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Prevalence and Public Health Risks of Intestinal Parasites in Duhok Governorate, Kurdistan Region, Iraq: A Contemporary Review

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Abstract
A detailed evaluation of the prevalence of intestinal parasites and the associated public health risks was performed in Duhok Governorate, in the Kurdistan Region of Iraq, by performing a narrative and quantitative synthesis of the peer-reviewed literature available from PubMed and Google Scholar. Evidence from this study suggests that high prevalence rates of intestinal parasitic infections continue to occur, especially within the child and rural populations, and that *Entamoeba histolytica* and *Giardia lamblia* are the major protzoan parasites that cause infection. Ongoing transmission of intestinal parasites is facilitated by several factors including environmental conditions, socioeconomic status, and behaviours. The high burden of disease caused by intestinal parasites leads to significant health impact, such as malnutrition or impaired cognitive development. Further control measures are recommended to reduce the burden of disease caused by intestinal parasitic infections, including health education, sanitation, and molecular diagnostic techniques.

Keywords: Intestinal Parasites, *Entamoeba histolytica,* Water, Sanitation and Hygiene (WASH)

1. Introduction
There is evidence that (IPIs) are still one of the most common infectious diseases in the world today and occur mostly in low- and middle-income countries where hygiene and sanitation are not good enough (Fletcher *et al*., 2012) [3]. The primary means by which intestinal parasites are transmitted is through faecal-oral contact through contaminated water, food or soil; therefore, poverty, overcrowding and limited access to healthcare have a close relationship with their transmission (Hotez *et al*., 2008) [7]. Globally, intestinal parasitic infections are a substantial burden of disease, especially among children, as they contribute to malnutrition, anaemia, and impaired growth and cognitive development (Kotloff *et al*., 2013) [10].
In the Middle East, rates of intestinal parasitic infections in a population vary according to levels of sanitation, density of the population, and the degree of displacement within a given population due to war. Duhok Governorate (Kurdistan Region, Iraq), which encompasses both urban and rural populations as well as an internally displaced population, represents a population with diverse exposure to intestinal parasites. High rates of intestinal parasitic infections have been reported in Duhok, particularly among children and those of lower socioeconomic status (Jameel & Eassa, 2021; Salih *et al*., 2022) [9, 12].
As the public health implications of intestinal parasitic infections are significant, this review will review the data on the prevalence, distribution, and risk factors associated with intestinal parasite infections in Duhok and discuss the implications for public health intervention.

2. Methods
A comprehensive literature search was performed to identify relevant articles published in peer-reviewed journals, using Pubmed, Google Scholar, and other databases. The following search terms were used: “intestinal parasites, Duhok, Iraq, prevalence, and risk factors.” The inclusion criteria used to evaluate the articles included peer-reviewed studies written in English with full-text access that had a valid DOI. Studies of interest included all peer-reviewed studies that were conducted on human intestinal parasites, their prevalence, and their associated risk factors. The following criteria were used to eliminate articles from the review: non-peer-reviewed articles, duplicate articles, and articles that did not contain a DOI.
Data extracted from the articles included: study locale, sample size, demographics, parasite species, prevalence rates,

diagnostic methodology, and reported risk factors. The data synthesis incorporated both a narrative review and quantitative summaries where applicable.

3. Results

3.1 Prevalence in Duhok

In Duhok, many studies show a high prevalence of IPI in the pediatric population. The prevalence of IPI can be found to be in the 27%-50% range when hospitals treat pediatric patients (Ismael *et al*., 2024; Salih *et al*., 2022) [8, 12]. However, studies in rural communities show IPI prevalence rates as high as 60% (Salih *et al*., 2023) [13]. In general, school-aged children have higher prevalence rates than other age groups in Duhok.

3.2 Distribution of Parasite Species

Protozoan parasites are the most prevalent type; *Entamoeba histolytica* is the most common pathogen, while *Giardia lamblia* and Cryptosporidium spp. have lower prevalences. Helminth infections are the least prevalent but are persistent in rural Duhok.

Study	Sample Size	Parasite	Prevalence (%)
Ismael *et al*., 2024 [8]	740	*E. histolytica*	78.0
Ismael *et al*., 2024 [8]	740	*C. parvum*	17.1
Ismael *et al*., 2024 [8]	740	*G. lamblia*	4.9
Salih *et al*., 2023 [13]	1,025	Mixed protozoa	42.5

3.3 Demographic Characteristics

Children less than 10 years have the highest frequency rate of IPI and are more likely to have infections associated with behavioral exposures. Males are slightly more affected than females in some studies. Sanitation deficits increase the risk of infection for internally displaced people (IDPs) and rural populations.

3.4 Factors that Influence Risk

Infectious risk factors involve environmental (e.g. contaminated water, inadequate sanitation), socioeconomic (e.g. low income, low level of parental education, overcrowded living conditions), and behavioral factors (e.g. poor hygiene, direct contact with soil).

4. Discussion

This research demonstrates that Intestinal Parasitic Infections continue to be a significant public health issue in Duhok. Protozoan infections clearly dominate, which is consistent with the patterns found in both the region and around the world (Fletcher *et al*. 2012) [3]. The paediatric population is at the greatest risk for infection due to IPI, with infection contributing to malnutrition and cognitive deficits (Kotloff *et al*. 2013, Hall and Roman 2013) [10, 6].

Comparisons to Erbil and Zakho show heterogeneity at the regional level while also showing similar species distributions (Chalabi, 2024; Naqid, 2024) [2, 11]. Environmental determinants, such as inadequate water, sanitation and hygiene (WASH) services, have a significant impact on the transmission of Intestinal Parasites (WHO, 2020; Freeman *et al*., 2013) [15, 4]. In addition, socioeconomic factors further exacerbate risks related to infectious disease transmission.

Limitations in diagnostic testing methodologies, particularly the use of microscopic examination for the diagnosis of intestinal parasites, may have resulted in an underestimation of the prevalence of infection. Furthermore, current molecular diagnostic methodologies (e.g. polymerase chain reaction) provide increased sensitivity and specificity as compared to current diagnostic methodologies (Verweij and Stensvold, 2014; Garcia, 2016) [14, 5]. Currently, public health responses are not coordinated; therefore, it is recommended that programmes should be developed to provide integrated programmes that include sanitation, health education, and routine screening for intestinal parasites.

Finally, research gaps include lack of longitudinal studies assessing reinfection, seasonal patterns, and long-term effects on child development. Addressing these gaps is crucial for evidence-based policy and intervention planning.

5. Recommendations

1. Develop comprehensive Water, Sanitation and Hygiene (WASH) programs in poor rural communities where there are high rates of risk.
2. Enhance Health promotion in schools around hygiene and the importance of drinking safe water.
3. Routine screening and treatment must be implemented, particularly for children and displaced individuals.
4. The use of molecular diagnostics should be implemented to improve the accuracy of diagnosis.
5. Longitudinal studies must be conducted to determine the dynamics of reinfection and the effectiveness of intervention measures.

6. Conclusion

The prevalence of intestinal parasitic infection among the population of Duhok Governorate is high, with protozoan parasitic disease comprising the majority of those infected. The children and the socioeconomically disadvantaged members of the community are at the highest risk of acquiring intestinal parasitic diseases. Integrated interventions, including improving sanitation, health education, routine screening, and using molecular diagnostics to improve diagnosis and treatment access, are crucial to decreasing the burden of disease and improving public health outcomes.

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