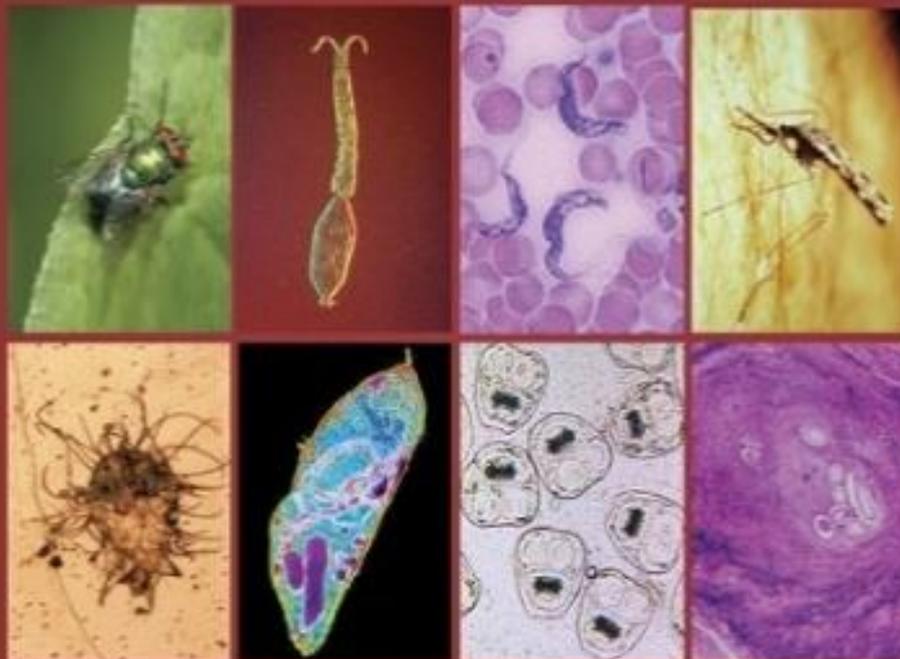




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Seroprevalence Study of Giardiasis Among Children with Diarrhoea in Duhok City, Kurdistan Region of Iraq

Arshad M. Abdullah and Darya S. Hussein

College of Pharmacy, University of Duhok, Kurdistan Region-Iraq

E-mail : arshadzanko@gmail.com

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ABSTRACT

Giardia lamblia is one of the pathogenic parasites that infect the gastrointestinal tract and commonly causes diarrhoea, iron deficiency anemia, and other gastrointestinal problem in men, especially among children in poor sanitation areas with contaminated drinking water resources. This study aimed to detect and determination of the rate of giardiasis in Duhok city. In this study, 105 Stool samples were collected from children of different ages and both sex, during different days from May to August 2019. Serological tests have been applied for the identification of giardiasis. From the results, 5.71% (6) stool samples were given positive, 4.87% in males and 6.25% in females, Depending on the stool types, 3.1% (1) of infection were reported in semi-formed stool type, 7.69% (3) in loose and 5.88% (2) in watery stool type. According to the age groups, the highest infection (3) was recorded in the 6-10 years' accounting (8.57%), while the lowest infection rate was 3.12% (1) in > 10 years' age groups, with no significant differences. This study shows the prevalence rate of *G. lamblia* among children in Duhok city. Preventing this infection requires good plans and strategies with good individual hygiene, the use of a healthy drinking water supply, and useful educational program to control this disease.

INTRODUCTION

Giardiasis is one of the important parasitic diseases that infect a large number of people per year (Einarsson *et al.* 2016; Ryan and Caccio, 2013). It is caused by the flagellated protozoan parasite known as *Giardia lamblia* or *G. intestinalis*, which can infect a wide variety of vertebrate hosts including humans, and according to World Health Organization reports, it is classified in the Neglected Diseases group (Ramírez *et al.* 2017; Rodriguez *et al.* 2017). Many global studies report that giardiasis infection in more than 200 million people yearly, the higher-risk infected groups are children with poor habits and overcrowded schools and families (Al-Mekhlafi, 2017; Ajjampur *et al.* 2011; Thompson, 2001). In the first stage, giardiasis appears in humans as acute diarrhea, in untreated cases, it can appear as chronic and may cause several problems in children as abdominal cramps, bloating, malabsorption, iron deficiency, anemia, growth retardation, and weight loss (Manko *et al.* 2019; Samie *et al.* 2020; Tembo *et al.* 2020). The main transmission methods of giardiasis are polluted food and water with the infective stage of the parasite, and the faecal-oral route is direct from person to person (Aw JYH *et al.* 2019).

Different factors affect the prevalence of giardiasis among individuals, like weather, education level, management, socioeconomic status and availability of healthy drinking water (Grazioli *et al.* 2006; Naz *et al.* 2018; Periago *et al.* 2018; Samie *et al.* 2020; Veronesi *et al.* 2010). There are several methods in the diagnosis of this parasite including; microscopic, serology (ELISA), and molecular techniques which are useful for the diagnosis of disease (Fantinatti *et al.* 2016). This study aims to determine and assess the rate of giardiasis infection among children in Duhok city.

MATERIALS AND METHODS

Sample Collection:

In this study, 105 Stool samples were collected from children of both sex and different age groups who had been referred to the laboratory in Duhok province/ Kurdistan Region-Iraq, on different days from May to August 2019. All information from collected samples was tabulated, and then all stool samples were transferred to the laboratory, and all samples were examined by light microscope then the suspected samples were examined by a serological method.

Serological Examination:

All primarily identified samples as *G. lamblia* in the lab were examined by serological test (ELISA kit, TECHLAB), according to the manufacturer's instructions (Samie *et al.* 2020).

Statistical Analyses:

In this study, the prevalence of *G. lamblia* was analyzed by the Chi-squared test/SPSS software, version 20.

RESULTS

In the current study, overall 105 stool samples were collected in Duhok city (Table No.1) and were examined serologically. The total infection rate with *G. lamblia* in Duhok city was 5.71%, with 4.87% of infection in males and 6.25% in females. Based on the stool types, 3.1% of infections were detected in semi-formed stool type, 7.69% in loose and 5.88% in watery stool type. Regarding the age groups, all examined individuals were arranged into three age groups, which the highest infection (8.57%) recorded in the 6-10 years age group, 5.26% and 3.12% of infection in 1-5 years and > 10 years' age groups respectively. However, there were no significant differences according to gender ($p=0.76$), stool type ($p=0.71$), and age groups ($p=0.62$).

Table1. Prevalence of *Giardia lamblia* in Duhok city.

Characteristics		Total No. of samples	Infected (ELISA) (%)	P-Value
Gender	Male	41	2 (4.87)	0.76
	Female	64	4 (6.25)	
Stool type	Semi-formed	32	1 (3.1)	0.71
	Loose	39	3 (7.69)	
	Watery	34	2 (5.88)	
Age groups	1-5 years	38	2 (5.26)	0.62
	6-10 years	35	3 (8.57)	
	> 10 years	32	1 (3.12)	
Total		105	6 (5.71)	

Regarding the impact of age group on *Giardia* infection in both male and female gender (Table No.2), the male infection with giardiasis was shown in 6.66% in the 1-5 years age group, 5.88% in the 6-10 years age group and no infection in > 10 years age group, but in the female

infection with giardiasis, the highest infection was shown in 6-10 years age group (7.14%), 6.66% in the age group of > 10 years and 4.76% in 1-5 years age group. There were no significant differences according to different age groups and gender.

Table2. Impact of age group on *Giardia* infection according to gender.

Gender	Age groups	No. of collected samples	Infected (ELISA) (%)	P-Value
Male	1-5 years	15	1 (6.66)	0.74
	6-10 years	17	1 (5.88)	
	> 10 years	9	0 (0)	
	Total	41	2 (4.87)	
Female	1-5 years	21	1 (4.76)	0.94
	6-10 years	28	2 (7.14)	
	> 10 years	15	1 (6.66)	
	Total	64	4 (6.25)	

The occurrence of Giardia infection based on the impact of stool type and patients sex (Table No.3), the male patients were shown a high rate of infection in watery stool type (6.25%), and 5.55% in loose stool type, but in female patients, the

high rate of giardiasis was recorded in the loose type of stool (9.52%), followed by 5.55% and 5% of infection in both watery and semi-formed stool types respectively. Statistically, there were no significant differences regarding stool type and gender.

Table3. Impact of stool type on Giardia infection according to gender.

Gender	Stool type	No. of collected samples	Infected (ELISA) (%)	P-Value
Male	Semi-formed	12	0 (0)	0.68
	Loose	18	1 (5.55)	
	Watery	16	1 (6.25)	
	Total	46	2 (4.34)	
Female	Semi-formed	20	1 (5)	0.82
	Loose	21	2 (9.52)	
	Watery	18	1 (5.55)	
	Total	59	4 (6.77)	

DISCUSSION

Giardia lamblia is one of the important gastrointestinal protozoan parasites and is associated with diarrhoea, gastrointestinal illness, iron deficiency anemia, and growth disorders special in infected children in communities with poor sanitation and contaminated drinking water resource (Ryan *et al.* 2017). The prevalence of this parasite in different percentages returns to environmental factors, nutritional sources, and geographic and socioeconomic conditions with different management processes in the diagnosis and treatment of this disease (Veronesi *et al.* 2010). In this study, the prevalence of infection among children was recorded at 5.71%, which is much the same as the results of Pipikova *et al.* 2020, but much less than Al- Abbudi *et al.* 2020 in Iraq (8.1%) and Abbaszadeh *et al.* 2020, with 10.6% of giardiasis infection.

In our study, according to gender, infected females were higher than infected males which is the same as in Raof, 2011, in Iraq and Calegar *et al.* 2020 in Brazil with high infection of females than males, but in another study in the Kurdistan region of Iraq, male infection is higher than female (Pipikova, 2020). In this study, the prevalence and occurrence of infection were shown at different rates according to age, which higher infection recorded in the 6-10 age group with 8.57%, and lower infection in the >10 age group with 3.12%, which agrees with Samie *et al.* 2020. Higher infection in younger children can be due to high activities and poor personal hygiene, for example, high activities in playgrounds and school (Samie *et al.* 2020). The high occurrence of giardiasis in our study reported in loose stool type samples (7.69%), may as a result of poor

environmental and personal hygiene, which is in accordance with the results of Samie *et al.* 2020 in Pretoria. Irritation and inflammation of the small intestine surface and damage of intestinal mucosa by *G. lamblia* parasite, are the main causes of fluids loss, watery and loose diarrhea (Shepherd and Gibson, 2006).

CONCLUSION

The present cross-sectional study shows that the prevalence of giardiasis is not very high, in Duhok city, and we can conclude that the infection of *Giardia lamblia* was low in children, and there were no significant differences regarding stool type and gender, however, for prevention of this disease, is important to use particular and proper health programs.

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Ethical Considerations:

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. The research proposal was reviewed by the Scientific Committee of the college of pharmacy, and all the conditions of the research are accepted by the scientific committee.

Conflict of interest:No conflict of interest.

Author's contribution: Authors have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Data Availability:All datasets generated or analysed during this study are included in the manuscript.

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