

STUDY OF THE RELATIONSHIP BETWEEN ANEMIA AND ENTEROPARASITOSIS IN CHILDREN WHO USE DAY CARE CENTERS: A NARRATIVE REVIEW

 <https://doi.org/10.56238/arev6n3-289>

Submitted on: 21/10/2024

Publication date: 21/11/2024

Juliano César Marques Guilherme¹, Eleuza Rodrigues Machado², Kamilla Antônia Moraes Dutra³, Gabriela Alves Carvalho Duarte⁴, Nicolas Martins Honorato da Silva⁵, Aline de Oliveira Gimenes⁶ and Rosângela Maria Rodrigues⁷

ABSTRACT

Enteroparasitosis is an important public health problem, especially in developing countries. It especially affects the child age group, as they have immature immunity and few notions about hygiene habits. It is essential to study the relationship between anemia and enteroparasitosis in children, as they can cause various health damages, such as malnutrition, gastrointestinal problems and contribute to the low physical and cognitive development of children. The objective of this study was to perform a narrative review on the relationship between anemia and enteroparasitosis in children who use day care centers. The search for articles took place in the international databases Scientific Electronic Library Online (SciELO), National Library of Medicine (PubMed), Regional Library of Medicine (Bireme) and Google Scholar (Google Scholar). The descriptors "anemia", "children", "intestinal parasitosis" and "prevalence" were used, combined using the Boolean operator "AND". Articles with a text available in full for free, with a time frame between January 2011 and January 2022, in Portuguese, English, or Spanish, were included in the study. Review, thesis or dissertation articles, experience reports and duplicate articles were excluded. Articles that contained evidence of agreement with the study were read in full in order to structure this work. A total of 2,228 articles were found, of which 572 articles met the established criteria, but only 16 matched the theme of this work. An association between anemia and enteroparasitosis was demonstrated, and the main associated factors were related to the precarious living conditions of each population studied, low income, inadequate hygiene, lack of quality basic sanitation, lack of basic health care, scarce diet and low schooling. It is emphasized the need to implement measures aimed at improving the living conditions of the population, especially the child age group, and in addition, to carry out more studies to better understand the relationship between anemia and enteroparasitosis.

Keywords: Helminths, Protozoa, Preschool, Iron deficiency.

¹ Bachelor's Degree in Biomedicine, Federal University of Jataí

² Dr. in Parasitology, State University of Campinas (UNICAMP)

³ Master in Applied Health Sciences Federal University of Jataí

⁴ Bachelor's Degree in Biomedicine, Federal University of Jataí

⁵ Bachelor's Degree in Biological Sciences, Federal University of Jataí

⁶ Specialist in Pharmacology, Federal University of Goiás

⁷ Dr. in Applied Immunology and Parasitology, Federal University of Uberlândia

INTRODUCTION

Intestinal parasitosis is an important global public health problem, especially in developing countries, where basic sanitation, housing and socioeconomic conditions are precarious. The spread of enteroparasitosis can occur through contaminated water and/or food or through the active penetration of infective larvae present in the soil (GONÇALVES et al., 2011; WERNECK; HASSELMAN; GOUVÊA, 2011; CABRERA et al., 2017; BRAGAGNOLLO et al., 2018).

Parasitic infections mainly affect the child age group, and can cause various clinical conditions such as diarrhea, malabsorption syndrome, malnutrition, delayed physical and cognitive development, anemia and, depending on the severity, these symptoms can lead to death (WALCHER; PEDROSO; FRIZZO, 2013; PEDRAZA; QUEIROZ; SALES, 2014; CABRERA et al., 2017; ASSANDRI et al., 2018; SOLANO-BARQUERO et al., 2018). In addition, intestinal parasites can cause numerous damages to the child's health, due to the despoiling capacity of some species of parasites, which consists of the absorption of nutrients or blood, causing lesions in the intestine, which can impair the intestinal absorption of nutrients – since the healing of these lesions generates the gradual disappearance of the intestinal folds, making the area of absorption limited – which contributes to a deficit in erythropoiesis, triggering anemia (ARAÚJO-FILHO et al., 2011; WALCHER; PEDROSO; FRIZZO, 2013; ASSANDRI et al., 2018).

Anemia is a condition in which hemoglobin in the blood is below the normal reference value, which makes oxygen transport insufficient to meet physiological needs, causing symptoms such as fatigue, weakness, dizziness, and shortness of breath (ALBUQUERQUE, 2014; WHO, 2016; MORAES et al., 2019). It can be detected through the blood count, capable of evaluating the morphological aspects and numerical indicators of the blood series, presenting more reliable results (SPEZIA et al., 2018; FREIRE; ALVES; MAIA, 2020).

Deficiency anemias are nutritional problems of great relevance to public health, especially in developing countries, since they affect children and adolescents and are responsible for high mortality and morbidity (PEDRAZA; QUEIROZ; SALES, 2014; ZUFFO et al., 2016). Food insecurity and lack of nutritional diversity in the diet can cause a deficiency of essential nutrients for the body, such as iron, vitamin B12 and folic acid. In case of parasitic infection, this nutritional deficiency can be aggravated, generating iron

deficiency anemia or megaloblastic anemia (CARMONA-FONSECA; CORREA, 2015; ALAMNEH et al., 2021).

Anemia is related to parasitosis, especially in terms of iron deficiency, but its development depends on several factors, such as parasite species and parasite load, duration of infection, body iron storage, consumption and physiological needs (ARAÚJO-FILHO et al., 2011; CABADA et al., 2015). Studies indicate a prevalence of anemia of 20.9% in Brazilian children under 5 years of age, and children with concomitant infection by parasites such as *Trichuris trichiura* and hookworms have hemoglobin levels below the reference values, when compared to those without enteroparasites (NGUI et al., 2012; ZANIN et al., 2015; EFFANGA; IMALELE, 2018). Considering that children are growing and need a greater demand for nutrients, anemia can cause great damage to their physical and cognitive development, affecting their growth and school performance (CAVALCANTE; MELO; LIMA, 2015; ZUFFO et al., 2016).

In infections caused by *Trichuris trichiura*, *Strongyloides stercoralis* and *Entamoeba histolytica*, changes in the intestinal mucosa can be observed due to its penetration, causing blood loss and lesions, which hinders intestinal absorption of nutrients, culminating in the appearance of anemia (LIMA; SAINTS; SOUZA, 2012; NGUI et al., 2012; NUNES; ALMEIDA; NUNES, 2014). In addition, the parasites *Ascaris lumbricoides* and *Giardia lamblia* act in a secondary way in relation to anemia, causing decreased absorption of iron and vitamins (NUNES; ALMEIDA; NUNES, 2014; MIOTTO et al., 2014; SANTOS JUNIOR et al., 2015; GIER et al., 2016).

Studies have shown that in cases of infection by hookworms *Ancylostoma duodenale* and *Necator americanus*, anemia is most often iron deficiency, due to iron deficiency, due to the fact that these parasites are inserted in the mucosa of the small intestine, causing chronic spoliation, with continuous blood loss (LIMA; SAINTS; SOUZA, 2012; NUNES; ALMEIDA; NUNES, 2014; SANTOS JUNIOR et al., 2015). Walcher, Pedroso and Frizzo (2013) demonstrated that 17% of enteroparasitized children had anemia.

Despite the importance of the relationship between intestinal parasite infection and anemia regarding the negative effects they induce on the host, there are few studies that emphasize the importance of these diseases, especially in the child age group. In this context, this study aimed to perform a narrative review on the relationship between anemia and enteroparasitosis in children who use day care centers, aged between zero and six years.

METHODOLOGY

A narrative review of the literature was carried out in order to synthesize the knowledge about the relationship between anemia and enteroparasitosis in children who use day care centers. To this end, a search for articles was carried out in the following international databases: *Scientific Electronic Library Online* (SciELO), *National Library of Medicine* (PubMed), *Regional Library of Medicine* (Bireme) and *Google Scholar* (Google Scholar). The descriptors "*anemia*", "*children*", "*intestinal parasitosis*" and "*prevalence*" were used. From the advanced search of each database, these descriptors were combined using the Boolean operator "AND".

For inclusion in the study, the following criteria were defined: articles with text available in full for free, time frame between January 2011 and January 2022, language in Portuguese, English, or Spanish. Review, thesis or dissertation articles, experience reports and duplicate articles were excluded. After these steps, the articles were read by title/abstract, in order to filter material consistent with the main theme of the work. Articles that contained evidence of agreement with the study were read in full to structure this work.

RESULTS

A total of 2,228 articles were found in the four databases, of which 572 articles met the established criteria. After reading the title/abstract and subsequent analysis of the content in full, the final number of 16 articles was reached that were consistent with the main theme of this work. Table 1 shows the selection of articles related to the databases. Chart 1 shows the title, authors, objectives and approach of the publications used.

TABLE 1: Articles selected and read in full, time frame between January 2011 and January 2022, in English, Portuguese, and Spanish.

	SciELO	PubMed	Bireme	Google Scholar	TOTAL
Identified	10	314	204	1.700	2.228
Eligible	7	82	67	416	572
Used	2	7	4	3	16

TABLE 1: Characterization of each study used in terms of title, authorship, objectives and approach.

TITLE	AUTHOR/DATE	GOALS	APPROACH
Anemia, nutritional status and intestinal parasitosis in children belonging to vulnerable households in Montevideo.	Assandri et al., 2018	To determine the prevalence of anemia, nutritional disorders and enteroparasitosis in children aged 6 to 48 months, from a	Cross-sectional description

		vulnerable population in Montevideo, to establish possible synergisms and to analyze the presence of risk factors.	
Intestinal parasitosis, anaemia and risk factors among pre-school children in Tigray region, northern Ethiopia.	Wasihun et al., 2020	To assess the prevalence of intestinal parasitic infections, anemia and associated factors among preschool children in rural areas of the Tigray region, northern Ethiopia.	Transverse
Nutritional status and intestinal parasites among young children from pastoralist communities of the Ethiopian Somali region.	Osman et al., 2020	To assess nutritional status and its association with PILs in <5-year-old children living in Adadle district of Somalia region, Ethiopia	Transverse
Intestinal Parasites, Anemia and Nutritional Status in Young Children from Transitioning Western Amazon.	Marques et al., 2020	OBJECTIVE: To evaluate intestinal parasitosis and nutritional status (anemia and linear growth) in preschool children living in contemporary Amazonian communities.	Transverse
Ascaris lumbricoides infection: Still a threat for iron deficiency anaemia in 2-year-old Bangladeshi slum-dwelling children.	Hossain et al., 2019	To assess the prevalence of anemia and IDA in two-year-old children from Bangladesh and to determine the association of specific intestinal parasites with IDA	Transverse
Parasitic infections, anemia and malnutrition among rural settled and mobile pastoralist mothers and their children in Chad.	Bechir et al., 2012	To assess the spectrum of parasitic infection and the level of anemia and its effect on nutritional status in settled and mobile pastoral mothers and children near Lake Chad	Transverse

Nutritional status, intestinal parasitism and risk factors in a vulnerable population in the municipality of Iza (Boyacá), Colombia year 2013.	Rodríguez, Camacho, Baracaldo, 2016	To establish the nutritional status, intestinal parasitism and its risk factors in pregnant women, the elderly and children under 5 years of age	Cross-sectional description
Determinants of Iron Deficiency Anemia in a Cohort of Children Aged 6-71 Months Living in the Northeast of Minas Gerais, Brazil.	Zanin et al., 2015	To identify the prevalence and incidence of anemia in children and to identify predictors of this condition, including intestinal parasitosis, social, nutritional, environmental factors, and comorbidities	Cohort
Health and nutrition situation of indigenous children and children in the indigenous people of the Peruvian Amazon.	Díaz et al., 2015	To assess the nutritional status of children under 5 years of age, indigenous and non-indigenous, from two provinces of the Peruvian Amazon	Cross-sectional description
Prevalence of intestinal parasitosis, anemia and malnutrition in children of an indigenous shelter Nasa, Cauca, Colombia, 2015.	Gaviria et al., 2017	To determine the prevalence of intestinal parasitosis, anemia, and malnutrition in children from a Nasa de Caldono indigenous reserve, in the department of Cauca, and their distribution according to clinical, sociodemographic, and health infrastructure variables.	Transverse
Parasitic infections, malnutrition and anemia among preschool children living in rural areas of Peshawar, Pakistan.	Din et al., 2018	To estimate the severity of malnutrition and anemia in association with PI in preschool children and to identify the possible risk factors that contribute to these health problems.	Transverse

Magnitude of anemia and associated factors among children aged 6–59 months at Debre Markos referral hospital, Northwest Ethiopia: a hospital-based cross-sectional study.	Alamneh et al., 2021	To assess the magnitude and associated factors of anemia in children aged 6 to 59 months attending Debre Markos Referral Hospital, Northwest Ethiopia.	Quantitative Cross-Sectional
Association between intestinal helminthic infections and anaemia status in preschool children in the district Skardu of Pakistan.	Afridi et al., 2021	To evaluate the frequency of parasitic infections and to evaluate the relationship between intestinal helminth infection and anemia status in preschool children	Transverse
Prevalence of nutritional deficiencies and morbidity by infectious diseases in children 0-5 years of age in Iñapari in the Peruvian Amazon.	Santos et al., 2016	Identify prevalence of the main childhood morbidities caused by anemia, malnutrition, intestinal parasitosis, toxocariasis and hepatitis A, and identify connections with socioeconomic and environmental conditions found in Iñapari	Transverse
Prevalence of iron deficiency anemia and its association with intestinal parasitosis in children and adults in the Municipality of Sucre, Sucre State, Venezuela.	Hannaoui et al., 2016	To evaluate the prevalence of iron deficiency anemia and its association with parasitosis in a population of children and adults, belonging to three parishes of the Municipality of Sucre, Sucre State.	Cross-sectional analytical description
High prevalence of intestinal helminthic infection among children under 5 years in a rural Ghanaian community: an urgent call for attention.	Abaka-Yawson et al., 2020	To determine the prevalence of intestinal helminth infections in children under 5 in one of the most deprived communities from Ghana	Cross-sectional prospective

DISCUSSION

Parasitism is a process in which an aggressive parasite uses the host's body to nourish and develop, which can cause damage to the health of that host, such as diarrhea, malnutrition, gastrointestinal problems, and anemia (ALEXANDRE et al., 2015; CAVALCANTE; MELO; LIMA, 2015; SILVA; MASSARA, 2016).

Regarding the prevalence of enteroparasitosis, the studies by Assandri et al. (2018), Wasihun et al. (2020), Marques et al. (2020), Bechir et al. (2012), Díaz et al. (2015), Gaviria et al. (2017), Alamneh et al. (2021) and Afridi et al. (2021) demonstrate values above 50%. The high prevalence of intestinal parasitosis in children is due to constant person-to-person contact, especially in closed places such as schools, daycare centers and orphanages, contact with animals, in addition, there is a lack of basic notions of hygiene, precarious economic conditions and still immature immunity (SILVA; TEIXEIRA; GONTIJO, 2012; FOSTER; BARBOSA; FERREIRA, 2017). It is worth noting that polyparasitic children can present a reduction of up to 20% in the absorption of iron ingested in the diet, triggering anemia (MORAES et al., 2019).

Anemia is an important public health problem, especially among preschool children. Iron deficiency is the most common cause of anemia, however it can also be caused by nutritional deficiencies (folate, vitamin B12), acute and chronic inflammation, intestinal parasitosis, and hereditary or acquired diseases (CARMONA-FONSECA; CORREA, 2015; RAMOS et al., 2021). Studies by Osman et al. (2020), Díaz et al. (2015), Din et al. (2018), and Afridi et al. (2021) showed a prevalence of anemia above 50% in enteroparasitized children.

In the study by Assandri et al. (2018), a statistically significant association was observed between positivity for soil-transmitted helminths and anemia in all age groups studied. In addition, the authors reported that there is an association between these helminthiases and anemia with growth retardation in children. Another relevant factor observed in this study was the absence of adequate infrastructure to dispose of feces, as well as frequent flooding that increased the chances of contact with enteroparasites and, consequently, can trigger clinical symptoms of anemia.

Wasihun et al. (2020) found a prevalence of 36.1% of *Entamoeba histolytica/dispar* among the children surveyed. The consequences of infection with this parasite include malnutrition, anemia and growth retardation. However, in this study, there was no

statistically significant association between anemia and parasitosis, even with a prevalence of 19% of anemia among parasitized children.

In Eastern Ethiopia, Osman et al. (2020) observed a high prevalence of anemia (75%) among children from a pastoral community, as well as a prevalence of 22% for *Giardia lamblia* infections. No association between giardiasis and anemia was observed, but children infected with *G. lamblia* were 3.5 times more likely to be malnourished. This study demonstrated that the high prevalence of giardiasis and anemia may be related to the living conditions of this community, which has a scarce diet low in iron and vitamin B12, lack of infrastructure to provide drinking water, poor basic sanitation, and lack of access to health.

A comparative study carried out by Marques et al. (2020) between two families living in the Western Amazon – fishermen from Itapuã and miners from Bom Sucesso – showed, in general, 98% of children parasitized, with a higher rate of polyparasitism in Itapuã. The frequency of anemia was higher among the fishing population (33%) than in the mining family (20%), but no association was observed between anemia and enteroparasitosis.

Hossain et al. (2019) observed a strong association between *Ascaris lumbricoides* infection and iron deficiency anemia among 24-month-old children. It is worth mentioning that the parasite *A. lumbricoides*, a helminth transmitted by the soil, lives in the intestine and is nourished by despoiling action, causing a decrease in the host's iron and proteins, which can result in the appearance of anemia.

Bechir et al. (2012) analyzed fecal samples from children in Lake Chad, on the African continent, and noted an association between anemia and intestinal parasitosis, since anemic children were infected by intestinal parasites when compared to non-anemic children. That same study showed that malnourished children were more likely to be anemic, since a lack of nutrients such as iron, vitamin B12, and folic acid can affect erythropoiesis. In this study, the helminth *Hymenolepis nana* showed a significant association with malnutrition, in addition to being more frequent in children aged between 24 and 36 months.

In the municipality of Iza, Colombia, authors Rodríguez, Camacho and Baracaldo (2016) observed a high prevalence of parasitosis in children (50%), with a predominance of infection by the commensal *Entamoeba coli* and protozoan *Blastocystis hominis*. A rate of 14.9% of children with anemia was observed, but there was no significant association with intestinal parasitosis. Most of the population in this study lived in rural areas, with a lack of

sewage networks and adequate garbage collection, in addition to precarious housing conditions, a risk factor for acquisition and increased prevalence of enteroparasitosis, since they are more subject to infection.

Research carried out in the state of Minas Gerais by Zanin et al. (2015) showed that both iron deficiency and parasitic infections were significantly associated with the occurrence of anemia. In addition, this study revealed that the protozoan *Giardia lamblia* and commensal *E. coli* were the most frequent, which may be related to the development of anemia, in addition to helminthiasis.

A study carried out by Díaz et al. (2015) in the Peruvian Amazon showed that indigenous children appear at a disadvantage in terms of poverty rates, maternal and child literacy, access to drinking water services, basic sanitation, electrification and health, when compared to non-indigenous children. The prevalence of anemia and enteroparasitosis was high, especially in indigenous children (51.3% and 77.4%, respectively), but there was no significant association. On the other hand, they observed that intestinal parasitosis was more frequent in children from families whose drinking water came from natural sources or improvised pipes, and who did not have an adequate system for eliminating excrement. In this context, these data point to the importance of the authorities' attention to the indigenous population, which implies increasing the water and sanitation infrastructure and promoting dialogues to improve the use of health services, thus aiming to reduce the prevalence rate of enteroparasitosis and consequently anemia.

In the study conducted by Gaviria et al. (2017), a high prevalence of parasitosis was reported 95.2%, and 31% positivity for anemia in a Colombian indigenous community, a fact considered urgent by the WHO, since the value detected for anemia was above 21%. However, they did not observe a statistically significant association between anemia and intestinal parasitosis, which may be explained by the fact that this relationship is more frequent in helminth infections than in protozoa, since in this study a higher prevalence was observed for infections caused by *Blastocystis* spp. (87.1%).

A study conducted by Din et al. (2018) revealed a prevalence of parasitosis of 27.5% among Pakistani preschoolers, 61% of whom were anemic. There was an association between worm infestation and anemia, since parasitized children were more anemic than those not infected. It is said that most of these children lived among large families, muddy houses with an open sewage system, and had illiterate or poorly educated parents. These findings demonstrated that these factors are associated with an increase in parasitic

infection among children. Family overcrowding combined with precarious conditions and lack of parental awareness increase the probability of parasitic transmission, making the family susceptible to parasitosis and consequently to anemia.

Alamneh et al. (2021) observed prevalences of anemia and enteroparasitosis in 11.9% and 69% of the children analyzed, respectively. Based on bivariate logistic regression, anemia was associated with intestinal parasitosis, child's age, mother's age, annual family income, period of initiation of complementary feeding, dietary diversity, and food insecurity, some of which were predictive factors for childhood anemia. The chances of developing anemia were three times higher among individuals with intestinal parasitosis, which may be related to the action of certain parasites in the body, such as hookworms that feed on blood and cause lesions in the intestinal mucosa – generating bleeding – which contributes to anemia.

Afridi et al. (2021) demonstrated that 53.67% of the children studied were parasitized, and among boys there was a higher prevalence (31%). The prevalence of anemic children was 67.4%. Among them, 49.3% were infected by a parasite, which confirms the association between anemia and intestinal parasitosis. Other causes for anemia include dietary deficit, chronic infections, malabsorption syndrome, and hemoglobinopathies.

In a study conducted by Santos et al. (2016) with children from Iñapari, Peruvian Amazon, it was observed that 20% had anemia. Intestinal parasitosis was identified in 31.4% of the cases, 26.5% of which were pathogenic intestinal parasites – *Giardia lamblia* 15.7%, hookworms 6.9% and *Ascaris lumbricoides* 3.9%. There was no association between anemia and enteroparasitosis. The factors associated with the presence of anemia were the intake of non-boiled water and monthly family income below 689 reais. The presence of parasites in feces was associated with the shared use of sanitary facilities, as well as age over 2 years – which can be explained by the greater autonomy of children and contact with the soil.

Hannaoui et al. (2016) reported a prevalence of anemia in 20.66% of the children evaluated, with 11.16% iron-deficiency anemia and 9.50% non-iron-deficiency anemia. The prevalence of intestinal parasites was 74.1% among children with iron deficiency anemia and 78.3% among children with non-iron deficiency anemia. No significant association was found between anemia and enteroparasitosis. The most frequent parasite among the children studied was *Blastocystis* sp. com an average prevalence of 30%, which may be

related to anemic conditions, since this parasite causes unspecified gastrointestinal and extraintestinal manifestations.

In a study with children from Ghana, Abaka-Yawson et al. (2020) did not observe a significant association between anemia and enteroparasitosis, although 17.11% of the children had anemia and parasitosis. The overall prevalence of anemia was 35.53%, while 44.08% of the children were positive for intestinal parasites. The prevalence of parasites were: 20.39% *Ascaris lumbricoides*, 13.16% hookworms and 10.53% *Trichuris trichiura*, and it was reported that the prevalence of infections by *Ascaris lumbricoides* and hookworms increased with advancing childhood while *Trichuris trichiura* decreased with age.

This study demonstrated the importance of enteroparasitosis for public health, especially among children in day care centers. Among the studies analyzed, an association between anemia and enteroparasitosis was demonstrated, and the main associated factors were related to the precarious living conditions of each population studied, low income, inadequate hygiene, lack of quality basic sanitation, lack of basic health care, scarce diet and low education.

CONCLUSION

Therefore, considering the results obtained, the importance of implementing measures aimed at improving sanitary conditions, implementing programs to support the needy population, as well as the need to educate the population about personal and collective hygiene measures is emphasized. In addition, it is important to draw attention to further studies aimed at the association of enteroparasitosis and anemia, since these diseases can cause damage to the development of children.

REFERENCES

1. Abaka-Yawson, A., et al. (2020). High prevalence of intestinal helminthic infection among children under 5 years in a rural Ghanaian community: An urgent call for attention. *Journal of Parasitic Diseases*, 44(3), 625-632.
2. Afridi, M. F., et al. (2021). Association between intestinal helminthic infections and anaemia status in preschool children in the district Skardu of Pakistan. *JPMA. The Journal of the Pakistan Medical Association*, 71(10), 2309–2312.
3. Alamneh, Y. M., et al. (2021). Magnitude of anemia and associated factors among children aged 6-59 months at Debre Markos referral hospital, Northwest Ethiopia: A hospital-based cross-sectional study. *Italian Journal of Pediatrics*, 47(1), 172.
4. Albuquerque, S. D. (2014). Prevalência de anemia ferropriva e condicionantes demográficos e antropométricos em pré-escolares no município de Marau/RS. Porto Alegre: Universidade Federal do Rio Grande do Sul, Faculdade de Medicina.
5. Alexandre, T. S., et al. (2015). Prevalência de protozoários intestinais em escolares de uma unidade de ensino da rede pública do município de Vitorino Freire-MA. *Revista Científica do ITPAC*, 8(2), 55-63.
6. Araújo Filho, H. B., et al. (2011). Parasitoses intestinais se associam a menores índices de peso e estatura em escolares de baixo estrato socioeconômico. *Revista Paulista de Pediatria*, 29(4), 521-528.
7. Assandri, E., et al. (2018). Anemia, estado nutricional y parasitosis intestinales en niños pertenecientes a hogares vulnerables de Montevideo. *Archivos de Pediatría del Uruguay*, 89(2), 86-98.
8. Bechir, M., et al. (2012). Parasitic infections, anemia and malnutrition among rural settled and mobile pastoralist mothers and their children in Chad. *EcoHealth*, 9, 122-131.
9. Bragagnollo, G. R., et al. (2018). Intervenção educacional sobre enteroparasitoses: Um estudo quase experimental. *Revista Cuidarte*, 9(1), 2030-2044.
10. Cabada, M. M., et al. (2015). Prevalence of intestinal helminths, anemia, and malnutrition in Paucartambo, Peru. *Revista Panamericana de Salud*, 37(2), 69-75.
11. Cabrera, F., et al. (2017). Enteroparasitosis en niños de dos Centros de Atención a la Infancia y la Familia (CAIF) del barrio Casavalle, Montevideo. *Archivos de Pediatría del Uruguay*, 88(6), 315-321.
12. Carmona-Fonseca, J., & Correa B, A. (2015). Perfil hematológico de niños colombianos de zonas palúdicas y su relación con desnutrición crónica y parásitos intestinales patógenos en Urabá, Colombia, 2012. *Medicas UIS*, 28(2), 196-208.

13. Cavalcante, U. M. B., Melo, S. A. L., & Lima, C. M. B. L. (2015). Enteroparasitoses na população infantil, sua prevalência e os modelos de decisão utilizados: Revisão sistemática. *Revista Saúde e Pesquisa*, 8(3), 585-590.
14. Díaz, A., et al. (2015). Situación de salud y nutrición de niños indígenas y niños no indígenas de la Amazonia peruana. *Revista Panamericana de Salud Pública*, 38, 49–56.
15. Din, Z. U., et al. (2018). Parasitic infections, malnutrition and anemia among preschool children living in rural areas of Peshawar, Pakistan. *Nutrición Hospitalaria*, 35(5), 1145–1152.
16. Effanga, E. O., & Imalele, E. E. (2018). Intestinal parasites and anaemia amongst adult patients attending a tertiary hospital in Calabar, Nigeria. *Journal of Global Biosciences*, 7(9), 5633-5653.
17. Freire, S. T., Alves, D. B., & Maia, Y. L. M. (2020). Diagnóstico e tratamento da anemia ferropriva. *RRS-FESGO*, 3(1), 124-131.
18. Fonseca, R. E. P., Barbosa, M. C. R., & Ferreira, B. R. (2017). High prevalence of enteroparasites in children from Ribeirão Preto, São Paulo, Brazil. *Revista Brasileira de Enfermagem*, 70(3), 566-571.
19. Gaviria, L. M., et al. (2017). Prevalencia de parasitosis intestinal, anemia y desnutrición en niños de un resguardo indígena Nasa, Cauca, Colombia, 2015. *Revista Facultad Nacional de Salud Pública*, 35(3), 390-399.
20. Gier, B., et al. (2016). Species-Specific Associations between Soil-Transmitted Helminths and Micronutrients in Vietnamese Schoolchildren. *The American Journal of Tropical Medicine and Hygiene*.
21. Gonçalves, A. L. R., et al. (2011). Prevalence of intestinal parasites in preschool children in the region of Uberlândia, State of Minas Gerais, Brazil. *Revista da Sociedade Brasileira de Medicina Tropical*, 44(2), 191-193.
22. Hannaoui, E., et al. (2016). Prevalencia de anemia ferropénica y su asociación con parasitosis intestinal, en niños y adultos del Municipio Sucre, Estado Sucre, Venezuela. *Multiciencias*, 16(2), 211-217.
23. Hossain, M. S., et al. (2019). *Ascaris lumbricoides* infection: Still a threat for iron deficiency anaemia in 2-year-old Bangladeshi slum-dwelling children. *Journal of Infection in Developing Countries*, 13, 933-938.
24. Lima, W. A., Santos, M. P., & Souza, L. A. P. (2012). Anemia associada às parasitoses intestinais. *Revista Conexão Eletrônica*, 9(1-2).
25. Marques, R. C., et al. (2020). Intestinal Parasites, Anemia and Nutritional Status in Young Children from Transitioning Western Amazon. *International Journal of Environmental Research and Public Health*, 17, 577.

26. Miotto, J. E., et al. (2014). Diagnóstico laboratorial de enteroparasitoses e anemia e sua possível associação com eosinofilia em crianças em idade escolar em Ubiratã – PR. *Biosaúde*, 16(2), 52-62.
27. Moraes, L. J. R., et al. (2019). Prevalência de anemia associada a parasitoses intestinais no território brasileiro: Uma revisão sistemática. *Revista Pan-Amazônica de Saúde*, 10, 1-12.
28. Ngu, R., et al. (2012). Association between anaemia, iron deficiency anaemia, neglected parasitic infections and socioeconomic factors in rural children of West Malaysia. *PLoS Neglected Tropical Diseases*, 6(3), e1550.
29. Nunes, X. P., Almeida, J. R. G. S., & Nunes, X. P. (2014). Anemia ferropriva, enteroparasitoses e esgotamento sanitário. *Revista Brasileira de Pesquisa e Saúde*, 16(1), 118-124.
30. Organização Mundial da Saúde. (2016). Haemoglobin concentration for the diagnosis of anaemia and assessment of severity. Geneva: WHO, Vitamin and Mineral Information Nutrition System.
31. Osman, K. A., et al. (2020). Nutritional status and intestinal parasites among young children from pastoralist communities of the Ethiopian Somali region. *Maternal & Child Nutrition*, 16, e12908.
32. Pedraza, D. F., Queiroz, D., & Sales, M. C. (2014). Doenças infecciosas em crianças pré-escolares brasileiras assistidas em creches. *Ciência & Saúde Coletiva*, 19(2), 511-528.
33. Ramos, B. O. S., et al. (2021). Parasitosis intestinal y anemia en niños de 6 a 60 meses de edad atendidos en el periodo 2015 al 2020, en un centro de salud Altoandina de Perú. *Ciencia Latina Revista Científica Multidisciplinar*, 5(6), 11247-11256.
34. Rodríguez, A. Y., Camacho, J. M., & Baracaldo, C. M. (2016). Estado nutricional, parasitismo intestinal y sus factores de riesgo en una población vulnerable del municipio de Iza (Boyacá), Colombia, año 2013. *Revista Chilena de Nutrición*, 43(1), 45-53.
35. Santos, A. P., et al. (2016). Prevalence of nutritional deficiencies and morbidity by infectious diseases in children 0-5 years of age in Iñapari in the Peruvian Amazon. *Revista de Patología Tropical/Journal of Tropical Pathology*, 45(3), 305-321.
36. Santos Júnior, J. G. A., et al. (2015). Anemia associada às parasitoses intestinais de pacientes atendidos em um laboratório de análises clínicas no município de Juazeiro do Norte-CE. *Revista Interfaces: Saúde, Humanas e Tecnologia*, 3(9), 47-55.
37. Silva, A. V. M., & Massara, C. L. (2016). *Ascaris lumbricoides*. In D. P. Neves (Ed.), *Parasitologia humana* (13th ed., pp. 295-301). São Paulo: Editora Atheneu.
38. Silva, M. G., Teixeira, D. J., & Gontijo, E. E. L. (2012). Prevalência de parasitas intestinais em alunos de 5 a 12 anos da rede pública do município de Gurupi, Tocantins, Brasil. *Revista Eletrônica de Farmácia*, 9, 13-24.

39. Solano-Barquero, M., et al. (2018). Prevalencia de parasitosis en niños de 1 a 7 años en condición de vulnerabilidad en la Región Central Sur de Costa Rica. *Acta Médica Costarricense*, 60(2), 19-29.
40. Spezia, J., et al. (2018). Prevalence of anemia in schools of the metropolitan region of Curitiba, Brazil. *Hematology, Transfusion and Cell Therapy*, 40(2), 151-155.
41. Walcher, D. L., Pedroso, D., & Frizzo, M. N. (2013). Associação entre parasitoses intestinais e alterações do hemograma. *Revista Mirante*, 3(1), 18-40.
42. Wasihun, A. G., et al. (2020). Intestinal parasitosis, anaemia and risk factors among pre-school children in Tigray region, northern Ethiopia. *BMC Infectious Diseases*, 20, 379.
43. Werneck, G. L., Hasselmann, M. H., & Gouvêa, T. G. (2011). Panorama dos estudos sobre nutrição e doenças negligenciadas no Brasil. *Ciência & Saúde Coletiva*, 16(1), 39-62.
44. Zanin, F. H. C., et al. (2015). Determinants of iron deficiency anemia in a cohort of children aged 6-71 months living in the Northeast of Minas Gerais, Brazil. *PLOS ONE*, 10, e0143039.
45. Zuffo, C. R. K., et al. (2016). Prevalence and risk factors of anemia in children. *Jornal de Pediatria*, 92(4), 353-360.