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ORIGINAL ARTICLE

ENTEROPARASITES, DEMOGRAPHIC PROFILE, SOCIOECONOMIC STATUS AND EDUCATION LEVEL IN THE RURAL POPULATION OF THE RECÔNCAVO OF BAHIA, BRAZIL

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ABSTRACT

Demographic and social studies, as well as economic and cultural factors in a community are important regarding public health. This study identified demographic, socioeconomic and cultural aspects correlated with intestinal parasites in the population of Santo Antônio de Jesus, Bahia-Brazil, from July to October 2015. 53 semi-structured questionnaires were applied to the rural population of the municipality with previous clarification on the purpose of the study. There were questions related to the individual's gender, family income and parental level of education. Laboratory parasitological analyzes were performed to investigate enteroparasites and produced the following results: 53.7% (n=58) were female; 62.8% (n=66) with monthly family income lower or equal to the minimum wage and 48% (n=48) of adults with incomplete basic education. The main enteroparasites found in this population were: *Iodamoeba butschlii, Entamoeba histolytica/Entamoeba dispar* complex, *Giardia intestinalis, Entamoeba coli* and *Endolimax nana* in addition to some geohelminths, such as hookworms and *Enterobius vermicularis*. The profile visualized can be understood as a risk factor for the development of certain parasitic infections that are intrinsically associated to the social and economic aspects of vulnerable populations.

KEY WORDS: Teenager; adult; child; parasitic diseases.

INTRODUCTION

Intestinal parasitic diseases are a serious public health issue highly prevalent in underdeveloped countries (Ludwig et al., 1999). The agents are diverse and can cause a number of complications for the infected individuals. Helminths and protozoa, for instance, can trigger asymptomatic, acute and chronic diseases. According to Fernandes (2014), the helminthiases with

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the highest occurrence in humans are ascaridiosis (*Ascaris lumbricoides*), enterobiosis (*Enterobius vermicularis*), hookworm (*Ancylostoma duodenale, Necator americanus*) and *Strongyloides stercoralis* infection; while the protozooses are: giardiasis (*Giardia intestinalis*) and amebiasis (*Entamoeba histolytica*).

Globally, approximately 300 million people suffer from severe morbidity, resulting in 10 000–135 000 deaths annually (WHO, 2012). Helminths occur in areas where the socioeconomic level is low, especially where there is no basic sanitation or this is precarious, causing transmissions, depending on the parasite type, through contact with soil, hands and utensils, or by eating food contaminated by eggs or larvae, as well as skin penetration of hookworm and/or *Strongyloides* infective larvae (WHO, 2011).

In spite of technological advances, the reduction in the prevalence of parasitic diseases has been insignificant in several localities, a fact that worries health professionals worldwide, not only regarding the problems caused by these diseases themselves, but also due to other resulting diseases, such as anemia, malnutrition, intestinal obstruction, bleeding, neurological problems, among others. These jeopardize the clinical status of the individuals, since the asymptomatic diseases not previously diagnosed can become parasitic agent disseminators (Fernandes, 2014).

Infections may happen due to precarious hygiene, health and basic sanitation conditions, related to socioeconomic factors in certain populations, as well as environmental factors such as no sewage systems, personal and household waste thrown away in open spaces, garbage accumulation, lack of domestic hygiene and continued coexistence with insects and parasitized animals. The referred conditions cause children to become infected by enteroparasites from contact with contaminated environments and objects, reinforcing the epidemiological triad of the infection between the agent, the environment and the host. The agent is the essential factor for the occurrence of the disease; the host is the organism capable of becoming infected by an agent, and the environment is the set of factors that interact with the agent and the host (Belo et al., 2012).

In Brazil, the rate of infection by parasitic diseases is still high. It is estimated that 12% of children from underdeveloped countries present this type of infection, which may harm their cognitive function as well as influence their nutritional status and, consequently, their normal growth (Vieira & Amarante, 2011).

Cabral-Miranda et al. (2010) found a very high percentage of enteroparasites in children and teenagers in the quilombola community of Tijuaçu (Senhor do Bonfim-Bahia-Brazil), with high prevalence of *Entamoeba coli* and *Giardia intestinalis*, and risk of infection by pathogenic parasites due to living conditions with inadequate or no basic sanitation. The relationship between household income and sanitary sewage showed that most individuals

(68.4%) earned less than the minimum wage and that those who had treated water at home presented lower incidence of infections, demonstrating a direct association between socioeconomic and demographic aspects regarding enteroparasite infections.

Considering that the socioeconomic, cultural and environmental conditions of a population can influence the development of infections caused by enteroparasites, this study was carried out to investigate the prevalence of intestinal parasites and the socioeconomic and cultural profile of individuals living in the rural area of Santo Antônio de Jesus, Brazil.

MATERIAL AND METHODS

Study design

The study was carried out from July to October 2015 with 53 families from Rio do Onha and Riacho Dantas, a rural area in the municipality of Santo Antônio de Jesus-Bahia-Brazil, totaling 154 participants. The families were all next door neighbors and their respective residences were located very close to each other when viewed from the street. A sample per person was analyzed in each family. The 53 families surveyed lived in all the 53 occupied houses in the researched area (100%) during the period of study, where rural labor was the main activity performed by these families' breadwinners.

Participating adults and those responsible for the local child and teenage population answered a semi-structured questionnaire for the collection of socioeconomic, demographic, clinical and cultural data, after signing the informed consent form. In addition, there was a free and informed consent form signed by the over five minors themselves. This research was authorized by the Human Research Ethics Committee at the Federal University of Recôncavo da Bahia (UFRB) (CAAE: 40542314.5.0000.0056).

Laboratory analysis

The following were utilized for the parasitological diagnosis (helminths and intestinal protozoa): Qualitative coproscopic methods of Hoffmann, Pons and Janer (spontaneous sedimentation); Baermann-Moraes and adhesive tape (Graham) as well as Kato-Katz quantitative, performed at the Parasitology Laboratory in the Food and Nutrition Security Nucleus of the Center of Health Sciences/UFRB. On the day of the visit, identified plastic containers and a glass slide with adhesive tape and instructions were handed out for the parasitological exams of feces (one container per individual) and for the Graham adhesive tape technique.

Considering the receipt of only one sample per resident, more than one method was used to increase the possibility of finding parasitic forms in the analyzed samples, as well as the possibility of quantifying the parasitic load in the studied individuals, increasing the diagnostic accuracy.

The Hoffman, Pons and Janer method, also known as spontaneous water sedimentation method, is a qualitative test to identify helminth eggs and larvae as well as protozoan cysts (with less sensitivity to the latter pathogens), by gravitational sedimentation of these organisms. It is considered a simple, economical and practical exam, with the disadvantage of the visualization time being of at least 2 hours, when ideally there should be 24 hours between the sediment washings. The advantage consists in its low cost and wide spectrum of use, frequently the only technique adopted in laboratories with few resources. The Kato Katz technique was used in this study as it allows the identification and quantification of some helminth eggs per gram of feces by means of a card with a central hole 6 mm in diameter, defining the amount of feces to be examined per sample. Made-up slides may be transported and stored at room temperature for months, without impairing results. In order to find helminth larvae, Baermann's method of larval concentration was utilized, based on the positive thermo hydrotropism of these larvae. Graham's method, consisting of the use of a piece of transparent gummed tape, adapted to a glass microscopy slide, facilitates, for instance, access to the perianal region for collecting *Enterobius vermicularis* or *Taenia* sp eggs, (De Carli, 2011).

Statistic data

The data were tabulated and analyzed in the SPSS STATISTICS 16.0 version program, elaborating categories and establishing the analytical description of the data, considering statistical significance using the Pearson chi-square test with p value <0.05.

RESULTS

A total of 154 semi-structured questionnaire samples were applied resulting in 144 (93,5%) stool samples.

In relation to the coproparasitological analysis, the high frequency of hookworm encountered in the feces of the studied population stands out. The following parasites were found: *Endolimax nana* (63.9%), *Entamoeba coli* (29.9%), *Giardia intestinalis* (27.1%), *Entamoeba histolytica/E. dispar* complex (16%), *Iodamoeba butschlii* (2.1%); hookworms (47,9%), *Enterobius vermicularis* (10.4%), *Ascaris lumbricoides* (9.7%), *Trichuris trichiura* (5.5%), *Trichostrongylus* sp. (2.1%), *Schistosoma mansoni* (2.1%), *Strongyloides stercoralis* (1.4%) and *Taenia* sp. (2.8%).

The panorama of the species by method (Figure 1) suggests the classic spontaneous sedimentation (in common collector and processing for 24 hours) as an adequate method for identifying most of the parasitic forms. The Graham method with the greatest sensitivity for finding *Enterobius vermicularis* eggs and the Kato-katz method showed a slight quantification in the individuals studied (for the hookworm, *Trichuris trichiura, Enterobius vermicularis, Schistosoma mansoni* and *Ascaris lumbricoides* parasites).

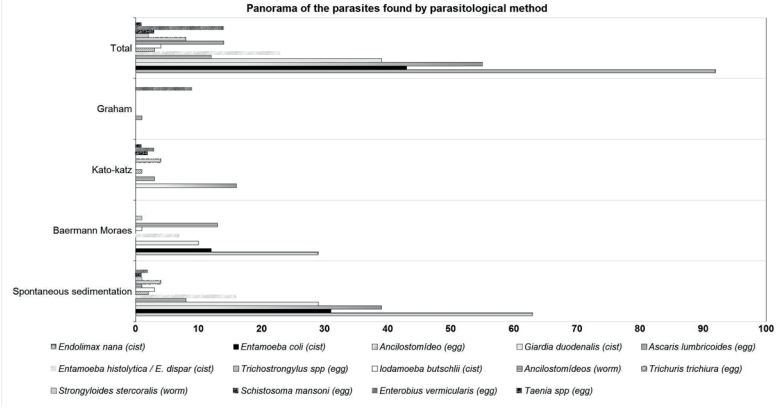

Figure 1. Panorama of the parasites found by parasitological method - Population of the rural area of Santo Antônio de Jesus-Bahia, 2015.

Figures 2A and 2B present the laboratory analysis data. In 2A, the highest prevalence of infection by intestinal protozoa was observed, with an approximate percentage of 35% (n = 50). In 2B, the category (degree) of parasitism accentuates a higher prevalence for infection by more than one parasite [biparasitic plus polyparasitic individuals, totaled 48% (n = 69) of the samples].

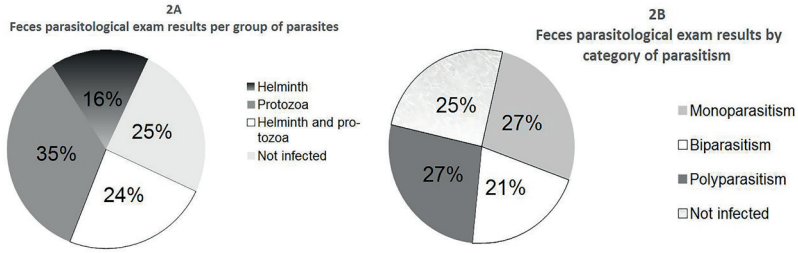

Figure 2. Feces parasitological exam results: (A) per group of parasites; (B) by category of parasitism-Santo Antônio de Jesus-Bahia, 2015.

The lower the monthly household income of the families surveyed, the greater the occurrence of parasites associated with bi- and/or polyparasitism (Figure 3A). The data presented predominantly the gender / female gender with a higher percentage of positivity for some enteroparasites (53.7%), with emphasis on bi- and polyparasitism (Figure 3B).

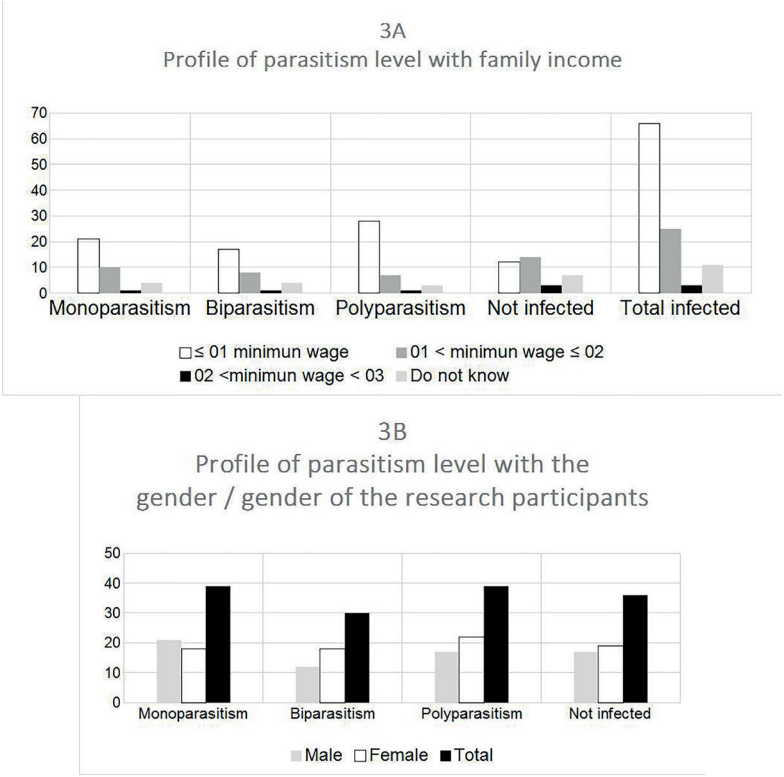

Figure 3. Profile of parasitism level: (A) with family income; (B) with the gender / gender of the research participants-Santo Antônio de Jesus, 2015.

The age brackets from 5 to 8 and from 38 to 43 years of age presented a higher prevalence of positive fecal samples, 12.0% and 9.3%, respectively. The total number of teenagers from 14 to 18 years of age and of the elderly over 81 years of age were 100% parasitized (Table 1). Statistical significance was observed with a p value <0.05 regarding positivity for enteroparasites among the age groups surveyed by Pearson's chi-square test.

Table 1. Age distribution of participants, level of education, marital status and labor data of adults correlated with positive for enteroparasites - Rural area of Santo Antônio de Jesus, 2015.

Variables	Parasitological Examination of Stool						P value
	Positive (n=108;75%)		Negative (n=36; 25%)		Total		
	n	%	n	%	n	%	
Age group (years)							< 0.05
0 ≥ x < 1	2	1.85	3	8.33	5	3.47	
1 ≥ x < 5	5	4.6	3	8.33	8	5.56	
5 ≥ x < 8	13	12.04	1	2.78	14	9.72	
8 ≥ x < 11	5	4.63	2	5.56	7	4.86	
11 ≥ x < 14	7	6.48	1	2.78	8	5.56	
14 ≥ x < 17	3	2.78	0	0	3	2.08	
17 ≥ x < 18	4	3.7	0	0	4	2.78	
18 ≥ x < 23	5	4.63	1	2.78	6	4.17	
23 ≥ x < 28	4	3.7	6	16.67	10	6.94	
28 ≥ x < 33	7	6.48	3	8.33	10	6.94	
33 ≥ x < 38	9	8.33	1	2.78	10	6.94	
38 ≥ x < 43	10	9.26	3	8.33	13	9.03	
43 ≥ x < 48	8	7.41	4	11.11	12	8.33	
48 ≥ x < 53	5	4.63	2	5.56	7	4.86	
53 ≥ x < 58	3	2.78	3	8.33	6	4.17	
58 ≥ x < 61	1	0.93	1	2.78	2	1.39	
61 ≥ x < 71	9	8.33	1	2.78	10	6.94	
71 ≥ x < 81	4	3.78	1	2.78	5	3.47	
81 ≥ x < 91	1	0.93	0	0	1	0.69	
91 ≥ x < 101	1	0.93	0	0	1	0.69	
≥ 101	2	1.85	0	0	2	1.39	

Variables	Parasitological Examination of Stool			
	Positive	Negative	Total	P value
	%	%	%	
Schooling for those over 18 years of age				< 0.05
None	24	16.36	18.75	
Incomplete basic	48	60	56.25	
Complete basic	8	0	2.5	
Incomplete Middle	12	18.18	16.25	
Complete Middle	8	3.64	5	
Incomplete higher education	0	1.82	1.25	
Marital status for those over 18 years old				>0.05
Not married	34.62	40	38.27	
Married	38.46	38.18	38.27	
Divorced	0	3.64	2.48	
Widowed	15.38	1.82	6.17	
Stable union	11.54	16.36	14.81	
Labor data for those over 18 years of age				>0.05
Works with a formal contract	7.69	5.36	6.1	
Works without a signed handbook	42.31	44.64	43.9	
Receive research grant or similar	0	3.57	2.44	
Other	34.62	21.43	25.61	
Received government benefit	15.38	25	21.95	

Source: Authors' data.

The parasites were widely distributed among the studied age groups. It is worth noting that from 14 to 18 years, the parasites were: *Entamoeba coli, Entamoeba histolytica / E. dispar* complex, *Endolimax nana, Giardia intestinalis, Ascaris lumbricoides*, hookworms, *Trichuris trichiura, Enterobius vermicularis.* For the age group above 81 years, the identified parasite was *Endolimax nana* (non-pathogenic, but indicative of oral-fecal contamination). Considering positivity in the age group between 0 and 1 year of age, the parasites found were: *Giardia duodenalis, Ascaris lumbricoides, Enterobius vermicularis* and *Endolimax nana*.

Regarding adult education, most of the interviewed people do not present complete basic education. The only individual with incomplete higher education did not present positivity in the analyzed sample (Table 1). Statistical significance was observed with $p < 0.05$ for positivity for enteroparasites among the studied schools, based on Pearson's chi-square test.

The largest portion of the adult population in the communities surveyed, considering the total percentages, consisted of married individuals within a stable union, also presenting higher frequencies for positivity to enteroparasites. It is noteworthy that 80% of the declared widows were parasitized (Table 1).

Most individuals worked without a formal labor contract. In regard to this variable, higher percentages were verified for the individuals with a negative sample for each category of the item. Data were not statistically significant (Table 1).

In the studied population, the highest percentages of individuals had undergone a feces parasitological evaluation one year or 6 months to more than a year before the moment of the interview for this study (Table 2).

Data were not statistically significant. Individuals who reported not having had a stool parasitology test less than 6 months previously or who had never had one or did not know how long it was since the last one stood out regarding polyparasitism.

Regarding positive result for helminths or protozoa on a previous feces parasitological examination, we highlight those who answered negatively to this question and presented positivity to enteroparasites in this study (Table 2). Data were not statistically significant ($p > 0.05$).

Even those who reported having used helminth or protozoan drugs in the last 12 months presented samples with positive results for enteroparasites and polyparasitism (Table 2).

Table 2. Data on parasitological exams and use of drugs correlated with positive for enteroparasites-Rural area of Santo Antônio de Jesus, 2015.

Variables	Parasitological Stool Examination				Total	P value
	Monoparasitism	Biparasitism	Polyparasitism	Not infected		
	n	n	n	n		
Time elapsed since the last parasitological feces examination						>0.05
Under 6 months	7	2	3	6	18	
From 6 to 12 months	8	8	11	9	36	
More than 12 months	17	17	16	16	66	
Never done	3	1	5	3	12	
Do not know	4	2	4	2	12	
Total	39	30	39	36	144	
Have had positive parasitological stool examination for helminths or intestinal protozoa						>0.05
Yes	5	10	10	9	34	
No	25	14	19	21	79	
Not applicable	2	1	3	3	9	
Do not know	7	5	7	3	22	
Total	39	30	39	36	144	
Have you taken any medicine for helminths or intestinal protozoa in the past twelve months						>0.05
Yes	14	9	11	19	53	
No	23	21	25	17	86	
Do not know	2	0	3	0	5	
Total	39	30	39	36	144	

Source: Authors' data.

DISCUSSION

Data on the identification of parasitic contamination in peridomiciliary soil, enteroparasite infection in humans and domestic animals in Riacho Dantas and Rio do Onha, rural community of Santo Antônio of Jesus (Bahia, Brazil) can be found in Andrade et al. (2018). Another view of this study generated the results presented in this paper.

The enteroparasites found in the studied population, whether pathogenic or commensal, and the association with socioeconomic, demographic and

cultural aspects, suggest a contamination cycle in the environment, mainly due to lack of basic sanitation. These data persist in a large number of municipalities in Bahia (Cabral-Miranda et al., 2010; Seixas et al., 2011; Oliveira & Amor, 2012; Carvalho et al., 2016).

The variable on adult educational level presented a higher prevalence of enteroparasite infections for those with incomplete elementary education, with statistical significance, which may be linked to ignorance regarding personal hygiene and / or food hygiene, a factor of extreme importance for the persistence of infection by enteroparasites. Since the highest percentage of positive fecal samples were found in adults with this level of education, the possibility of compromising the individual and the collective as well as association with care for the young population is explicit. Mascarini & Donalísio (2006) demonstrated a significant influence of maternal schooling and environmental quality, indicating that mothers with better schooling have more access to information on child development and can provide a better physical and emotional environment for the development of their children.

Intestinal parasitic diseases are observed more frequently in the lower social classes which present lower levels of schooling, and decrease gradually in the economically privileged classes with better levels of educational (Vasconcelos et al., 2011). The monthly income prevalent in the population in this study seems to be associated with higher positivity for enteroparasites.

Public agencies should establish public policies focusing on the reduction of parasitic infections, especially those actions focusing on health education plans in order to raise public awareness regarding hygiene and diseases caused by enteroparasites. Investments in areas such as health and infrastructure are also necessary (Fernandes, 2014). It is known that sanitary precariousness confirms socio-environmental inequality, which affects quality of life and harms human dignity (Maia et al., 2014).

The present study shows a general prevalence of 75% of the individuals parasitized by at least one parasite, a relatively high value when compared to other studies and with a higher prevalence of intestinal parasitism in the child and teenager population. The data corroborates the study carried out by Oliveira & Amor (2012) in the city of Araci-Bahia, Brazil.

Infection by enteroparasites should be observed from the first years of life, which complements the study by Busato et al. (2014), in which children presented risk of infection by intestinal parasites in Chapecó (Santa Catarina, Brazil). Therefore, those that often play barefoot, in soil that may be contaminated, in addition to the habit of placing their hands and objects in their mouths, are particularly vulnerable to infection by enteroparasites.

The two parasitized children under 1 year of age were positive for *Giardia intestinalis, Ascaris lumbricoides, Enterobius vermicularis* and *Endolimax nana*, enhancing how the environment can jeopardize the physical

and intellectual growth of these children, due to the cycle of infection and re-infection to which they will be submitted.

The presence of *Enterobius vermicularis*, is outstanding in stool samples from members of different families.

It is important to note that the elderly population, over 81 years of age, also presented parasitism with 100% positivity for a non-pathogenic parasite - *Endolimax nana* - which evidences the fecal-oral contamination in this population. Coproparasitological surveys should be carried out with the adult population, mainly with the elderly group, identifying their particularities, with the objective of proposing sanitary and educational measures to improve the health status of the population in general. The elderly group is considered vulnerable to parasitic diseases for many reasons such as the unfavorable environmental conditions and the progressive loss of autonomy regarding self-care with frequently inadequate personal and food hygiene, often dependent on caregivers who are not always prepared for this function (Matos & Murai, 2005).

The prevailing marital status was that of married individuals reportedly coexisting in stable unions. This group also presented higher percentages of enteroparasites in the samples analyzed. Considering the possibility of a family cycle, it is important to increase knowledge on personal and/or food hygiene, as well as the destination of residues and care with the presence of domestic animals which can serve as vectors for parasite dissemination and environmental contamination (Vieira & Benetton, 2013).

Another factor to be considered is that most of the infected individuals are engaged in informal work, without a formal contract, and since it is a rural environment, many of them work as farmers, in activities with the soil which is contaminated daily with fecal waste, facilitating the infection of these individuals. The previous analysis of the soil in the surveyed communities showed that it presents great contaminating potential, with the concomitance of protozoa and helminth nematodes, as well as some of the soil biota and other elements pathogenic to humans and/or their domiciled animals (Fonsêca et al., 2015).

The number of infected individuals who were polyparasited was higher than that found by Belo et al. (2012) in the city of São João del-Rei, Minas Gerais (Brazil), in which he discusses the controversy of the situation as high levels were expected since polyparasitism has been considered a norm rather than an exception. These data show the need to better investigate the impacts and occurrences that may be caused by polyparasitism in humans and the factors that predispose this occurrence to the particular community.

The data show that, even for individuals who reported the use of antiparasitic drugs for helminths and protozoa, positive samples were found for some of these enteroparasites or for both, indicating that curative medication is only punctual, requiring the onset of a more preventive practice, the result

of health education in conjunction with environmental modifications and the implementation of adequate sanitation.

The distribution of drugs to combat parasitic infection has been increasing over recent years in Brazil (Martins et al., 2014), where the prescription of broad-spectrum drugs has been a recurrent practice by physicians to combat parasitic diseases, especially in children, even without any classic symptoms. However, it is believed that without constant preventive measures and/or the establishment of infrastructure that avoids contact between the parasite and the host, cycles of infection and reinfection will continue to occur in these environments.

The inadequacy noted in studies of this type lies in the fact that not all the population researched received preventive return treatment according to the different degrees of prophylaxis, whether first degree or prevention, so that the infection does not occur by one of the parasites; for the second degree to combat parasitosis; and the third degree, to minimize damage already caused by the action of the parasite. In addition, there are not enough studies aimed at implementing measures that are relevant and essential to the community because many places are still deficient regarding basic sanitation and information on the correct way to perform personal and food hygiene (important mechanisms of infection for enteroparasites when inadequate). Therefore, it is necessary to monitor the health conditions of the population, especially children and teenagers, both those living in rural areas (countryside) and those living in urban environments (capitals) which present poor sanitary conditions in this country.

In order to better understand the specific demands related to health research in Brazil, defining priorities is a difficult task. In this way, it is hard to perform a survey of the country's epidemiological profile, characterized by persistent problems, including tropical and neglected diseases, emerging epidemics and chronic non-communicable diseases, in localities where the health investments needed are numerous and the resources to address them are limited. Identifying these priorities is fundamental to maximize the use of investments by directing public resources responsibly to meet the needs of the population (Brasil, 2018).

Ideally, the results of this study will help to prevent as well as solve public health problems, improve the quality of care and contribute to the implementation of more effective public health policies.

The prevalence of parasitic infections in the locality studied in Santo Antônio de Jesus, Bahia is still very high, especially in children and teenagers. In this context, it is necessary to develop knowledge-building activities regarding personal hygiene, domestic, environmental, and food hygiene associated with the implementation of basic sanitation by the authorities, since these are the factors that interfere directly in the contamination and infection of the comunity.

Most of the analyzed individuals were bi- and/or polyparasitized, and this result is associated with schooling, marital status and the type of work performed by the breadwinners, probably unable to actively contribute to the socio-educational training of the children and/or teenagers leading to their insufficient basic hygiene practices.

Further studies related to polyparasitism, its causes, factors and possible consequences in nutritional status and cognitive development, especially in children, are required, as well as the need for in depth understanding of risk factors correlated to geohelminths, in an attempt to improve the effectiveness of preventive and control measures regarding intestinal parasites.

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