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Impact of giardiasis on haematological and biochemical profiles among children in Tikrit city, Iraq

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Abstract

Background: Giardiasis is an important public health problem in many parts of the world, including developing areas where it has been shown to be a leading cause of malnutrition and systemic complications among children. This study was carried out to estimate the prevalence of *Giardia lamblia* infection among children in Tikrit city, Iraq, and its effect on some hematological and biochemical parameters.

Methods: A study was performed from January 1, 2025 to June 30, 2025. In total, 342 stool specimens were collected from children aged 1–12 years who referred to Tikrit hospitals and private clinics. Confirmation of diagnosis was done using standard direct wet mount microscopy. Venous blood analysis was performed with an automated hematology analyzer for complete blood counts, and the serum biochemical profiles (total protein, albumin, and globulin) were measured using spectrophotometric commercial kits. Statistical analysis was performed with the Student's t-test.

Results: The prevalence of *G. lamblia* infection was 11.7% (40/342 children). Infection rate was higher in male (6.73%) as compared to female children (4.97%). The maximum infection was in the age group of 5-8 years (5.50%) and minimum among the patients aged from 1 to less than4 years(1.80%). The infected children showed a marked and significant reduction in hemoglobin (8.64 g/dl) and packed cell volume(27.71%) with a significantly increased total white blood cell counts still statistically greater than the controls as 11.12×10^9/L($P < 0.05$). Furthermore, serum biochemical analysis revealed a significant decrease in both total protein and albumin levels for infected children relative to healthy controls ($P < 0.05$). In contrast, a significant increase of about one-third in globulin concentrations within the children's sera was statistically significant ($p<0.025$).

Conclusions: *Giardia lamblia* infection is highly prevalent among children aged 5–8 years in this region. The parasite causes significant pathophysiological effects, commonly involving microcytic anemia, high levels of systemic leukocytosis and protein losing enteropathy. Routine screening is highly suggested to address the chronic developmental risk in infected pediatric populations, along with early therapeutic intervention and introducing micro-nutritional support.

Keywords: *Giardia lamblia*; Children; Haematological parameters; Biochemical profiles; Anemia; Iraq.

1 Introduction

Giardia lamblia is one of the most neglected intestinal protozoa by public health [1]. Clinical features are heterogeneous but usually comprise diarrhea, abdominal pain bloating nausea and weight loss. More serious cases can result in malabsorption, end up presenting with anemia due to iron deficiency leading to increased fatigue and nutritional

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deficiencies [2]. Diarrheal diseases are still ranked as one of the leading health problems around the world, especially in developing countries which account for 20–40% mortality rates among children. [3] There are different diagnostic approaches to identify intestinal protozoa. Direct smear enables the motility of trophozoite to be visualized without alteration in structure [4]. Staining with Lugol's iodine helps in improving of visualization degree the inner structures. Other than that, the diagnosis of *G. lamblia* is made using a microscopic stool examination which has its weaknesses; cysts are not shed continuously, and at times leads to low sensitivity in diagnosing positive cases of giardiasis [5]. Moreover, it is also hard to identify its cyst from non-pathogenic protozoa or mixed infections with other parasites and microorganism [6].

Other intestinal parasites infecting humans, such as *Giardia lamblia*, obtain nutrition from the host and consume nutrients like proteins, lipids (fats), carbohydrates and minerals. By persisting in the intestine, they interfere with these key nutrients involved in metabolic regulation, tissue integrity and immune responses that are crucial for defending against infections [7]. Malnutrition and parasitic infections are strongly interrelated, often creating a vicious cycle of weakened immunity and recurrent illness, particularly in children [8].

Nutrient deficiencies are closely associated with intestinal diseases, especially in children from low-resource settings. Iron and copper are essential for hemoglobin synthesis and enzymatic activity [9]. Deficiencies in these micronutrients are linked to stunted growth, impaired development, and higher susceptibility to infections [10].

2 Materials and methods

A study was carried out in Tikrit city during period from January 1 ,2025 to June 30, 2025 to determinate the distribution of *Giardia lamblia* on children and how it affects certain hematological and biochemical parameters on affected patients. A total of 342 stool samples were collected from children (males &females) aged 1-12 years visiting Tikrit hospitals and private clinics. The samples put in disposable container and numbered it. Microscopic examination was done to the stool samples within 30 minutes of arriving at the lab by direct wet mount method to detect cyst and trophozoite of *Giardia lamblia using* magnification *40x.*

Venous blood was drawn from the children whose stool samples were collected, using a medical syringe. The blood was divided into two types of laboratory tubes. The first tube contained EDTA for hematological tests, while the second tube did not contain EDTA for biochemical test. The samples in the second tube left at laboratory temperature for 30 minutes, after that the samples were centrifuged at 2500 rpm for 10 minutes for obtaining the serum was drawn and stored in the freezer until biochemical tests are conducted on it.

The percentage of hemoglobin, packed blood cells, and the total number of white blood cells were calculated using Automated Hematology Analyzer (Sysmex KX-21N, Japan). Briefly, 300 µL of blood introduced into the device to obtain the complete blood count. The serum levels of albumin, total protein and globulin in both infected and non-infected children was determined according to the method mentioned in the kit and prepared by the company Biolabo.

The results were statistically analyzed according to student's t-test to show the effect of *G.lamblia* infection on some haematological and biochemical variables among children.

3 Results and discussion

According to the current study, 40 out of 342 children had an overall *Giardia lamblia* infection rate of 11.7%. Our findings indicated that the infection rate was higher in male (6.73%) than in female (4.97%). Males and females in this study had significantly different infection rates, according to the statistical analysis (Table 1).

Table 1 Giardiasis Distribution by Sex

Gender	No. of infected	% of infected	No. of non infected	% of non infected	Total	
					Total	%
Male	23	6.73	165	48.25	188	54.97
Female	17	4.97	137	40.05	154	45.03
Total	40	11.7	302	88.3	342	100

Significant difference was observed in the infection rate between males and females ($p \leq 0.05$).

The results of the current study concerning the effect of sex agreed with some previous studies, [11] reported a higher infection rate in males (63.5%) compared to females (36.5%) and a study in Kirkuk city [12] confirmed that the infection rate in males (29%) was higher than in females (21%).

The reason for the higher infection rate in males compared to females may be due to differences in environmental factors, habits, and living conditions, increased activity, and contact with polluted environments, while females spend most of their time indoors which, in turn reduces their chances of infection.

The study revealed that the age range 5–8 years had the highest rate of *G. lamblia* infection, at 5.5% (19 out of 342). Table (2) of the statistical analysis revealed a significant difference between the age groups. [10] found that preschoolers had the highest infection rate (35%) in his study.

A weakened immune system that exposes people to a variety of pathogens, including bacteria, viruses, fungi, and parasites, may be the cause of this high prevalence [13,14]. In addition to inadequate education, poor health hygiene, low socioeconomic level, particularly among immigrants, and the lack of play places, which forces kids to play close to trash in their homes, raising the risk of infectious diseases [15].

Table 2 Distribution of Giardiasis according to age groups.

Age groups	No. of infected	% of infected	No. of non infected	% of non infected	Total	
					No.	%
1-4	6	1.80	76	22.2	82	24
5-8	19	5.50	139	40.7	158	46.2
9-12	15	4.40	87	25.4	102	29.8
Total	40	11.7	302	88.3	342	100

The infection rate varied significantly between age groups ($p < 0.05$).

At a significance threshold of ($p \leq 0.05$), the current investigation revealed significant variations in blood parameters between the infected and non-infected groups. There was a significant decrease in hemoglobin (Hb) and packed cell volume (PCV0, as shown in the table (3). This study results consistent with the findings of [16] he showed significant differences in PCV levels between infected and non-infected group. The reason for the decrease in the Hb level in infected groups is due to intestinal malabsorption, which in turn is mainly caused by iron deficiency anemia resulting from the child's and host's shared malnutrition, as well as the malnutrition that affects the infected person [17,18].

The study also revealed significant differences in the white blood cell (WBC) count between infected with Giardiasis and non-infected groups. This result is consistent with what was recorded by [15]. The reason for the increase in the white blood cell counts in infected patients is that these cells are the primary defense mechanism against foreign bodies, germs, and parasites that invade the body [17], as shown in table (3).

Table 3 Effect of Giardiasis infection on the levels of some haematological parameters

Giardiasis	No.	%	Hb(Mean±SD)	PCV(Mean±SD)	WBC (Mean±SD)
Infected	40	11.7	8.64 ±0.3 [a]	27.71 ±0.49 [a]	11.12 ±0.33 [a]
Non infected	302	88.3	13.54 ±0.24 [b]	37.08 ±0.71 [b]	7.25 ±0.30 [b]
P value			0.030	0.030	0.030

At $p < 0.05$, means with distinct superscripts in the same column differ significantly.

The current study recorded a decrease in the levels of total protein and albumin in children infected with giardiasis compared to the non-infected group. The level of total protein in the infected was 6.21 gm/dl, while in the control group it was 7.43 gm/dl. As for albumin its levels was 3.44 gm/dl in the infected and 3.63 gm/dl in the control group.

This decrease in the mean of total protein and albumin in patients with giardiasis due to the inability of the *G. lamblia* parasite to synthesize amino acids and a lack of essential nutrients for protein synthesis. It depends on obtaining them

from the environment in which the trophozoite stage develops [19]. In addition, there is malabsorption as a result of mechanical damage to the host's intestines, which leads to protein-losing enteropathy. Consequently, protein loss increases when infected with this parasite several times more than the normal state [20,21]. While an increase was recorded in the level of globulin in the infected group 2.71 gm/dl compared to the control group 2.45 gm/dl. Table (4).

Table 4 Effect of Giardiasis infection on levels of some biochemical tests

Giardiasis	No.	%	Total protein (Mean±SD)	Albumin (Mean±SD)	Globulin (Mean±SD)
Infected	40	11.7	6.21±0.20[a]	3.44±0.07 [a]	2.71±0.088 [a]
Non infected	302	88.3	7.43±0.19[b]	3.63±0.11 [b]	2.45±0.084 [b]
P value			0.020	0.020	0.020

Means with different superscripts within the same column are significantly different at $p \leq 0.05$

4 Conclusion

The infection rate of *Giardia lamblia* differed significantly between males and females in this study, with higher prevalence observed in children aged 5 to 8. Certain hematological and biochemical indicators were strongly correlated with the infection. The study's findings revealed that the infected group's packed cell volume (PCV) and blood hemoglobin (Hb) were significantly lower than those of the non-infected group, while the infected group's total white blood cell count was higher.

The study's findings also demonstrated that the infection rate affects certain biochemical tests, with globulin levels rising and total protein and albumin levels falling in infected youngsters as compared to the non-infected group.

Recommendations

It is highly recommended to implement routine and periodic stool screening for school and kindergarten children to ensure early detection of parasitic infections. Furthermore, public health authorities should guarantee the provision of sterilized drinking water while launching educational campaigns to raise health awareness among mothers regarding personal hygiene and prevention practices.

Compliance with ethical standards

Disclosure of conflict of interest

No conflicting interests are disclosed by the authors.

Statement of informed consent

Verbal consent was obtained from the parents of the children participating in this study

Author Contributions

M.M.S.designed the study, collected the data and enrolled the manuscript; Z.S.O. performed statistical analysis and interpreted the results; R.M.E. performed the experiments; Each author approved the final version of the manuscript after critically evaluating it for significant intellectual content.

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