

An Epidemiological Study of Intestinal Parasites in Children Attending the Pediatric Teaching Hospital in the Holy City of Karbala, Iraq

Aseel Kariem Al-Sultany, Kassim Abdulla Hamza Al-Morshidy¹

Department of Biology, College of Science, University of Kerbala, Karbala, ¹Department of Biology, College of Science, University of Babylon, Babylon, Iraq

Abstract

Background: Intestinal parasitosis remains an important public health concern worldwide because of its high incidence reached in several countries as well as its nutritional consequences. The role of intestinal parasites in causing morbidity and mortality, as well as the pathogenesis of other infectious diseases, is determined. Intestinal parasitic infection is most common among school-age children and tends to cause high-intensity infection in this age group. Intestinal parasites are divided into two major types: helminths and protozoa. Protozoa are unicellular organisms and belong to the Protista kingdom and can reproduce in the human body which can allow the formation of serious infections. **Objectives:** The objective of this study was to detect the incidence of intestinal parasites in children attending and hospitalized at Karbala Teaching Hospital in the holy city of Karbala, Iraq. **Materials and Methods:** Between February 2021 and January 2022, 3748 feces samples from children between the age of 1 and 15 years were tested using both direct smear and acid fast stain test in addition to rapid test techniques. **Results:** The result showed that the total percentage of infection with intestinal parasites was 13% and recorded five types of intestinal parasites: *Entamoeba histolytica* (10.54%), *Giardia lamblia* (2.46%), *Cryptosporidium parvum* 0.4%, *Hymenolepis nana* (0.24%), *Enterobius vermicularis* (0.13%), and *Trichomonas hominis* (0.03%). Males were more likely to get infected than females, and the incidence of intestinal parasite infection (IPI) changed over the month of the study. Also, the infection with one species has more incidence than two and three species. The age groups of the infected children were likewise impacted by the infection rate. The statistical analysis revealed differences in the percentage of IPI by age and gender of children ($P \leq 0.05$). **Conclusion:** We conclude from the result of the present study that the incidence of infection with *E. histolytica* is more than that of other intestinal parasites, and intestinal parasites were affected by most epidemiological criteria such as gender, the duration of the study, and age of infected patients.

Keywords: Children, intestinal parasites, Karbala city

INTRODUCTION

Intestinal parasites pose a serious threat to public health, particularly in tropical and subtropical areas. It is estimated that 3.5 billion people are infected, the majority of whom are children in poor nations. Different intestinal parasites were identified, including protozoa and the helminths. The *Entamoeba histolytica*, *Giardia lamblia*, and *Cryptosporidium* species are the most common intestinal parasites of protozoa that infect humans.^[1,2] The incidence of intestinal parasites varies by place, and it is influenced by a variety of factors including geography, climate, hunger, poverty, dense population, and hygiene of individuals and

communities,^[3] in addition to lack of drinkable water and unfavorable health circumstances. These factors promote the growth and spread of intestinal parasites.^[4]

In children and immunocompromised individuals, intestinal parasite infections (IPIs) can cause gastrointestinal

Address for correspondence: Ms. Aseel Kariem Al-Sultany, MSc,
Department of Biology, College of Science,
University of Kerbala, Karbala, Iraq.
E-mail: aseel.k@uokerbala.edu.iq

Submission: 14-Nov-2022 **Accepted:** 27-Nov-2022 **Published:** 27-Apr-2023

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How to cite this article: Al-Sultany AK, Al-Morshidy KA. An Epidemiological study of Intestinal parasites in children attending the pediatric teaching hospital in the holy city of Karbala, Iraq. *Med J Babylon* 2023;20:95-100.

Access this article online

Quick Response Code:



Website:
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DOI:
10.4103/MJBL.MJBL_276_22

problems, growth retardation, iron deficiency anemia, diarrhea, nausea, vomiting, and abdominal discomfort. This contributes to numerous co-infections such as *Mycobacterium tuberculosis* and *Helicobacter pylori*. The effects of IPI, apart from morbidity and mortality, include nutritional issues (such as chronic blood loss, poor vitamin A levels, iron deficiency anemia, weight loss, and stunted growth), psychological and social well-being, and compromised mental development (symptoms as cognitive impairment, stopped growing, and decreased school attendance).^[5,6]

The parasites have many antigens because the body structure is complex and they can evade the immunity of the host by inhibiting the host's immune response by different ways, such as changing their surface antigen, encystment, and migration.^[7] The purpose of the current study was to identify the kinds of intestinal parasites and the frequency of infection in patients in the holy Karbala province.

MATERIALS AND METHODS

Collection of stool samples

Stool samples from patients at the Karbala Teaching Hospital for Children in the holy city of Karbala were collected, during the period from February 2021 to January 2022. About 3748 stool samples were collected. A questionnaire sheet was obtained that covered kind of infection from patients and age, residence region, gender, and duration, as well as sterilized plastic containers with a tight lid that is used to retain stool samples to prevent dryness and moisture.

Stool sample examination

Macroscopic examination

The volume of feces, form, consistency, and color of stool samples are all factors to consider when examining them. Trophozoites frequently appear in liquid or soft specimens, whereas cyst phases can be found in semisoft samples. The sections of the feces that may contain blood or mucus should be carefully checked as it may contain the parasite's trophozoites stage. The liquid sample and mucus should be analyzed first if there were multiple samples brought to the laboratory.^[8]

Microscopic examination

The examined stool samples with direct smear methods involved putting a tiny drop of normal saline (0.9%) or iodine stain on the sliding glass, mixing well with a tiny amount of stool using a wooden stick, covering the slide, and looking at the sample under 40× and 100× power magnification.^[9,10] Staining by hot modified Ziehl-Neelsen stain, this method is used for parasites such as *Cryptosporidium parvum*.^[11] Rapid test (chromatographic immunoassay) was used to detect *E. histolytica*, *G. lamblia*, and *C. parvum*.^[12]

Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients' verbal and analytical approval before samples were taken. The study protocol and the subject information and consent form were reviewed and approved by a local Ethics Committee according to the document number 7/18/6138 dated October 26, 2020 to get this approval.

RESULTS

The total percentage of infection with intestinal parasites

The present analysis revealed that the IPI was 13% in patients attending Karbala Teaching Hospital for children, where the number of patients infected with intestinal parasites was 487 from 3784 patients examined.

The percentage of IPI according to gender

The result in Table 1 showed the percentage of parasite infection with intestinal parasites in both genders. The total infected males were about 14.1%, whereas the total infected females were 11.7%. The statistical analysis showed a significant difference between percentages of infection in males and females ($P \leq 0.05$).

The percentage of IPIs according to the species of parasites

The results revealed that the most common species of intestinal parasites was *E. histolytica*, whereas the lowest infected species was *Trichomonas hominis* [Table 2]. Statistical analysis using the χ^2 test showed a significant

Table 1: Distribution of incidence of intestinal parasites infection according to gender

Gender	No. of the tested patients	Infected patients		Non-infected patients	
		No.	%	No.	%
Males	1966	278	14.1	1688	85.9
Females	1782	209	11.7	1573	88.3
Total	3748	487	13.0	3261	87.0

$\chi^2 = 4.810$ calculated; $\chi^2 = 3.841$ tabled; df=1

Table 2: Distribution of infection percentages with different intestinal parasites species (n = 3748)

Species of parasites	Number of the infected patients	%
<i>E. histolytica</i>	395	10.54
<i>G. lamblia</i>	92	2.46
<i>C. parvum</i>	15	0.4
<i>Hymenolepis nana</i>	9	0.24
<i>Enterobius vermicularis</i>	5	0.13
<i>T. hominis</i>	1	0.03

$\chi^2 = 1.39$ calculated; $\chi^2 = 3.841$ tabled; df=1; $P \leq 0.05$

difference between the infection percentages of the parasitic species recorded in the current study ($P \leq 0.05$).

Distribution of infection percentages with intestinal parasites according to the type of infection (single or mixed)

Table 3 illustrated the percentages of single and mixed infections with intestinal parasites from the total number examined during the study. It was found that most patients infected with intestinal parasites were infected with one type of parasites (12.65%), whereas^[12] patients were infected with two types of intestinal parasites (3.2%), and only one patient was infected with more than two types of parasites (0.03%). The percentage of single infection and mixed infection differed significantly according to the statistical analysis.

Distribution of the infection percentage with intestinal parasites according to the duration of the study

Figure 1 showed the infection percentages of intestinal parasites according to the study's duration. September (2021) illustrated the highest infected percentage (30.1%), whereas February (2022) has shown the lowest percentage

(3.5%). Statistical analysis using the χ^2 test showed significant differences in the incidence percentage during the duration of the study ($P \leq 0.05$).

Distribution of percentages of infection with intestinal parasite according to the age groups

Table 4 illustrated the distribution of IPI percentages according to the age groups of patients. Since the ages of the participants were divided into subgroup, results indicated that the highest infected age group was the children who were less than 5 years old, and the lowest infected was for the age group who were more than 10 years. The results of the statistical study revealed that the percentages of infection in the various age groups varied significantly.

DISCUSSION

The total percentage of infection with intestinal parasites

The result showed that the percentage of IPI in the current study was 13% among people in the Karbala province. This present percentage of total infection nears many studies such as the study of Al-Hasheme *et al.* (2020) in the holy city of Karbala, Iraq. The overall incidence of intestinal parasites was 18.93%.^[4] In Al-Shulaa and Al-Khadimya Baghdad, Iraq, the percentage of infection is 13.64%^[13]; also in Erbil City, the percentage of infection is 14%.^[14] In Al-Furat General Hospital, Baghdad, Iraq, the result showed that the incidence of *E. histolytica* was 15.89% among 497 patients.^[15] The results revealed that there were variations in the overall percentage of IPI, which may be influenced by various environments and areas where the samples were obtained. Sample

Table 3: The percentages of single and mixed infections with intestinal parasites (n = 3748)		
Type of infection	No. of infected patients	%
Infected with one species	474	12.65
Infected with two species	12	3.20
Infected with more than two species	1	0.03

$\chi^2 = 89.7$ calculated; $\chi^2 = 5.991$ tabled; df = 2; $P \leq 0.05$

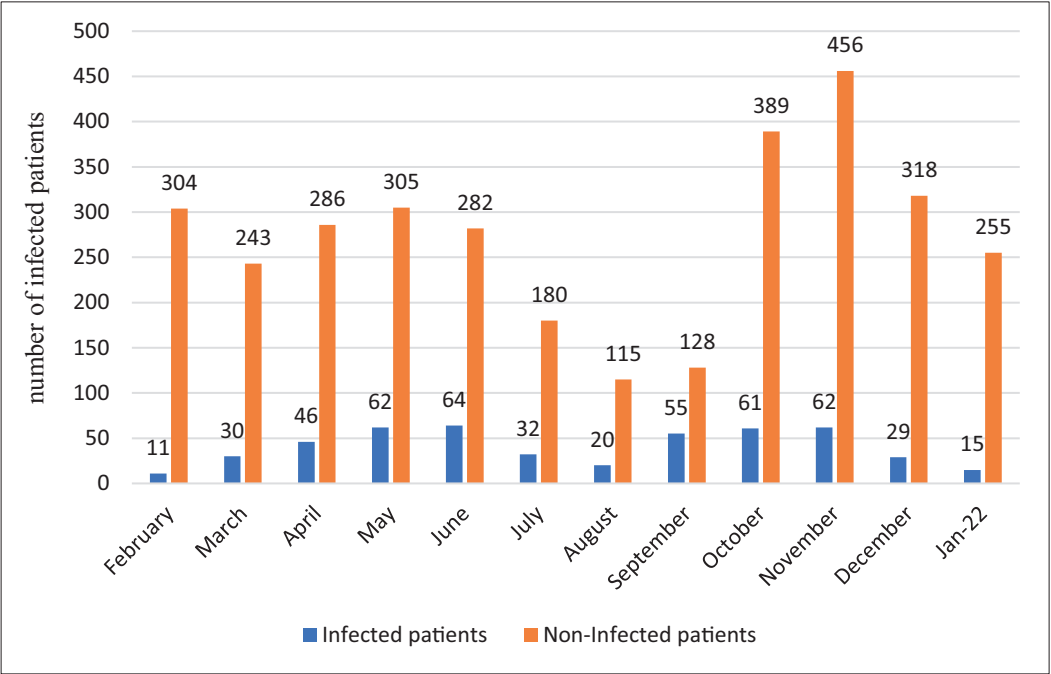


Figure 1: The infection percentages of intestinal parasites according to the duration of the study

Table 4: Distribution of IPI percentages according to the age groups of patients

Age group	Number of tested patients	Infected patients		Non-infected patients	
		No.	%	No.	%
<5	1937	253	13.1	1684	86.9
5–10	1150	198	17.2	952	82.8
>10	661	36	5.4	625	94.6
Total	3748	487	13	3261	87

$\chi^2 = 51.46$ calculated; $\chi^2 = 5.991$ tabled; df = 2; $P \leq 0.05$

size measurement, the duration of the study as well as various climatic and economic factors were taken into account. Along with the different age groups, the range of types tested and the setting of the research are used to determine whether intestinal parasites are present, such as using only the direct approach and excluding the use of additional concentration when studying feces and using sedimentation or flotation techniques.^[4,16]

The percentage of IPI according to gender

The result showed that the highest rate of IPI in Karbala province was in the males (14.1%), whereas the lowest rate of infection in the females was 11.7%.

The current study agreed with the study in Mosul, Iraq, which recorded that the highest rate was in the males (9.59%), whereas females had the lowest infection rate (6.19%).^[17]

The current study also agreed with the study in Khartoum, Sudan, which recorded the highest rate of infection among males (80%) and the lowest infection rate among females (60%).^[18] Physiological variables, which are typically hormonal in nature, and ecological (sociological in humans) factors are typically attributed for these variations.

Differential exposure to infections due to sex-specific behavior or morphology is a result of ecological variables.^[19] Variations in endocrine-immune interactions can also be invoked to explain these differences in infection between genders. Additionally, sex steroids, particularly androgens in males and estrogen in females, alter a variety of aspects of host immunity by regulating the expression of Toll-like receptors, cytokines, and antibodies. Androgens also lower immune competence. The steroid hormones have an impact on the genes and behaviors that increase male susceptibility to infection and disease. The lesser incidence in females may also be related to their greater attention to personal cleanliness.^[20]

The percentage of IPI according to the species of parasites

The result showed the highest rate of infection with *E. histolytica* (10.54%), then *G. lamblia* (2.46%), *C. parvum* (0.4%), *H. nana* (0.24%), and *Enterobius vermicularis* (0.13%), and the lowest rate of infection with *T. hominis*

(0.03%) in Karbala province. In Al-Diwaniyah City, Middle Iraq, the highest rate (41.93%) was reported for *Enterobius vermicularis*, followed by *G. lamblia* (23.46%), *E. histolytica* (15.06%), *Escherichia coli* (3.70%), *H. nana* (4.44%), *Dientamoeba fragilis* (1.73%), *Ascaris lumbricoides* (1.48%), and *Taenia saginata* (0.49%).^[21] Also in Erbil city, Iraq, *E. histolytica* was the most prevalent parasite (80.1%), followed by *G. lamblia* (19.8%) and *H. nana* (0.1%).^[22] Libya recorded the highest rate of *E. histolytica* (60.70%) and *G. lamblia* (31.73%).^[23] We can attribute the high incidence of *E. histolytica* to the direct mode of transmission because it does not require an intermediate host. On the other side, there is no focusing on aseptic water treatment, a shortage of materials required for water purification, and pesticide use.^[24] Flies carrier mechanical for cysts of parasites can participate in increasing the rate of incidence of this parasite.^[25] This study found that more people had protozoan infections than helminth infections; this finding may be related to the fact that protozoa parasites are easier to transfer than helminth eggs or larvae. Additionally, for parasitic worms, these eggs or larvae continue to grow and multiply in soil or an intermediate host before they infect people.^[26]

Distribution of infection percentage with intestinal parasites according to the types of infection (single or mixed)

The results showed that a single infection pattern is the most common (12.65%), whereas the rates of double and triple infections were 3.2% and 0.03%, respectively. Statistical analysis using the χ^2 showed a significant difference between the ratios of types of intestinal parasites in children at a probability level of $P \leq 0.05$. In Babylon province, Iraq, the double infection recorded the lowest rates (0.49%), whereas a single parasite infection had the highest percentage (99.51%).^[27] Al-Diwaniyah City, Middle Iraq recorded that a single infection pattern is the most common (38.27%), whereas the rates of double, triple, and quadruplicate infections were 25.40%, 11.29%, and 0.81%, respectively.^[21] In Wasit Province, Iraq, it was found that the numbers and percentages of single and double (two types of parasites) infections were 95.4% and 4.6%, respectively.^[28] Owing to the existence of favorable conditions for the growth and development of several parasites, children are more likely to contract multiple types of intestinal parasites^[29] in addition to

socio-environmental elements that regulate the occurrence and spread of intestinal parasite diseases, such as climatic elements, drinking water, sanitation, and personal hygiene practices.^[30,31]

Distribution of the infection of intestinal parasites according to the duration of the study

The result found a difference in the infection rate during the duration of the years. The highest rate of infection was in September 2021 (30.1%), whereas the lowest rate of infection was in February 2022 (3.5%). A study in Karbala showed that the months of November and February each had their respective peak and trough infection rates of 47.88% and 36.36%, respectively.^[32] Al-Diwaniyah City, Middle Iraq also showed the highest incidence of 92.5% in July, whereas the minimum was 36.36% in January,^[21] whereas Erbil City, Iraq showed that September had the greatest infection rate (10.3%), and October and November had the lowest rate (6.2%).^[22] The presence and spread of insects and other animals that are thought to be intermediate or reservoir hosts for many parasites, as well as agricultural practices, water availability, high temperatures, little rain and moisture, and climatic conditions that vary according to latitude and longitude, may all be factors in the variations in parasitic disease incidence throughout the year.^[32] This might be because Iraq is among the countries with long, dry, hot summers and short, chilly, rainy winters. The population characteristics, such as swimming in rivers and lakes, increase susceptibility to infections and have a part in the promotion of parasite infection in hot and dry weather.^[33,34] Consuming fresh vegetables, such as lettuce, leeks, and celery, which are essential to the Iraqi diet, without properly cleaning them can significantly increase the risk of infections.^[22,35]

Distribution of intestinal parasites infection rates according to age groups

The result showed the incidence of IPI in different age groups in the present study, which shows the highest rate of infection (17.2%) was at the age of 5–10 years, whereas the lowest rate of infection (5.4%) was at the age >10 years. The result agrees with the study in Karbala, which showed that the highest infection was recorded in children >3–6 years representing 52.38%, and the lowest infection was recorded in children 9–12 years representing 24.33%.^[32]

In Baghdad, they recorded the incidence of intestinal parasites between the younger ages that were more affected than the older patients (1–10), (15–60) (9.7% and 2.9%), respectively.^[36] In Sudan, we found that intestinal parasites were more prevalent among the age groups 5–7 years (55%), whereas it was less frequent in the age groups 12–14 years (33.3%).^[18] Also in Madagascar, they recorded higher IPI among children between 4 and 5 years

of age (53.9%) compared with children aged 2 and 3 years (44.9%).^[37] This study identified that children belonging to the age group of 5–10 years were more infected with IPIs when compared with children between <5 and >10 years of age. The reason for this outcome may be that children, especially of this age, play and eat close to the mud and still water where the excrement removed from latrines are dumped without parental supervision. Another explanation is that children around this age begin to venture farther from home, increasing their exposure to unclean places and unsanitary situations.^[37] Some bad habits, such as putting fingers in their mouth and may be exposed to soil-transmitted parasites more than older by playing outside, and their exposure to various parasitic agents accompanied by poor healthcare unhygienic condition and a lower standard of education also they enjoy playing with pets like cats and birds, which are believed to serve as intermediate or reservoir hosts for numerous parasites.^[8] The reason for widespread of *E. histolytica* in this age group is due to the reason children eat unwashed fruits and vegetable that contain cysts of parasite.^[38]

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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