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PUBLIC HEALTH & PRIMARY CARE | RESEARCH ARTICLE

Prevalence and associated risk factors of intestinal parasitic infections in Kurdistan province, northwest Iran

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Abstract: Objective: Intestinal parasitic infections are among the main health problems worldwide. The signs and symptoms depending on the type of parasite and conditions of host can be mild, moderate, or severe. In the present study, we attempted to determine the prevalence and risk factors for intestinal parasitic infections in individuals referred to medical laboratories in Sanandaj city, in the center of Kurdistan province, northwest Iran. **Methods**: This cross-sectional study was done from 1 June 2015 to 31 August 2016, during which 1383 fecal samples were collected randomly from individuals who were referred to medical laboratories. All the samples were examined using direct slide smear, formalin-ether concentration, and staining methods. **Results**: Out of the 1383 stool specimens examined, 297 (21.5%) were infected with single or multiple intestinal parasites. Protozoan parasites were detected the most from the samples and helminths were very much less prevalent. Finally, the analyzed data showed a significant difference between intestinal parasitic infections and reasons for referral ($p = 0.002$), age groups ($p \le 0.01$), education ($p \le 0.01$), and seasonal variation ($p \le 0.01$). **Conclusions**: Intestinal parasitic infections especially protozoan parasites are still prevalent in the center of Kurdistan province. Therefore, health providers are recommended to consider this health problem by establishing accurate diagnosis and designing interventional program to decrease the rate of such infections in this district.

Subjects: Infectious Diseases; Population Health; Epidemiology; Gastroenterology; Tropical Medicine

Fares Bahrami

ABOUT THE AUTHOR

We are a team of researchers from Iran, who work on parasitological research issues striving for a better understanding of the influence of parasitic infections on health and communities. Our research focus is on issues related to intestinal parasitic infection and involves in area of zoonotic pathogens and molecular detection methods. Throughout our research, we identified and discussed about prevalence of parasitic infection and molecular detection of these parasites in order to provide prevention, control and appropriate treatment from them.

PUBLIC INTEREST STATEMENT

This work was a part of the Ph.D thesis of Fares Bahrami under supervision of Prof. Ali Haghighi and Dr. Ghasem Zamini. In this study, we found that the various species of intestinal parasites are prevalent in Kurdistan province, it should be noted that the *Blastocystis* sp. had the highest prevalence among all parasites and rate of helminth infections is low. Study on intestinal parasitic infections in animals and identify the route of transmission of these parasites by molecular tools in order to control of them is on our next program.

Keywords: prevalence; risk factors; intestinal parasitic infections; Kurdistan

1. Introduction

In developing countries, intestinal parasitic infections (IPIs) are the most common infections (Sayyari, Imanzadeh, Bagheri Yazdi, Karami, & Yaghoobi, 2005). If IPIs are not recognized and treated appropriately, they can result in significant morbidity and mortality (Gilles & Hoffman, 2002). IPIs can be caused by protozoan organisms or helminths. The most common intestinal pathogenic parasites include: *Giardia intestinalis, Entamoeba histolytica/E. dispar, Cryptosporidium* spp., microsporidia, *Cyclospora cayetanenensis, Ascaris lumbricoides, Ancylostoma duodenale, Blastocystis* sp. *Necator americanus, Hymenolepis nana, Taenia saginata, and Trichuris trichiura* (Haque, 2007; Horton, 2003).

Studies have shown that amebiasis is one of the major neglected diseases in developing countries with considerable long-term morbidity and mortality (Ximénez et al., 2011). The disease is manifested as either non-pathogenic or invasive amebiasis (IA) form of intestinal parasites, which is caused by *Entamoeba histolytica/E. dispar*. It is also worth mentioning that most cases of amebiasis are asymptomatic (Ali, Clark, & Petri, 2008).

Giardiasis is also another important disease, which has a global distribution. In developing countries due to poor sanitary conditions and low water quality control, *Giardia lamblia* is more common. According to available evidence, this disease is diagnosed most frequently in children and those aged below 12 years are most likely to be infected (Choy et al., 2014).

Cryptosporidium spp. is an emergent parasite, which causes diarrheal diseases and is found worldwide. *Cryptosporidium* is transmitted by consuming drinking water or food contaminated with feces, and also by contact with animals (Snel, Baker, & Venugopal, 2009).

Blastocystis sp. is one of the most widespread protozoan parasites, which is commonly found in human and animal fecal samples. The overall prevalence of *Blastocystis* infection in developing countries is high. The possible pathogenicity of *Blastocystis* has been the subject of debate (Hammood, Ahmed, & Salman, 2016).

Microsporidia is an emerging infection with worldwide distribution, which is considered as the most important parasites (recently was classified as fungi) from the viewpoint of public health. Spores of these fecal oral parasites spread from infected humans and animals through contaminated food and water. Microsporidiosis has been linked to the consumption of contaminated vegetables and fruits, which had been exposed to contaminated irrigation water (Slifko, Smith, & Rose, 2000).

Hymenolepis nana is a common intestinal helminth that is found worldwide and more frequently in children, especially among poor communities (Alruzug, Khormi, & Alhanoot, 2016).

Enterobius vermicularis is another intestinal helminth in humans and is often observed in family members. It is transmitted commonly through direct contact between infected and uninfected people (Anuar et al., 2016; Degerli, Malatyali, Ozcelik, & Celiksoz, 2009).

Taenia saginata which is usually called the beef tapeworm infects humans through eating raw or poorly cooked beef. The presence of the tapeworm in the intestine can cause some abdominal discomfort, mild diarrhea, and weight loss (Dorny & Praet, 2007).

Dicrocoelium dendriticum, a lanceolate fluke which is found more frequently among ruminants and rarely causes disease in humans. Actually many reported cases of human infection are false parasitism, because eggs can be passed through the intestinal tract and are found in feces as a result of eating liver (Searcey et al., 2013). It is virtually impossible to differentiate true and false human parasitism only through stool exam (Gonçalves, Araújo, & Ferreira, 2003).

Generally, the prevalence of various species of intestinal parasites varies in different regions because of several environmental, social, and geographical factors (Legesse & Erko, 2017). Hence, a study on the prevalence of various IPIs is important to identify specific risk factors and formulation of appropriate control strategies (Legesse & Erko, 2017; Rinne, Rodas, Galer-Unti, Glickman, & Glickman, 2005).

IPIs are mainly associated with demographic risk factors. Some studies in different parts of the world have shown that age (Muñoz-Antoli, Pavón, Marcilla, Toledo, & Esteban, 2014; Wördemann et al., 2006), source of drinking water (Amuta, Houmsou, & Mker, 2010; Muñoz-Antoli et al., 2014; Ngui, Ishak, Chuen, Mahmud, & Lim, 2011; Wördemann et al., 2006), sex (Al-Shammari, Khoja, El-Khwasky, & Gad, 2001), location (Muñoz-Antoli et al., 2014), educational status (Al-Shammari et al., 2001; Gelaw et al., 2013), contact with animals (Dwivedi et al., 2007), and seasonal variations (Tuli, Gulati, Sundar, & Mohapatra, 2008) are major risk factors in the transmission of parasitic infections, especially protozoan infections.

The lifestyle of people in Sanandaj city in recent years has met the necessary health standards and is developed in terms of public health and environment health. For example, this region has standard water and sewage treatment system. And all households are equipped with sanitary toilets. In spite of that, studies show that the IPIs are still prevalent (Akhlaghi, Shamseddin, Meamar, Razmjou, & Oormazdi, 2009; Arani, Alaghehbandan, Akhlaghi, Shahi, & Lari, 2008; Badparva, Kheirandish, & Ebrahimzade, 2014; Kiani et al., 2016). This led us to consider a study based on the socio demographic risk factors of IPIs, and lifestyle risk factors were not evaluated in this study.

Studying the prevalence of intestinal parasites in developing countries such as Iran might improve our insight toward the control of these health problems. Besides, it can provide novel approaches for designing effective prevention programs. The aim of the current study was therefore to investigate the prevalence and associated risk factors of intestinal parasites in 1383 fecal samples that were collected using simple random sampling method from individuals who had been referred the medical laboratories in Sanandaj city, in the center of Kurdistan province, northwest Iran.

2. Material and methods

2.1. Study areas and population

This cross-sectional study was performed on 1383 individuals, who had been referred to 14 medical laboratories in center of Kurdistan province (Sanandaj city, northwest Iran, Figure 1) using simple random sampling method. Sample size was calculated as follow: the reference prevalence was estimated as 32% (Kiani et al., 2016), with a 95% level of confidence, and 0.25% margin of error.

2.2. Questionnaire

Oral informed consents were obtained from all the participants based on the guidelines of the Ethics Committee of Shahid Beheshti University of Medical Sciences (SBMU) before gathering data. For each patient, we specified the socio-demographic characteristic including age, sex, location, drinking water supply, contact with domestic animals, education, and health status.

2.3. Stool collection and processing

After routine diagnosis, all fecal samples in each laboratory were transferred to the parasitology laboratory of the Department of Parasitology and Mycology in Kurdistan University of Medical Sciences and were examined again using routine stool examination test including direct slide

Figure 1. Geographical location of Kurdistan province in north-west of Iran.

smear (saline wet mount and Lugol staining) and formaldehyde–diethyl ether concentration. In addition to the aforementioned methods, three complementary methods were also used, namely (Ziehl-Neelsen staining (Dhanabal, Selvadoss, & Muthuswamy, 2014) for the detection of *Cryptosporidium* spp. and microsporidia for all samples; a modified Trichrome (chromotrope) (Kokoskin et al., 1994; Ryan et al., 1993) for the diagnosis of suspicious samples and accurate determination of microsporidia and trichrome staining for suspected *Entamoeba* (Control and Prevention, 2013).

The slides of wet mounts and formaldehyde–diethyl ether concentration were examined at 100× and 400× magnification using light microscope. The slides of Ziehl-Neelsen technique and trichrome staining were investigated at 1000× magnification using light microscope for the identification of Coccidian oocysts, microsporidia spores, and accurate determination of the amoeba parasites.

2.4. Statistical analysis

The data were analyzed using SPSS software version 16.0 (SPSS, Chicago, IL, USA). percentages were used to describe the characteristics of the participants, including the frequency of IPIs according to age, sex etc. Chi square test or Fisher's exact test were used to analyze the association between IPIs and mean differences were tested by *t* test. *p* values < 0.050 were considered as statistically significant.

3. Results

Based on the results shown in Table 1, 297 patients (21.5%) were infected with single or multiple intestinal parasites. Protozoan infections (21%) were more common compared to helminth ones (0.36%). Table 2 shows the association between demographic data and IPIs. Tables 3, and 4 show the frequency and associated risk factors of pathogenic parasites such as *Blastocystis* sp., *Giardia lamblia, E. histolitica/E. disparar/E. moshkovskii, Cryptosporidium* spp., microsporidia, and helminths.

4. Discussion

To the best of our knowledge, the current study is one of the few large scale investigations, which were carried out to determine the prevalence of intestinal parasites in the center of Kurdistan province, Iran.

Table 1. Frequency of all detected parasites in patients referred to the medical laboratories in Sanandaj city in center of Kurdistan province (northwest Iran)

Parasite type	Positive cases *n*	Frequency (%)
Protozoan infections	**292**	**21%**
Blastocystis sp.	239	17.3%
Endolimax nana	41	2.96%
Entamoeba coli	24	1.73%
Giardia lamblia	23	1.66%
Chilomastix mesnili	10	0.72%
E. histolitica/E. disparar/E. moshkovskii	8	0.58%
Iodamoeba butschlii	7	0.5%
Microsporidia	6	0.43%
Cryptosporidium spp.	5	0.36%
Helminth infections	**5**	**0.36%**
Dicrocoelium dendriticum	2	0.14
Hymenolepis nana	1	0.07
Taenia saginata	1	0.07
Enterobius vermicularis	1	0.07
Polyparasitism	**58**	**4.2%**

Table 2. Frequency of infection, based on demographic characteristics

Variable		Total	Infection N (%)	OR	$CI_{95\%}$ Lower	$CI_{95\%}$ Upper	*p*-Value
Sex							0.31
	Male	799 (57.8%)	164 (20.5%)	0.876	0.676	1.134	0.3
	Female	584 (42.2%)	133 (22.8%)	Reference	-	-	-
Age group (years)							0.01
	< 6	271 (19.6%)	32(11.8%)	0.327	0.208	.512	0.00
	6–12	125 (9%)	39 (31.2%)	1.106	0.7	1.748	0.67
	13–18	66 (4.8%)	20 (30.3%)	1.060	0.591	1.903	0.84
	18–30	252 (18.2%)	48 (19%)	0.574	0.382	.861	0.00
	30–50	387 (28%)	76 (19.6%)	0.596	0.416	.854	0.00
	> 50	282 (20.4%)	82 (29.1%)	Reference	-	-	-
Educational status							0.01
	Preschool	335 (24.2%)	50 (14.5%)	0.696	0.419	1.154	0.67
	Illiterate	277 (20%)	84 (30.3%)	1.726	1.067	2.792	0.02
	Primary school	357 (25.8%)	81 (22.7%)	1.164	0.723	1.875	0.5

(*Continued*)

Table 2. (*Continued*)

Variable		Total	Infection N (%)	OR	CI95% Lower	CI95% Upper	*p*-Value
	High school	270 (19.5%)	53 (19.6%)	0.969	0.584	1.606	0.9
	Collage	144 (10.4%)	29 (20.1%)	Reference	-	-	-
Reasons for referral							0.02
	Check-up	508 (36.7%)	94(18.5%)	1.169	0.779	1.755	0.4
	GIDs	629 (45.5%)	163(25.9%)	1.801	1.229	2.641	0.00
	Non- GIDs	246 (17.8%)	40(16.3%)	Reference	-	-	-
Source of drinking water							0.31
	Treated	1319 (95.4%)	280 (21.2%)	0.745	0.421	1.318	0.3
	Untreated	64 (4.6%)	17(26.6%)	Reference	-	-	-
Contact with domestic animals*							0.64
	No	1342 (97%)	287 (21.4%)	0.843	0.409	1.741	0.6
	Yes	41 (3%)	10 (24.4%)	Reference	-	-	-
Location							0.39
	Urban	1265 (91.5%)	268 (21.2%)	0.915	0.583	1.434	0.7
	Rural	118 (8.5%)	29 (24.6%)	Reference	-	-	-
Job							0.08
	Food Staff	204 (14.7%)	41 (20%)	0.281	0.133	.591	0.00
	House wife	286 (20.7%)	74 (25.8%)	0.503	0.238	1.064	0.07
	Self-employment	222 (16%)	47 (21.1%)	0.698	0.431	1.429	0.3
	Student > 6yrs	216 (15.6%)	64 (29.6%)	0.537	0.256	1.125	0.1
	Gov't employer	99 (7.2%)	19(19.2%)	0.842	0.407	1.742	0.6
	Farmer	39 (2.8%)	13 (33.3%)	0.475	0.207	1.092	0.08
	Workless and Child < 6yrs	317 (23%)	39 (12.3%)	Reference	-	-	-
Seasons							0.01
	Spring	346 (25%)	63(18.2%)	0.839	0.576	1.221	0.358
	Summer	345 (25%)	101(29.3%)	1.560	1.103	2.207	0.012
	Fall	346 (25%)	60(17.3%)	0.785	0.537	1.147	0.211
	Winter	346 (25%)	73(21%)	Reference	-	-	-

Table 3. Frequency (%) of pathogenic parasites among positive cases based on demographic characteristics

Variable		Type of parasites					
		Blastocystis N (%)	**GiardiaN (%)**	**E. histolytica/E. dispar N (%)**	**CryptosporidiumN (%)**	**Microsporidia*N* (%)**	**Helminths*N* (%)**
Sex	Male	126 (15.7%)	13(1.6%)	5 (0.62%)	4 (0.5%)	3 (0.37%)	1 (0.12%)
	Female	113 (19.3%)	10(1.7%)	3 (0.51%)	1 (0.17%)	3 (0.51%)	4 (0.68%)
Age group (years)	<6	28 (10.3%)	3 (1%)	0	0	2 (0.7%)	0
	6–12	29 (23.2%)	8 (6.5%)	0	0	2 (1.6%)	1 (0.8%)
	12–18	13 (19.7%)	2 (3%)	0	0	0	2 (3%)
	18–30	34 (13.5%)	6 (2.4%)	2 (0.8%)	2 (0.8%)	1 (0.4%)	0
	30–50	65 (16.8%)	2 (0.5%)	2 (0.5%)	0	0	2 (0.5%)
	> 50	70 (24.8%)	2 (0.7%)	4 (1.4%)	3(1.1%)	1(0.4%)	0
Educational status	Preschool	42 (12.5%)	5 (1.5%)	0	0	3 (0.84%)	1 (0.28%)
	Illiterate	73 (26.3%)	3 (1%)	2 (0.7%)	3 (1%)	1(0.36%)	0 (0.84%)
	Primary school	63 (17.6%)	9 (2.5%)	4 (1.1%)	0	2 (0.56%)	2 (0.56%)
	High school	40 (14.8%)	4 (1.5%)	0	1 (0.37%)	0	2 (0.74%)
	Collage	21 (14.5%)	1(1.4%)	2 (1.3%)	1(0.7%)	0	0
Source of drinking water	Treated	277 (21%)	21(1.6%)	7 (0.53%)	2 (0.15%)	3(0.22%)	5 (0.38%)
	Untreated	12(18.7%)	2 (3.1%)	1 (1.56%)	3 (4.7%)	3 (4.6%)	0
Contact with domestic animals*	No	231 (17.2%)	20(1.5%)	8 (0.6%)	2 (0.15%)	5 (0.37%)	5 (0.37%)
	Yes	8 (19.5%)	3 (7.3%)	0	3 (7.3%)	1 (2.44%)	0
Location	Urban	214 (16.9%)	20 (1.7%)	7 (0.55%)	3 (0.23%)	5 (0.4%)	5 (0.4%)
	Rural	25 (21%)	3 (2.5%)	1(0.8%)	2 (1.7%)	1 (0.8%)	0
Job	Food Staff	32 (15.6%)	4 (2%)	2 (0.98%)	1(0.5%)	0	0
	House wife	63 (22%)	2 (0.7%)	2 (0.7%)	1(0.35%)	1 (0.35%)	2 (0.7%)
	Self-employment	40 (18%)	2 (0.9%)	2 (0.9%)	0	0	0

(Continued)

Table 3. (*Continued*)

Variable		Type of parasites					
		Blastocystis N (%)	**GiardiaN (%)**	**E. histolytica/E. dispar N (%)**	**CryptosporidiumN (%)**	**Microsporidia*N* (%)**	**Helminths*N* (%)**
	Student > 6yrs	46 (21.3%)	9 (4.2%)	1 (0.46%)	0	2 (0.92%)	2 (0.9%)
	Gov't employer	13 (13.1%)	3 (3%)	1(2.5%)	1(1%)	0	0
	Farmer	12 (30.8%)	0	0	2 (5.4%)	1 (2.56%)	0
	Workless and Child < 6yrs	33 (10.4%)	3 (0.9%)	0	0	2 (0.63%)	1 (0.3%)
Seasons	Spring	59(17%)	0	2(0.58%)	0	2(0.58%)	0
	Summer	64(18.6%)	16(4.6%)	4(1.16%)	4(1.6%)	3(0.87%)	5(0.3%)
	Fall	48(13.8%)	7(2%)	1(0.29%)	1(0.29%)	1(0.29%)	0
	Winter	68(19.6%)	0	1(0.28%)	0	0	0

*domestic animal include: cattle, sheep, cat and dog

Table 4. Analysis of risk factors (*p*-Value) associated with pathogenic parasites in patients referred to the medical laboratories in Sanandaj city in center of Kurdistan province (northwest Iran)

	Blastocystis	Giardia	E. histolytica/dispar	Cryptosporidium	Microsporidia	Helminths
Sex	0.048	0.532	0.542	0.299	0.502	0.105
Age group (years)	0.006	0.000	0.258	0.472	0.114	0.002
Educational status	0.002	0.431	0.330	0.255	0.638	0.419
Reasons for referral	0.129	0.288	0.500	0.347	0.065	0.111
Source of water	0.428	0.288	0.316	0.001	0.000	0.789
Contact with animals	0.415	0.028	0.786	0.000	0.165	0.860
Location	0.148	0.402	0.511	0.061	0.415	0.640
Job	0.001	0.035	0.745	0.000	0.243	0.559
Seasons	0.206	0.000	0.387	0.034	0.340	0.002

We have demonstrated that the overall prevalence of parasites regardless of the type of parasites was 21.5% (297/1383). Fifty-eight cases (19.5%) had co-infections with two, three, or four parasites. In addition, analysis of the prevalence rate of IPIs, with respect to age, educational status, and reasons for referral showed that the rates were higher in age group below 6 years and above 18 years compared to other age groups, in illiterates than other participants, and also in those who were referred for gastrointestinal disorders (Table 2). It should be noted that the overall prevalence rate of IPIs were higher in the summer and autumn than in winter and spring. Therefore these variables were considered as significant risk factors of IPIs in our population study. Previous studies in Iran have shown that there are several risk factors associated with the high prevalence and incidence of IPIs including age, low level of education, contact with livestock (Kiani et al., 2016), seasons (Fallah, Pirali-Kheirabadi, Shirvani, & Saei-Dehkordi, 2012; Kiani et al., 2016), sex (Nematian, Nematian, Gholamrezanezhad, & Asgari, 2004), and location (Badparva et al., 2014).

The prevalence of IPIs is similar to the results of IPIs in Tehran (2008), Mazandaran (2005) and Kirkuk (2015), with reported prevalences of 21.2%, 25% and 19.66%, respectively (Akhlaghi et al., 2009; Kia, Hosseini, Nilforoushan, Meamar, & Rezaeian, 2008; Salman, A-Ra, & Abid, 2016). However lower frequencies were reported in the south of Tehran (2005), and Karaj city (2008), with IPIs prevalences of 10.7%, and 4.7%, respectively (Arani et al., 2008; Nasiri, Esmailnia, Karim, Nasir, & Akhavan, 2009). The prevalence found in our study is lower than some studies in other areas of Iran such as, Tonekabon (1992), and Nahavand (2014), or in South Chennai, India (2013), and Northwest Ethiopia (2011) with IPIs prevalences of 74.6%, 32.2%, 75.7%, and 62.2%, respectively (Abate et al., 2013; Dhanabal et al., 2014; Kiani et al., 2016; Rezaiian & Hooshyar, 1996). By considering the results and observations obtained from this study, we found that the prevalence of intestinal parasites in the center of Kurdistan province was higher than the rate reported by the healthcare system of Iran (unpublished data). It should also be noted that the dissimilarities between our findings and those of Iran healthcare system may be partly due to the lack of IPIs surveillance and prevalence underestimation by healthcare system.

It is also worth mentioning that most participants in this study were referred from urban areas. Virtually all (99%) of the positive cases were protozoan infections and the rate of detected helminth infection was only 1% (It is noteworthy that the positive cases of *Dicrocoelium dendriticum* had a history of consumption of raw liver [false parasitism]). The positive rates of helminths infection were slightly higher in the female (Table 3) and these rates are significantly associated to age and seasons (Table 4). In a previous study, Kiani and colleagues in Nahavand, in the west of Iran, and Akhlaghi and co-workers in Tehran showed that the frequency of protozoan infections was 99% and their results also indicated that the frequency of protozoan infections was higher than helminth infections (Akhlaghi et al., 2009; Kiani et al., 2016).

Our results showed that *Blastocystis* sp. was the most predominant organism in all of the co-infected isolates and was the most prevalent parasites in the center of Kurdistan province. This finding is in accordance with a recent study reporting in a similar population (Kiani et al., 2016). Salehi et al., in Ahvaz, Iran, reported that the correlation between seasons, age, and *Blastocystis* was significant and, this correlation was not significant for the sex (Salehi et al., 2017). Our results showed that the rate of *Blastocystis* infection has significant difference in relation to sex, age, job, and educational status and this correlation was not significant for the seasons (Table 4).

Based on previous knowledge, Blastocystosis is a symptomatic infection caused by *Blastocystis* and can be transmitted in a variety of ways. Symptomatic and asymptomatic infections may be dependent on different subtypes of *Blastocystis* and parasite burden (Tan, Mirza, Teo, Wu, & MacAry, 2010). Previous reports by the CDC recommended that treatment of Blastocystosis is required in the following situations: when symptoms are present and there is no other factor that can cause the symptoms (Control and Prevention, 2014). In the present study, we cannot demonstrate the association between *Blastocystis* and clinical symptoms, because there was no possibility of checking other factors that can cause the symptoms.

The frequency of amebiasis, as one of the major infections caused by the protozoan parasite *E. histolytica/E. dispar* (Ximénez et al., 2011) among all the positive cases was 2.7%. Research conducted by Morton and colleagues show that *Entamoeba* infection rate increases with age (Morton et al., 2015), which is similar to our finding (Table 3). In addition, we observed that the rate of *Entamoeba* infection has no difference in relation to sex, source of drinking water, location, and season(Table 4). In contrast to our results, place of residence, age, and quality of water consumed were identified as risk factors for *E. histolytica/E. dispar* in the city of Manous (Benetton, Gonçalves, Meneghini, Silva, & Carneiro, 2005). Also statistical analysis of the results indicates that 56.5% of the positive cases for giardiasis (13 of 23) were in children aged less than 18 years, and 43.3% (10 of 23) were aged > 18 years. In addition to age, job (student) and contact with domestic animals were also considered as significant risk factors for *giardiasis* (Table 4). Mahdy et al. in Kuala Lumpur reported that giardiasis is significantly higher in consumers of untreated water, females and children aged lower than 12 years (Mahdy et al., 2009). In our study the positive rates of giardiasis were also significantly higher in the summer and fall compared with the spring and winter (Tables 3, 4). Ismail, El-Akkad, Rizk, El-Askary, and El-Badry (2016) observed a seasonal pattern peaking of giardiasis in mid-summer and late winter in a study of Egyptian children (Ismail et al., 2016).

Cryptosporidiosis has been observed in five cases (0.36%) of all the studied subjects and 1.7% in the positive cases. In Shiraz, Iran, a prevalence of 10.8% has been reported (Mirzaei, 2007), which is higher compared with our result. In another study performed in New Zealand, a prevalence rate of cryptosporidiosis was higher in rural areas compared with urban areas (Snel et al., 2009). And cryptosporidiosis was also reported to be more common during late summer than the other seasons (Painter et al., 2015). Similarly, our results confirm that 80% of positive cases for cryptosporidiosis were diagnosed in summer, 20% in the middle of autumn, and 60% (3 of 5) were from rural areas in patients who had contact with domestic animals and who obtained water from wells and springs (Table 3). These findings have indicated that the summer, untreated water, contact with animals and job (farmer) are significant predictors for cryptosporidiosis (Table 4).

In a study conducted in southeastern Iran (Ghaderipour et al., 2017), no significant difference was reported between sex, age, job, education, contact with livestock, water supply and microsporidia infection. Our study showed that the rate of microsporidia infection was significantly higher in consumers of untreated water (Table 4). Two-thirds (66%) of the diagnosed cases were in the age group of less than 12 years (Table 3), and they also had loose stool. These results are inconsistent with the observations reported by Ipek Mumcuoglu and colleagues. They reported that the prevalence of microsporidia infections increased significantly with age and also the rate of positivity was higher in patients with hard stool. It should be noted that they used methods such as modified trichrome, calcofluor white, and uvitex 2B stain in their study (Mumcuoglu, Cetin, Al F, Oguz, & Aksu, 2016).

In conclusion, various species of intestinal parasitic infection especially protozoan parasites are still prevalent in Kurdistan province, Iran. Age groups below 6 years and above 18 years, low educational status (illiteracy), gastrointestinal disorders, and summer have significant associations. Therefore, health providers are recommended to consider this health problem by establishing accurate diagnosis and designing interventional program to decrease the rate of such infections in this district.

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Competing Interest
The authors declare that there is no conflict of interests.

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Authors' contribution
F. Bahrami, A. Haghighi and Gh. Zamini designed the study, performed the research, laboratory assays, recorded the data and the manuscript writing. MB. Khadem-erfan helped to collect samples and laboratory assays. All the statistical analysis was performed by E. Azargashb.

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