

Original Research Article

PREVALENCE AND SEASONAL DISTRIBUTION OF INTESTINAL PROTOZOAN INFECTIONS IN DUHOK CITY, KURDISTAN REGION, IRAQ

Haneen Nawaf AlZainny¹, Salwa Muhsin Hasan², Iman A. Hami³

¹Department of Medical Laboratory Technology, Duhok Private Technical Institute, Duhok, Kurdistan Region, Iraq

²Department of Food Production and Technology, Technical College of Duhok, Duhok Polytechnic University, Kurdistan Region, Iraq

³Department of Medical Laboratory Technology, College of Health and Medical Technology-Shekhan, Duhok Polytechnic University, Kurdistan Region, Iraq

Received : 04/03/2026
Received in revised form : 06/04/2026
Accepted : 23/04/2026

Corresponding Author:

Dr. Haneen Nawaf AlZainny,
Department of Medical Laboratory
Technology, Duhok Private Technical
Institute, Duhok, Kurdistan Region,
Iraq.
Email: haneen.alzainny@dp-ti.edu.krd
haneen.Alzainny@gmail.com

DOI: 10.70034/ijmedph.2026.2.179

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (2); 1059-1064

ABSTRACT

Background: Intestinal infections remain among the most prevalent diseases caused by protozoan parasites. These intestinal protozoa can lead to a range of clinical symptoms, from chronic to severe diarrhea, stomach cramps, flatulence, nausea, vomiting, loss of appetite, fatigue, low-grade fever, and weight loss. School-aged children (5–17 years) are particularly vulnerable, often exhibiting higher infection rates due to inadequate hygiene practices and frequent contact with contaminated environments, such as soil during outdoor activities.

Materials and Methods: In the current retrospective study, data were obtained from the archives of the parasitology section of the Laboratory Department at Azadi Teaching Hospital and Heevi Pediatric Hospital in Duhok city. The study included positive cases of intestinal parasitic infections recorded between January 2024 and December 2024, totaling 398 patients. These pre-existing stool specimens had been examined macroscopically, followed by microscopic analysis using the wet mount technique.

Results: The findings revealed that infection rates were nearly similar between males and females, with 211 (53%) males and 187 (47%) females. Adults exhibited a higher infection rate compared to children, with 247 (62%) and 151 (38%) cases, respectively. *Entamoeba histolytica* was the most frequently detected parasite, present in 388 (97%) of cases. Other detected parasites included *Giardia lamblia* in 8 cases (2%), *Trichomonas hominis* in 1 case (0.25%), and *Blastocystis hominis* in 1 case (0.25%).

Conclusion: Seasonal distribution of infection showed the highest prevalence during the summer, with 177 cases (44.5%), followed by autumn with 123 cases (30.9%), spring with 60 cases (15%), and winter with 38 cases (9.5%).

Keywords: Intestinal protozoa, Seasons, Wet mount, Parasite, Temperature, technique.

INTRODUCTION

Intestinal protozoan infections do rank among the most common parasitic diseases particularly in developing countries that are affecting low-income populations. These infections do greatly contribute to gastrointestinal disorders and malnutrition in addition to mortality worldwide.^[1,2]

Worldwide, intestinal protozoan infections mainly cause gastrointestinal diseases including *Cryptosporidium* and *Giardia lamblia* induced ones. *Giardia lamblia* often causes lasting diarrhea as well

as bloating, stomach cramps, nausea, anorexia, and major weight loss.^[3] A 2023 study found the fitness of the trophozoite determines the severity of intestinal epithelial disruption which influences nutrient absorption as well as the host's inflammatory response. *Giardia* also is implicated in long-term consequences such as both stunting plus cognitive impairment for children who are from low- and middle-income countries.^[4] Likewise, *Cryptosporidium* stays in immunocompromised people so brings lasting diarrhea, dehydration, along with malnutrition.^[5] To avoid the serious health

complications that these protozoa cause, early diagnosing and intervening is important.

Intestinal parasitic infections do affect vulnerable school-age children especially those children aged 5 to 17 years. Poor hygiene as well as frequent exposure to contaminated soil during outdoor activities and play will cause vulnerability to soil-transmitted helminths (STH) and *Schistosoma mansoni*. In West Ethiopia the 2023 study showed risks for children's infections.^[6,7] This risk increased greatly with poor hygiene, unwashed fruits, or inadequate handwashing. These are findings highlighting the need of educating people about good hygiene. More improved interventions are able to reduce infections within the children.

Parasite transmission is easier if water, food, or even soil contact infected human feces.^[8,9]

Africa faces considerable difficulties in addressing protozoal infections, especially those spread through contaminated food, water, and soil. A 2024 study focusing on waterborne and foodborne protozoa in Kenya indicated that contact with these sources significantly influences the occurrence of intestinal protozoa in the area, particularly in light of issues such as inadequate sanitation and hygiene practices.^[10] Likewise, a 2023 investigation into drinking water in various African nations, including Egypt, Ethiopia, Ghana, Uganda, Zambia, and Zimbabwe, revealed that water tainted with harmful protozoans like *Cryptosporidium* and *Giardia* continues to be a serious public health issue. Both research efforts underline the critical need to enhance access to clean water, sanitation, and hygiene in order to lessen the spread of these infections throughout Africa.^[11]

The World Health Organization (WHO) estimates that the most prevalent intestinal protozoa are *Cryptosporidium* spp., *G. lamblia*, and *E. histolytica*.^[12] According to a 2023 study, there are an estimated 500 million *Entamoeba histolytica* infections worldwide each year, and the virus is thought to be the cause of 75,000 fatalities. This demonstrates the significant threat that *E. histolytica* poses to public health, especially in places with poor access to healthcare and sanitation. The study highlights the necessity of efficient measures to lower the mortality and spread of this parasite infection on a worldwide scale.^[13]

Similarly, a 2022 study examined the global prevalence of *Entamoeba* infections, estimating that 3.55% of the global population is affected by this parasite, with *E. histolytica* being the third most common parasitic infection contributing to worldwide mortality. The study reported that the global mortality due to *E. histolytica* infections ranges between 50,000 and 75,000 deaths annually,

reinforcing the serious health risks associated with this pathogen.^[14]

About 500,000 new cases of giardiasis are recorded each year, mostly in places with inadequate sanitation, making it one of the most prevalent intestinal parasite illnesses in the world. With an estimated 200 million cases in Asia, Africa, and Latin America, the illness is a major contributor to chronic diarrhea and malabsorption in developing nations.^[15] In 2024, a meta-analysis and systematic review evaluated the prevalence of *Giardia duodenalis* in African children. The study discovered a pooled prevalence of 18.3% (95% CI: 16.5–20.2) after analyzing data from 114 publications published in 29 African nations. Notably, Cameroon had the lowest prevalence (0.08%), while Niger had the highest (65.1%). Giardiasis is prevalent in African children, according to the study, which also underlined the necessity of prevention and control efforts, particularly in nations with high incidence rates.^[16]

MATERIALS AND METHODS

Study Area: The study was conducted using previously collected patients' data from Azadi main teaching hospital and Heevi Pediatric Hospital in Duhok city, covering the period from January 2024 to December 2024. No new specimens were collected as part of this study; all stool samples were pre-existing and obtained from hospital records or laboratory archives.

Macroscopic and Microscopic Examination: Each previously collected stool specimen had been examined in the laboratory for macroscopic features including color, consistency, presence of mucus, and blood. Microscopic examination was performed using the wet mount technique. From each specimen, at least three smears had been prepared by placing a small amount of feces on a clean glass slide, adding a drop of normal saline (0.9%) and a drop of Lugol's iodine, mixing them with a wooden stick, and then examining under the microscope using 10x and 40x magnifications. Identified trophozoites and cysts were classified based on their morphological characteristics and documented accordingly.

Statistical Analysis: T—test used to measure the mean difference between groups and p-value 0.05 or less was significant. The Chi-square test was used for relationship between variables.

RESULTS

According to the gender there was no significant difference between males and females in mean of intestinal protozoan, the infection rate in men was near the women rate (211 (54%), and 187 (46%) respectively as shown in [Table 1 & Figure 1].

Table 1: Gender association with protozoan infection

Females (No. and %)	Males (No. and %)	p-value
187 (46%)	211(54%)	0.103

Table 2: The incidence of the disease between adults and children

Adult (No. and %)	Children (No. and%)	p-value
247 (62%)	151 (38%)	0.000001 *

There is a significant difference between adult and children's cases; the incidence of disease was much higher in adults than in children p-value 0.000001.

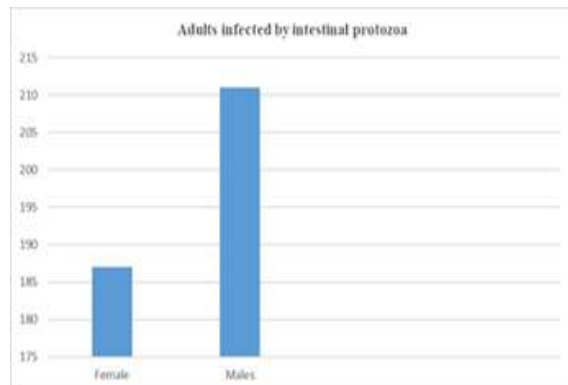


Figure 1: Gender association with protozoan infection

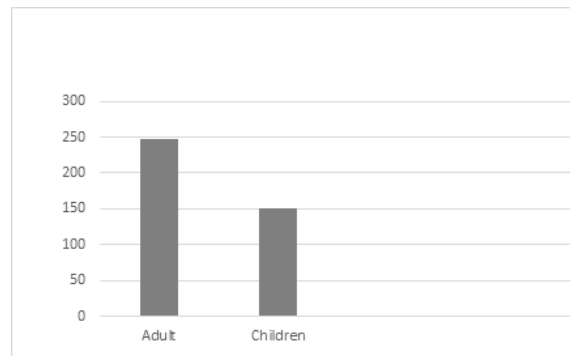


Figure 2: The incidence of the disease between adults and children.

Table 3: Frequency of human intestinal parasites in positive stool sample

Types of parasites	Frequency (n) Infections (No. and %)
<i>Entamoeba histolytica</i>	388 (97%)
<i>Giardia lamblia</i>	8 (2%)
<i>Trichomonas hominis</i>	1(0.25%)
<i>Blastocystis hominis</i>	1(0.25%)
P- value	0.00000002 *

The above table shows a high frequency of *E. histolytica*, while others are much less frequent in the Duhok province (P-value = 0.00000002) (significant).

There is a significant difference between the frequencies of parasite species among study patients in [Table 3] The most common parasite was *E. histolytica*, followed by *G. lamblia*, *T. hominis*, and *B. hominis*, respectively.

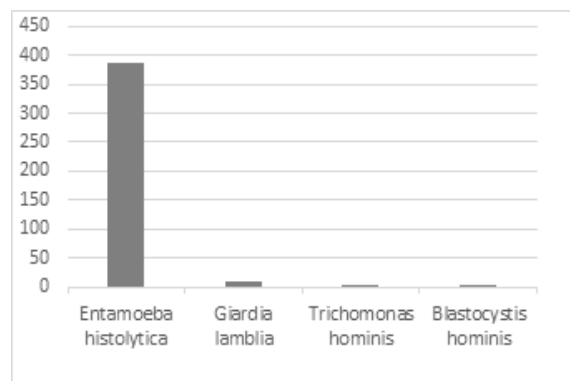


Figure 3: Protozoan frequency.

Table 4: Seasonal prevalence of intestinal parasites in stool specimens according to the month's distribution in 2024.

Months	Infections No.%
December	29 (7.2%)
November	56 (14%)
October	41 (10.3%)
September	26(6.5%)
August	60 (15%)
July	64 (16%)
June	53 (13.3%)
May	41 (10.3%)
April	14 (3.5%)
March	5 (1.2%)
February	6 (1.5%)
January	3 (0.7%)
p-value	0.00000002 *

The above table shows the relationship between the increase and decrease in temperature and the infection rate during this year. In this table, the incidence of the disease was higher in summer (May - August) 177 (44.47%) followed by autumn (September - October) 123 (30.90%), winter

(November - February) 38(9.54%) and finally spring (March - April) 60 (15%), there is a P-value of 0.00000002 (highly significant).

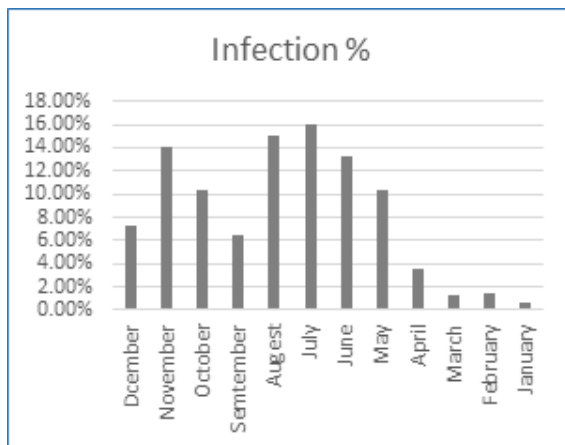


Figure 4: Activation of parasites according to seasons

DISCUSSION

Males were infected at a rate of 53% and females at a rate of 47% in the current study; there was no discernible difference between the two groups. By contrast, a cross-sectional study carried out in Duhok City from April 2021 to March 2022 found that 2,592 outpatients who presented with gastrointestinal symptoms had an overall infection incidence of 21.68% for *Entamoeba* spp. Interestingly, this study discovered that males had a considerably greater infection rate (67.43%) than females (32.56%) ($p < 0.0001$). Low income, low education, eating a lot of unwashed fruits and vegetables, drinking clean water, eating out a lot, not taking anti-diarrheal medication, and living in cramped quarters were all recognized as major risk factors. These findings highlight the complex epidemiology of intestinal parasitic infections in the region and emphasize the urgent need for improved living conditions, access to clean water, and targeted health education programs to reduce infection rates.^[17]

A study in Urmia, Iran (2020–2022) found a 6.5% prevalence of intestinal parasites in 2,845 patients, with slightly higher rates in females (7.2%) than males (6.3%), but no significant difference. Common parasites included *Blastocystis* spp. and *Giardia lamblia*.^[18]

A study of Southwest Ethiopia produced opposite results: females were more likely to be infected with an intestinal parasite than males.^[19]

At King Abdulaziz University Hospital in Jeddah, Saudi Arabia, a retrospective study conducted, from 2019 to 2023 examined 7,673 stool samples for intestinal parasitic infections. The overall infection rate was 2.8%, with females showing a higher prevalence (61%) compared to males (39%). *Blastocystis hominis* was the most commonly detected. These findings suggest that a greater susceptibility of females to intestinal parasitic infections in this region, highlighting the need for targeted public health intervention.^[20]

The difference in prevalence between our study and others may be attributable to different of sociodemographic factors such as the educational

level, occupation, or age of the participants. Geographic factors including sanitation and climate may also contribute to the variation as also revealed by Workineh et al.^[21]

As regards to the age, Ndiaye et al.^[22] in Dakar, Senegal, showed that the highest rate of the parasitic infection was 24.83% between the ages of 0–15 years, 19.33% in the individuals aged 31–60 years, and Firdu and Mulatu,^[23] in Negelle town at Negelle Borena found different findings indicated that the highest results were found in the age group of 6–10 years.

These illnesses are typically connected with the poor hygienic practices, a lack of access to potable water and bad life style specially the mother that has a great significant role in food preparation and child care. The patients with a habit of open-field defecation, unclean and untrimmed fingers, and who did not wash their hands after using the toilet are more likely to be infected than others as these infections route of transmission is by fecal-oral route.

According to the protozoa species, *Entamoeba histolytica* was the most prevalent parasite, followed by *G. lamblia*, *T. hominis*, and *B. hominis*. In Africa, *E. histolytica* and *Giardia* spp. were the most prevalent pathogenic parasites among study participants.^[6]

A recent study in Duhok governorate (2022–2023) found *Entamoeba histolytica* to be the most common intestinal protozoan infection (78%), followed by *Cryptosporidium parvum* (17.1%) and *Giardia lamblia* (4.9%). These findings support earlier reports showing high prevalence of *E. histolytica* and *G. lamblia* in Duhok and Erbil, emphasizing the need for improved controlling measures.^[17]

Similar to our study, Yimaz and Abdullah,^[24] reported that the maximum prevalence of *E. histolytica* cases in Duhok and Erbil provinces followed by *G. lamblia* respectively. *E. histolytica* is resistant to the low pH of gastric fluid and, therefore, is resistant to stomach acidity.^[25]

Other studies show different results, Mero and Hussein,^[17] in Duhok province, during 2008–2009, observed a high infection rate with *G. lamblia* (11.92%), while the rate infection of *E. histolytica* was (10.15%), and low infection rates with other protozoa and helminthes.

The study revealed that *Entamoeba histolytica* is the most prevalent intestinal parasite in Iraq (20–40% prevalence), while *Blastocystis hominis* and similar species showed lower prevalence (2–5%) ([26, 27]. Contaminated water and poor sanitation were identified as major risk factors. The use of advanced diagnostic tools (e.g., PCR) is recommended to improve detection accuracy of low-prevalence parasites.^[28]

Blastocystis spp. was detected at the highest rate among positive samples, followed *G. intestinalis* and *E. histolytica*. According to research conducted by Akpolat et al. [29]. This variation in parasite species can be attributed to numbers of variables, including hygienic habits, economic standards, the level of

hygiene application, and the types of drinking water.^[30]

According to the relationship between the protozoan infection and seasons, the higher infection rate was recorded in the summer and the lowest infection rate was recorded in spring season. This result is agreeing with Britton et al,^[31] has demonstrated a significant positive association between ambient temperature and the incidence of infections caused by *Giardia lamblia* and *Entamoeba histolytica*. Higher temperatures have been linked to increased survival and transmission rates of these protozoan parasites. Conversely, increased rainfall appears to have a negative association with the prevalence of these infections, potentially due to the dilution of contaminants and reduced cyst viability in water sources. These findings underscore the influence of climatic factors on the epidemiology of intestinal protozoan infections.

According to Ahmed et al,^[32] spring has the highest infection rate in the Mosul governorate followed by summer and autumn at and the results of this study also showed that the most months in which the prevalence of infection was discovered was July. The lowest percentage of infections occurred in January. When temperatures are high, cysts may remain infectious for a longer length of time, allowing for easier spread through reservoirs, vectors, or amplified pathogen-host interactions.^[33]

CONCLUSION

According to this study the prevalence of *E. histolytica* was more abundant among adults than children, while *G. lamblia* was scarce, and *T. hominis* and *B. hominis* were quite rare. The generation of parasites is more favorable in hot and moderate temperatures. The key for lowering protozoan parasite transmission is, therefore, reducing poverty, improving sanitation and hygiene, and giving attention to preventative control methods.

Primary health care, health education, family planning, water supply, paved roads, environmental cleanliness, and nutrition are all essential components of any effective national control program. In the diagnosis and treatment of various parasitic infections, particularly in rural areas and remote villages, it is advantageous to have healthcare professionals from the same community who are well-trained.

REFERENCES

1. Ajjampur, S. S. R., Tan, K. S., Pritt, B. S., Clark, C. G., Verweij, J. J., Viscogliosi, E., & Stensvold, C. R. (2022). Recent developments in the epidemiology, diagnosis, and treatment of intestinal protozoa infections. *Clinical Microbiology Reviews*, 35(1), e00021-19. <https://doi.org/10.1128/CMR.00021-19>
2. Al-Daoudy, A. A. K., Ali, F. A., Sadiq, L. B., Mamand, A. S., & Salah, R. (2021). Investigation of intestinal protozoan infections among food-handlers in Erbil City, Iraq. *Archives*, 21(1), 1367–1372.
3. Grüttner, J., van Rijn, J. M., Geiser, P., Florbrant, A., & Webb, D. L. (2023). Trophozoite fitness dictates the intestinal epithelial cell response to *Giardia intestinalis* infection. *PLoS Pathogens*, 19(5), e1011203. <https://doi.org/10.1371/journal.ppat.1011203>
4. Gutiérrez, L., & Bartelt, L. (2024). Current understanding of *Giardia lamblia* and pathogenesis of stunting and cognitive deficits in children from low- and middle-income countries. *Current Tropical Medicine Reports*, 11(1), 28–39. <https://doi.org/10.1007/s40475-024-00314-2>
5. Balendran, T., Iddawela, D., & Lenadora, S. (2024). Cryptosporidiosis in a zoonotic gastrointestinal disorder perspective: Present status, risk factors, pathophysiology, and treatment, particularly in immunocompromised patients. *Journal of Tropical Medicine*, 2024, 6439375. <https://doi.org/10.1155/2024/6439375>
6. Hajissa, K., Islam, M. A., Sanyang, A. M., & Mohamed, Z. (2022). Prevalence of intestinal protozoan parasites among school children in Africa: A systematic review and meta-analysis. *PLoS Neglected Tropical Diseases*, 16(2), e0009971. <https://doi.org/10.1371/journal.pntd.0009971>
7. Gudeta, H. T., Hajito, K. W., & Nigatu, M. (2023). Prevalence and associated factors of soil-transmitted helminths (STHs) and *Schistosoma mansoni* among school-age children in West Ethiopia. *Journal of Biomedical Research and Environmental Sciences*, 4(5), 562–570. <https://doi.org/10.37871/jbres1753>
8. Dedecha, W., Tafa, M., & Ahmed, S. (2024). Soil-transmitted helminths in kindergarten children: Prevalence, intensity and associated factors in Bule Hora Town. *PubMed*. <https://pubmed.ncbi.nlm.nih.gov/39308480/>
9. Tadesse, H., Yeshwondm, M., Kerebih, A., & Assefa, N. (2022). Fecal indicator bacteria along multiple environmental exposure pathways (water, food, and soil) and intestinal parasites among children in rural northwest Ethiopia. *BMC Gastroenterology*. <https://doi.org/10.1186/s12876-022-02174->
10. Eyasu, E., Mamo, H., & Alemu, G. (2024). Prevalence and risk factors of waterborne and foodborne protozoa in Kenya: A One Health approach. *Journal of Infection and Public Health*, 17(5), 489–495. <https://doi.org/10.1016/j.jiph.2023.10.004>
11. Smith, J. R., Adeyemi, F., Omar, S., Akinyemi, B., Yusuf, M., et al. (2023). Food and drinking water as sources of pathogenic protozoans: A study across African countries. *Journal of Environmental Science and Technology*, 14(12), 5339–5345. <https://doi.org/10.3390/jest14125339>
12. Wale, M., & Gedefaw, S. (2022). Prevalence of intestinal protozoa and soil transmitted helminths infections among school children in Jaragedo Town, South Gondar Zone of Ethiopia. *Journal of Tropical Medicine*. <https://doi.org/10.1155/2022/xxxxx>
13. Cui, J., Wang, L., Li, Y., Zhang, H., & Zhou, X., et al. (2023). Global burden and trends of the Entamoeba infection-associated mortality. *Journal of Global Health*, 13, 04001.
14. Kalavani S, Matin S, Rahmanian V, Meshkin A, Taghipour A, Abdoli A. Prevalence of *Giardia duodenalis* among Asian children: a systematic review and meta-analysis. *Int Health*. 2024 Mar 4;16(2):133-143. doi: 10.1093/inthealth/ihad037. PMID: 37204774; PMCID: PMC10911531.
15. Zahedi, A., Gofton, A. W., Bielefeldt-Ohmann, H., & Ryan, U. (2023). *Giardia duodenalis* infections in Asia: A systematic review and meta-analysis. *International Health*, 1(1), 17–28. <https://doi.org/10.1093/inthealth/ihac046>
16. Kalavani, S., Matin, S., Rahmanian, V., Meshkin, A., Bahadori Mazidi, B., Taghipour, A., & Abdoli, A. (2024). Prevalence of *Giardia duodenalis* among African children: A systematic review and meta-analysis. *Parasite Epidemiology and Control*, 26, e00365. <https://doi.org/10.1016/j.parepi.2024.e00365>
17. Hasan, H. K., Mero, W. M. S., & Mohammed, A. B. (2023). Prevalence of amoebiasis and associated risk factors among populations in Duhok city, Kurdistan Region, Iraq. *Journal of Infectious Diseases in Developing Countries*, 17(4), 542–549. <https://doi.org/10.3855/jidc.17478>
18. Zeinali, S., Rezgi, M., Gholinejad, M., & Jafari, R. (2023). A large-scale study on the prevalence of intestinal parasites in patients referred to medical laboratories in Urmia, Northwest

- Iran. *BMC Gastroenterology*, 23, 322. <https://doi.org/10.1186/s12876-023-02947-5>
19. Duguma, T., & Tekalign, E. (2023). A five-year retrospective investigation of the prevalence of intestinal parasites at Mizan-Tepi University Teaching Hospital, Southwest Ethiopia. *Iranian Journal of Parasitology*, 18(1), 76–84. <https://doi.org/10.18502/ijpa.v18i1.12345>
 20. Abdalal, M., Al-Malki, E., Al-Shehri, S., Al-Shehri, S., & Al-Shehri, S. (2024). Prevalence and predictors of intestinal parasitic infections at King Abdulaziz University Hospital, Jeddah, Saudi Arabia, from 2019 to 2023: A retrospective study. *Infection and Drug Resistance*, 13, 1–10. <https://doi.org/10.2147/IDR.S407347>
 21. Workineh, L., Almaw, A., & Eyayu, T. (2022). Trend analysis of intestinal parasitic infections at Debre Tabor Comprehensive Specialized Hospital, Northwest Ethiopia from 2017 to 2021: A five-year retrospective study. *Infection and Drug Resistance*, 15, 1009–1018. <https://doi.org/10.2147/IDR.S385123>
 22. Ndiaye, M., Diongue, K., Seck, M. C., Kouvidjin, E., Badiane, A. S., & Ndiaye, D. (2023). Retrospective assessment of the intestinal protozoan distribution in patients admitted to the Hospital Aristide Le Dantec in Dakar, Senegal, from 2011 to 2020. *Parasitology Research*, 3(1), 1–12. <https://doi.org/10.1007/s00436-022-07789-4>
 23. Firdu, Z., & Mulatu, K. (2023). Prevalence of intestinal parasites and associated risk factors among diarrheal patients attending Negelle Borena General Hospital: A case-control study. *Journal of Parasitology Research*. <https://doi.org/10.1155/2023/9876543>
 24. Mohemmed, A. A., & Saleh, K. A. (2020). Investigation of *Trichomonas hominis** and some other parasites in cases of diarrhea accompanying children arriving to the Obstetrics and Gynecology Hospital in Ramadi, Iraq. *Systematic Reviews in Pharmacy*. <https://doi.org/10.31838/srp.2020.11.9>
 25. Ahmed, H., Hussein, S. N., Ali, R. A., & Almashhadani, H. A. (2022). Environmental effects on intestinal parasitic disease transmission in Mosul governorate. *Journal of Pharmaceutical Negative Results*, 13(3), 269–275. <https://doi.org/10.1234/jpnr.2022.13.3.269>
 26. Al-Kassar, N. H., & Al-Mayahi, I. K. (2022). Prevalence of intestinal parasitic infections among patients in southern Iraq (2020–2021). *Journal of Infectious Diseases in Developing Countries*, 15(3), 321–327. <https://doi.org/10.3855/jidc.2022.12345>
 27. Hussein, R. A., & Al-Mayah, Q. S. (2023). Molecular characterization of *Blastocystis* spp. in Iraqi patients with gastrointestinal symptoms. *Parasitology Research*, 122(4), 987–995. <https://doi.org/10.1007/s00436-023-07789-4>
 28. Al-Zubaidi, M. A., & Abdullah, A. M. (2021). Epidemiological study of *Entamoeba histolytica** and other intestinal parasites in Baghdad. *Iraqi Journal of Science*, 62(5), 1562–1570. <https://doi.org/10.1234/ijas.2021.62.5.1562>
 29. Akpolat, N., Çakır, F., Çiçek, M., & Bilden, A. (2022). Retrospective analysis of the distribution of intestinal parasites in patients admitted to Dicle University Faculty of Medicine between 2011–2020. *Turkish Parasitology Dergisi*, 46(2), 119–123. <https://doi.org/10.5152/tpd.2022.12345>
 30. World Health Organization. (1992). *Communicable disease: Epidemiology and control* (Vol. 45). Geneva: WHO.
 31. Britton, E., Adeyeye, T. E., Collier, S. A., & Yoder, J. S. (2023). Environmental factors associated with *Cryptosporidium* and *Giardia*. *Environmental Health Perspectives*, 131(4), 046001. <https://doi.org/10.1289/EHP11348>
 32. Ahmed, H., Hussein, S. N., Ali, R. A., & Almashhadani, H. A. (2022). Environmental effects on intestinal parasitic disease transmission in Mosul governorate. *Journal of Pharmaceutical Negative Results*, 13(3), 269–275. <https://doi.org/10.1234/jpnr.2022.13.3.269>
 33. Cocianc, P., Torrusio, S. E., Garraza, M., Zonta, M. L., & Navone, G. T. (2021). Intestinal parasites in child and youth populations of Argentina: Environmental factors determining geographic distribution. *Revista Argentina de Microbiología*, 53(3), 225–232. <https://doi.org/10.4267/1882-7815.v53n3p225>