



## Intestinal protozoa parasites association with anemia in people from Brazilian western Amazon communities

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### ABSTRACT

**Introduction:** Nowadays intestinal parasitic infection remains an important public health trouble in Latin and South America, emphasizing the Amazon region. Furthermore, intestinal parasites have been considered important factors in etiology of nutritional anemia and malnutrition. **Objective:** This study aimed to evaluate the intestinal parasitic infection and its possible association with anemia in people from Amazon communities. **Methods:** The study was a research in documentary records, descriptive, retrospective and cross-sectional, with confirmed cases of parasites infection found in State Hospital of Cacoal-Rondônia, Brazilian Western Amazon. The parameters evaluated were gender, age, race, parasites, hematocrit and hemoglobin. **Results:** Females were slight higher for the number of cases of parasites occurrence (51%) compared to males (49%) and children had higher parasitic index (43%) followed by adults (37%), teenagers (11%) and seniors (9%). With regards to race, pardos (brown skin color) group was the most affected by the parasites with 69% of cases, followed by caucasians (17%), indians (11%) and blacks (3%). The major parasites diagnosed were *Endolimax nana* (55%), *Giardia lamblia* (28%), *Entamoeba coli* (14%) and *Iodamoeba bütschlii* (3%). In relation to the association of intestinal parasites and anemia, children had a 60% anemia increase when compared to adults ( $p < 0.05$ ) and the indians increased by 100% anemia when paired against caucasians ( $p < 0.05$ ). **Conclusion:** Thus, it is suggested that attention should be given to the increase in protozoa parasitic infection prevalence in Amazonian communities and expedite the emergency of improvements in political and sanitation programs of water treatment and waste and sewer management.

**Keywords:** Entereparasitoses, *Endolimax nana*, *Giardia lamblia*, indian people, neglected tropical diseases.

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### 1. INTRODUCTION

Intestinal parasitic infections are diseases caused by helminths or protozoa present in a large number of cases in populations worldwide, particularly in developing countries with precarious basic sanitation situations, disproportionately affecting populations in social and economic disadvantages<sup>1,2</sup>.

In Latin America and the Caribbean about 200 million people live below the poverty line, 2.4 billion people do not have basic sanitation and one billion do not have access to drinking water<sup>3</sup>. In this sense, it is emphasized that living conditions, housing and basic sanitation are to a large extent determinants of parasite transmission, so that associations of the high prevalence of intestinal parasites to poverty and underdevelopment remain established<sup>3</sup>.

Moreover, the municipalities in the northern region of Brazil have the worst rates of basic sanitation per households sanitary sewage coverage<sup>3,4</sup>, which may imply water table infiltration from septic tanks and contamination of fecal origin in water. Thus, the health-sanitation relationship is complex, since it understands cultural, social, economic, and sanitary variables influence the health status of the population<sup>4</sup>.

In Brazil, as diseases caused by intestinal parasites are not under compulsory notification, data is available only

for some regions. In the Northeastern region there are reports of parasitic indexes of more than 80%<sup>5</sup> and in the Amazon region there are reports of positivity indexes for enteroparasitoses between 70 and 95% in certain population segments, reflecting the precarious conditions of life<sup>6,7</sup>.

The most commonly found parasitosis in Brazil are helminths, especially *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale* and *Strongyloides stercoralis*<sup>1-3,5-7</sup>, *Schistosoma mansoni*<sup>3</sup> and among protozoa the occurrence of *Giardia sp.*, *Entamoeba sp.*<sup>5,7,8</sup> and *Endolimax nana*<sup>8</sup> stands out.

It should be noted that most of the parasites (*Ascaris lumbricoides*, *Trichuris trichiura*, *Giardia lamblia*, *Entamoebas*, *Hymenolepis nana*, *Taenia solium*, *Enterobius vermicularis*, *Iodamoeda bütschlii*, *Endolimax nana*) are transmitted through the ingestion of eggs or cysts in contaminated water and food (such as the case of tomato, lettuce, arugula, cabbage, kale, cabbage, chard, among others)<sup>3,9</sup>.

A review points out that parasites promote symptoms such as anorexia, anemia, irritability, sleep disorders, nausea, occasional vomiting, abdominal pain and diarrhea<sup>3</sup>. Severe symptoms occur in patients with higher parasitic loads, immunosuppressed and malnourished<sup>3</sup>.

The World Health Organization defines anemia as the

state where hemoglobin concentration is normally low as consequence of the deficiency of one or more essential nutrients, despite the deficiency source<sup>10</sup>. Anemia develops slowly, once exhausted iron stores in the body and bone marrow<sup>11</sup>.

Besides the insufficient intake of iron-based foods, it is argued that parasitic diseases are also considered important factors in the etiology of deficient anemia<sup>1,5</sup>, since intestinal parasites may not only promote diarrhea frameworks but also intestinal malabsorption, competition for nutrients<sup>5</sup>, lesions and bowels blood spoliation<sup>1,3,12</sup>, bile salt metabolism alteration, intestinal exudation, favoring bacterial proliferation and haemorrhages<sup>3</sup>, so that there is a possible synergistic effect between infections and nutritional status in the etiology of deficient anemia.

In fact, malnutrition and iron-deficiency anemia are important public health problems, with a 50% prevalence in Amazonian children<sup>2</sup>, in underdeveloped or developing countries such as Brazil, given that in these countries environmental factors influence the high prevalence of infectious and parasitic processes<sup>5</sup>.

In view of the above, the objective of this study was to analyze the profile of enteroparasitoses and their association with anemia in patients of a state hospital in a municipality in the interior of Rondônia, western Brazilian Amazon.

## 2. MATERIALS AND METHODOS

### 2.1. Ethical Considerations

This study was approved by the Research Ethics Committee under protocol no. 36605514.6.0000.5298 and all the procedures followed were in accordance with the ethical standards of the Regional Committee on Human Experimentation and in keeping with the Helsinki Declaration of 1964, as revised in 1975, 1983, 1989, 1996, and 2000.

### 2.2. Experimental design

This is a descriptive, retrospective and cross-sectional documentary study with medical records, analysing 35 medical records of patients admitted in 2014, aged between 1 and 77 years old, from several municipalities in the interior of the state of Rondônia - Western Brazilian Amazon (Costa Marques, Espigão do Oeste, Ministro Andreazza, Cacoal, Rolim de Moura, Alta Floresta and São Felipe), who underwent parasitological examinations of faeces in the laboratory of a state hospital in the municipality of Cacoal-RO and whose results were positive. The variables evaluated were: sex, age, race, types of parasites, hematocrit and hemoglobin, origin and schooling.

### 2.3. Parasitological Analysis

The parasitological examinations were performed in a certified outsourced laboratory, which is located at the hospital where the research was performed. The method used in parasitological fecal examination was the Hoffman method (Spontaneous sedimentation method)<sup>13</sup>.

### 2.4. Hematological Analysis

The device used for the measurement of hemoglobin and hematocrit was Kx21-N (Sysmex) and anemia was diagnosed when hemoglobin and hematocrit values were below the following reference values: for children aged 1 to

2 years the reference value for hemoglobin was 10.5 to 14.5 mg / dl and the hematocrit was 33 to 42% for children 2 to 6 years old: hemoglobin 11.0 to 14.5 g / dl and hematocrit 33 to 44% for children from 6 to 13 years: hemoglobin 12.0 to 15.0 g / dl and hematocrit 36 to 48%, for women aged > 14 years: hemoglobin 11.50 to 16.0 g / dl and hematocrit 35 to 47% and for men aged > 14 years: hemoglobin 13.00 to 17.00 g / dl and hematocrit 39 to 53%.

### 2.5. Statistical Analysis

For the statistical data analysis statistical descriptive tools were adopted using the Microsoft Office Excel (Microsoft) and Chi-square association test, adopting a significance level of 5% ( $p < 0.05$ ) using Statistica 12.0 (StatSoft).

## 3. RESULTS

According to the results found, women (18) 51% showed slight higher parasite positivity in relation to men (17) 49%. The age group most affected by verminosis was children (0-9 years) with 43% of cases, followed by adults (20-59 years old) with 37%, teenagers (10-19 years) 11% and elderly 9% ( $\geq 60$  years) (Figure 1).

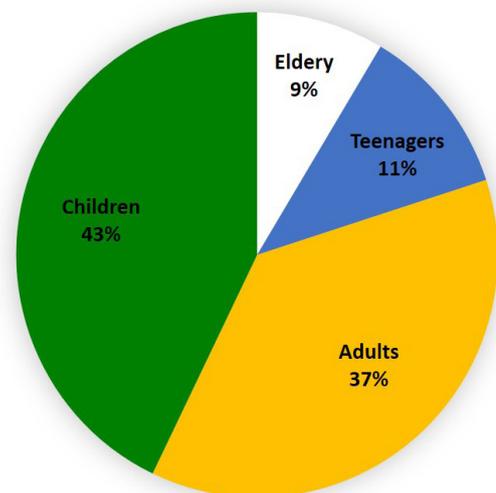


Figure 1. Profile of age groups affected by intestinal parasites.

In the present study, the highest rates of intestinal parasites were diagnosed in patients from the urban area (71%) and 29% in the rural area. According to the data collected for this study, patients with incomplete elementary education were most affected by the parasites, with 63% of the cases confirmed.

Clustering by race, the most common parasitic cases were on pardos with 69%, followed by caucasians (17%), indians (11%) and blacks (3%) (Figure 2). As a considerable proportion of the population of the northern region of Brazil is pardo and many indigenous people self-declare as pardo, emphasis should be given to the results obtained with regard to patients from indigenous peoples.

According to Figure 3, the most prevalent parasite in this study was *Endolimax nana* with 55% of diagnosed cases, followed by *Giardia lamblia* (28%), *Entamoeba coli* (14%) and *Iodamoeba butschlii* (3%).

With regards to the association of enteroparasitoses with anemia, children presented an increase of 60% in anemia compared to adults ( $p < 0.05$ ). The children also presented a marginally significant increase of 40% in anemia compared to the elderly ( $p < 0.10$ ) (Table 1).

The indigenous race had shown an increase of 100% of anemia cases in relation to the caucasians ( $p < 0.05$ ). In the association between pardos and indians, indians had a 35% greater chance of having anemia ( $p < 0.05$ ) (Table 2).

In addition, through this study it was possible to identify that the parasite with the highest prevalence (58%) in the anemic patients was *Endolimax nana*.

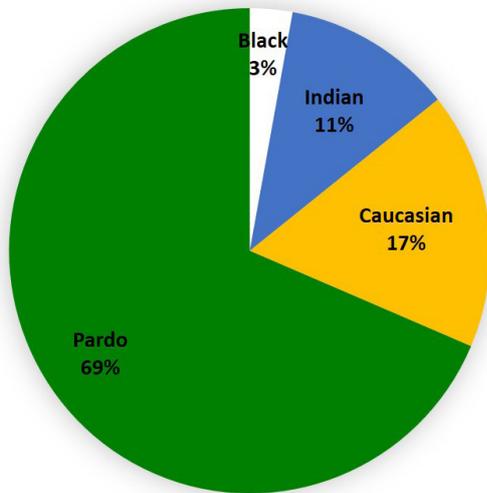


Figure 2. Racial distribution of parasitic infections.

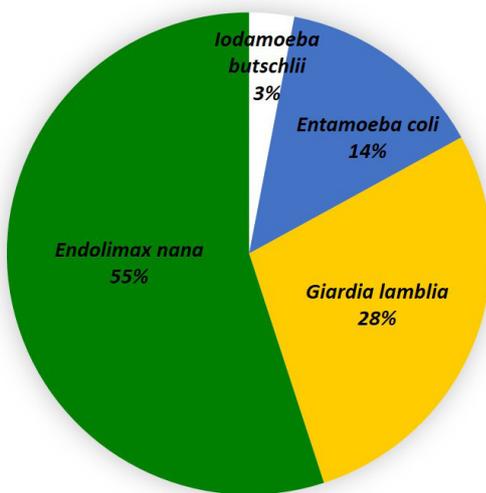


Figure 3. Prevalence of intestinal parasites in municipalities in the interior of Rondônia - Western Amazonia.

Table 1. Association between anemia and the age groups of patients affected by parasites.

	Children	Teenagers	Adults	Elderly
Anemic	10*	1	1	0
Not anemic	5	3	12	3

Qui-squared test at 5% level of significance. (\*) Statistically different in relation to adults ( $p < 0,05$ ).

Table 2. Association between anemia and the races of patients affected by parasitic diseases.

	Indian	Caucasian	Black	Pardo
Anemic	4	0*	0	8*
Not anemic	0	6	1	16

Qui-squared test at 5% level of significance. (\*) Statistically different in relation to indian ( $p < 0,05$ ).

#### 4. DISCUSSION

Other studies have also detected high frequencies and prevalences (around 70%) of parasitic infections in children in the Brazilian Amazon<sup>2,7</sup> and more recent data remain identifying the presence of helminth infection in more than 50% of children of the Yanomami indigenous peoples of the Amazonian forest<sup>14</sup>.

The results obtained were also in the same line as a study, which demonstrated that the age groups with the highest parasite positivity were between (3-8 years) with 25.6% followed by ages between 15-24 years with 17.9%<sup>8</sup>.

In the vulnerable communities of the outskirts of urban centers and slumms, more than 50% of parasitological faeces are positive for one or multiple parasites<sup>15</sup>, differentiating themselves from middle-class patients from well-resourced urban areas, where this percentage drops to 1 to 5%<sup>15</sup>.

Some authors point out that the determinants of high parasitism were attributed to the lower family income, the number of people living in each household, schooling and the habit of eating vegetables and fruits without proper hygiene<sup>16-18</sup>.

In fact, studies in indigenous tribes of the Peruvian Amazon had already found a positivity greater than 90% for helminths<sup>19</sup>. More recent data show prevalence of up to 82.4% in Amazonian indigenous peoples<sup>20</sup>.

Due to factors such as the quality of water for consumption<sup>21</sup>, poor basic sanitation and also due to difficulties in access to adequate sanitation, preparation and preservation of food<sup>3</sup> there are reports that indigenous peoples are more prone to and are affected by multiple diseases transmitted by water and food, such as enteroparasitoses<sup>7</sup>.

Recent studies point out that young age (particularly children), lack of sanitation and access to bottled water were identified as factors significantly associated with helminthiasis and giardiasis and that current socioeconomic and environmental measures were not sufficient to reduce the prevalence of giardiasis (16% in 2003 and 23% in 2011)<sup>22</sup>.

These results are compatible with the data presented in studies on the prevalence of enteroparasitoses that presented a large number of individuals parasitized by *Endolimax nana*<sup>16-18</sup>. Studies have also reported a high prevalence of *Endolimax nana* in other South American countries, such as Chile (34.4%), Argentina (34.6%) and Venezuela (22.9%)<sup>23</sup>.

Infection rates of 32.6% for *Entamoeba coli*, 6.2% for *Iodamoeba butschlii* and 8.5% for *Endolimax nana* were also detected in Amazonian children<sup>2</sup>.

Another study conducted found that 60.7% of the children evaluated had parasitoses, with 32.1% of these being caused by *Entamoeba coli*, 28.6% by *Endolimax nana*, 15.5% by *Giardia lamblia* and 5.9% by *Iodamoeba butschlii*<sup>24</sup>. These results resemble those of this study, since it presented the same parasitoses found herein differing only in the distribution of the parasites with a higher prevalence of *Endolimax nana* (55%).

In fact, a temporal analysis covering a period of seven years (2003 to 2010) high spots that while there was a significant reduction in the prevalence of *Ascaris lumbricoides* and *Trichuris trichiura*, a related increase in the prevalence of *Endolimax nana*, *Iodamoeba butschlii* and *Ancylostoma / Necator* in Amazonian children was noted<sup>22</sup>.

Recent studies have also features a high prevalence of *Giardia*, specifically *Giardia intestinalis* (22.2%), in

children descended from Amerindians of the Brazilian Amazon<sup>25</sup>.

Thus, it is suggested the adoption of improvements in the state's basic sanitation policy, personal hygiene guidelines and care with raw water and food consumed, targeting mainly indigenous peoples and children, the most affected in this study, aiming the prevention of these parasites and their comorbidities in a sustainable way.

Similarly to the results found in this work, a study conducted in the population of Aracaju schoolchildren found that 26.7% were anemic with prevalence of 42% for parasitoses in general, with a statistically significant association between anemia and the presence of intestinal parasitoses<sup>26</sup>.

Other studies in the northern region of Brazil also found an association of the infection with geohelminths with an increased risk of anemia, iron deficiency anemia and iron deficiency in children younger than 2 years<sup>12</sup>.

Studies that detected a high prevalence (24%) of anemia in the Yanomami Indians of the Venezuelan Amazon, inversely associated infections for helminths and *Giardia lamblia* with indicators of nutritional status and anthropometric indicators such as height for age and body mass index. Furthermore, they found that infection by *Ancylostoma duodenale* and *Necator americanus* was significantly more present in anemic children (51%) than in non-anemic children (35%) and that there was a significant reduction in hemoglobin levels in children infected with *Ancylostoma duodenale* and *Necator americanus*<sup>14</sup>.

It is noteworthy that although many indigenous peoples of the Amazon have contact with the outside culture, they still maintain the relevant aspects of their ancestors' lives, living from hunting, fishing, plant extractivism and agriculture, in a sense that they adopt a cassava-based diet and fish<sup>27</sup>. Associated with that, authors pointed out that the main complications of *Giardia lamblia* infection are steatorrhea, malabsorption of fat, liposoluble vitamins (A, D, E and K), fatty acids, B12 vitamins and folic acid<sup>28</sup>. In this context, there may be a connection between a relative monotonous and restricted diet with the alarming rates of malnutrition in indigenous children in the northern Amazon<sup>29</sup>, which, together with the high aforementioned rates of parasitic infection, may contribute to anemic condition.

World Health Organization forebodes that iron deficiency should be tackled through nutritional guidance associated with measures to increase mineral consumption, control of parasitic infestations, drug supplementation and fortification of foods with iron<sup>30</sup>, and in this sense, emphasis should be placed on the special needs of indigenous peoples.

## 5. CONCLUSION

In view of the data obtained, it should be noted that there was a reduction of parasitic infections by the traditional helminths on the other hand there was a significant prevalence of parasitic infections by *Endolimax nana* and *Giardia lamblia* protozoa in municipalities in the interior of Rondônia - Western Amazon, which is in accordance with previously indicated in Amazon region studies and other regions of Brazil as well<sup>2,24</sup>, in other countries of South America<sup>23</sup> and corroborated in recent developed studies<sup>22,25</sup>. In this sense, the evidence may be pointing to new trends to be considered in the neglected tropical diseases scenario since it is possible that the parasitic diseases caused by

protozoa may be related not only to diarrhea, but also to malnourishment and anemia that still affect several countries in South America and, in particular, communities in the Amazon.

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## CONFLICT OF INTEREST

The authors declares that there is no conflict of interest regarding the publication of this paper.

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