. (2013) noted a significant association between parasitic positivity and low levels of parental education. On the other hand, Quihui et al. (2006) showed that the level of maternal education is an important element in preventing infection by intestinal parasites. Despite this fact, there was a significant difference between mothers with high school education and positivity for intestinal parasitism. This result might have been determined by the existence of fragmented information about parasites, leading to unfamiliarity and increasing the risk. This suggests that although the level of education was good, these people did not possess adequate knowledge about prevention, which would minimize the risk of acquiring intestinal parasites. Another issue to be considered would be the difference between awareness and behavior change caused by that awareness, which is the great problem in health promotion and educational activities for health promotion.

The majority of the parasitized children came from families with incomes of R$600.00 to R$1,000.00 and higher than R$2,000.00. Vasconcelos et al. (2011) pointed out that low purchasing power among families is a factor that influences the occurrence of intestinal parasitic diseases.

All the children in the present study lived in homes with piped water supply provided by the government. With regard to drinking water, eight of the parents or guardians said that they consumed water filtered through an activated carbon filter. Belo et al. (2012) observed that use of water filters in homes was strongly associated with a reduction in the general prevalence of helminths and protozoa, which could have resulted in the low positivity found.

All the children lived in homes with access to the public sanitation treatment network. Belo et al. (2012) stated that the presence of toilets in the homes was related to a lower occurrence of helminths. This factor, along with the anti-helminth treatment, may have determined the low frequency of helminths in the present study.

Soares and Cantos (2005) stated that consuming vegetables *in natura* increases the risk of infection by intestinal parasites because these can transmit evolutionary forms of parasites. Regarding consumption of raw vegetables in the present study, 11 children presented this eating habit and this can be correlated with the positivity found in this study, although without statistical significance.

Silva et al. (2010) suggested that the habit of placing their hands in their mouths is one of the behaviors that favors transmission of enteroparasites in people with mental disorders. Ten children in the present study presented habits and behaviors of placing their hands in their mouths, and in six children this was also associated with the act of placing objects in their mouths and being in direct contact with the floor. These actions may have been associated with positivity for intestinal parasites.

Ribeiro and Marçal-Júnior (2003) stated that the main risk factor identified in their study was the unsatisfactory understanding about geohelminth diseases among parents. Regarding knowledge about parasitic diseases in the present study, six parents or guardians stated that they did not have any information on the subject. Although this finding did not present any statistical difference, lack of knowledge can favor exposure to parasitic diseases.

The results obtained in this study revealed that the frequency of intestinal parasitic diseases was low among the children with mental disorders. There was higher positivity for protozoa, especially those non-pathogenic. Non-pathogenic protozoa serve as indicators of socio-sanitary conditions and fecal contamination, to which people are exposed (Brito et al., 2014). The observation of such non-pathogenic protozoa in the present study should be highlighted, because although these parasites do not determine disease, they have an important implication in the epidemiology of parasitic diseases, since they have the same transmission mechanisms of other pathogenic protozoa, such as *E. histolytica* and *G. intestinalis*. The presence of protozoa, in this study, may have been associated with individual behavior and/or ingestion of raw vegetables. There was statistical significance only regarding the mothers who had finished high school. This suggests that in this group the frequency of parasitic diseases would

probably be associated with random situations, since the risk is multifactorial. These results suggested that the disabled children studied here presented good hygiene and basic sanitation conditions. In the case of the positive individuals, there is a need for greater attention to issues such as personal and environmental hygiene, and regarding food consumption, in order to ensure better quality of life.

It is also important to expand these studies in children in order to strengthen the information about intestinal parasites in this group. The importance of such studies is mainly reinforced regarding confirmed autochthonous fever transmission by Zika virus in the country from April 2015 (Brasil, 2015) and the association between the Zika virus and the microcephaly outbreak in northeastern Brazil (Brazil, 2016). The infection is spreading throughout the country and it is thought that the number of microcephaly cases tends to increase. Thus, in the coming years there will be a greater number of disabled children and adults, requiring health care programs including in regard to intestinal parasites.

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