American Journal of Food Science and Technology, 2015, Vol. 3, No. 4A, 24-31
Available online at http://pubs.sciepub.com/ajfst/3/4A/5

DOI:10.12691/ajfst-3-4A-5

Eating Habits as a Risk Factor for Intestinal Parasites in Individuals from Belém-PA

Leite MAG[1,*], Gomes MA[1], Santos JFG[4], Gil F[1], Travassos Filho D[2], Pertuzatti PBK[3]

[1]Departamento de Parasitologia, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Belo Horizonte - MG
[2]Hospital Universitário João de Barros Barreto(HUJBB), Universidade Federal do Pará, Belém-PA
[3]Instituto de Ciências Exatas e da Terra, Campus Universitário do Araguaia, Universidade Federal de Mato Grosso, Barra do Garças-MT
[4]Hospital do IPSEMG, Belo Horizonte, MG
* Corresponding author: merciagl@gmail.com

Received February 20, 2015; Revised April 25, 2015; Accepted September 10, 2015

Abstract Food security is fundamental for the maintenance of health indicators of a population. Enteroparasites are often associated with ingestion of water and contaminated food. The high prevalence of parasitic infection in the northern region compared to other regions of Brazil, with similar characteristics: lack of sanitation infrastructure and exposure to poor socioeconomic conditions is a fact to be investigated, it would be the power of the individual considered a determining risk factor for these indices? In this study the association between dietary habits, environmental exposure and hygienic-sanitary factors to the prevalence of intestinal parasites was evaluated. They collected blood for serology, stool to faecal examinations and parasitological examination of individuals residing in Belém-PA. A health-food questionnaire was applied at the time leading up to the gathering. In 40% of the samples evaluated in the EPF was found some kind of parasite. The complex E. histolytica / E. dispar showed 9.7% positivity. Serology for amebiasis showed high positive (44.03%), confirming the endemicity of the disease in the region. Although the responses from the health-food questionnaire reveal low socioeconomic status of the population under study we found no association between any of the items evaluated with the highest prevalence of amebiasis or intestinal parasites. This study revealed, therefore, that diet and hygiene and inadequate health in a population even though they are important sources of contamination, can not be decisive for intestinal parasites. Possibly the individual behavior is an important factor in relation to dietary habits, environmental and / or hygienic-sanitary. Considering the great diversity of eating habits and training in health education in Brazil, other regions should be evaluated to confirm these results continuing to study.

Keywords: *eating habits, intestinal parasites, risk factors*

Cite This Article: Leite MAG, Gomes MA, Santos JFG, Gil F, Travassos Filho D, and Pertuzatti PBK, "Eating Habits as a Risk Factor for Intestinal Parasites in Individuals from Belém-PA." *American Journal of Food Science and Technology*, vol. 3, no. 4A (2015): 24-31. doi: 10.12691/ajfst-3-4A-5.

1. Introduction

Intestinal parasites are a major public health problem in developing countries. Many parasites are responsible for these infections. Some, like *E. histolytica*, *E. dispar*, *Giardia lamblia*, *Hymenolepis nana*, *Taenia solium*, *Ascaris lumbricoides*, *Trichuris trichiura*, *Cryptosporidium parvum* and *Enterobius vermicularis* are transmitted by contaminated food or water [1]. They are also strongly associated with poor sanitation, hygiene, living and housing conditions, affecting not only the health of the individual but also the workforce thus having an impact in generating the country's wealth.

In literature, reports available on the prevalence of intestinal parasites in Brazil are scarce and very circumstantial because they generally consider specific populations (school, children, elderly or immunocompromised patients) and only reflect the reality of small towns. Thus, one does not know the prevalence of these parasites at the national level [2].

In relation to environmental conditions, underdeveloped countries are at higher risk of contamination. However, it is not a *sine qua non*. An example is Brazil, where, despite favorable conditions for *E. histolytica*, *E. dispar* predominates in most states. In a study by [3] on the prevalence of intestinal parasites in Fortaleza in two periods: before (1992-1996) and after the implementation of health interventions (2010), it was observed that improvements in health conditions in the area were reflected in a sharp change in the prevalence of intestinal parasites in the assessed community.

Several epidemiological surveys have been conducted to estimate the incidence and prevalence of amebiasis in Brazil. The Northern region stands out with the highest rates, with Belém-PA having the highest prevalence of *E. histolytica* with 29.5% of the resident population in the metropolitan area being infected [4].

Considering the endemicity of parasitic infection in the northern region compared to other regions of Brazil, with similar characteristics: lack of sanitation infrastructure and exposure to poor socioeconomic conditions, would the

eating habits of individuals be considered a key risk factor for intestinal parasites? The possible association of dietary habits, environmental exposure and hygienic-sanitary factors to the prevalence of intestinal parasites in the region was investigated.

2. Materials and Methods

2.1. Population

The study consisted of 318 patients treated at the Unified Medical Care Sector (SOAMU) of the Evandro Chagas Institute/MS (IEC) and the João de Barros Barreto University Hospital/UFPA (HUJBB), randomly invited to participate in the study. Patients were residents in Belém-PA and/or the metropolitan area, consisting of Belém, Ananindeua, Marituba, Benevides, Santa Barbara and Santa Izabel (Legislative Assembly of Pará 1995 and 2010). The material was collected in the months of March, April and July 2013, in both locations.

This research was approved by the Research Ethics Committee (COEP) of the Federal University of Minas Gerais. Before the collection, an interview was carried out, where the individual was presented with an Informed Term of Consent (TCLE) and a detailed explanation of the research objective.

A questionnaire was applied about the hygiene profile - sanitary and food, blood was collected and stool requested from the participants.

The results of parasitological and serological tests were sent to the participants about 30 days after collection, the positive cases were referred to medical care in the collaborating institution.

2.2. Sanitary-Dietary Investigation

A semi structured questionnaire was applied in order to evaluate a possible relation between hygienic-sanitary and dietary factors and seropositivity for invasive amebiasis in the participating study subjects.

The sanitary-dietary investigation presents approaches on the individual's profile regarding living conditions, hygiene and nutrition, which can provide information related to risk factors for incidence of infectious diseases via oral-fecal contamination.

With the sanitary-dietary investigation, information on the following variables was obtained: demographics (sex), eating habits (type of diet, alcohol intake, food hygiene), factors related to housing (type of construction, water quality, access to sanitation, garbage disposal), factors related to water distribution and wastewater treatment.

Afterward, participants were advised on preventive measures to avoid infection by intestinal parasites.

2.3. Parasitological Examination of Stools

Fecal material was collected in pots made available by the institution and frozen at -20°C on reception, without adding preservatives. The samples were then sent to the Laboratory of amoebiasis and Intestinal Parasites (LAPI) in the Institute of Biological Sciences (ICB) at UFMG.

Upon analysis, the sample was thawed and concentrated by centrifugation in formol-ether for microscopic observation of pellets, and then stained with Lugol for intestinal parasites research.

For the diagnosis of infection by *E. histolytica*/*E. dispar*, optical microscopy, has been historically chosen, despite its inability to differentiate the two forms.

2.4. Serology for Amebiasis

In this study, the ELISA technique was used, according to a protocol defined by [5] modified and used as a routine method for amebiasis serology in the and in the Laboratory of Amebiasis and Intestinal Parasites (LAPI / ICB / UFMG).

Venous blood (5ml) was collected in vacuum tubes from each individual without an anticoagulant. After clot formation, the serum was separated, aliquotted in plastic tubes and stored in a freezer at -20°C.

The material was transported covered in artificial ice, inside sealed coolers for to the Laboratory of amoebiasis and Intestinal Parasites diseases at the ICB Institute of UFMG where the technique was performed.

The presence of anti-*E. histolytica* antibodies was detected in the sera of the participants by means of the ELISA reaction.

Plates were coated with antigens obtained from axenic strains and cutoff point was determined for the community under study, using negative sera as controls.

The confirmation of *E. histolytica* infection is an invasive indicator of intestinal amoebiasis and/or extra intestinal amebiasis, with hepatic abscesses being among the most frequent extra-intestinal forms [6].

2.5. Statistical Analysis

Absolute frequency was calculated individually for the questionnaire results, the Parasitological Stool Examination (EPF) and serology, for a clearer and independent view of the data. The SPSS program (*Statistical Package for Social Science* - Version 22.0) was then used for association between the results obtained in each section.

Initially, the average, median, quartiles, minimum, maximum and standard deviation were used for the identification of the main characteristics of the participants. For comparison between groups, the comparison test of two independent groups t-Student was used.

In the analysis of normality, the Kolmogorov-Smirnoff test was used, finding that the variable "percentage of ancestry" did not have normal distribution. Thus, when comparing the groups, the continuous variables were compared using the Mann-Whitney U-test and Kruskal-Wallis non-parametric ANOVA.

In analyzing the normality of continuous variables, the Kolmogorov-Smirnoff test was used. Categorical variables were described as proportion and percentages, and continuous variables as mean ± SD, or median with interquartile range (25-75%). When comparing the groups, Student's t-test was used for continuous parametric variables, and U-Mann-Whitney test for the non-parametric.

To Compare the categorical variables, the chi-square test or Fisher's exact test were used. The non-parametric Kruskal-Wallis ANOVA was also used to compare multiple groups, followed by the Dunn test. Differences

with p <0.05 were considered statistically significant at the 95% confidence interval.

3. Results

3.1. Parasitological Examination of Stools

Analyses were performed on the stool of 195 individuals who provided the material. The parasite with the highest frequency was *Blastocystis* sp (25.6%), followed by *E. histolytica* / *E. dispar* (9.7%) and *Endolimax nana* (8.2%). The table below (Table 1) shows the distribution of parasites in the tests and the relation to water supply and sewage services.

Table 1. Association of different parasites with the water supply and sewage service.

	Distribution of parasites in 195 tests		Prevalence of parasites species and absence of water supply					Prevalence of parasites species and absence of sewage service				
			WoWS		WWS			WoSS		WSS		
Parasites	N	%	N	%	N	%	p	N	%	N	%	p
Blastocistys sp	50	25.6	22	24.4	28	26.7	0.723	42	26.8	8	21.1	0.470
E coli	18	9.2	8	8.9	10	9.5	0.879	13	8.3	5	13.2	0.351
E histolytica E dispar	19	9.7	6	6.7	13	12.4	0.180	17	10.8	2	5.3	0.299
Trichura trichiura	14	7.2	6	6.7	8	7.6	0.797	12	7.6	2	5.3	0.610
Endolimax nana	16	8.2	5	5.6	11	10.5	0.212	14	8.9	2	5.3	0.461
Giardia lamblia	5	2.6	2	2.2	3	2.9	0.780	5	3.2	0	0.0	0.265
Ancilostomídeos	3	1.5	1	1.1	2	1.9	0.654	3	1.9	0	0.0	0.390
Ascaris lumbricoides	2	1.0	0	0.0	2	1.9	0.188	2	1.3	0	0.0	0.484
Hymenolepis nana	1	0.5	0	0.0	1	1.0	0.353	0	0.0	1	2.6	0.042

WoWS= Without Water Supply; WWS= With Water Supply; WoSS = Without Sewage Service; WSS= Whth Sewage Service

3.2. Serology

In serology, a high positivity index was observed in the ELISA test, at a dilution of 1:100 in serum samples and 2 standard deviations. Of the 318 participants in the study, 140 patients (44.03%) were positive for anti *E. histolytica* antibodies, i.e., presented or present amoebic infection, since the detection of IgG may mean a returning or current infection.

The association between positive and negative serology with the results of stool testing are shown in Table 2.

Table 2. Prevalence of parasite species and serology for *E. histolytica*.

	Negative serology		Positive serology		
Parasites	N	%	N	%	p
Blastocistys sp	26	25,7	24	25,5	0,973
E histolytica E dispar	12	11,9	7	7,4	0,297
Trichura trichiura	11	10,9	3	3,2	0,037
Endolimax nana	11	10,9	5	5,3	0,157
E coli	9	8,9	9	9,6	0,873
Ancilostomídeos	2	2,0	1	1,1	0,603
Giardia lamblia	2	2,0	3	3,2	0,593
Ascaris lumbricoides	1	1,0	1	1,1	0,959
Hymenolepis nana	1	1,0	0	0,0	0,333

3.3. Epidemiological Investigation

The objective of this survey from the collected data was to identify environmental factors, health and eating habits that could contribute to the incidence and aggravation of infectious diseases with an oral-fecal contamination route.

The survey covered the following topics: sex, quality of water consumed, exposure to environmental risk factors, personal hygiene, food quality, consumption of alcohol.

3.3.1. Sex

The survey had 43.7% male individuals and 56.3% females.

3.3.2. Quality of the Consumed Water

Regarding the water supply available to the residences, most have access to the general network (55.7%). 44.7% of participants consumed well water and 0.9% reported that they used water from other sources such as river, streams, etc.

Considering the high percentage of users of non potable water, participants were asked about the care of the water consumed at home. Among the respondents, 29.9% filtered water before consumption, 0.9% do chlorination in their own residence, none of the respondents claimed to use the boiling process (0%) and most (69.5%) reported consuming water just the way it reached the household, without further treatment.

Among the individuals who chose “not do any treatment” to the water consumed in their household, there were many reports of mineral water use, however, in the absence of resources to acquire this, they consumed any water available in the home regardless of the origin.

3.3.3. Exposure to Environmental Risk Factors

In 54 (17.0%) households, the general sewage network was the target of sanitary wastewater, while the septic tank was present at the residence of 236 respondents (74.2%), the answer "other" was informed by 1 participant, and 6.9% of households had no sewage at all.

Garbage Destination

The conditions of allocation of the waste produced in the home were assessed. The reported data showed that in 94.7% of households, garbage is collected frequently, in 12 households garbage is burnt/buried (3.8%) and 6 residents leave it out in the open (1.6%).

Type of Housing Construction

The housing conditions of the participants: type of construction, number of rooms and number of residents were assessed. For the last two questions there were no defined options for answers, the categories were prepared from the data obtained. Thus, the number of rooms mentioned ranged from 1 to 10 and the amount of people in each residence from 1 to 13.

Most respondents (78.9%) lived in brick houses. Two respondents said they live in wattle and daub houses (0.6%), 48 people said they live in wooden houses (15.1%) and 18 (5.7%) on stilts.

As for the rooms of the houses, the answers ranged from 1 to 10 rooms, the majority of participants lived in dwellings with four (23.6%) or 5 (22.3%) rooms (Figure 1). The number of residents in each household ranged

from 1 to 13, with 4 people per household being more frequent (Figure 1b).

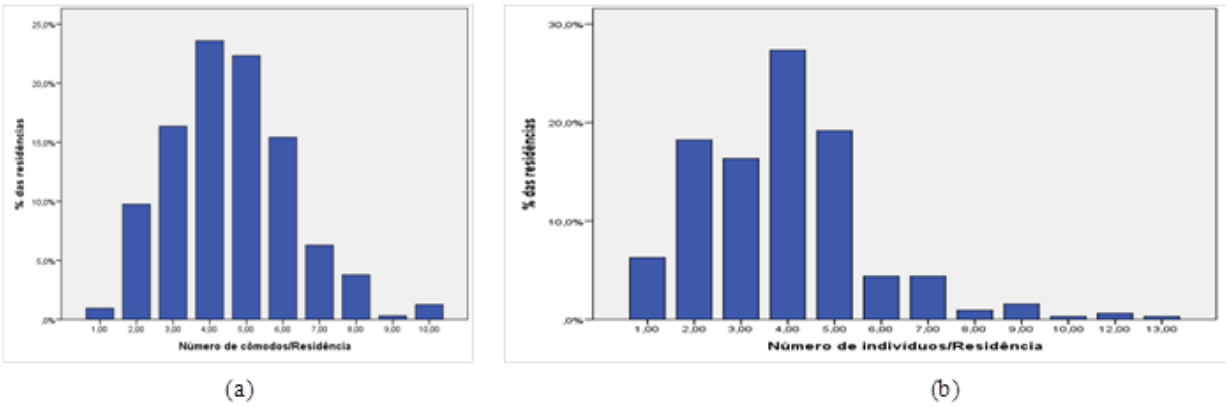

Figure 1. (a) number of rooms per residence; (B) Number of individuals per residence.

3.3.4. Food Quality

Looking to determine the dietary routine of participants, it was found that rice (83.6%), flour (58.9%), beef (38.1%), chicken (28.9%), beans (27.7%), fish (25.5%) and açaí (23.0%) were the most cited and only three participants said they eat shrimp (0.9%).

The frequency in the preferred food consumption revealed that the vast majority (95.3%) of participants consumed their food of "preference" daily.

Seeking to set the frequency of ingestion of raw foods, it was found that 45.3% of participants had this eating habit. Among the individuals who consume raw food, the choice of vegetables was the most frequent (51.9%), followed by legumes (31.8%) and fruits (34.0%). Regarding the intake frequency, 17.3% of respondents said they consume raw foods daily.

Most of the study participants (99.4%) do not grow food at home, just 2 respondents (0.6%) reported the habit of producing vegetable gardens or orchards. These said they lived in coastal communities in municipalities in the metropolitan region of Belém-PA.

Participants who used raw foods were asked about the form of cleaning them. The majority (51.3%) just washed the food in tap water, whereas 46 subjects claimed they sanitized food with vinegar (14.5%), 31 using hypochlorite (9.7%) and 6 cleaned with filtered water (1.9%).

Regarding the intake of high nutritional value protein, the consumption of meat and milk were considered. Most participants responded that they eat meat daily (33.6%), followed by 28% of participants who said to eat meat three times a week and 15.7% of participants who consumed meat two times a day. In a smaller quantity, a once a week (7.9%) consumption was also reported and a weekly consumption of 4 times (5.0%), while participants who said they did not eat meat and those who eat five times per week had the same percentage (4.7%) and finally 0.9% of participants reported eating meat rarely.

With regard to drinking milk, 247 participants (77.7%) reported drinking it every day, followed by 49 participants (15.4%) who do not have the habit of consuming milk. In lower numbers, 2.5% of the participants reported that they rarely consumed milk, while 1.9% consumed three times per week and 1.3% consumed twice or once a week.

3.3.5. Alcohol Consumption

Whereas excessive consumption of alcohol leads to intestinal infections, frequency of consumption was investigated. Among the participants, 18.6% said they were consumers, with the majority (11.6%) drinking once a week on average and 6.9% said they consumed twice a week.

3.4. Serology Association with Independent Variables

Association serology for *E. histolytica*, with water, sanitation and housing, number of rooms and residents in dwellings (Table 3, Table 4 and Table 5):

Table 3. Relation of *E. histolytica* serology with water, sanitation and housing

Variables	Negative Serology		Positive Serology		p
	N	%	N	%	
Water Treatment: Filtered	51	28.7	44	31.4	0.591
Water Treatment: Chlorination	1	0.6	2	1.4	0.427
Water Treatment: Boiling	0	0.0	0	0.0	.
Water Treatment: other	125	70.2	96	68.6	0.751
Sewage Service: General Network	36	20.2	18	12.9	0.082
Sewage Service: Septic tanks	129	72.5	107	76.4	0.423
Sewage Service: Other	1	0.6	0	0.0	0.374
Sewage Service: None	10	5.6	12	8.6	0.303
Garbage Destination: Collected	168	94.4	133	95.0	0.808
Garbage Destination: Burnt	6	3.4	6	4.3	0.671
Garbage Destination: Leave it out open	4	2.2	1	0.7	0.275
Garbage Destination: Other	0	0.0	0	0.0	.
Housing Construction: Brick	140	78.7	111	79.3	0.891
Housing Construction: Daub	1	0.6	1	0.7	0.864
Housing Construction: Wooden	30	16.9	18	12.9	0.323
Housing Construction: Other	8	4.5	10	7.1	0.310

Table 4. Relation of *E. histolytica* serology with the number of rooms in housing

Variables	Negative Serology		Positive Serology		p
	N	%	N	%	
Number of rooms: 1	1	0.6	2	1.4	0.427
Number of rooms: 2	19	10.7	12	8.6	0.530
Number of rooms: 3	34	19.1	18	12.9	0.135
Number of rooms: 4	46	25.8	29	20.7	0.285
Number of rooms: 5	33	18.5	38	27.1	0.067
Number of rooms: 6	25	14.0	24	17.1	0.447
Number of rooms: 7	12	6.9	8	5.8	0.694
Number of rooms: 8	8	4.5	6	4.3	0.928
Number of rooms: 9	0	0.0	1	0.7	0.259
Number of rooms: 10	1	0.6	3	2.1	0.209

Table 5. Relation of *E. histolytica* serology with the number of residents per household

Variables	Negative Serology		Positive Serology		p
	N	**%**	**N**	**%**	
Number of residents: 1	12	6.7	8	5.7	0.708
Number of residents: 2	33	18.5	25	17.9	0.876
Number of residents: 3	29	16.3	23	16.4	0.974
Number of residents: 4	42	23.6	45	32.1	0.090
Number of residents: 5	40	22.5	21	15.0	0.093
Number of residents: 6	6	3.4	8	5.7	0.312
Number of residents: 7	11	6.4	3	2.2	0.084
Number of residents: 8	2	1.1	1	0.7	0.708
Number of residents: 9	3	1.7	2	1.4	0.851
Number of residents: 10	0	0.0	1	0.7	0.257
Number of residents: 11	0	0.0	0	0.0	.
Number of residents: 12	0	0.0	2	1.4	0.110
Number of residents: 13	0	0.0	1	0.7	0.259

4. Discussion

For contextualization of the reality of Belém and the risks of getting infection by intestinal parasites, positioning becomes necessary. The city of Belém is intersected by Guamá and Acara rivers, which meet in Guajará Bay forming many islands, with high rainfall, which puts the region in a distinct situation of environmental risk and health. One of the main means of transport is the river and the forest is still very present in the landscape of the region.

In feeding, native fruits like açai and peach palm become more scarce every year due to the low sustainability of production and high cost of marketing. Since there is still availability of fish due to geographic site structure, this is still a preferably eaten food with cassava flour and/or açai [7].

In the responses to the questionnaire asked during the interview, there were many spontaneous reports on the occurrence of parasitic infections in several episodes throughout the life of individuals. In their childhood, many lived in riverside communities or even used the waters of the rivers and springs for consumption and leisure, and in the report they used painful expressions to express episodes of colitis and diarrhea experienced.

However, we found no association between any of the analyzed factors (gender, quality of water consumed, exposure to environmental risk factors, quality of food and alcohol drinking) with the presence of intestinal parasites. Similar results were found by [8], who found high prevalence of intestinal parasites in communities on the outskirts of Belo Horizonte, finding no association with environmental factors and health structure. These results suggest that individual behaviors could be related to higher transmission of intestinal parasites in the two regions.

4.1. Enteroparasitosis

The poor socioeconomic conditions of the studied region, and the lack of sanitation in most locations, exposes people to greater risk of contracting infections via oral-fecal route. In the northern region of Brazil, the occurrence of intestinal parasites is high, especially in the riverine population, area of greatest deficiency of basic sanitation. The results of [9] showed positivity in 94.5% of the Parasitological stool examination (EPF), finding Entamoeba sp. (36.26%) as the most frequent among the protozoa.

Among the listed individuals, 195 provided material for the stool test. In 40% of the samples evaluated in the EPF, some kind of parasite was found. The complex E. histolytica / E. dispar showed 9.7% positivity. Exceptional numbers for Brazil, nevertheless considered low compared to the numbers found in literature for this region [4].

According to [10] the time between the evacuation of feces and the transport to the laboratory may influence the result, the ideal is that research take place in three stool samples on alternate periods of up to ten days, thereby increasing security of operations in enteroparasite research as it contemplates the intermittence in their life cycle.

In Brazil, the geographical distribution of amebiasis is diverse, communities located in the Southeast and Northeast with a reduced number of individuals infected with E. histolytica / dispar in relation to the North.

The reference [11] found E. histolytica / E. dispar in 34 samples (2.0%) in a study in Rio de Janeiro. In a research conducted in Alagoas in 68 (3.8%) fecal samples analyzed by optical microscopy, the presence of complex E. histolytica /E. dispar was detected [12].

The reference [8] evaluated the prevalence of intestinal parasites in communities on the outskirts of Belo Horizonte, and identified 3.5% infected with the complex.

The multiparasitism situation is common among the patients in this study, and other parasites were also found.

The data indicate a prevalence of Blastocystis hominis (25.6%) and Endolimax nana (8.2%).

The reference [13] showed significant association between E. histolytica / E. dispar and B. hominis, from 34 cases positive for E. histolytica / E. dispar, 20 cases (58.8%) also had B. hominis, indicating a possible influence of one on the pathogenicity of the other, as occurs in relation to the bacteria of the intestinal flora.

4.2. Environmental, Sanitary and Dietary Factors

Respondents mostly consumed water from the water supply system (55.7%), however, there is a significant percentage of individuals who use well water (44.7%), when asked about the fact, these justified that the quality of water reaching the taps was the main reason for the choice. Given that the water coming out of the central supply is of good quality, possibly the contamination occurs along the path leading to the household tap, this could be by inadequate pipes (old, damaged) and / or the reservoir of the houses.

People who said they use water from rivers and streams for drinking without any treatment were categorized as other (0.9%), this figure is considered low compared to the total sample, this data is attributed to the fact that most respondents reside in urban areas, different profile of coastal communities.

During the interview several people said they use bottled water for drinking, however, as financial resources are often limited, they end up alternating with tap water. This statement was fairly frequent and exposure to the risk factor associated with low health education is observed in this statement, as the interviewee does not know the importance of this practice in getting diseases. These participants were then instructed, at the end of the interview, to consume filtered water, since it would solve the issue of quality of drinking water and make consumption of mineral water unnecessary, saving money for the family, this water treatment method is used by 29.9%, who said they filter water before consumption.

Participants who did chlorination in their own homes lived in riverside communities without access to the water supply network and were instructed to use this method by health workers who visit their homes.

The ingestion of water or food contaminated with waste is an important risk factor for the occurrence of parasitic infections [14], most of the subjects in our study (69.5%) did not do any treatment in the water consumed in their homes. Despite this, we found no correlation between water consumption in general and a higher risk of parasitic infection. Perhaps this result relates indifference on water quality from the supply network and artesian wells, which, incidentally, consisted of almost half of the respondents.

We know that it is not the water supply only, but also the sewage network is a base for improving the quality of life and increase human development index in a region. Infectious diseases are the main obstacles for the development of regions that do not have the benefits of Sanitary Engineering. In Belém, the majority of respondents (74.2%) said they use septic tanks at their home. Some respondents reported that despite the use of septic tanks or bathroom, the waste produced by residents is distributed in the vicinity of their homes. Considering the high rainfall in the region, the spread of infected waste becomes reality. This behavior of respondents might relate to indifference in the prevalence of intestinal parasites among the recipients of the sewage network and by those who use the septic tank, and we consider that much of the population under study did not have sanitation.

The type of housing was evaluated to idealize the financial condition of the respondents, since we obtained material from individuals of Belém. The type of housing, number of rooms and people in each housing led us to conclude that we worked with a population of low income.

The food consumption patterns depend on factors such as socioeconomic and demographic, cultural and historical aspects of life of individuals [15]. So we try to assess the possibility of differences in the menu of the North relate to higher prevalence of amebiasis.

There was a variety of dishes mentioned (31 kinds), with the most common being rice (83.6%), flour (58.8%), beef (38.1%), chicken (28.9%), fish (25.5%), bean (27.7%) and acai (23.0%). We did not identify any different food consumed in other areas that could be related to greater predisposition to amebiasis. We actually did not verify differences in the consumption of raw foods (about 50% of respondents consume them), which can enhance the spread of intestinal parasites, mainly due to poor hygiene of the same.

Most respondents (51.3%) used only tap water for cleaning, similar to what is observed in other regions [8,16].

Most cited food eaten raw were tomato and lettuce. A report by [9] shows the presence of parasites in all evaluated lettuce samples. The most frequent were *Entamoeba coli* (67%), *E. histolytica* (20%), *Giardia* sp (13%) and *Ascaris lumbricoides* (7%).

Protein malnutrition can be an important predisposing factor for acquiring infections [17]. We evaluated the intake of protein of high nutritional value by participants through milk and meat consumption. We also assessed alcohol intake as predisposition factor for malnutrition.

Most people said they consumed meat and milk with great frequency. Alcohol consumption remained reasonable (18.6%) with no exacerbations that culminated in danger to health. So our study population did not present nutritional deficiencies.

Our results corroborate a study by [15] who found a reduced frequency of consumption of vegetables, fruits and vegetables and high intake of meat, sausages, milk and dairy products in more than 1/3 of the population studied.

4.3. Serology

Serology for amebiasis was an important analysis in this work. The amebiasis, infection by *E. histolytica*, can happen across the globe, but symptomatic infections are more common in certain regions. The asymptomatic amoebiasis produces no detectable antibody response in conventional immunoassay. The opposite is observed for symptomatic cases, where there is invasion of intestinal and extra-intestinal tissues by the amoebae with positive serology in almost all cases in unknown time, even after treatment [18-23]. Considering the above, we can conclude that the positive serology is a marker of severity and prevalence of infection in the region.

The Northern region of Brazil was chosen to carry out the work to maximize the possibility of finding people with the disease. However, diagnosis in this region is usually presumptive. Individuals showing symptoms of severe hepatomegaly and dysenteric colitis are treated for amoebiasis. So it was hard to find anyone with the disease currently. Many of our respondents reported being treated for amoebiasis (the disease is well known in the region). In this clash, serology has become a tool to identify amebiasis whether invasive, active or returning.

There is a small number of research in the region studied using the ELISA method for serology in the amoeba research, the data in the literature only shows values in the EPF, coproantigen and PCR. The method used in an investigation may underestimate or overestimate the prevalence of the disease. The ELISA has high sensitivity and specificity in the diagnosis of amebiasis [24].

Immunological and molecular methods have better sensitivity and specificity for optical microscopy. The detection of antibodies by the ELISA test is one of the most used tools in the diagnosis of invasive extra intestinal amebiasis, such as amebic liver abscess, with 90% sensitivity. In the invasive intestinal forms, the sensitivity is around 70% for anti *E. histolytica* antibodies in serum [25,26].

The positive serology for amebiasis may indicate previous infection, since, the immunoglobulin G (IgG) for *E. histolytica* detected by the method can be found in the individual years after being infected (Santos and Smith 2008). However, high titers of IgG, are observed only at the beginning of the infection a few weeks of the onset of symptoms of amoebic colitis and amebic liver abscess [25,27].

The results found in the serology of the 318 participants in this study indicated a high frequency (44.03%) of amebiasis in the studied community. However, this method is not routinely used in the diagnosis because of the cost associated with under-reporting of the disease in the region, resulting in no documented evidence which may be used as a parameter for controlling the strategic management of amoebiasis.

To identify *E. histolytica* in positive samples for the complex in the stool test, we carried out the specific test for *E. histolytica* coproantigen.

Participants who tested positive also had their stool processed for the specific enzyme immunoassay for identifying *E. histolytica*. None of the 174 samples analyzed was positive. Possibly due to low levels of antigens present in the samples. According to [28], high levels of *E. histolytica* antigen are required for detection, suggesting an inability of this kit to detect low numbers of parasites in samples, especially in asymptomatic individuals in endemic areas, which may be infected with both types of amoebae.

5. Conclusion

Historically it is considered that eating habits can be considered a determining risk factor for intestinal parasites, the data obtained in this study indicate that this association was not significant.

High prevalence of intestinal parasites and the complex *E. histolytica* / *E. dispar* is observed in this population compared to other regions of Brazil.

By identifying symptomatic amoebiasis (active or not), detected by serology, this proved to be very prevalent in the population sample, corroborating descriptions of respondents and the expectation for the region.

Dietary factors, environmental and health were not associated with parasitic infections and even serology for amebiasis, signaling a re-reading of this relationship.

References

[1] Neves, Neves DP, De Melo AL, Vitor RWA, *Parasitologia Humana*, 12.ed. São Paulo: Atheneu. 2011, 494 pp.

[2] Braz AS, de Andrade CAF, da Mota, LM H e Lima CMBL, Recomendações da Sociedade Brasileira de Reumatologia sobre diagnóstico e tratamento das parasitoses intestinais em pacientes com doenças reumáticas autoimunes. *Revista Brasileira de Reumatologia*, 2014.

[3] Oliveira, MAA, Prevalência de enteroparasitoses em comunidade carente de Fortaleza-Ce: comparação entre duas décadas. Dissertação, Universidade Federal do Ceará, Fortaleza, 2011, 74 pp.

[4] Silva MCM, Monteiro CSP, Araújo BAV, Silva JV, Povoa MM Determinação da infecção por *E. histolytica* em residentes da área metropolitana de Belém, Pará, Brasil, utilizando ensaio imunoenzimático (ELISA) para detecção de antígenos. *Cadernos de Saúde Pública*, 21(3): 969-973, 2005.

[5] Okazaki M, Miranda P, Neto J, Diegues V, Alves J, Cauas M,. .. & Takeuchi T,. Parasitological and serological studies on amoebiasis and other intestinal parasitic infections in Recife and its suburban area, Northeast Brazil. *Rev. Inst. Med. trop. S. Paulo*, 30: 313-321, 1988.

[6] Benetton MLFN, Estudo epidemiológico para identificação de fatores de risco para amebíase na cidade de Manaus-Amazonas. PhD Thesis, Universidade Federal de Minas Gerais, Belo Horizonte, 169 pp, 2003.

[7] Santana ACD, Santana ÁLD, Santana ÁLD, Santos MASD & Oliveira CMD, Multiple discriminant analysis of the retail açaí market in Belém do Pará. *Revista Brasileira de Fruticultura*, 36 (3): 532-541, 2014.

[8] Gil FF, Busatti HG, Cruz VL, Santos JF, Gomes MA, High prevalence of enteroparasitosis in urban slums of Belo Horizonte-Brazil. Presence of enteroparasites as a risk factor in the family group. *Pathogens and global health*, 107 (6): 320-324, 2013.

[9] Silva AMBD, Bouth RC, Costa KSD, Carvalho DCD, Hirai KE, Prado RR & Ribeiro KTS, Ocorrência de enteroparasitoses em comunidades ribeirinhas do Município de Igarapé Miri, Estado do Pará, Brasil. *Revista Pan-Amazônica de Saúde*, 5 (4): 45-51, 2014.

[10] Rey, L. *Bases da Parasitologia Médica*, 3.ed. Rio de Janeiro: Guanabara Koogan, 2010. 379 p.

[11] Macedo HW, Gonçalves AMH, Almeida CB, Dias LVB, Muniz MF, Infecção por *Blastocystis hominis* e *E. histolytica/Entamoeba dispar* em pacientes atendidos em um hospital localizado em Niterói, Rio de Janeiro. *Revista de Patologia Tropical*, 39 (1): 56-62, 2010.

[12] Duarte, IAC, Santos RV, Fontes G, Galindo LF, Ximenes RAA, Maciel MAV, Aca IS, Rocha EMM, Prevalencia de infección por *E. histolytica* en escuelas públicas de la ciudad de Maceió, Alagoas, Brasil. *Revista Cubana de Medicina Tropical*, 65 (1): 4-12, 2013.

[13] Cordeiro TGP, De Macedo HW, Amebíase. In: *Revista de Patologia Tropical*, Rio de Janeiro, 36 (2): 119-128, 2007.

[14] Cardoso BC, Avaliação da incidência de enteroparasitos em crianças e manipuladores de alimentos no centro de referência em educação infantil. Monografia. Universidade Federal da Paraíba, João Pessoa, 2014, 51 p.

[15] Azevedo EC, da Silva Diniz A, Monteiro JS & Cabral PC, Padrão alimentar de risco para as doenças crônicas não transmissíveis e sua associação com a gordura corporal-uma revisão sistemática. *Revista Ciência & Saúde Coletiva*, 19 (5), 2014.

[16] Nolla AC & Cantos GA, Relação entre a ocorrência de enteroparasitoses em manipuladores de alimentos e aspectos

epidemiológicos em Florianópolis, Santa Catarina, Brasil. *Cad Saúde Pública*, 21 (2): 641-5, 2005.

[17] Corware K, Yardley V, Mack C, Schuster S, Al-Hassi H, Herath S & Kropf P, Protein energy malnutrition increases arginase activity in monocytes and macrophages. *Nutrition & Metabolism, 11* (1): 51, 2014.

[18] Haque R, Mollah NU, Ali IK, et al. Diagnosis of amebic liver abscess and intestinal infection with the Techlab Entamoeba histolytica II antigen detection and antibody tests. J Clin Microbiol, 38: 3235-9, 2000.

[19] Gandhi BM, Irshad M, Chawla TC & Tandon BN, Enzyme linked protein-A: an ELISA for detection of amoebic antibody. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 81 (2): 183-185, 1987.

[20] Jackson TFHG, Anderson CB & Simjee AE, Serological differentiation between past and present infection in hepatic amoebiasis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 78 (3): 342-345, 1984.

[21] Juniper K, Worrell CL, Minshew MC, Roth LS, Cypert H & Lloyd RE, Serologic diagnosis of amebiasis. *The American journal of tropical medicine and hygiene*, 21 (2): 157-168, 1972.

[22] Krupp IM & Powell SJ, Comparative Study of the Antibody Response in Amebiasis Persistence after Successful Treatment. *The American journal of tropical medicine and hygiene*, 20 (3): 421-424, 1971.

[23] Yang J & Kennedy MT, Evaluation of enzyme-linked immunosorbent assay for the serodiagnosis of amebiasis. *Journal of clinical microbiology*, 10 (6): 778-785, 1979.

[24] Tan ZN, Wong WK, Noordin R, Zeehaida M, Olivos GA & Lim BH, Efficacies of two in-house indirect ELISAs for diagnosis of amoebic liver abscess. *Tropical Biomedicine*, 30 (2): 250-256, 2013.

[25] Sánchez-Guillén MC, Pérez-Fuentes R, Salgado-Rosas H, Ruiz-Arguelles A, Ackers J, Shire A, Talamás-Rohana P, Differentiation of *E. histolytica* / *Entamoeba dispar* by PCR and their correlation with humoral and cellular immunity in individuals with clinical variants of amoebiais. *American Journal Tropical and Medicine Hygiene*, 66 (6): 731-737, 2002.

[26] Tanyuskel M, Petri WA, Laboratory diagnosis of amebiasis. *Clinical Microbiology*, 16 (4): 713-729, 2003.

[27] Weber C, Guigon G, Bouchier C, Frangeul L, Moreira S, Sismeiro O & Guillén N, Stress by heat shock induces massive down regulation of genes and allows differential allelic expression of the Gal/GalNAc lectin in E. histolytica. *Eukaryotic cell*, 5 (5): 871-875, 2006.

[28] Acuna-Soto R, Samuelson, J, Girolami, P, Zarate, L, MillanVelasco, F, Schoolnick, G, Wirth, D, Application of polymerase chain reaction amplification to the epidemiology of pathogenic and non pathogenic E. histolytica. American Journal of Tropical Medicine and Hygiene, 48 (1): 58-70, 1993.