Infection and Drug Resistance

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Distribution of the Intestinal Parasites According to Species and Gender in Patients Presented to the Microbiology Laboratory in a Tertiary Hospital, in Somalia Between January 2018 and October 2022

Serpil Doğan[1], Said Mohamed Mohamud[1], Rahma Yusuf Haji Mohamud[2], Ahmed Mohamed Ali Orey[3], Zerife Orhan[4]

[1]Department of Medical Microbiology, Mogadishu Somalia Turkey Recep Tayyip Erdogan Training and Research Hospital, Medical Microbiology Laboratory, Mogadishu, Somalia; [2]Department of Education, Mogadishu Somalia Turkey Recep Tayyip Erdogan Training and Research Hospital, Department of Education, Mogadishu, Somalia; [3]Department of Infectious Diseases, Mogadishu Somalia Turkey Recep Tayyip Erdogan Training and Research Hospital, Department of Infectious Diseases, Mogadishu, Somalia; [4]Department of Medical Microbiology, Kahramanmaraş Sütçü Imam University, Vocational School of Health Services, Kahramanmaraş, Türkiye

Correspondence: Said Mohamed Mohamud, Department of Medical Microbiology, Mogadishu Somalia Turkey Recep Tayyip Erdogan Training and Research Hospital, Microbiology Laboratory, Mogadishu, Somalia, Tel +252615499152, Email sraage2020@gmail.com

Purpose: In this study, it was aimed to determine the 5-year prevalence of intestinal parasites in patients admitted to the Microbiology laboratory of a tertiary hospital in Somalia. Intestinal parasites; Types of patients, age and sex of the patients, and the distribution by years were examined.

Patients and Methods: Stool samples were examined using wet preparation, native lugol and trichrome staining methods. Statistical analysis was performed using IBM SPSS V23 software and a P value of <0.05 was considered statistically significant. Tables and figures were used to show the results.

Results: One or more parasites were detected in 6766 of 56,824 stool samples examined. It was observed that *Giardia lamblia* had a higher prevalence than other parasites (60.84%) in a five-year period. *Entamoeba histolytica* (33.07%) second rank and *Ascaris lumbricoides* (3.18%) third rank according to their prevalence. When the distribution of the parasite population by gender is evaluated; no statistically significant difference was found ($p = 0.235$). When the frequency of parasites was evaluated according to age groups, it was seen that the prevalence of parasites between the ages of 0–15 was higher (45.5%) compared to other age groups. A statistically significant difference was found between the distribution of parasite groups according to age groups ($p < 0.001$).

Conclusion: Considering the effects of intestinal parasites on public health, it is still considered to be an important health problem for developing countries. It is thought that the frequency of parasitic diseases in society will decrease with the education of individuals, effective diagnosis, treatment, and implementation of preventive measures.

Keywords: intestinal parasite, prevalence, Somalia

Introduction

Gastrointestinal parasites are a serious health burden for the poor world and one of the neglected tropical diseases, which is a global health problem especially in underdeveloped countries, is intestinal parasite infections.[1,2] Different intestinal parasites are present in over 3 billion people in a large number of people worldwide, resulting in morbidity in a large number of people.[3] Parasites are a global health problem in both developed and developing countries. Especially because of their hot and humid climate, poor health conditions, and/or difficulty accessing drinking water, these infestations are more common in underprivileged groups, especially in tropical and subtropical regions.[4,5] Their prevalence is influenced

Received: 8 September 2023
Accepted: 25 October 2023
Published: 1 November 2023

by a number of socioeconomic factors, including age, climate, and cleanliness in addition to geographic location.[6] According to estimates, more than 10.5 million new cases are reported each year, and the most prevalent intestinal parasites include *Ascaris lumbricoides, hookworms, Trichuris trichiura, Giardia lamblia, Entamoeba histolytica, and Schistosoma* species.[7] The most common means of spreading these intestinal parasites is through ingesting infected food and drink. Additionally, after an infectious larval stage in contaminated soil actively penetrates the epidermis, infection might develop.[8] Intestinal parasites are key aetiological agents of different gastrointestinal troubles such as dysentery, diarrhoea, abdominal distension, vomiting and lack of appetite. They can also cause iron deficiency anaemia, growth retardation and mentally related disorders. Such clinical complications commonly affect high-risk populations like pregnant females, immunocompromised individuals and children.[9] Few data are available from the most easterly located African country, in Somalia on the risk factors affecting the distribution and prevalence of parasites by species in stool samples in patients with gastrointestinal symptoms.[10]

In this study, it was aimed to investigate the factors affecting the distribution and prevalence of intestinal parasites according to species and gender in patients who applied to the Microbiology laboratory in a tertiary hospital in Somalia.

Materials and Methods

Between January 2018 and November 2022, a total of 56,825 stool samples were retrospectively analyzed in the Microbiology Laboratory of our hospital.

Stool samples were first examined macroscopically in terms of odor, consistency, mucus-blood content and structures of adult forms of parasites. Then, all stool samples were examined microscopically at X10 and X40 magnification with wet preparation and native lugol method. After the stool samples taken from the patients who applied with the complaint of diarrhea were examined with physiological saline, the Trichrome staining method was applied to evaluate the suspicious cysts and trophozoites in terms of amoeba, and were examined with the apparatus at a magnification of X100.

Cellophane tape specimen for Enterobius vermicularis has only been evaluated in a small number of specimens from pediatrics. In cellophane slide samples, *Enterobius vermicularis* eggs were searched microscopically at X10 and X40 magnification.

The gender and age characteristics of the cases and the incidence of the detected parasites were evaluated. The age was defined in four categories: 0–15 years, 16–30 years, 31–45 years, 46–60 years and over 60 years.

Statistical Analysis

Data were analyzed with IBM SPSS V23. Pearson chi-square test was used to compare categorical data according to groups, and multiple comparisons were analyzed with Bonferroni corrected Z test. Analysis results were presented as frequency (percentage). The significance level was taken as $p < 0.050$.

Results

A total of 56,824 stool samples sent to the laboratory were included in our study. Of these samples, 50.4% (31,891) were taken from female patients and 49.5% (24,933) from male patients. While the presence of parasites was detected in 11.9% (6766) of the samples, the presence of parasites was not detected in 88% (50,058). It was determined that 52.1% (3529) of the parasite-positive cases were female and 47.9% (3237) were male. Singleparasitism was found in 96.6% (6535) of parasite positive patients and polyparasitism was found in 3.4% (232). A statistically significant difference was found between the distribution of parasite groups according to age groups ($p < 0.001$). This difference is due to the difference between the rates of those aged over 60 and those aged 0–15, 16–30, 31–41, and 46–60, and the difference between the proportions of those aged 0–15 and 16–30. The rate of those with a single parasite in the 0–15 age group is 97.6%, the rate of a single parasite in the 16–30 age group is 96%, the rate of single parasite in the 31–45 age group is 96.7%, the rate of single parasite among 46–60 age group is 96.4% and the rate of those who are over 60 years old with single parasite was 91.8%. There was no statistically significant difference between the distribution of parasite groups by gender ($p = 0.235$) (Table 1).

The rate of *E. histolytica* type was 47% in 2018, 31.7% in 2019, 31.9% in 2020, 31.6% in 2021 and 34.1% in 2022. The rate of *G. lamblia* species was 47.5% in 2018, 54.5% in 2019, 64.1% in 2020, 62.2% in 2021 and 61.4% in 2022.

Table 1 Comparison of Parasite Groups by Age and Sex

Demographic Data	Parasite Groups*		Total	Test ist.	p[d]
	Single parasite	Polyparasite (Double+ Triple)			
Age					
0–15	3003 (97,6)a	73 (2,4)a	3076 (45,5)	91,925	<0.001
16–30	1465 (96)b	61 (4)b	1526 (22,6)		
31–45	931 (96,7)ab	32 (3,3)ab	963 (14,2)		
46–60	675 (96,4)ab	25 (3,6)ab	700 (10,3)		
>60	461 (91,8)c	41 (8,2)c	502 (7,4)		
Gender					
Female	3399 (96,3)	130 (3,7)	3529 (52,2)	2894	0.235
Male	3135 (96,8)	102 (3,2)	3237 (47,8)		

Notes: *Multiple response, Pearson chi-square test, a-c: There is no difference between groups with the same letter. Frequency (percent).

The rate of *A. lumbricoides* species was 0.3% in 2018, 2.4% in 2019, 2.2% in 2020, 4.2% in 2021 and 2.7% in 2022 (Table 2). Descriptive statistics are presented in (Table 2).

It was observed that *G. lamblia* had a higher prevalence than other parasites (60.84%) in a five-year period. *E. histolytica* (33.07%) and *A. lumbricoides* (3.18%) rank second and third according to their prevalence (Figure 1).

Those with double parasites made up %3.4 (230) of the polyparasitism population, whereas those with triple parasites made up %0.03 (two) (Table 3). When double parasites are examined within themselves; the most common double parasites are *G. lamblia +E. Histolytica* with a rate of 40% and *A. lumbricoides+G. lamblia* with a rate of 37.8% in the second frequency. In addition, two triparasites including *T. trichiura+A. duodenale +E. histolytica* and *T. trichiura +A. lumbricoides+ H. nana* were observed (Table 3).

Table 2 Descriptive Statistics of Parasite Species by Year

Species*	2018	2019	2020	2021	2022	Total
Entamoeba histolytica	178 (46,97)	175 (31,7)	322 (31,88)	987 (31,55)	499 (34,06)	2161 (33,07)
Giardia lamblia	180 (47,49)	301 (54,53)	647 (64,06)	1947 (62,24)	900 (61,43)	3975 (60,84)
Ascaris lumbricoides	1 (0,26)	13 (2,36)	22 (2,18)	132 (4,22)	40 (2,73)	208 (3,18)
Trichuris trichiura	0 (0)	8 (1,45)	5 (0,5)	21 (0,67)	12 (0,82)	46 (0,7)
Enterobius vermicularis	1 (0,26)	6 (1,09)	2 (0,2)	9 (0,29)	7 (0,48)	25 (0,38)
Hymenolepis nana	1 (0,26)	11 (1,99)	5 (0,5)	16 (0,51)	3 (0,2)	36 (0,55)
Ancylostoma duodenale	0 (0)	1 (0,18)	0 (0)	0 (0)	2 (0,14)	3 (0,05)
Taenia saginata	0 (0)	0 (0)	0 (0)	2 (0,06)	0 (0)	2 (0,03)
Enteromonas hominis	16 (4,22)	7 (1,27)	4 (0,4)	1 (0,03)	0 (0)	28 (0,43)
Trichomonas hominis	2 (0,53)	27 (4,89)	4 (0,4)	9 (0,29)	1 (0,07)	43 (0,66)
Strongyloides stercoralis	0 (0)	3 (0,54)	0 (0)	4 (0,13)	1 (0,07)	8 (0,12)
Total	379 (100)	552 (100)	1010 (100)	3128 (100)	1465 (100)	6534 (100)

Note: *Multiple response, frequency (percent).

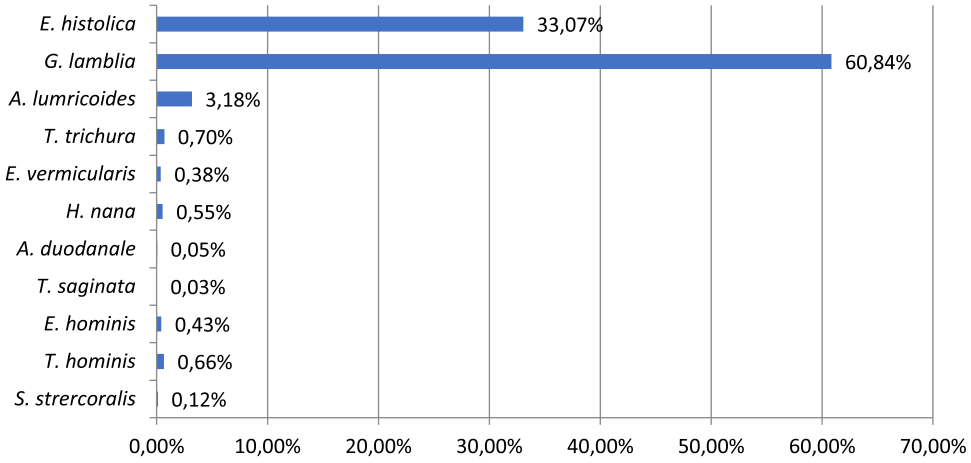

Figure 1 Bar graph of parasite species.

Discussion

Intestinal parasitic infections (IPI) affect large numbers of people worldwide, especially in developing countries.[11] IPIs are a major health concern in sub-Saharan Africa, where risk factors include ignorance, malnutrition, poor sanitation, and

Table 3 General Descriptive Statistics for Double Parasites and Triple Parasites

Double Parasite*	**Frequency (n)**	**Percentage (%)**
G. lamblia +E. histolytica	92	40,0
A. lumbricoides +G. lamblia	87	37,8
A. lumbricoides +H. nana	1	0,4
G. lamblia +T. hominis	5	2,3
G. lamblia +T. trichiura	4	1,7
G. lamblia +E. vermicularis	1	0,4
E. histolytica +A. lumbricoides	16	7.0
E. histolytica +E. vermicularis	2	0,9
A. lumbricoides +T. trichiura	5	2,2
E. histolytica +T. trichiura	5	2,2
E. histolytica +H. nana	2	0,9
E. histolytica +E. hominis	1	0,4
E. hominis+H. nana	1	0,4
G. lamblia +H. nana	8	3,4
Total	**230**	**100**
Triple Parasite*		
T. trichiura +A. duodenale +E. histolytica	1	50
T. trichiura +A. lumbricoides +H. nana	1	50
Total	2	100

Note: *Multiple responses.

poverty.[12] Intestinal parasites, which usually progress with asymptomatic or atypical findings, cause mental and physical development retardation, as well as cause loss of workforce with the complaints they cause, and show negative effects on both physical and mental health and the country's economy.[13–15]

Regional epidemiological data are important to prevent infections caused by parasites and to develop effective treatment strategies. There are many publications in which the results of the frequency of parasites vary according to years and regions.[16,17] The prevalence of IPI in our study was 11.9%, which is consistent with the prevalence of 15.8% found in a study conducted in the parasitology laboratory of LeDantec University Hospital in Dakar, Senegal, between January 2011 and December 2015.[16] On the other hand, a study conducted in Turkey between 2012 and 2014 reported a lower prevalence (3.7%) than we did.[17] Sylla et al[18] founded a prevalence of 26.8% in the Fann hospital between 2006 and 2010 in the lab of the Dakar University Hospital. In Pakistan (52.8%)[19] and in Nepal (31.5%),[20] Ghana (%17,33)[21] and a prevalence of 60.8% was reported in Burkina Faso, a West African country.[22] In other research, Nigeria was reported to have a higher prevalence of 95.7%.[23] The South American intertropical region likewise saw this development, with a prevalence of 70.7% recorded in Brazil in 2005.[24] Considering the geographical features and climatic conditions, it is seen that there are significant differences between countries in terms of parasites.

The incidence of parasitic diseases in a society varies according to the parasite, human, environmental factors, the infrastructure of the region, and the education level of the society.[25]

Differences in prevalence are also closely related to the age and socioeconomic status of the study group.[26] Whereas in our study when the frequency of parasites was evaluated according to age groups, it was seen that the prevalence of parasites between the ages of 0–15 was higher than other age groups (45.5%). A statistically significant difference was found between the distributions of parasite groups according to age groups. ($p<0.001$) (Table 1). Considering other studies on this subject; In the Maghreb, a prevalence of 68.1% was found school-aged population in Morocco in 2009.[27] Another study among schoolchildren in three districts of Mauritania, also in West Africa, revealed a 33.4% frequency of intestinal parasite diseases.[28]

Intestinal parasitic infections are the cause of many long-term conflicts, including iron deficiency anemia, growth failure in children, and physical and mental health disorders.[29] We think there is a need for emergency response programs that concentrate on providing safe drinking water and educating both parents and kids about personal and environmental hygiene given the high frequency of IPIs in children.

When the distribution of the parasite population by sex was evaluated in our study, no statistically significant difference was found ($p = 0.235$). Parasite incidence rate in women is 52.2% (3529), while in men; It was found to be 47.8% (3237) (Table 1). In a study conducted in Senegal, intestinal parasite infections were found to be higher in women (50.7%) than in men (49.3%), without a statistically significant difference.[16] Similar ratios of 51% men to 49% women were found in Malaysia in a research on intestinal protozoa.[30] In terms of intestinal parasites there are also other studies reporting that the difference between men and women is not significant.[25] In a study done in Turkey was found that the prevalence of intestinal parasite infection was (%53) higher in women than (%47) in men.[31] There are also studies from Azezo North-West Ethiopia,[32] Nepal[33] and Brazil[34] that found that men have more IPI than women. As a result, it is thought that the parasite rates being close to each other will not make a significant difference in terms of the incidence of intestinal parasites in both men and women.

In our study, intestinal parasites were detected in 11.9% of 56,824 stool samples, and the most common intestinal parasites were *G. lamblia* %60.84 (3975/6535) and *E. histolytica* %33.07 (2161/6535*) A. lumbricoides* %3.18 (208/6535) was seen in the 3rd place, while other parasite species were found to have a very low prevalence (Figure 1). Many studies have been conducted on the effect of climate on the incidence of parasites. In a study conducted in northeast Egypt, *G. lamblia* (12.6%), *E. histolytica/dispar* (10%), *A. lumbricoides (*8.8%) and *H. nana* (8.6%) were reported to be the most common parasites.[35] *E. histolytica/dispar* (1.96%) was found to be the most common parasitic infections in a hospital in a tertiary hospital in Nepal.[36] The main parasites detected in asymptomatic food handlers in Ethiopia were *E. histolytica/dispar*(5.5%), *A. lumbricoides* (4%) and *G. lamblia* (3%).[37] The most commonly identified species in terms of intestinal parasites detected in another study were *E. histolytica/dispar* (24.5%), *hookworm* (22%), (10%), *A. lumbricoides* (13.6%), and *G. lamblia* (11.4%). This current result shows a high correlation between drinking water source, hand washing behavior, unclean fingernails, and *E. histolytica/dispar* infection.[3] Considering the geographical

features and climatic conditions, it is seen that there are significant differences between countries in terms of the most common parasites.

In our study, 230 (3.4%) of the samples found to have parasites were found to be double parasites and two (0.03%) triparasites. When double parasites were examined, *G. lamblia+E. Histolytica*was the most common with 40%, and *A. lumbricoides* + *G. lamblia* was the second most common with 37.8%. In addition, two triparasites including *T. trichura+A. duodanale+E. histolytica* and *T. trichura+A. lumbricoides+H. nana* were observed (Table 3).

In a study, double parasitism was found in 13.6%. In the same study, a very low rate of (0.7%) triparasitism including two helminths (*A. lumbricoides* and *T. Trichiura*) and one protozoan (*E. histolytica/dispar*) was observed.[6] Another study found that 39.1% of children had polyparasitism, with 36.1% having double intestinal parasites and 2.9% having triple parasites. 46.4% of people were infected with just one parasite.[38] In relation to the degree of environmental contamination, the degree of public knowledge of parasitic infection, and socioeconomic conditions, the incidence of multiple parasite infections simultaneously may vary.[3]

Conclusion

Intestinal parasites are still considered to be an important health problem, especially in developing countries. Education of individuals in society is important in terms of parasitic diseases, and it is thought that their frequency in society will be reduced by implementing preventive measures such as effective diagnosis, treatment, and routine deworming programs. Another issue is that direct microscopic examination is a subjective method for diagnosis, and different results can be obtained depending on the experience and education level of the doctor or health personnel who make the evaluation. For this reason, performing microscopic examination by health personnel with sufficient experience, using this method together with other diagnostic methods, and evaluating three different samples in a row will increase and facilitate the possibility of making a correct diagnosis.

Data Sharing Statement

The dataset used and/or analyzed in the study is available from the corresponding author upon reasonable request.

Ethical Approval

Before the commencement of the study, we obtained ethical clearance from the ethics committee of Mogadishu Somalia Turkey Recep Tayyip Erdogan Training and Research Hospital (approval number: MSTH/12752) we conducted the study following the Declaration of Helsinki.

Informed Consent

Although our hospital's ERB waived informed consent due to the retrospective nature of the study, all participants were informed in the past that, in the future, their data could be used in studies and that their written informed consent had been obtained.

Author Contributions

All authors contributed significantly to the work that was published, whether it be in the ideation, study design, implementation, data collection, analysis, and interpretation, or in all of these areas. They also participated in revising, and critically evaluating the article, gave their final approval for the version that would be published, agreed on the journal to which the article would be submitted, and agreed to be responsible for all aspects of the work.

Funding

There is no funding to report.

Disclosure

The authors declare that they have no conflicts of interest in relation to this work.

References

1. Taghipour A, Ghodsian S, Jabbari M, Olfatifar M, Abdoli A, Ghaffarifar F. Global prevalence of intestinal parasitic infections and associated risk factors in pregnant women: a systematic review and meta-analysis. *Trans R Soc Trop Med Hyg*. 2021;115(5):457–470. doi:10.1093/trstmh/traa101
2. World Health Organization Expert Committee. Public health significance of intestinal parasitic infections. *Bull WHO*. 1987;65(5):575–588.
3. Hailegebriel T. Prevalence of intestinal parasitic infections and associated risk factors among students at Dona Berber primary school, Bahir Dar, Ethiopia. *BMC Infect Dis*. 2017;17(1):362. doi:10.1186/s12879-017-2466-x
4. Sahimin N, Lim YAL, Ariffin F, Behnke JM, Lewis JW, Zain SNM. Migrant workers in Malaysia: current implications of sociodemographic and environmental characteristics in the transmission of intestinal parasitic infections. *PLoSNegl Trop Dis*. 2016;10(11):e0005110. doi:10.1371/journal.pntd.0005110
5. Sabiti SN, Aloni MN, Linsuke SWL, et al. Prévalence des géohelminthiases chez les enfants à Kinshasa. *Archives Depédiatrie*. 2014;21(6):579–583. doi:10.1016/j.arcped.2014.03.003
6. Dhital S, Pant ND, Neupane S, et al. Prevalence of enteropathogens in children under 15 years of age with special reference to parasites in Kathmandu, Nepal; a cross-sectional study. *SpringerPlus*. 2016;5(1):1813. doi:10.1186/s40064-016-3477-6
7. World Health Organization. *Working to Overcome the Global Impact of Neglected Tropical Diseases*. Geneva: WHO; 2010.
8. Alo M, Ugah U, Elom M. Prevalence of intestinal parasites from the fingers of school children in Ohaozara, Ebonyi State, Nigeria. *Am j Biol Chem Pharm Sci*. 2013;1(5):22–27.
9. Mahmud MA, Spigt M, Bezabih AM, Dinant GJ, Velasco RB. Associations between intestinal parasitic infections, anaemia, and diarrhoea among school aged children, and the impact of hand-washing and nail clipping. *BMC Res*. 2020;13(1):1.
10. Ilardi I, Sebastiani A, Leone F, et al. Epidemiological study of parasitic infections in Somalia nomads. *Trans R Soc Trop Med Hyg*. 1987;81(5):771–772. doi:10.1016/0035-9203(87)90027-7
11. WHO; PAHO. *Neglected Infectious Diseases in the Americas: Success Stories and Innovation to Reach the Neediest*; 2015.
12. Noden BH, van der Colf BE. Neglected tropical diseases of Namibia: unsolved mysteries. *Acta Trop*. 2013;125(1):1–17. doi:10.1016/j.actatropica.2012.09.007
13. Doyle PW, Helgason MM, Mathias RG, Proctor EM. Epidemiology and pathogenicity of Blastocystis hominis. *J Clin Microbiol*. 1990;28(1):116–121. doi:10.1128/jcm.28.1.116-121.1990
14. Nematian J, Nematian E, Gholamrezanazhad A, Asgari AA. Prevalence of intestinal parasitic infections and relation with socio-economic factors and their habits in Tehran primary school students. *Acta Trop*. 2004;92(3):179–186. doi:10.1016/j.actatropica.2004.06.010
15. World Health Organization. Prevention and control of intestinal parasitic infections. *WHO Technical Reports Series*. 1987;749:1–86.
16. Diongue K, Ndiaye M, Seck MC, et al. Distribution of Parasites Detected in Stool Samples of Patients in Le Dantec University Hospital of Dakar, Senegal, from 2011 to 2015. *J Trop Med*; 2017:5.
17. Selek MB, Bektore B, Karagöz E, Baylan O, Ozyurt M. Distribution of parasites detected in stool samples of patients admitted to our parasitology laboratory during a three-year period between 2012 and 2014. *Turkish J Parasitol*. 2016;40(3):137–140. doi:10.5152/tpd.2016.4533
18. Sylla K, Tine RCK, Sow D, et al. Epidemiological aspects of intestinal parasitic infection diagnosed in parasitology and mycology laboratory of Fann hospital, Dakar, Senegal. *Medecined'Afrique Noire*. 2013;60(7):339–346.
19. Mehraj V, Hatcher J, Akhtar S, Rafique G, Beg MA. Prevalence and factors associated with intestinal parasitic infection among children in an urban slum of Karachi. *PLoS One*. 2008;3(11):e3680. doi:10.1371/journal.pone.0003680
20. Sah RB, Bhattarai S, Yadav S, Baral R. A study of prevalence of intestinal parasites and associated risk factors among the school children of Itahari, Eastern Region of Nepal. *Trop Parasitol*. 2013;3(2):140–144. doi:10.4103/2229-5070.122143
21. Mirisho R, Neizer ML, Sarfo B. Prevalence of Intestinal Helminths Infestation in Children Attending Princess Marie Louise Children's Hospital in Accra, Ghana. *J Parasitol Res*. 2017;8524985. doi:10.1155/2017/8524985
22. Ouermi D, Karou SD, Ouattara I, et al. Prevalence of intestinal parasites at Saint-Camille center in Ouagadougou (Burkina Faso), 1991 to 2010. *Med Sante Trop*. 2012;22(1):40–44. doi:10.1684/mst.2012.0008
23. Ugbomoiko US, Onjole AT, Edungbola LD. Prevalence and intensity of geohelminths infection in Oba-Ile Community of Osun state, Nigeria. *Niger J Parasitol*. 2007;27(1):62–67.
24. Nascimento SA, Moitinho MLR. Blastocystis hominis and other intestinal parasites in a community of Pitanga city, Parana State, Brazil. *Rev Inst Med trop S Paulo*. 2005;47(4):213–217. doi:10.1590/S0036-46652005000400007
25. Alver O, Töre O. Uludağ Üniversitesi Tıp Fakültesindeki bağırsak parazit olgularının prevalansı ve dağılımı [Prevalence and distribution of intestinal parasite cases in Uludağ University Faculty of Medicine]. *Türkiye Parazitol Derg*. 2006;30(4):296–301. Turkish.
26. Yılmaz U, Östan İ, Kayran E, Özbilgin A. Celal Bayar Üniversitesi Araştırma ve Uygulama Hastanesi'nde 2000-2001 yıllarında saptanan bağırsak parazitlerinin dağılımı [Distribution of intestinal parasites detected in Celal Bayar University Research and Application Hospital in 2000-2001]. *Türkiye Parazitol Derg*. 2002;26(1):60–63. Turkish.
27. Elqaj M, Belghyti D, Ahami A, Loutfi H, Elkharrim K, Taboz Y. Prévalence des parasitoses intestinales chez les écoliers en milieu rural Kenitra-Maroc [Prevalence of intestinal parasitoses among school children in rural Kenitra-Morocco]. *World J Biol Res*. 2009;2(1):1–6. French.
28. Baba OASC, Aminetou BM, Ba O, et al. Prevalence of intestinal parasites among school children in the Gorgol, Guidimagha, and Brakna area (Mauritania). *Revue Francophone des Laboratoires*. 2012;440(440):75–78. doi:10.1016/S1773-035X(12)71367-9
29. Eslahi AV, Olfatifar M, Zaki L. The worldwide prevalence of intestinal helminthic parasites among food handlers: a systematic review and meta-analysis. *Food Control*. 2023;148:109658. doi:10.1016/j.foodcont.2023.109658
30. Noor Azian MY, San YM, Gan CC, et al. Prevalence of intestinal protozoa in an aborigine community in Pahang, Malaysia. *Trop Biomed*. 2007;24(1):55–62.
31. Doğan N, Demirüstü C, Aybey A. Eskişehir Osmangazi Üniversitesinin beş yıllık bağırsak paraziti prevalansının türlereve cinsiyetlere göre dağılımı [Distribution of five-year intestinal parasite prevalence of Eskişehir Osmangazi University by species and gender]. *Türkiye Parazitol Derg*. 2008;32(2):120–125. Turkish.
32. Endris M, Lemma W, Belyhun Y, Moges B, Gelaw A, Angaw B. Prevalence of intestinal parasites and associated risk factors among students of Atse Fasil General Elementary SchoolAzezo, Northwest Ethiopia. *Ethiop J Health Biomed Sci*. 2010;3(1):25–33.

33. Khanal L, Choudhury D, Rai S, et al. Prevalence of intestinal worm infestations among school children in Kathmandu, Nepal. *Nepal Med Coll J*. 2011;13(4):272–274.
34. Faria CP, Zanini GM, Dias GS, et al. Geospatial distribution of intestinal parasitic infections in Rio de Janeiro (Brazil) and its association with social determinants. *PLoS Negl Trop Dis*. 2017;11(3):e0005445. doi:10.1371/journal.pntd.0005445
35. Omar M, Abdelal HO. Current status of intestinal parasitosis among patients attending teaching hospitals in Zagazig district, Northeastern Egypt. *Parasitol Res*. 2022;121(6):1651–1662. doi:10.1007/s00436-022-07500-z
36. Baral R, Jha P, Amatya R, Khanal B. Prevalence of intestinal parasitic infections among patients attending in a tertiary care hospital of the eastern region of Nepal – a retrospective, laboratory-based study. *Asian J Med Sci*. 2017;8(3):55–59. doi:10.3126/ajms.v8i3.16909
37. Kebede E, Seid A, Akele S. Prevalence and associated risk factors of intestinal parasitic infections among asymptomatic food handlers in Wollo University student's cafeteria. Northeast Ethiopia. *BMC Res Notes*. 2019;12(1):139. doi:10.1186/s13104-019-4182-7
38. Gyang VP, Chuang TW, Liao CW, et al. Intestinal parasitic infections: current status and associated risk factors among school-aged children in an archetypal African urban slum in Nigeria. *J Microbiol Immunol Infect*. 2019;52(1):106–113. doi:10.1016/j.jmii.2016.09.005