INTESTINAL PARASITOSIS AND ITS INFLUENCE ON THE ONSET OF ANEMIA IN ELEMENTARY SCHOOL CHILDREN

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ABSTRACT

The incidence of intestinal parasitosis in poor locations is a problem for public health. The lack of basic sanitation, drinking water, correct food and adequate hygiene make parasitosis constantly present in vulnerable populations, leading to other diseases such as anemia, which negatively influence child development and the quality of life of adults. The objective of this study was to analyze fecal and blood samples from children at the Fita Bisol Municipal School, in the town of Imasa, in the municipality of Monte Carlo, Santa Catarina, in order to identify the presence of intestinal parasites and anemia. To better study the locality, data were obtained through a questionnaire applied to 30 families living in the neighborhood, containing questions about sanitary conditions. Fecal and blood samples were analyzed in the Parasitology and Hematology sectors of the Clinical Analysis School Laboratory of the Alto Vale do Rio do Peixe University. To instruct health education, folders with information on simple ways to prevent intestinal parasitosis were distributed. The results showed that 66.7% of the families eat raw food, 43.3% use untreated water, 46.7% have septic tanks and 50% have garbage collected by the city hall. Among the 24 stool samples collected, 16.66% had intestinal parasites, including Giardia lamblia, Entamoeba coli and Endolimax nana. The results of blood counts did not show any alterations. Inadequate hygiene and sanitation practices facilitate the transmission of parasites. Collection limited to one stool sample per patient, rather than three, represents a limitation to diagnostic accuracy.

Keywords: Intestinal parasitosis. Anaemia. Social vulnerability.

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INTRODUCTION

Intestinal parasitosis is a disease caused by parasites of the phylum helminths and protozoa, its main forms of infection are oral-fecal. Human infection most often occurs through the ingestion of water and food contaminated by the parasites due to poor hygiene, or because they are consumed raw, as well as by skin contact with the infective form of the parasite (Vilar et al., 2021). The principle of pathophysiology of parasitic diseases occurs through a complex relationship between the parasite, host and the environment in which both coexist. In this dynamic, factors such as the host's immune response and the parasite's infectious potential stand out, which play crucial roles in the progression and severity of the infection (Júnior; Alves; Barbosa, 2020).

Parasites are classified as neglected diseases by the World Health Organization (WHO), predominantly affecting populations in social and economic vulnerability. The absence of basic sanitation, access to clean water, good hygiene practices, as well as the lack of knowledge about the risks they cause to health, are the main factors that contribute to the high incidence of these diseases in these groups (PAHO, 2022).

The precarious socioeconomic conditions of the population contribute to the increase in the prevalence of intestinal parasitosis and other health complications, particularly in children aged 0 to 9 years. In addition, childhood susceptibility to parasitic diseases can be explained by the immaturity of the immune system, dependence on third-party care, contaminated water, among other factors. Children who are in a situation of social vulnerability, therefore, may be more prone to the occurrence of intestinal parasitosis (Rivero et al., 2017).

Intestinal parasitosis is responsible for human health problems, especially in countries with less socioeconomic development, where environmental and cultural conditions also favor the maintenance and dissemination of the biological cycles of parasites responsible for intestinal diseases. The main complications associated with intestinal parasitosis include intestinal malabsorption, malnutrition, abdominal pain, and anemia, factors that contribute significantly to reduced work and learning capacity (Vega et al., 2023).

The worsening of host health due to intestinal parasitosis occurs mainly through three mechanisms, nutrient depletion action, induction of irritation and inflammation of the intestinal mucosa and obstruction of the gastrointestinal tract. Spoliation occurs by the parasite's absorption of essential nutrients from the host, which can lead to malnutrition and nutritional deficiencies. Irritative actions include local inflammatory responses that can result in tissue injury and abdominal pain, while obstructive actions can lead to partial or total

blockage of the intestinal lumen, especially in intense infections (Naveed and Abdullah, 2021).

Due to the parasites' spoliative actions on the host, parasitosis can trigger some other diseases, such as anemia, which has become a very prevalent disease in school-age children (Francisco et al., 2020). It is common to associate anemia with parasitic diseases, since a large part of the absorption of nutrients takes place in the intestine, where the parasites affect it directly, depending on their actions on the host, and due to the relationship with social vulnerability, where there is a lack of good nutrition (Antunes; Moraes, 2019).

Anemia is caused by a drop in hemoglobin in the blood, causing a deficit in the transport of oxygen to the tissues, and can be caused by a lack of iron, vitamin B12, among other important nutrients for the proper functioning of the body. Anemia, when left untreated, can harm child development, and lead to weakening and physical fatigue in adults (Paula et al., 2020).

The diagnosis of parasitosis is made through the examination of fecal samples, the parasitological examination of feces, which consists of performing macroscopic analyses, such as color, appearance, consistency and odor, and microscopic analyses, where the most appropriate technique for the study of the suspected parasite is chosen. In addition, to complement the diagnosis, a blood count is performed, where the presence of factors that may indicate a parasitosis is seen, such as eosinophilia, common in infections caused by helminths, as well as changes suggestive of anemia (Sadovsky et al., 2020).

In view of the importance of conducting studies associated with intestinal parasites, especially in populations that are socially vulnerable, the objective of this study was to analyze the feces and blood samples of children enrolled in the Fita Bisol Municipal School, in the Imasa locality, Rua Projeta, in the municipality of Monte Carlo, in Santa Catarina, in order to identify the presence of intestinal parasites and anemia. It should be noted that this research is aligned with the Sustainable Development Goals (SDGs) of the United Nations (UN), especially SDG3 (Health and Well-being), by providing essential data to implement public health interventions that improve child well-being. As the study was carried out in a socially vulnerable community that is in precarious conditions of basic sanitation, the study also addresses SDG 1 (eradication of poverty) and SDG 4 (Quality education), since children with parasitosis and anemia may have impairment in their physical and cognitive development, directly impacting school performance and future prospects.

METHODOLOGY

PLACE OF STUDY

The study was carried out in a peripheral neighborhood, Imasa, which is the farthest from the center of the municipality of Monte Carlo/SC, with emphasis on the Fita Bisol school. The Imasa neighborhood is shown in image 1. The choice was made because it is a place that is neglected in terms of basic sanitation conditions and the population is in conditions of social vulnerability

Image 1 - Territorial map of the Imasa neighborhood in the municipality of Monte Carlo/SC.

Source: Google Maps (2024).

SAMPLE CHARACTERIZATION

The study was carried out in a group of school-age children aged 5 to 9 years, enrolled in the Fita Bisol School, located in an economically vulnerable community in the city of Monte Carlo/SC. Parasitological examinations of feces and blood count of the children enrolled in the School were carried out, using the facilities of the School of Clinical Analysis Laboratory of the Alto Vale do Rio do Peixe University (UNIARP), totaling a group of 24 children.

DATA COLLECTION

The collection of socioeconomic data from the region studied was carried out by government platforms, Open Data Portal and by the implementation of a questionnaire to the 30 families residing in Imasa, chosen at random. The questionnaire was delivered on printed paper to facilitate those who do not have access to the internet, with questions

related to the intake of raw food, treatment of the water used, sewage distribution and disposal of the garbage produced in the houses.

The results of the parasitological examination of feces were obtained using the Hoffman, Janer and Pons (HPJ) method, which uses spontaneous sedimentation to identify parasites. In this method, the fecal sample is diluted in water and homogenized. After a resting period, the sediment that forms at the bottom of the container (image 2) is removed and a small drop is placed on a microscopy slide. Then, a drop of Lugol is added to facilitate the visualization of the parasites' structures (Carli; Geraldo. 2001).

Image 2 - Method of spontaneous sedimentation in a calyx.

Source: The authors (2024).

The results of the blood count were obtained through the AUDH5 Automatic Hematology Analyzer, available at the School of Clinical Analysis Laboratory of UNIARP, which allows results of platelets, size and color of red blood cells, hemoglobin, hematocrit, as well as leukocyte differentiation. For the verification of the white and red series in the blood samples, slides were made, stained with hematological dye and read under a microscope.

The collections were carried out at the school, through a schedule created from the availability of the students' parents. The transport of the biological material was done by the academic, during the collection days, in boxes suitable for transport, ensuring the good storage of the samples.

ETHICAL CRITERIA

This is a prospective study, where all procedures were only carried out after approval by the Human Research Ethics Committee (CEP), receiving approval opinion 6,978,159, and in sequence, a declaration of awareness and agreement of the institutions involved was filled out by the Monte Carlo Secretary of Education, and finally, they were filled out by the parents, an informed consent form (ICF) for minors.

All biological samples (blood and feces) from school-age children enrolled at the Fita Bisol School, whose parents or guardians signed the Informed Consent Form, were included. Blood samples were collected in an EDTA tube, with sufficient volume, adequate transport and storage, and collection time within the compliances, in addition to fecal samples collected in a collection bottle, suitable for parasitology.

Blood samples collected with incorrect anticoagulants, or that were coagulated, and stool samples that were not collected in sufficient volume for analysis, as well as those contained in non-standardized containers, were excluded.

After the informative meeting with the parents, and the signing of the Informed Consent Form, the samples were collected on school days, during the month of September, and later taken to the School Laboratory of Clinical Analysis for parasitological examinations, using the Hoffman, Pons and Janer method, based on spontaneous sedimentation. The blood count was performed with the aid of a hematology analyzer, thus obtaining the necessary results for the preparation of the report.

After obtaining the report, they were delivered to the parents or guardians and when they presented any alteration they were oriented and referred to a medical consultation.

HEALTH EDUCATION: APPLICATION OF AN EDUCATIONAL FOLDER

To assist in health education, folders were given to the children, consisting of information and figures indicating simple acts that can prevent infection and spread of parasitic diseases. The educational folder is shown in image 3. Parents and guardians were also instructed on health education issues and ways to prevent parasitosis.

Image 3 - Educational folder on the prevention of intestinal parasitosis.

Source: The authors (2024).

DATA ANALYSIS

Initially, it was planned to perform correlational analyses between the results of parasitological feces and blood count to investigate potential associations between the parasitosis present and the development of anemias. However, due to the sample size, the low number of parasitized children and the lack of adherence to the collection of 3 samples, it was not possible to perform these analyses in a robust way. Instead, a descriptive analysis of the data was chosen, with presentation of frequencies, to characterize the profile of the variables studied. This approach allowed the interpretation of the results within the limitations found, providing an overview of the data collected.

RESULTS AND DISCUSSIONS

During the development of the study, 24 stool and blood samples from children of both sexes between 5 and 9 years of age were analyzed. Of the total of 34 children living in the locality, 10 of them did not participate in the research due to the absence of the signature of the informed consent form or the non-delivery of the requested stool samples. Table 1 presents the characteristics of the children participating in the study.

Table 1 - General characteristics of the children participating in the study.

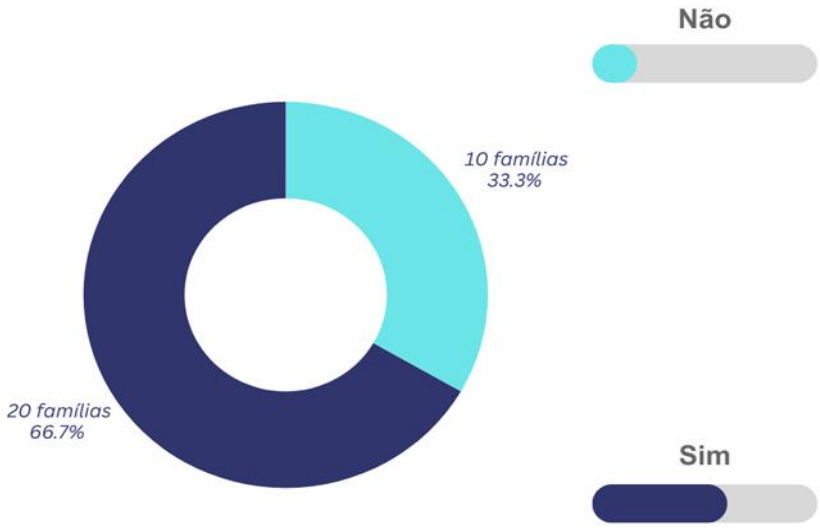
Sex	Number	%
Female	11	45,83
Male	13	54,16
Age (years)		
5	9	35,5
6	7	29,16
8	3	12,5
9	5	20,83

Source: The authors (2024).

The predominant gender among the participants was male, corresponding to 54.16% of the sample, while females represented 45.83% of the population studied. Regarding the age group, it was observed that 9 children (37.5%) were 5 years old, 7 children (29.16%) were 6 years old, no child was 7 years old (0%), 3 children (12.5%) were 8 years old and 5 children (20.83%) were 9 years old. Intestinal parasitosis is more frequent in school-age children, due to social and recreational activity, increasing exposure to the outdoors, together with the habit of poor hygiene habits, in addition to living in a group, which can increase the transmission of parasites, due to the sharing of toys, being more common, protozoan infections in children between 3 and 8 years old, and by diners, in children over 8 years of age (Kantzanou; Maria, 2021).

The interpretation of the questionnaire applied to the families showed that 10 (33.33%) of them do not have the habit of eating raw food, while the other 20 (66.66) consume raw food (Graph 1).

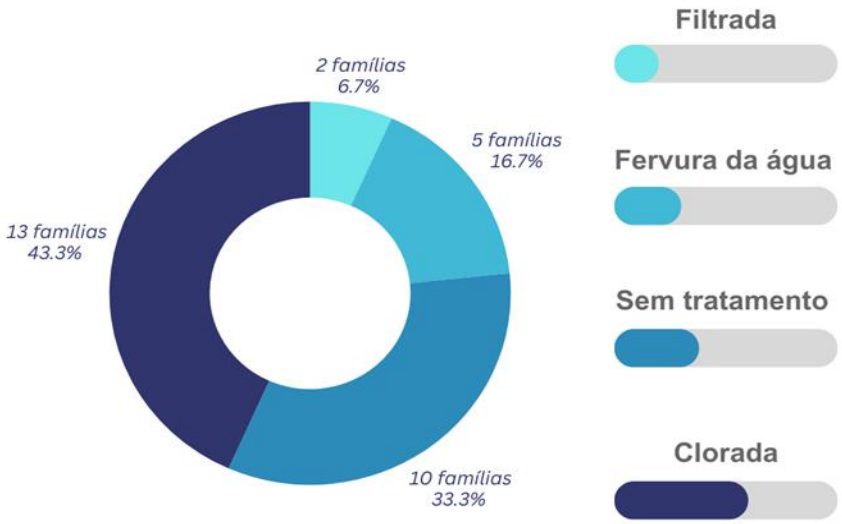
Graph 1 - Raw food intake.



Source: The authors (2024).

Regarding water treatment, only 2 (6.66%) families consume filtered water, 13 (43.33%) use chlorinated water, 5 (16.66%) boil before consuming and 10 (33.33%) have no treatment at all (Graph 2).

Graph 2 - Water treatment used.

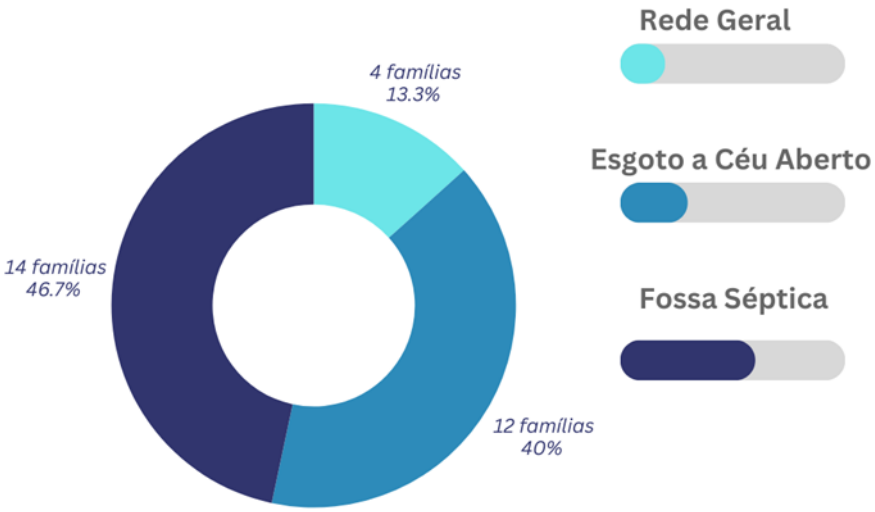


Source: The authors (2024).

The survey showed that a large part of the population does not use treated water, which can bring serious health risks, due to contamination with pathogenic microorganisms, causing gastrointestinal infections, which may be the main reason why there are cases of intestinal parasitosis in children in the neighborhood (Freitas; Magnabosco, 2023).

Regarding sewage treatment in their homes, 4 (13.33%) of the families use the general network as disposal, 14 (46.66%) of them have septic tanks and 12 (40%) dispose of open sewage (Graph 3).

Graph 3 - Destination of the household sewage used.

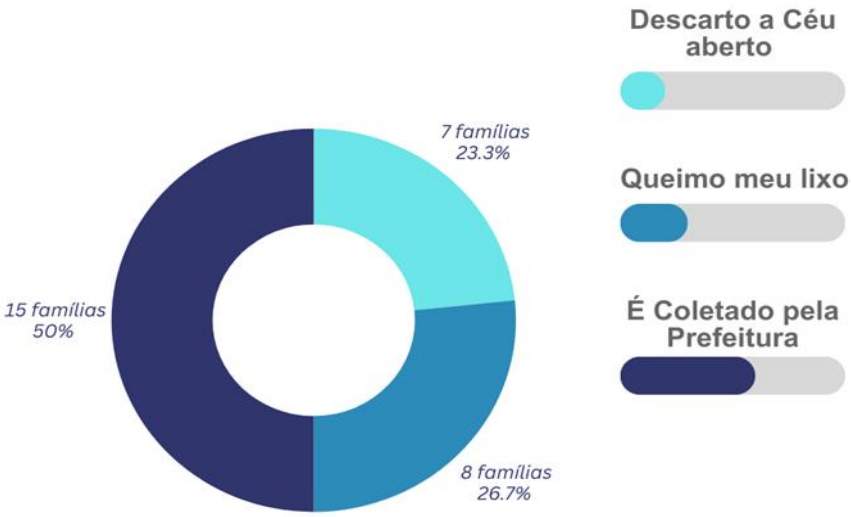


Source: The authors (2024).

These data make the subject even more worrying, since sewage, when disposed of in the open, can contaminate the soil, preventing vegetables and greens from being grown in a healthy way in that place, and contaminating water sources, can harm not only human health, but also the local fauna and flora (Teixeira *et al*, . 2018).

Regarding the destination of household garbage, 7 (23.33%) of the families dispose of their garbage in the open, 8 (26.66%) of them burn the waste and 15 (60%) families have their disposal collected by the city hall (Graph 4).

Graph 4 - Destination of household garbage.



Source: The authors (2024).

In addition to the spread of intestinal parasitosis, garbage, when not disposed of correctly, can cause other diseases, such as leptospirosis and dengue, in addition to leading to visual and olfactory pollution, deteriorating the quality of life and well-being of the population (Lemos; Ferreira; Guimarães, 2019). Therefore, it is necessary to find out why the garbage of some families is not being collected and adopt meditations so that they can solve this problem.

When analyzing the graphs, it can be observed a lack of basic sanitation for these families, which may be related to the appearance of intestinal parasitosis in the children studied, including these indices can lead to the spread of these diseases throughout the neighborhood.

Intestinal parasitosis is linked to the lack of health education, and this may be a strategy to minimize the spread of these diseases (Santos; Bezerra, Costa, 2021). Therefore, it is valid to consider that efforts aimed at reducing environmental contamination can reduce the risk of exposure to parasites. Measures such as access to clean water, adequate sanitation, and hygiene practices are essential for preventive control. The intervention should start with education and dissemination of knowledge to the population, followed by a continuous evaluation of the effectiveness of these actions (Nery et al., 2019). Thus , after the conclusion of the research, educational folders were distributed that teach ways to prevent the spread of these diseases, in order to improve the health of the residents of the neighborhood.

The parasitological analyses of the 24 fecal samples revealed that 4 of them were positive for intestinal parasites, and *Giardia lamblia* (4.16%), *Entamoeba coli* (8.32%) and *Endolimax nana* (8.32%) were identified in these samples. Polyparasitism was observed in 2 samples (8.32%), one containing *Giardia lamblia* and *Entamoeba coli* (4.16%), and the other *Endolimax nana* and *Entamoeba coli* (4.16%). The positive samples show a prevalence of parasites considered non-pathogenic, which characterize a clear sign of lack of access to drinking water, basic sanitation and precarious housing conditions, as well as contact with contaminated soils and ingestion of poorly sanitized food or food handled with dirty hands (Kantzanou *et al*., 2021). The other 20 samples (83.33%) did not present protozoa or helminths, as shown in Table 2.

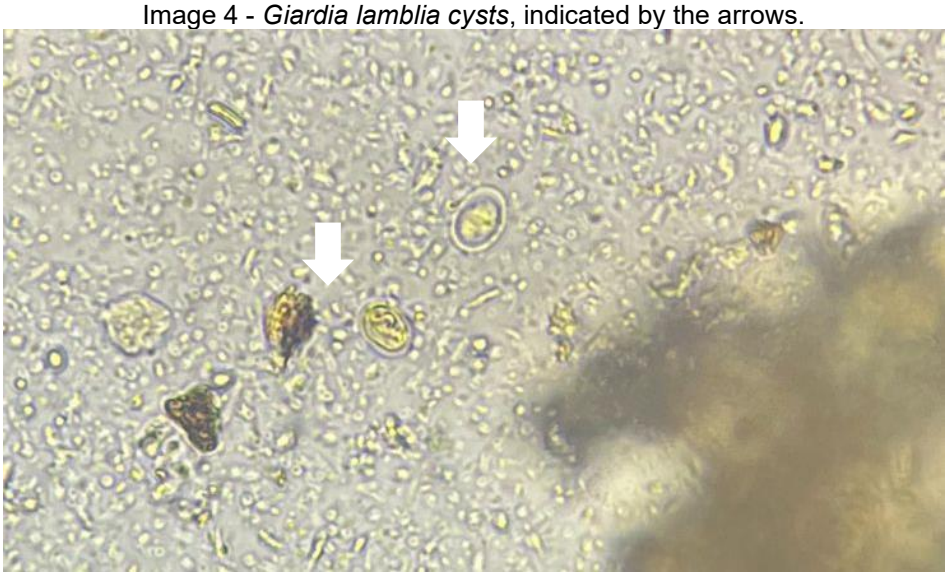
Table 2 - Results of parasitological examination of feces.

Parasitis Intestins	**N**	**%**
Positive		
Polyparasitism - *Giardia lamblia and Entamoeba coli*	1	4,16
Polyparasitism - *Endolimax dwarf and Entamoeba coli*	1	4,16
Monoparasitism- *Entamoeba coli*	1	4,16
Monoparasitismo- *Endolimax Nana*	1	4,16
Negatives for Protozoa and Helminths	20	83,33

Source: The authors (2024).

Giardia lamblia was the only pathogenic parasite found during this research, which causes giardiasis, is the most common cause of diarrhea in children, and can lead the patient to malnutrition and developmental delay. It is a strong indicator of poor sanitation and hygiene conditions, and is commonly present in communities with socioeconomic problems (Márcia *et al*., 2024). The low prevalence of *Giardia lamblia* may be related to its intermittent elimination factor, and it may not have been eliminated in the feces on the day of the collection analyzed, therefore, to increase the chances of finding cysts, it can be recommended to perform three collections on consecutive days (Felipe *et al.,* 2021). Image 4 shows *Giardia lamblia* cysts, found in the giardiasis-positive sample, viewed under a microscope.

Image 4 - *Giardia lamblia cysts*, indicated by the arrows.

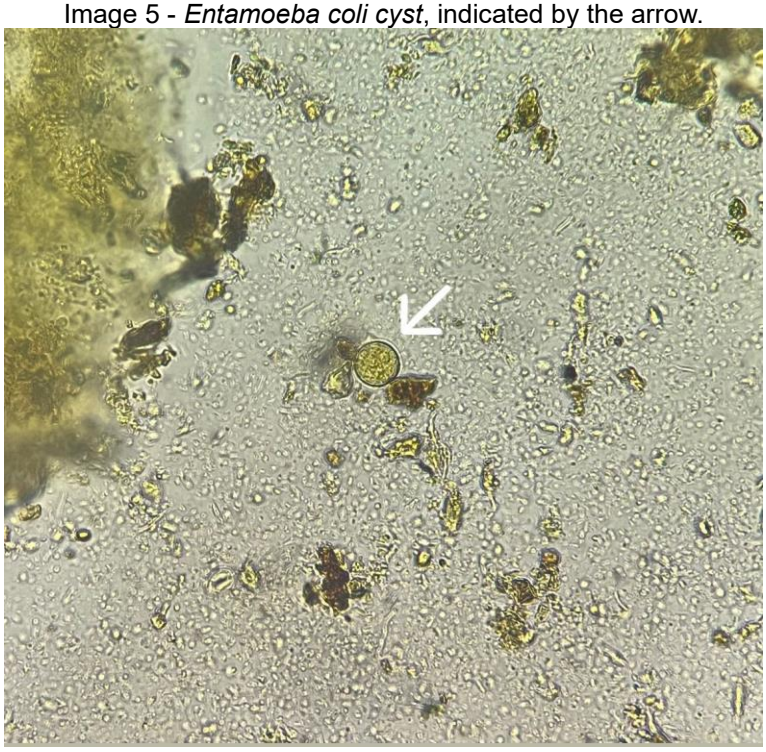


Source: The author (2024).

Although *Giardia lamblia* and *Entamoeba coli* have the same means of propagation, *Entamoeba coli* is not considered pathogenic to humans, but rather commensal, however it can help as an indicator of inadequate sanitation conditions and contamination (Bellin; Grazziotin, 2011).

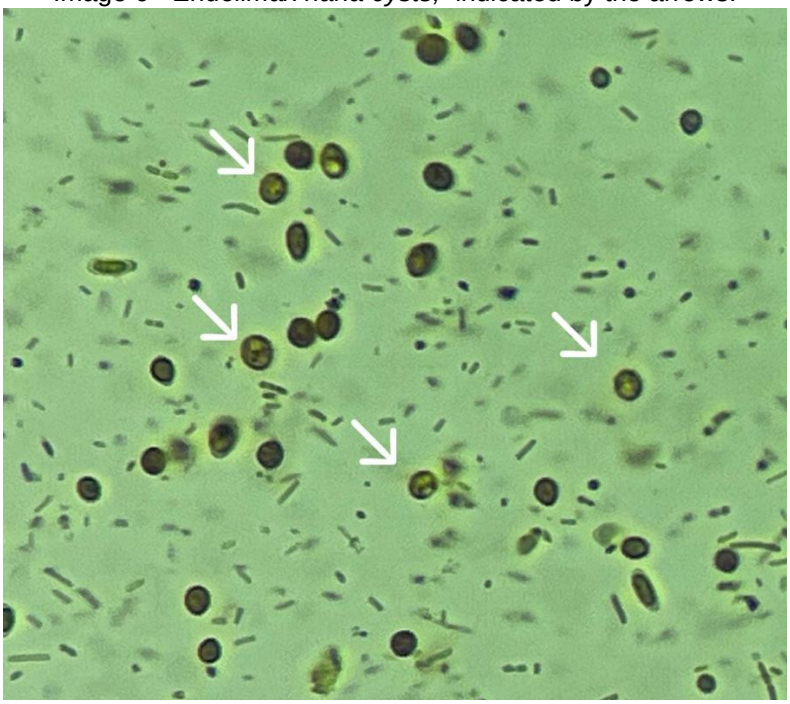
Like *Entamoeba coli*, *Endolimax nana* is also considered commensal, however, they are of great value in the diagnosis during the stool examination, indicating fecal contamination in the environment in which the individual is inserted (Santos; Juliano et al., 2014). Considering that the socioepidemiological data revealed precarious conditions of basic sanitation and inadequate water treatment, the low prevalence of intestinal parasitosis may be associated with the absence of parasite cysts in the samples collected. For a more accurate analysis, it would be recommended to collect three samples on consecutive days. In addition, the lack of information on the history of parasitic infections in participating children may indicate that the low incidence observed is possibly related to previous drug treatments. In image 5, there is the presence of an *Entamoeba coli* cyst, in image 6, *Endolimax nana cysts*, indicated by arrows.

Image 5 - *Entamoeba coli cyst*, indicated by the arrow.



Source: The authors (2024).

Image 6 - *Endolimax nana cysts,* indicated by the arrows.



Source: The authors (2024).

Analyzing the characteristics of patients who presented positive samples for a parasite, it is possible to highlight the male sex as the only one affected, totaling 100% of the positive samples. When analyzing the age range of the positive samples, it was found that two children are 5 years old (50%), one is 9 years old (25%) and one is 6 years old (25%), as shown in Table 3.

Table 3 - Age group and sex of the samples that presented some parasitosis.

Intestinal parasites present in the samples	**N**	**Age (years)**	**Sex**
Polyparasitism - *Giardia lamblia and Entamoeba coli*	1	9	Male
Polyparasitism - *Endolimax dwarf and Entamoeba coli*	1	5	Male
Monoparasitism- *Entamoeba coli*	1	5	Male
Monoparasitismo- *Endolimax Nana*	1	6	Male

Source: The authors (2024).

The reason why males may have been more affected, when compared to females, may be because boys, especially in the school environment, tend to be more active and may be more exposed to environments where parasites are common, such as outdoor play, or due to cultural issues, where they have more freedom to explore risky places and less supervision in hygiene matters (Rengifo; Maria, 2020).

The results of the blood counts, including those of patients whose stool samples show some parasitosis, did not show any alteration. The reference values (RV) considered standard were taken into account, both in the red series, as well as hematocrit (RV=35 to

45%), erythrocytes (RV=3.9 to 5.1 million/mm³), hemoglobin (RV=11 to 14g/dL), V.C.M (RV=77 to 95UM³/dL), H.C.M (RV=25 to 33pg) and C.H.C.M (RV=31 to 37g/dL), and in the white and platelet series.

The research did not show a relationship between positive samples for parasitosis and any anemia. Although parasitosis is the main cause of anemia, it is important to note that in most positive samples, except for the positive sample for giardiasis, only non-pathological parasites were found, which may be the reason why the blood counts did not show alterations (Moraes et al., 2019). In the case of *Giardia lamblia*, it is likely that despite its despoiling action, it has not yet formed the cystic carpet, which is the mechanism responsible for preventing the body from absorbing the necessary nutrients (Fabiana *et al*., 2022). Anemia is indeed associated with the presence of protozoa, however, it is worth mentioning that anemias are more related to the presence of helminths, when compared to protozoa, since helminths have a chronic and long-term interaction with the host, causing anemia through blood loss and nutrient consumption, reducing absorption by the intestine, protozoa, on the other hand, can cause acute crises, which may be the reason why the children studied did not have anemia (*Bandyopadhyay, Mamata et al, 2021).*

After the conclusion of the research, the parasitological reports and blood count of their children were given to the parents, and those who presented positive results for some parasitosis were instructed to look for the neighborhood health agent to make an appointment with the general practitioner of the health center responsible for the locality.

FINAL CONSIDERATIONS

Parasitological analyses of feces showed the presence of intestinal parasitosis in the region studied, probably associated with socioeconomic factors, given that the questionnaires indicated the absence of basic sanitation in some residences. Lack of access to information on proper personal hygiene and food practices can also contribute to the transmission of parasitosis. Although the children's blood counts did not identify anemia, it is recommended that parents maintain routine annual exams, considering the frequent association between parasitosis and anemia.

The study has some limitations that should be highlighted. The analysis was based on only one fecal sample per child, rather than the recommended three samples on consecutive days, which may have increased the risk of false-negative results. In addition, the sample size was small, including only 24 children, which limits the generalization of the findings and reduces the statistical power for detecting possible associations.

However, as intestinal parasitosis continues to be largely neglected, studies such as this one associated with health education programs emerge as essential tools for improving public health.

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