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ORIGINAL ARTICLE

COPROPARASITOLOGICAL SURVEY OF INTESTINAL PARASITES IN THE CITY OF LONDRINA, PARANA, BRAZIL: A RETROSPECTIVE ANALYSIS

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ABSTRACT

Intestinal parasites are a major public health problem. It is important to inform and educate the public about these infections, especially where such data are scarce. This study aimed to determine the prevalence of intestinal parasites from the analysis of medical records of individuals of the city of Londrina. We analyzed 11,641 fecal reports from February 2009 to December 2012. Data were cataloged after the completion of parasitological testing of Hoffmann, Pons & Janer, Faust and Kato-Katz. From 11,641 reports, 19.1% were positive for intestinal parasites. Among those, 52.1% pertained to females and 47.9% to males, with predominance of positivity of 27.1% among children 0-10 years. For the regions studied, the northern region stood out with 35.4% of cases and prevalence of 6.8%. Among the pathogenic protozoa, reports of *Giardia lamblia* comprised 19.1% of positivity, while hookworms were the most frequent among helminths, comprising 7.8% of positive cases. It follows that poor conditions of basic sanitation contribute to the dissemination of these parasites. Early diagnosis is a determinant of successful treatment. Additionally, epidemiological data may be used to study the risk factors for transmission and may result in measures applicable to improving living conditions in the community.

KEY WORDS: Intestinal parasites; parasitological diagnosis; helminths; protozoa; public health.

RESUMO

Inquéritos coproparasitológicos de parasitos intestinais na cidade de Londrina-PR: uma análise retrospectiva

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As parasitoses intestinais constituem importante problema de saúde pública, portanto é necessário informar à população acerca destas infecções, principalmente onde os dados são escassos. Este estudo teve como objetivo determinar a prevalência de parasitos intestinais com base na análise de prontuários de indivíduos provenientes da cidade de Londrina-PR. Foram analisados 11.641 prontuários de fevereiro de 2009 a dezembro de 2012. Os dados foram catalogados após a conclusão dos testes parasitológicos de Hoffmann, Pons & Janer, Faust e Kato-Katz. De 11.641 prontuários, 19,1% apresentaram resultados positivos para parasitos intestinais. Entre esses, 52,1% eram de indivíduos do sexo feminino e 47,9% do sexo masculino, com predomínio de positividade entre crianças de 0-10 anos (27,1%). Nas regiões estudadas, o norte destacou-se com 35,4% dos casos e prevalência de 6,8%. Entre os protozoários patogênicos, *Giardia lamblia* foi o mais relatado com 19,1% de positividade, os ancilostomídeos foram os mais frequentes entre os helmintos, com 7,8% de casos positivos. Conclui-se que condições precárias de saneamento básico contribuem para a disseminação destas parasitoses e o diagnóstico precoce é determinante para o sucesso do tratamento. Além disso, dados epidemiológicos são utilizados para o estudo dos fatores de risco de transmissão e podem resultar em medidas apropriadas para melhorar as condições de vida da comunidade.

DESCRITORES: Parasitos intestinais; diagnóstico parasitológico; helmintos.; protozoários; saúde pública.

INTRODUCTION

Parasitic diseases are among the most serious health problems in the world. It is estimated that approximately 200 million people in the Americas are infected with parasites, especially those of low socioeconomic status, living under poor sanitation, hygiene and education conditions (Macedo, 2005). In Brazil, intestinal parasites are a serious public health problem prominent among the tropical diseases. They result from the interaction of several factors (proximity to stray animals, contamination of soil, water, food and their handlers) that have an important role not only because of their epidemiological aspect, but mainly because of their medical and social implications (Abraham et al., 2007; David et al., 2013).

Enteroparasitic infections may cause serious health problems, particularly where nutritional status is concerned. Symptoms include nutrient malabsorption, chronic diarrhea, anemia, malnutrition, abdominal pain and growth disorders, in addition to changes in cognitive function affecting mainly schoolchildren (Buschini et al., 2007). The functional impairment of certain organs and the rapid replication of parasites can lead to life-threatening illnesses, especially in immunocompromised individuals (Brum et al., 2013). In most cases, the functional impairment is due to the obstruction of intestine, blood vessels and secretory canals, as well as the compression of organs and tissues (David et al., 2013).

Furthermore, given the deleterious effects of parasitism on the health of individuals and, above all, the economic impact, several programs have been directed to the control of intestinal parasites in different countries.

Unfortunately, there is a mismatch between the success achieved in economically developed countries and in developing economies (Silva et al., 2009). As most parasitic diseases cannot be diagnosed only by medical evaluation, laboratory investigations become necessary for an accurate diagnosis. Thus, it is essential to assess which laboratory methods have higher specificity, higher sensitivity and require fewer financial resources (Machado et al., 2008).

In order to minimize the number of cases, prophylactic and treatment measures must be established. Therefore, it is important to know the prevalence of intestinal parasites and the main species found in each region, taking into account the different socioeconomic classes in a given population (Oliveira et al., 2001; Marquez et al., 2002). The World Health Organization (WHO) estimates that parasitic diseases associated with poverty comprise 45% of all diseases in developing countries. Epidemiological studies have been conducted in southern Brazil, in order to identify the etiological agents associated with intestinal parasite infections in this population. However, in many regions of Paraná State, such results are still inconclusive (Ferreira et al., 2006; Buschini et al., 2007).

In this context, due to the public health relevance and to the limited data in the literature on this issue, our aim was to determine the prevalence of intestinal parasites in certain regions from records of individuals living in the city of Londrina, PR, Brazil.

MATERIALS AND METHODS

Study Area

The study area was the city of Londrina in Parana State, in the north of the State and southern Brazil (geographic coordinates S 23º08'47'' 50º52'23' W, S 23º55'46'' 51º19'11'' W). It is a city with 537, 566 inhabitants, with approximately 13, 181 belonging to the rural community and 41.76% of which are comprised of the elderly population. It is the second most populous city in the State. The climate is rated humid subtropical (average temperature 22 °C), with rainfall throughout the year (IBGE, 2013).

This study was approved by the ethics committee on human research of the State University of Londrina, under project number 1494.2013-56.

Data Analysis

The number of cases in the last four years (February 2009 to December 2012) was obtained from parasitological examinations of 11, 641 individuals from areas in the North, South, East, Central and Rural regions of Londrina

that were referred to the Clinical Hospital of the State University of Londrina, Londrina-PR, Brazil. In this hospital fecal samples were analyzed by the methods of Hoffmann, Pons and Janer (Hoffmann et al., 1934), Faust (Faust et al., 1939), Kato and Miura (Kato & Miura, 1954) and Kato-Katz (Katz et al., 1972).

The retrospective study was performed based on a previous work carried out by the health workers of Londrina Health Department, who collected biological samples from populations living in the regions of Londrina, in collaboration with the State University of Londrina. For this, collection flasks were distributed to all members of the families visited after obtaining their consent to participate in the survey. The presence of parasites, as well as age and gender, were considered in data analysis.

Statistical Analysis

Statistical analysis was performed with SPSS software version 20.0. The data are presented in absolute and relative frequency. The tests used to assess the association between variables were: Chi-square, Fisher's exact test and Likelihood-ratio test. From the associations, a logistic regression model was established. The variables: time in months, region, gender and age were included as predictors in the model with the incidence of infection as the outcome. The results show the odds ratio according to the proposed characteristics and in comparison with a reference group, represented in the tables as 1. The level of significance was $p < 0.05$.

RESULTS

Of the 11,641 records analyzed, 19.1% (n=2, 221) were positive for intestinal parasites. Of these, 52.1% (n=1, 157) related to females and 47.9% (n=1, 064) related to males; the ages ranged from zero to above 80 years old. There was no significant difference between genders; however, regarding age, the odds ratio (OR) of parasite presence was 1.8 times higher in children aged 0-10 years (Table 1).

Regarding the regions analyzed, it was found that the number of new cases of intestinal parasites, independent of age and gender, was higher in the central regions when compared to the rural region, with an odds ratio of 1.8, 1.2 for the North and 0.8 for the East. However the Northern region was notable with 786 cases (35.4%) and a prevalence of 6.8% (Table 1).

When we consider the period of sample collection and analyze its possible relationship with the occurrence of parasites, we notice a higher prevalence of parasites between the months of May and September of years 2009, 2010 and 2011. However, in 2012 these rates decreased dramatically in a monthly comparison, as shown in Table 2.

Table 1. Number of positive cases of intestinal parasites, prevalence and odds ratio, distributed according to regions, gender and age.

	n	CASES	PREVALENCE	OR (IC 95)
Rural	520	23.4	4.5	1
North	786	35.4	6.8	1.2 (1.1-1.4)*
East	461	20.8	4.0	0.8 (0.7-0.9)*
South	318	14.3	2.7	1.1 (0.9-1.4)
Center	136	6.1	1.2	1.8 (1.4-2.3)*
F	1157	52.1	9.9	1
M	1064	47.9	9.1	0.9 (0.8-1.1)
> 80years	16	0.7	0.1	1
0-10 years	601	27.1	5.2	1.8 (1.1-3.0)*
11-20 years	385	17.3	3.3	1.2 (0.6-2.0)
21-30 years	277	12.5	2.4	1.1 (0.6-1.9)
31-40 years	269	12.1	2.3	1.1 (0.6-1.9)
41-50 years	243	10.9	2.1	1.2 (0.7-2.1)
51-60 years	185	8.3	1.6	1.2 (0.6-2.0)
61-70 years	171	7.7	1.5	1.5 (0.8-2.6)
71-80 years	74	3.3	0.6	1.3 (0.7-2.3)

* $p<0.05$

Table 2. Number of positive cases distributed by month/year, Londrina-PR (2009-2012).

	GENERAL n (%)	2009 n (%)	2010 n (%)	2011 n (%)	2012 n (%)
Feb	82 (3.7)	00 (0.0)	37 (5.6)	39 (5.6)	06 (3.6)
Mar	220 (9.9)	39 (5.6)	84 (12.7)	79 (11.4)	18 (10.7)
Apr	174 (7.8)	85 (12.2)	34 (5.1)	30 (4.3)	25 (14.8)
May	256 (11.5)	99 (14.2)	71 (10.7)	44 (6.3)	42 (24.9)
Jun	233 (10.5)	55 (7.9)	81 (12.2)	81 (11.7)	16 (9.5)
Jul	250 (11.3)	72 (10.3)	98 (14.8)	80 (11.5)	00 (0.0)
Aug	271 (12.2)	57 (8.2)	98 (14.8)	116 (16.7)	00 (0.0)
Sep	243 (10.9)	125 (18.0)	32 (4.8)	86 (12.4)	00 (0.0)
Oct	199 (9.0)	57 (8.2)	50 (7.6)	64 (9.2)	28 (16.6)
Nov	209 (9.4)	76 (10.9)	54 (8.2)	54 (7.8)	25 (14.8)
Dec	84 (3.8)	31 (4.5)	23 (3.5)	21 (3.0)	09 (5.3)
TOTAL	2,221 (100)	696 (100)	662 (100)	694 (100)	169 (100)

n: number; %: percentage

Among the protozoa, in order of occurrence, results include: *Endolimax nana* with 44.7% (n=993), *Entamoeba coli* with 40.4% (n=898) and *Giardia lamblia* with 19.1% (n=425). For helminths, the most frequent were the hookworms with 7.8% (n=174), followed by *Enterobius vermicularis* with 3.8% (n=84) (Table 3). Additionally, there was 4.1% (n=472) of bi-parasitism reports and 0.7% (n=77) with polyparasitism (data not shown).

Table 4 shows the occurrence of intestinal parasites in relation to the odds ratio (OR) according to the period of the year (month and year), regardless of age, gender and region. Note that in the year 2011 enteroparasite appearance was 1.9 times more likely when compared to 2009. Regarding the period analyzed during each year, the odds ratio (OR) for the occurrence of more cases of parasitism, as shown in Table 4, mainly indicates the months from March to November, except for April and December, which showed no statistically significant difference when compared to February. But in 2012 the OR rate was the lowest when compared to other years (Table 4).

Table 3. Distribution of intestinal parasites per year, Londrina-PR (2009-2012).

	GENERAL	2009	2010	2011	2012
PROTOZOAN	n %	n %	n %	n %	n %
Endolimax nana	993 (44.7)	363 (16.3)	314 (14.1)	254 (11.4)	62 (2.8)
Entamoeba coli	898 (40.4)	278 (12.5)	245 (11.0)	297 (13.4)	78 (3.5)
Giardia lamblia	425 (19.1)	116 (5.2)	132 (5.9)	147 (6.6)	30 (1.4)
Entamoeba histolytica/ E. dispar	61 (2.7)	21 (0.9)	19 (0.9)	18 (0.8)	03 (0.1)
Iodamoeba butschilli	37 (1.7)	06 (0.3)	09 (0.4)	19 (0.9)	03 (0.1)
HELMINTHS					
Hookworms	174 (7.8)	56 (2.5)	42 (1.9)	65 (2.9)	11 (0.5)
Enterobius vermicularis	84 (3.8)	30 (1.4)	31 (1.4)	18 (0.8)	05 (0.2)
Ascaris lumbricoides	54 (2.4)	08 (0.4)	11 (0.5)	34 (1.5)	01 (0.0)
Hymenolepis nana	52 (2.3)	13 (0.1)	14 (0.6)	20 (0.9)	05 (0.2)
Trichuris trichiura	45 (2.0)	08 (0.4)	13 (0.6)	24 (1.1)	00 (0.0)
Schistosoma mansoni	18 (0.8)	04 (0.2)	08 (0.4)	03 (0.1)	03 (0.1)
Strongyloides stercoralis	05 (0.2)	02 (0.1)	00 (0.0)	02 (0.1)	01 (0.0)
Trichostrongylus sp.	03 (0.1)	00 (0.0)	03 (0.1)	03 (0.1)	00 (0.0)

n: number; %: percentage

Table 4. Odds ratio (OR) for the occurrence of intestinal parasites, distributed by month/year, Londrina-PR.

	OR (IC 95%)
2009	1
2010	0.8 (0.7-0.9)*
2011	1.9 (1.6-2.3)*
2012	0.9 (0.7-1.1)
FEB	1
MAR	1.5 (1.1-2.0)*
APR	1.2 (0.9-1.6)
MAY	1.3 (1.1-1.8)*
JUN	1.5 (1.1-2.0)*
JUL	1.8 (1.4-2.4)*
AUG	1.7 (1.3-2.2)*
SEP	1.6 (1.2-2.2)*
OCT	1.5 (1.1-1.9)*
NOV	1.5 (1.1-2.0)*
DEC	1.3 (0.9-1.8)

DISCUSSION

Intestinal parasites represent a serious public health problem. The prevalence of these infections depends on the degree of exposure to infective forms of the parasite and on factors such as housing and sanitation (Lodo et al., 2010). In Brazil, due to the geographical and climatic diversities, as well as the coexistence of different socioeconomic classes in a given area, it is important to know the prevalence of the main species in each region, to allow the establishment of appropriate prophylactic and curative measures (Oliveira et al., 2001).

In this work 19.1% positivity for intestinal parasites was observed, with predominance in the Northern, Eastern and Southern regions of Londrina. According to Cunha (1993), the key point in the fight against most infectious diseases, including parasitic infections, is education, since when people are educated about personal hygiene they are less vulnerable to infections. Children, particularly of pre-school and school age, and teenagers are the most affected because they are more frequently exposed to the conditions for infection: favorable environments for transmission and immaturity of the immune system (Pezzi & Tavares, 2007). This may explain the higher

incidence in children between 0-10 years in our study, with 5.2% prevalence and OR of 1.8 times compared to the age group above 81 years. According to the World Health Organization (WHO, 2006), it is estimated that about 3.5 billion people worldwide are infected with some kind of intestinal parasite, with about 450 million patients, mostly children, living in tropical areas of developing countries.

Our data show a high prevalence of non-pathogenic species such as *E. coli*, *E. nana* and *Iodamoeba butschlli* (Table 3). This high number of cases can be explained by fecal-oral contamination and contaminated water, as also demonstrated in other surveys (Lodo et al., 2010; Vasconcelos et al., 2011).

The pathogenic process induced by the presence of parasites in the human intestine can lead to the individual's underdevelopment by depletion of its nutritional reserves and poor systemic absorption and functional impairment. Furthermore, exacerbated development due to parasites may lead to patient death (Menezes et al., 2013). According to Menezes et al. (2008), the high prevalence of intestinal parasites is related to the precariousness of basic sanitation and individual hygiene, together with the existence of favorable environmental factors. The prevalence of parasitic waterborne diseases in Brazil reflects the failure of the public system and the fragility of the service offered to the community (Ferrete et al., 2007). In Londrina, there are a number of irregular occupations located, in most cases, in protected valley areas with little or no water treatment (Barros et al., 2003).

The reports above support, in part, what was shown in this study: the region with the highest prevalence (6.8%) was the Northern region, with an OR of 1.2 of that of the rural region. In addition to the demographic aspect, it is possible to infer that parasitism is closely related to a reduction in socioeconomic status, with an inverse correlation with economic power (Buschini et al., 2007; Menezes et al., 2008). This fact is confirmed in this study, mainly because the populations in the suburbs are more exposed to forms of contamination, which may occur by contact with soil, animals or drinking contaminated water (Rocha et al., 2010).

Another fact worth mentioning was the 23.4% of positivity in the rural area. Brazil has a favorable climate and socioeconomic conditions for the dissemination of parasitic diseases. In both rural and urban areas intestinal parasites are widespread due to poor sanitation conditions and contaminated vegetables, which are the main transmission vehicles, since the majority of intestinal parasites have mechanisms of passive oral infection (Silva et al., 2010). Belo and colleagues (2012) reported the occurrence of intestinal parasites in students from rural and urban areas in a city of Minas Gerais State (Brazil) and concluded that the higher prevalence of positivity was among schoolchildren from rural areas. This fact was attributed to the precariousness of the sanitation conditions in such areas. Accordingly, some authors support the idea that, once suitable socioeconomic, educational and environmental

conditions are met, the prevalence of intestinal parasites in those areas are comparable, if not lower, to that of urban areas (Martins et al., 2009).

According to Pedrazzani and colleagues (1988), enteroparasites alone are not implicated in high mortality rates. Some data show that about 400 million people worldwide are infected with *G. lamblia* and 200 million with *E. histolytica* and *E. dispar* (Borges et al., 2011; Menezes et al., 2013). The frequency of giardiasis varies in distribution worldwide, with an incidence ranging from 11% to 30% (Mbuh et al., 2009). In Brazil, the frequency of giardiasis varies depending on the population and region studied (Borges et al., 2011).

Similarly, our results demonstrated an occurrence of 19.1% for *G. lamblia*. Marquez and colleagues (2002) also reported high positivity of intestinal parasites in students from an outlying neighborhood in Londrina, especially for *G. lamblia* (22.8%). Another study conducted by our research group showed high *G. lamblia* index, in the city of Rolândia-PR with an occurrence of 12.1% and the city of Ibiporã-PR with 24.5% (Bosqui et al., 2014).

The higher prevalence of helminths in Londrina-PR was mainly attributed to hookworms, followed by *E. vermicularis* and *Ascaris lumbricoides*. In Brazil, the high occurrence of helminths is found both in rural and in urban areas, often in regions with poor socioeconomic conditions (El Fatni et al., 2014). Miranda and colleagues (1999), Rios and colleagues (2007) and Menezes and colleagues (2013) showed similar results, where the prevalence of helminths was higher for hookworms. One of the main reasons for this high rate is that these helminth eggs and larvae are released along with human feces, contaminating the environment and the soil, and are carried by wind and water, contaminating the food. In general, most helminth infections occur through ingestion of viable eggs or by larvae penetrating actively through the skin or mucosa (Menezes et al., 2013). Another helminth present in a large number of cases is *E. vermicularis*. This can be attributed to the fact that its eggs are disseminated in various forms, they are easily transmissible and have prolonged resistance, especially in places where there is a large influx of people (Silva et al., 2013).

In relation to *Strongyloides stercoralis*, throughout the analysis period, only five cases (0.2%) were reported. It is possible that this number is underestimated, since none of the cited references, including the present study, used specific methods for the detection of this species. These methods are based on the hydrothermal tropism and should be conducted in at least three stool samples per person for a reliable diagnosis. Thus, the true number of positive cases would be higher if the adequate method was employed (Olsen et al., 2009).

Characterization according to collection period shows a higher occurrence in the years of 2009 and 2011, especially between the months of August and September. Seasonality can contribute to the prevalence of intestinal parasites, as noticed in several studies showing that occurrence may increase during summer, possibly due to the higher exposure of the susceptible population to the contaminated environment (Menezes et al., 2013). However, in our study, 2010 and 2011 presented a higher OR when compared to 2009. Compared to February, OR values, ranging from 1.3 and 1.8, were associated with March and from May to November.

Moreover, a significant reduction in the occurrence of cases in 2012 was observed. This decrease in the occurrence of several parasites is likely related not only to changes in personal hygiene habits, particularly among children, but also to the development of a progressive and lasting immunity, along with the implementation of control programs (Nolla & Cantos, 2005). In recent years, studies have been conducted by the University of Londrina in the population of the periphery of the city in collaboration with the Clinical Hospital of the same institution, by which immediately after the positive parasitological diagnosis, individuals are referred to a specialized medical team for treatment. This partnership is extremely important for the community as it has shown satisfactory results in the fields of health promotion and education.

CONCLUSION

Given the high incidence of parasites in the study area, the data reported here are essential for the design of socio-educational and health measures, contributing to the early identification of parasite species, prompt treatment and reduction of transmission.

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