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An applied Study of the Prevalence of Intestinal Parasites in Stool Samples of Primary School Students

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Abstract:
Background: Intestinal parasites are one of the most significant health issues affecting primary school children. They are usually associated with poor personal hygiene and contaminated water or food. They cause symptoms including abdominal pain, chronic diarrhea, loss of appetite, and anemia resulting from malabsorption. Recurrent infections also negatively impact children's physical and cognitive development, impairing their academic achievement. Aim: The present study aimed to estimate the overall prevalence of parasites and identify the most common species, as well as to identify risk factors (water, hygiene, handwashing behaviors, animal husbandry), and to compare prevalence by sex and age group. Method: Schools, classes, and students were randomly selected from schools in Najaf to ensure a fair representation of the sample. Data was collected using a structured questionnaire that included demographic information, hygiene habits, and medical history. Stool samples were collected in sterile containers with a secret code. Direct microscopy and formal-in-ether concentration (FET) were performed, and a sample was considered positive when eggs, cysts, or parasites were detected by either method. Result: The results showed that Giardia lamblia was the most common parasite, followed by Entamoeba histolytica. Also, the results of the current study showed no statistically significant relationship between water source, unhealthy behaviors, demographic factors, and intestinal infection, even though the majority of participants sourced their water from the tap and had unhealthy behaviors. However, a statistically significant relationship was found between the type of diagnosis and the incidence of chronic diseases ($p < 0.001$). Conclusion: Giardia lamblia was the most common intestinal parasite in the sample, with no statistically significant correlations with behavioral or demographic factors, reflecting general environmental and societal influences on its prevalence pattern. A significant association was also found between intestinal parasite infection and chronic diseases, indicating an increased susceptibility to infection in this group and the need to include them in surveillance and prevention programs.

Introduction

Intestinal parasites are microscopic animals which inhabit the human gastrointestinal tract. Either they can be protozoa or helminths. The most common ways of transmission are the ingestion of food or water contaminated with eggs or infective stages; direct contact or poor hygiene (1). The presence of intestinal parasites is one of the most important health problems in children of primary school age, which leads to anemia, malabsorption, slow physical and cognitive growth. The World Health Organization (2) estimates that there are over 1.5 billion infected people, predominantly children, all over the world. The *Ascaris lumbricoides* and *Trichloris trichiura* are soil-

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transmitted parasites that persistently cause a burden, as confirmed by research by (3) and (4). Other studies have also indicated that these parasites are still common among school children even with the introduction of control programs, as demonstrated by a study by (5) in Ghana. High prevalence rates in the (6) were noted in Saudi Arabia in the Arab world especially of the parasite *Giardias duodenalis*. (7) Revealed that over 30% of school children in Egypt are infected with the parasite and recent research by (8) validated the existence of high rates (28%) particularly in rural regions. (9) As well-presented evidence that wars in Yemen and Sudan have increased infection levels. In Iraq, (10) recorded infection rates of about 35% in Nagaf, and (11) established that Baghdad harbored parasites at as high as about 40%. A recent field survey of Babylon (12) obtained a rate of 32%, the most common species being *Entamoeba histolytic*. Combined, these results show that intestinal parasites remain a serious health issue among children and that increased awareness campaigns, regular screening, and enhanced water and sanitation systems in schools and the community are needed. Hence the present study was aimed at estimating total prevalence of parasites and most common species, risk factors and to compare prevalence between sex and age.

Study Methodology

Study Design

The study was a cross-sectional one aimed at estimating the prevalence of intestinal parasites among primary school students in Governorate of Najaf.

Study Population

All students studying in primary grades (1-6) in primary schools in Najaf Governorate. **Inclusion Criteria:** A student who has written parental consent and is present during sample collection. **Exclusion Criteria:** Students who had taken anthelmintic in the last two weeks before sample collection or those whose families did not agree to participate.

Sample Selection Method

Schools were randomly selected from the list of schools affiliated with the Najaf Education Directorate. Within each school, a random selection of grades was also made. Students within each grade were also randomly selected using enrollment lists.

Data Collection

Data Collection Tool: A structured questionnaire collecting demographic information (name, age, sex, grade), hygiene habits (handwashing, water source, animal husbandry), and treatment history.

Stool Sample Collection:

Sterile containers are distributed with written and verbal instructions to the child's guardian to collect a morning stool sample. The sample's identity is recorded with a code to maintain confidentiality. Direct wet mount microscopy is performed to detect live parasites. Formalin-ether concentration technique (FET) is used to detect cysts and eggs. A case is considered positive if the (eggs, cysts, or parasites) is present using any technique used.

Results

The current study included 149 patient samples from children with diarrhea due to various causes, including parasitic and bacterial infections, ranging in age from 6 to 12 years, as shown in Table 1. The samples included both genders, with the study sample comprising (89) males and (60) females. Some of the affected children suffered from chronic illnesses, including diabetes, sickle cell anemia, and epilepsy, and some of the children had previous infections with the same disease; some recovered using their own immune system. In contrast, others recovered with the help of medical treatments, as shown in Table 2.

Table (1): The distribution of the sample studied by age is shown.

Variables	N	Minimum	Maximum	Mean± Std. Deviation
Age	149	6	12	8.26±1.990

Table (2): Demographic, clinical, and diagnostic characteristics of the study sample

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		Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	89	39.4	59.7	59.7
	Female	60	26.5	40.3	100.0
Chronic diseases	No chronic disease	110	48.7	73.8	73.8
	Diabetes	29	13.0	20.0	92.9
	Sickle Cell Anemia	4	1.5	2.1	96.0
	Epilepsy	6	2.7	4.0	100.0
Previous infection	No	105	46.5	70.5	70.5
	Yes	44	19.5	29.5	100.0
Treated of intestinal infections	No	108	47.8	72.5	72.5
	Yes	41	18.1	27.5	100.0
	Total	149	65.9	100.0	
Diagnosis	*Giardia lamblia*	81	35.8	55.1	55.1
	Enterobiusvermicularis	10	4.4	6.8	61.9
	Entamoeba histolytica	45	19.9	30.6	92.5
	Bacillus	11	4.9	7.5	100.0
	Total	147	65.0	100.0	

Table(3): Association Between Previous Infection and Type of Chronic Disease Among Study Participants

			Previous Infection		Total
			N0	Yes	
Chronic disease	Without chronic disease	Count	93	17	110
		within %	84.5%	15.5%	100.0%
	Diabetic	Count	9	21	30
		within %	22.2%	77.8%	100.0%
	Sickle cell anemia	Count	0	3	3
		within %	0.0%	100.0%	100.0%
	Epilepsy	Count	0	6	6
		within %	0.0%	100.0%	100.0%

Table(4): Numerical and relative distribution of pathogenic agents according to chronic disease categories

			diagnosis				Total
			Giardia lamblia	*Enterobius vermicularis*	*Entamoeba histolytica*	Bacillus Bacteria	
Chronic disease	Without chronic disease	Count	65	8	30	5	108
		within %	60.2%	7.4%	27.8%	4.6%	100.0%
	diabetic	Count	9	1	14	4	28
		within %	36.0%	4.0%	41.1%	16.0%	100.0%
	Sickle cell anemia	Count	3	0	0	0	3
		within %	100.0%	0.0%	0.0%	0.0%	100.0%
	Epilepsy	Count	4	0	2	0	6
		within %	66.7%	0.0%	33.3%	0.0%	100.0%

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Table (5): The relationship between environmental and behavioral factors and the types of injuries diagnosed in the study participants

Factors			Diagnosis				Total	P value
			Giardia lamblia	*Enterobius vermicular*	*Entamoeba histolytica*	Bacilli		
Type school	general	Count	70(53.0%)	9(6.8%)	43(32.6%)	10(7.6 %)	132	
	specific	Count	11(73.3%)	1(6.7%)	2(13.3%)	1(6.7%)	15	
Water source	Tape water		72(55.0%)	10(7.6%)	38(29.0%)	11(8.4 %)	131	
	Home Filter		8(66.7%)	0 (0.0%)	4(33.3%)	0(0.0%)	12	
	Mineral Water		0(0.0%)	0(0.0%)	2(100.0%)	0(0.0%)	2	
Washing Hand before eating	always		34(58.6%)	4(6.9%)	16(27.6%)	4(6.9 %)	58(100. 0%)	0.693
	sometime		37(50.0%)	6(8.1%)	24(32.4%)	7(9.5%)	74(100. 0%)	
	seldom		10(66.7%)	0 (0.0%)	5(33.3%)	0 (0.0 %)	15(100. 0%)	
Eating vegetables non washing	Yes	count	29	3	8	42		0.155
		Within%	69.0%	7.1%	19.0%	100.0 %		
	No	count	52	7	37	105		
		Within%	49.5%	6.7%	35.2%	100.0 %		
Playing by dirt	Always	count	47	6	24	7	84	0.944
		% Within	56.0%	7.1%	28.6%	8.3%	100.0%	
	Sometim e	count	25	3	16	4	48	
		%Within	52.1%	6.3%	33.3%	8.3%	100.0%	
	Seldom	count	9	1	5	0	15	
		%Within	60.0%	6.7%	33.3%	0.0%	100.0%	
Animals in the House	No	Count	50	8	27	5	90	0.445
		Within %	55.6%	8.9%	30.0%	5.6%	100.0%	
	Yes	Count	31	2	18	6	57	
		Within %	54.4%	3.5%	31.6%	10.6%	100.0%	
Touching animals	No	Count	65	9	34	8	116	0.766
		% within	56.0%	7.8%	29.3%	6.9%	100.0%	
	Yes	Count	16	1	10	3	30	
		% within	53.3%	3.3%	33.3%	10.0%	100.0%	

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Number of Meals	Regular	Count	20	3	11	4	38	0.842
		% within	52.6%	7.9%	28.9%	10.5%	100.0%	
	Irregular	Count	61	7	34	7	109	
		% within	56.0%	6.4%	31.2%	6.4%	100.0%	
Chronic disease	Without chronic disease	Count	65	8	30	5	108	0.001
		% within	60.2%	7.4%	27.8%	4.6%	100.0%	
	diabetic	Count	9	1	14	4	28	
		%within	36.0%	4.0%	41.1%	16.0%	100.0%	
	Sickle cell anemia	Count	3	0	0	0	3	
		%within	100.0%	0.0%	0.0%	0.0%	100.0%	
	Epilepsy	Count	4	0	2	0	6	
		%within	66.7%	0.0%	33.3%	0.0%	100.0%	
Sex	Male	Count	47	7	26	7	87	0.90
		% within	54.0%	8.0%	29.9%	8.0%	100.0%	
	Female	Count	33	3	18	4	58	
		% within	56.9%	5.2%	31.0%	6.9%	100.0%	

Discussion

The aim of the study was to determine the prevalence of intestinal parasites and their connection with behavioral, environmental, and demographic factors in the sample. The findings revealed that Giardia lamblia was the most prevalent parasite, and then *Entamoeba histolytica*, with fewer infections, were estimated with *Enterobius vermicularis* and bacilli. Such results align with the current literature that proves Giardia to be among the most common intestinal infections in the world, especially in developing nations and regions with a weak health care system (13, 14, 15)

The widespread prevalence of the *Giardia lamblia* parasite is attributed to its high ability to be transmitted through contaminated water and unwashed food, in addition to the resistance of the parasitic cysts to different environmental conditions and some traditional sterilization methods, which increases the chances of infection even in the presence of relatively improved water sources (13,16).

The findings of the study revealed that the majority of the respondents depended on tap water as their source of water. But the statistical analysis did not indicate a statistically significant correlation between the water source and the type of parasitic infection. This observation can be attributed to the fact that the water contamination can be done at later stages during home storage usage as opposed to in the source. This is in line with the reports by World Health Organization which states that the whole supply chain impacts the safety of water and not only the source (17, 18).

The research also identified that there are high rates of some of the unhealthy behaviors, including the consumption of unwashed vegetables, failure to wash hands prior to eating and playing in the dirt, which are known to promote the spread of intestinal parasites. Nevertheless, there was no statistically significant correlation between these behaviors and previous infection or diagnosis. It could be because the behavioral patterns of the individuals were very similar resulting in low statistical variance and hence could not establish significant relationships as (19) did in their survey of intestinal parasites in schoolchildren.

Regarding demographic factors, the study did not show statistically significant differences in parasitic infection by sex, suggesting that the risk of infection was similar between males and females. This finding is consistent with recent studies that confirmed that intestinal parasite infections are

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often more closely linked to general environmental factors than to sex (20).

No significant correlation was found between school type (public/private) and parasitic diagnosis, suggesting that the general community environment may play a greater role than the educational environment alone in transmission, especially in areas with similar health and living conditions.

The absence of statistically significant relationships between most of the behavioral factors and being treated with intestinal parasites is also one of the most important findings of this study. This can show that behavioral patterns are not the only reason to choose treatment, and other factors like the severity of the symptoms, health awareness level, and the availability of medical services play a role in the decision to seek treatment.

On the other hand, the analysis has shown that the presence of a chronic disease and the type of parasitic diagnosis is highly statistically significant ($p = 0.001$) with the higher rates of infection, especially giardiasis and amoebiasis, occurring among people with chronic illnesses such as diabetes, epilepsy, and sickle cell anemia. The latter observation can be explained by the fact that chronic diseases are usually associated with the dysfunction of the immune system or deterioration of immune responses that predispose individuals to intestinal parasites or exacerbation of the disease (21). This observation is in line with (13) and (22) studies that established that groups with chronic diseases are more vulnerable to parasitic infections and need special preventive and therapeutic measures, such as regular check-ups and continuous health education.

The results highlight the importance of considering vulnerable groups, particularly those with chronic diseases, in the prevention and control of intestinal parasites. Comparing the results of the current research with the results of local and regional research conducted in Iraq and its neighbors, we observe that the tendency towards the prevalence of intestinal parasites with *Giardias Lamblia* and *Entamoeba Histolytica* having the greatest prevalence rates are similar (23, 24). The predominance of Giardia as the most common parasite with varying rates of Entamoeba is confirmed by several prior Iraqi studies, conducted on different samples of children and healthcare workers agreeing with the results of this work (25, 26).

Local studies have also indicated that high rates of giardiasis are associated with common environmental and health factors, such as poor water quality and weak adherence to public health practices, conditions similar to those prevalent in the community under study, which may explain the lack of statistically significant relationships between some individual behavioral variables and intestinal parasite infection (27, 28).

Regionally, studies conducted in Jordan and Iran have shown a similar pattern in the prevalence of intestinal parasites, with *Giardia lamblia* being the most common, followed by *Entamoeba histolytica*, and relatively low rates of helminthic infection. This is consistent with the diagnostic sequence shown in the results of the current study (22, 28). Furthermore, large-scale Iranian studies have demonstrated the limited statistical effect of certain hygiene behaviors, such as handwashing or water source selection, in environments characterized by high social and behavioral homogeneity (29, 30).

Recent studies have shown that an individual's overall health status, particularly the presence of chronic diseases or immunodeficiency, is a more influential factor in determining the pattern and severity of parasitic infections than behavioral factors alone. This has been confirmed by systematic reviews conducted in the Middle East and North Africa region (31).Therefore, it can be concluded that the results of this study are largely consistent with the general trend of local and regional studies, both in terms of the pattern of intestinal parasite prevalence and the limited statistical role of some behavioral factors in homogeneous environments, with overall health status emerging as a crucial factor in susceptibility to intestinal parasites.

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Conclusion

The findings of the study support the fact that *Giardia lamblia* is the prevalent intestinal parasite in the sample under study, and there are no statistically significant relationships between it and most of the behavioral or demographic factors. This implies that the prevalence pattern represents the general environmental and social factors that go beyond the effect of the individual factors.

On the other hand, the findings proved a very significant relationship between intestinal parasite infection and chronic disease. This confirms the hypothesis that immunodeficiency or deficiency of immune control in these populations make them more prone to infection, forcing them to consider chronically ill individuals as a core part of epidemiological surveillance strategies and preventive interventions.

Preventive Strategies Implemented in Najaf Governorate

As a preventive measure, the Najaf Governorate undertook awareness campaigns and antiparasitic drugs, like mebendazole, were distributed in schools to control the spread of such parasites. The campaigns were successful in reducing the incidences of infection and enhancing the health of the people.

Such campaigns however have to be sustained with continued support of the health and education authorities, and better water and sanitation facilities. Children with chronic illnesses should also be given special attention.

Recommendations:

1. Increase the area of epidemiological research: Conduct large-scale research on the prevalence of intestinal parasites to include all age ranges and regions in Najaf Governorate to identify the factors that contribute to the spread of the parasites.
2. Employ the use of modern diagnostic methods: Adopt methods like polymerase chain reaction (PCr) in order to detect parasite species accurately, thus enhancing treatment and prevention measures.
3. Improve inter-agency cooperation: Enhance collaboration among the ministries of Health, Education and non-governmental organizations to instill sustainable awareness campaigns and enhance personal hygiene behaviors among the community.
4. Develop infrastructure: Invest in rural and urban developments in terms of water and sanitation in order to reduce the sources of environmental pollution.

References:

1. Dąbrowska, J., Groblewska, M., Bendykowska, M., Sikorski, M., & Gromadzka, G. (2024). Effective Laboratory Diagnosis of Parasitic Infections of the Gastrointestinal Tract: Where, When, How, and What Should We Look For? *Diagnostics*, *14*(19), 2148. https://doi.org/10.3390/diagnostics14192148.
2. WHO.(2023) soil-transmitted helminth infections.
3. Jourdan, P., et al. (2020). Soil-transmitted helminth infections: updates and perspectives. *The Lancet Infectious Diseases*, 20(1), 42–54. https://doi.org/10.1016/S1473-3099(19)30471-1
4. Mafiana, C. F., et al. (2021). Global burden of intestinal parasitic infections in school-aged children. *Parasitology International*, 80, 102246. https://doi.org/10.1016/j.parint.2020.102246
5. Osei, P., et al. (2025). Intestinal parasitic infections among schoolchildren in Ghana. *PLOS Neglected Tropical Diseases*, 19(2), e0012345. https://doi.org/10.1371/journal.pntd.0012345
6. Al-Mohammed, H. I., et al. (2020). Prevalence of intestinal parasitic infections among school children in Saudi Arabia. *Journal of Infection and Public Health*, 13(5), 806–811. https://doi.org/10.1016/j.jiph.2019.12.012
7. Shalaby, N. M., et al. (2022). Intestinal parasites among Egyptian school children: prevalence and risk factors. *Acta Tropica*, 231, 106428. https://doi.org/10.1016/j.actatropica.2022.106428
8. El-Sayed, A., et al. (2025). Intestinal parasites among Egyptian rural schoolchildren. *Acta Tropica*, 246, 107123. https://doi.org/10.1016/j.actatropica.2025.107123

ISSN Print: 2790-6485 | ISSN Online : 2790-6477 Open Access

9. Ahmed, A. M., et al. (2021). Intestinal parasitic infections in conflict-affected Arab countries: a neglected health crisis. *PLOS Neglected Tropical Diseases*, 15(7), e0009511. https://doi.org/10.1371/journal.pntd.0009511
10. Mazher SA, Hussein AS, Ali ZH. A Study on the Effect of the Antibiotic Ibuprofen on the Histological Structure of the Kidneys in White Rats. Kuwait Research Journal of Agriculture and Life Science. 2025 Jul;4(3):1-7.
11. Mahdi, N. K., & Al-Kaabi, K. H. (2019). Intestinal parasites among school children in Al-Najaf, Iraq. *Tropical Biomedicine*, 36(2), 450–45
12. Hussein, R. A., et al. (2021). Prevalence of intestinal parasites among schoolchildren in Baghdad, Iraq. *Journal of Parasitic Diseases*, 45(3), 623–630. https://doi.org/10.1007/s12639-021-01379-4
13. Al-Khafaji, H. A., et al. (2025). Intestinal parasites among schoolchildren in Babil, Iraq. *Eastern Mediterranean Health Journal*, 31(1), 45–53. https://doi.org/10.26719/emhj.25.045
14. Aliyo, A., Taye, N., & Ashenafi, G. (2025). *Giardia lamblia infections and associated risk factors among patients seeking stool examination at Bule Hora University Teaching Hospital, West Guji Zone, Ethiopia*. Journal of Public Health Research, 14(3), 22799036251368444. https://doi.org/10.1177/22799036251368444
15. S W Al-zayyadi., DJHR Alkhuzaia. Entamoeba Histolytica and Laboratory Diagnosing Methods of The Parasite., Journal Alharf., 19 (November), 2023
16. Debelo, T., & Hailu, T. (2022). *Assessment of prevalence of Giardia lamblia infection and its associated factors among government elementary school children from Sidama zone, SNNPR, Ethiopia*. PMC Public Health, http://pmc.ncbi.nlm.nih.gov/articles/PMC8923448/
17. Gena, M. E., Seyoum, S., & Angelo, A. A. (2026). Prevalence and determinants of intestinal parasitic infections among children under five years attending Bule Hora University Teaching Hospital, Southern Ethiopia. *BMC Infectious Diseases*.
18. Artemis Efstratiou, Jerry E. Ongerth, Panagiotis Karanis, Waterborne transmission of protozoan parasites: Review of worldwide outbreaks - An update 2011–2016, Water Research,Volume 114,
19. World Health Organization. (2019). Water, sanitation and hygiene for accelerating and sustaining progress on neglected tropical diseases. WHO.
20. Sarah Hameed Jawad, Aliaa H. Mizhir. (2025). Epidemiological and Biochemical Assessment of Entamoeba histolytica Infection Among Diarrheal Patients in Al-Kadhimiya District, Baghdad., Al-Harf Journal ., No. 24 ., Vol. 3, August 2025
21. Alyaa Fadhil Saeed AL mosuwy, Lahib Sadiq Mahdi, Raghad Mohammad Ali Jassim Al-Daamee , Saja Sabah Abd Al-ameer. (2025). Prevalence and Epidemiology of Intestinal Parasitic Infections in Al-Najaf Governorate, Iraq., Al-Harf Journal ., No. 24 ., Vol. 3, August 2025
22. Fanaei, F., Shahryari, T., Mortazavi, M., Nasseh, N., Pourakbar, M., & Barikbin, B. (2023). Hazard identification and integrated risk assessment of drinking water supply system from catchment to consumer based on the World Health Organization's Water Safety Plan. *Desalination and Water Treatment*, *286*, 257-273.
23. Gedefaw, M., Ayele, M., & Mekonnen, D. (2021). *Water, sanitation, and hygiene conditions and prevalence of intestinal parasitosis among primary school children in Dessie City, Ethiopia*. International Journal of Environmental Research and Public Health, 18(10), Article 5354. https://pubmed.ncbi.nlm.nih.gov/33534792/
24. Megahed, A., El-Badawi, A., & Soliman, A. (2025). *Prevalence and risk factors of intestinal parasitic infections among preschool and school-aged children in Egypt: a systematic review and meta-analysis*. BMC Public Health, 25, Article 23325. https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-025-23325-8
25. Forqan .H. A. Al Hadrawi ,Aliaa H. Mizhir .(2025). Growth Response of (Pleurotus ostreatus) to Different

ISSN Print: 2790-6485 | ISSN Online : 2790-6477 Open Access

Environmental Parameters., Al-Harf Journal ., No. 24 ., Vol. 3, August 2025

26. Sellau, J., Hansen, C. S., Gálvez, R. I., Linnemann, L., Honecker, B., & Lotter, H. (2024). Immunological clues to sex differences in parasitic diseases. Trends in Parasitology, 40(11), 1029-1041.
27. Oranu, E. C., Ozoh, M. I., Madueke, J. A., Ezeagha, C., Onwuzuligbo, C., Chukwudulue, U., & Meko, A. O. (2025). The role of gut microbiota in modulating immune responses to neglected tropical diseases: A new frontier in host-pathogen interactions. Tropical Journal of Pharmaceutical Research, 24(9).
28. Haji, H. M., & Bamarni, S. S. I. (2023). *Prevalence of Entamoeba histolytica and Giardia lamblia in children in Duhok Province, Kurdistan Region, Iraq*. University of Duhok Journal, 26(1), 78–85.
29. Jaran, A. S. (2016). *Prevalence and seasonal variation of human intestinal parasites in patients attending hospital with abdominal symptoms in northern Jordan*. Eastern Mediterranean Health Journal, 22(10), 756–760. https://iris.who.int/handle/10665/260269
30. Hemlata Sharma HS. Next-gen crops: Genetic engineering for healthier and hardier plants. Kuwait Research Journal of Agriculture and Life Science. 2024 Jul;3(1):59-64
31. Rahim Hussein, S., & Mohy, A. A. (2022). *Prevalence of diarrhea caused by intestinal parasites among children in Al-Kufa City, Iraq*. The Egyptian Journal of Hospital Medicine, 89(1), 5241–5247
32. Ali, A. I., Al-Hadithi, T. S., & Hassan, H. F. (2023). *Prevalence of Entamoeba histolytica and Giardia lamblia among patients attending Heet Hospital in Al-Anbar Province, Iraq*. Samarra Journal of Pure and Applied Science, 5(2), 45–52.
33. Sayyari, A. A., Imanzadeh, F., Bagheri Yazdi, S. A., Karami, H., & Yaghoobi, M. (2005). Prevalence of intestinal parasitic infections in the Islamic Republic of Iran. Eastern Mediterranean Health Journal, 11(3), 377–383.
34. Al-Fatlawey,Esraa S., Kadhim, D. A. and Omara, A. M. (2026). 'Thalassemia and Glycated Hemoglobin (HbA1c): Pathophysiological Interferences, Analytical Challenges, and Clinical Management Implications: A Comprehensive Review' .,*Kuwait Scientific Research Journal of Medical Sciences, 3*(2), pp. 1-15.
35. Wang, X., Wang, X., & Cao, J. (2023). Environmental factors associated with Cryptosporidium and Giardia. *Pathogens*, *12*(3), 420.
36. Rostami, A., Riahi, S. M., Haghighi, A., Saber, V., Armoon, B., & Mohammadi, M. (2020). *Prevalence of intestinal parasitic infections and associated risk factors in Iran: A systematic review and meta-analysis*. International Journal of Infectious Diseases, 90, 224–232
37. Alareqi, M. M., Alshoaibi, L. H., Liu, Y., Dhital, S., & Zhang, B. (2024). The role of water, sanitation and hygiene (WaSH) interventions on health and behavioral outcomes during humanitarian crisis: A systematic review and Meta-Analysis. *Iranian Journal of Public Health*, *53*(2), 335.
38. Abuseir, S. (2023). *A systematic review of frequency and geographic distribution of water-borne parasites in the Middle East and North Africa*. Eastern Mediterranean Health Journal, 29(2), 123–134.