Frequency of Giardia lamblia among children in Dohuk, northern Iraq

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دراسة انتشار الجيارديةاللامبلية بين الأطفال في مدينة دهوك، في شمال العراق

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الخلاصة: تم فحص 1261 نموذجاً من عيِّنات البراز التي أُخذت من الأطفال في مدينة دهوك، شمال العراق، حيث بلغ معدل انتشار الإصابة بالجيارديةاللامبلية 38.5٪. وقد بلغت أعلى معدلات العدوى في دور رعاية الأيتام (48.1٪) وأدنى المعدلات في مستشفيات الأطفال (31.3٪). ولوحظت أعلى نسبة للإصابة في الفئة العمرية (10–12 عاماً) بمعدّل (81.2٪)، وأدنى نسبة في الفئة العمرية (7–9 أعوام) بمعدّل (22.9٪)، وكانت معدلات إصابة الذكور أعلى من الإناث. وقد أظهرت بعض العينات المصابة (70/486) عدوى مزدوجة أو ثلاثية، إ كانت الجيارديةاللامبلية مصحوبة بالمحرشفة القزمة، والمتبرعمة الكيسية البشرية، والمتحوّلة الحالة للنسج، واليُودَميبة البوتشلية.

ABSTRACT Out of 1261 stool specimens collected from children in Dohuk city, northern Iraq, the prevalence of Giardia lamblia infection was 38.5%. The highest rate of infection was in orphan care centres (48.1%) and the lowest in the paediatric hospital (31.3%). The age group 10–12 years had the highest rate (81.2%) and 7–9 years the lowest (22.9%); boys had a higher rate than girls. Some infected samples (70/486) showed double or triple infections and G. lamblia was combined with Hymenolepis nana, Blastocystis hominis, Entamoeba histolytica and Iodamoeba buetschlii.

Fréquence de Giardia lamblia chez des enfants à Dohuk (Iraq septentrional)
RÉSUMÉ Dans les 1261 échantillons de selles prélevés chez des enfants de la ville de Dohuk (Iraq septentrional), la prévalence de l'infection à Giardia lamblia était de 38,5 %. Le taux d'infection le plus élevé se trouvait dans les centres d'accueil pour orphelins (48,1 %) et le plus faible à l'hôpital pédiatrique (31,3 %). Le groupe d'âge des 10-12 ans avait le taux le plus élevé (81,2 %) et celui des 7-9 ans le plus faible (22,9 %) ; le taux était plus élevé chez les garçons que chez les filles. Certains échantillons infectés (70/486) présentaient une double ou une triple infection et G. lamblia était associé à Hymenolepis nana, Blastocystis hominis, Entamoeba histolytica et Iodamoeba buetschlii.

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Introduction

Giardia lamblia is a protozoan parasite which has worldwide distribution and is common in warm and moist climates throughout the world. Giardiasis is an important unresolved health problem in developing countries, as it is related to poor sanitation and management of supplied water, a problem that is exacerbated by the absence of a simple reliable diagnostic test [*1*]. The prevalence of *G. lamblia* ranges from 2%–7% in industrialized countries and 20%–60% in developing countries [*2*]. The majority of infections are probably asymptomatic but some are associated with subacute or chronic diarrhoea and intestinal irritation [*3*], which contribute to malabsorption and nutritional deficiency especially in children [*4*,*5*].

Giardiasis is transmitted by the faecal–oral route and direct person-to-person spread. In most cases it is associated with contaminated drinking water but also occasionally by recreational activity in still water [*6,7*]. *G. lamblia* is more common in children but all age groups are affected in epidemic areas [*8*]. Infants under 1 year old are less likely to be infected than the older children [*9*]. It is particularly common in children's institutions such as day care centres, primary schools and big families [*10,11*].

Several surveys of intestinal parasitosis in Iraq have shown a high incidence of giardiasis among children [*12*,*13*]. The present study was conducted because little information is available about *G. lamblia* infection among children in northern Iraq.

The aim of this study in Dohuk city was directed to determine the frequency of *G. lamblia* in different age groups of children, the incidence of *G. lamblia* throughout the year and the association of *G. lamblia* with other intestinal parasites.

Methods

This study was conducted from 1 October 2001 to 31 July 2002 on children living in Dohuk city.

Sample

Stool samples were collected from boys and girls aged 3 months to 12 years attending day care centres, kindergartens, primary schools and the local paediatric hospital. With the assistance of the children's parents and supervisors of centres, a fresh stool specimen was collected from each child into a disposable plastic container. The stool samples were taken immediately to the laboratory of the Microbiology Department at the University of Dohuk College of Medicine for examination. Those with negative results had 2 other samples taken at different times for examination.

Laboratory methods

The stool samples were examined with the naked eye for colour, consistency and the presence of any adult helminths. They were then examined microscopically by direct and concentration methods for presence of *Giardia* trophozoite and cyst stages and for detection of other parasites stages. The concentration method used in this study was the zinc sulphate floatation method [*14*]. Two types of direct wet film preparation were done for each sample at the same time, 1 slide by using normal saline 0.85% for detecting the motility of trophozoites and Lugol's iodine 5% slide for demonstrating structures [*14*].

Data about age, sex and residence were recorded for each child on a special form, together with the stool examination results (type of stool, direct and concentration test results), stage of *Giardia lamblia* and associated parasites.

The results were analysed statistically using the F-test.

Results

A total of 1261 stool samples were collected and examined: 833 samples were from children in schools and care centres (451 attending primary schools, 261 attending kindergartens, 94 day attending care centres and 27 attending orphan care centres) and 428 samples were from children presenting at the paediatric hospital with a complaint of gastroenteritis.

The total infection rate with *G. lamblia* among the examined samples was 38.5% (standard error range 38.49%–38.51%).

The distribution of *G. lamblia* according to the children's institute and schools is summarized in Table 1. The highest rates of giardiasis were from the orphan care centres (48.1%) and kindergartens (45.6%), whereas the rates were lower in the primary schools, day care centres and the paediatric hospital) (41.2%, 36.2% and 31.3% respectively). The statistical analysis revealed a highly significant difference in infection rate between primary schools and other children's institutes ($P < 0.01$).

The rate of infection varied across different age groups of children (Table 2). The age group 10–12 years showed the highest rate of infection (81.1%), and the lowest rate was in children 7–9 years (22.9%). There was a highly significant difference among different age groups ($P < 0.01$). The infection rate was higher among boys (41.6%) than girls (35.6%).

The distribution of *G. lamblia* according to the months of the year is shown in Table 3. Although more samples were collected in the summer months, the rate of *G. lamblia* infection as a proportion of the number of stools examined was lowest in June (28.4%). Fewer sample were collected in the colder months but the highest infection rate of samples was in December (49.2%) followed by November (44.8%), April (43.5%) and May (43.4%). The difference in the rates of infection during the months was significant ($P < 0.05$).

Overall, 70 out of 486 infected samples showed double and triple infections with other intestinal parasites combined with *G. lamblia* (Table 4). *G. lamblia* was combined with *Hymenolepis nana* (46.4%), with *Blastocystis hominis* (39.4%) and each of *Entamoeba histolytica* and *Iodamoeba*

Table 1 Distribution of Giardia lamblia infection among children attending different institutions in Dohuk city

Institution (number)	Age group (years)	No. of samples examined	No. positive	% positive
Primary school (18)	6–8	451	186	41.2
Kindergarten school (3)	3–6	261	119	45.6
Day care centre (2)	< 1–3	94	34	36.2
Orphan care centre (2)	< 1–12	27	13	48.1
Paediatric hospital (1)	< 1–12	428	134	31.3
Total	< 1–12	1261	486	38.5

$\chi^2 = 17.6$, df = 4, P < 0.01.

Table 2 Distribution of Giardia lamblia infection among children in Dohuk city according to age and sex

Variable	No. of samples examined	No. positive	% positive
Age (years)			
< 1	235	60	25.5
1–3	235	118	50.2
4–6	389	157	40.4
7–9	301	69	22.9
10–12	101	82	81.2
	$\chi^2 = 141.3$, df = 4, P < 0.01		
Sex			
Male	618	257	41.6
Female	643	229	35.6
	$\chi^2 = 4.7$, df = 1, P < 0.05		
Total	1261	486	38.5

buetschlii (7.1%). These results indicated that the infection with *G. lamblia* was usually more associated with the intestinal cestode *H. nana*. As triple infections, *G. lamblia* was combined with *H. nana* and *B. hominis* in 61.9% of samples, and combined with *H. nana* and *Ent. coli* in 38.1%.

Table 3 Distribution of Giardia lamblia infection among children in Dohuk city according to months of the study 2001–02

Month	No. of samples examined	No. positive	% positive
October	40	16	40.0
November	67	30	44.8
December	65	32	49.2
January	102	40	39.2
February	86	30	34.9
March	91	38	41.8
April	184	80	43.5
May	198	86	43.4
June	211	60	28.4
July	217	74	34.1
Total	1261	486	38.5

$\chi^2 = 20.0$, df = 9, P < 0.05.

Discussion

The infection rate with *G. lamblia* in stool samples from children in Dohuk city was very high (38.5%). The narrow standard error range in the samples is due to the large number of samples analysed.

The rate of infection in the present study is similar to other studies in Iraq [*12,15–17*]. The results are also in agreement with studies in other parts of the world [*4,18,19*]. This high rate of infection among children could be related to a number of factors such as poor health hygiene and toilet training, overcrowding, low education of children, low socioeconomic status and climatic conditions [*20*]. *Giardia lamblia* was isolated from stool samples of children in all primary schools but the highest rate of infection was reported from children in a primary school which is located in a low socioeconomic area (Serheldan region).

Another important factor which affects the rate of giardiasis is the presence of asymptomatic patients in the community who can be considered as the main source of infection through continuously excreting the cysts stages with their stools [*21*]. Most of the cases in this study were infected with cysts. Regarding the life-cycle of these parasites, those carrier patients act as a source of infection by continuously excreting the cyst stage with their stool [*22*]. Although carrier persons are asymptomatic, the infection may be converted to acute infection through excystation of cysts inside the intestine resulting in the main complaints of giardiasis such as abdominal pain, steatorrhoea and loss of weight [*23*].

Table 4 Distribution of other intestinal parasites associated with Giardia lamblia infection among children in Dohuk city

Organism	No. of samples infected	% positive
Double infections		
G. lamblia + Hymenolepis nana	13	46.4
G. lamblia + Blastocystis hominis	11	39.4
G. lamblia + Entamoeba histolytica	2	7.1
G. lamblia + Iodamoeba buetschlii	2	7.1
Triple infections		
G. lamblia + Blastocystis hominis + Hymenolepis nana	26	61.9
G. lamblia + Hymenolepis nana + Entamoeba coli	16	38.1
Total	70	100.0

The higher rate of infection with *G. lamblia* among children in orphan care centres, kindergartens and primary schools might be related to bad personal hygiene or overcrowding. On the other hand, the lower rate of infection among children in day care centres and the hospital might be an indication of good care taken by the supervisors of these centres [*24*].

Regarding the results of *G. lamblia* infection among different age groups, the < 1 year old group had a low rate of infection, perhaps because parents are responsible for their hygiene [*25*]. The infection rate was highest in the age group 10–12 years. This may be because this group of children are fully independent in toilet use and are more involved in outdoor activities which might lead to *Giardia* transmission [*26*]. The present results are similar to studies of intestinal parasitosis in Saudi Arabia and Senegal [*27,28*].

Higher numbers of samples were collected during the summer months when the maximum temperature in Dohuk is about 40–45 ºC. Cold weather kills the infective cysts [*29,30*]. The unfavourable temperature of *G. lamblia* cyst is less than 5 ºC and the cysts usually die at more than 62 ºC [*31*]. In Dohuk city the temperature in winter is 0 ºC or less to 5 ºC [*32*]. Other behavioural factors could be involved, for example there is greater consumption of drinks and food, e.g. ice cream, in summer which may be sources of infection [*33*].

The present study revealed that the intestinal cestode *H. nana* was the most common intestinal parasite associated with *G. lamblia* infection. Although other studies have demonstrated the same results [*34*], there was no clear reason for this association. However, it may be related to the infective stage of both parasites being resistant to various environmental conditions and remaining viable for a long time [*35*]. The other important pathogenic intestinal parasites recorded were *B. hominis* and *Ent. histolytica.*

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