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Prevalence of zoonotic intestinal parasites in household and stray dogs in rural areas of Hamadan, Western Iran

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Abstract. Zoonotic parasitic infections are a major global public and veterinary health problem and widespread among dogs. The objective of this study was to assess the prevalence of intestinal parasites in stray and household dogs in the rural areas of Hamadan district. During 2012, 1,500 fresh fecal samples from 243 household and 1,257 stray dogs were examined by using direct wet mount, simple zinc sulfate flotation, and Lugol's solution staining. Of 1,500 dogs, 20.4% were positive for intestinal parasites. Helminthes eggs were more frequently found in fecal samples than protozoan cysts or trophozoites (15.9% vs. 4.5%, respectively). *Toxocara canis* was the most frequently detected parasite, with a prevalence of 6.3%, followed by *Taenia/Echinococcus* spp. (2.9%), *Isospora* spp. (2.7%), and *Toxascaris leonina* (2.6%). Helminthes and protozoa were significantly more prevalent in household dogs than in stray dogs (P<0.001). There were significant differences in the prevalence of *Isospora* spp., *T. canis* and *D. caninum* among three age groups (P<0.05). The wide range of isolated parasites indicated that people residing in this area are at risk of exposure to these potentially hazardous zoonotic pathogens. Mass education of the general population is highly recommended to increase awareness of the potential for horizontal transmission of these parasitic infections from dogs to humans.

INTRODUCTION

Some dog pathogens are zoonotic parasites that can cause serious human diseases such as cystic and alveolar echinococcosis and visceral and ocular larva migrans (Beiromvand *et al.*, 2013). Several intestinal parasites commonly associated with dogs include *Toxocara canis*, *Ancylostoma caninum*, *Giardia intestinalis*, *Cryptosporidium* spp., *Echinococcus* spp., *Dipylidium caninum*, and *Uncinaria stenocephala*. These parasites often cause malabsorption, vomiting, anemia, and loss of health in dogs (Itoha *et al.*, 2011).

In Iran, several studies have demonstrated the importance of dogs as potential reservoirs of intestinal parasites (Razmi, 2009). *T. canis* is a common gastrointestinal parasite in dogs, whose eggs may be found in soil of public parks contaminated by infected dog excrement (Overgaauw & van Knapen, 2013). *Giardia* is one of the most common protozoa in dogs, with a worldwide prevalence of 5.4–55.2% (Hamnes *et al.*, 2007). Its prevalence in some parts of Iran has been reported to be between 0.7% and 1.3% (Jafari *et al.*, 2008; Sardarian *et al.*, 2010). A serological survey has shown that 5.3% of Hamadan population under ten years of age is infected with *T. canis* larvae (Fallah *et al.*, 2005). Therefore, larva migrans infections could be an important problem in this area. To control and reduce the prevalence rate of zoonotic parasitic infections, comprehensive data about their epidemiological features are required. Therefore, the present investigation

evaluated the prevalence and distribution of zoonotic intestinal parasites in household and stray dogs in the rural areas of Hamadan.

MATERIALS AND METHODS

Study area

Hamadan city is located at 48° 35' longitude and 34° 52' north latitude from the Greenwich meridian. This city is located in a mountainous area and the climate of the province is variable. Winter is usually cold and snowy and summer is moderate.

Sample collection and parasitological procedures

In this descriptive-analytical study, a total of 1,500 stool samples were collected from stray and household dogs from 15 villages in 2012. These villages were randomly selected using a cluster sampling method from a total of 63 villages located in rural areas of the Hamadan district. Fresh fecal samples were collected from 243 and 1,257 household and stray dogs, respectively. Information including sampling time and location, dog owner's name, and age of dog was entered in a structured questionnaire and samples were collected in sterile containers and transported to the Parasitology Laboratory of the School of Medicine, Hamadan University of Medical Sciences, where they were stored refrigerated before processing for parasitological examinations. The ages of the household dogs were determined using the dental formula; while the ages of the stray dogs were estimated by comparing stool volume and diameter with those of household dogs. The samples were examined within 48 hours using direct wet mount, simple flotation with zinc sulfate, and Lugol's solution staining.

Statistical analysis

Statistical analysis was performed using SPSS for Windows (version 11; SPSS Inc. Chicago, Illinois, USA). Chi-square (χ^2) and Fisher's exact tests were used to evaluate relationships between parasite infections and variables. P values less than 0.05 were considered statistically significant.

RESULTS

A total of 1,500 dogs were surveyed, including 243 (16.2%) household and 1,257 (83.8%) strays. Of 1,500 fecal samples evaluated for intestinal parasites, 306 (20.4%) were positive for at least one parasitic species. The prevalence of intestinal parasitic infections in stray and household dogs was 13.7% (172 of 1,257) and 55.1% (134 of 243), respectively (P<0.001). The overall prevalence of protozoa and helminthes was 4.5% (67 of 1500) and 15.9% (239 of 1500), respectively (Table 1). The prevalence of helminthes in household dogs were higher than in stray dogs (40.3% vs. 11.2%) (P<0.001). The prevalence of protozoa in household dogs (14.8%) was also higher than in stray dogs (2.5%) (P<0.001). Table 2 shows the frequency of intestinal protozoa and helminthes in stray and household dogs. *T. canis* was the most common helminth (6.3%) and *Isospora* spp. was the most common protozoa (2.7%). *Blastocystis hominis*, *U. stenocephala*, *Mesocystoides* spp., *Capillaria* spp., and *A. caninum* had the lowest prevalence (each 0.1%). The prevalences of

Table 1. Prevalence of intestinal zoonotic parasites in all studied dogs

Parasite	No. (%)
Protozoa	
Isospora spp.	41 (2.7)
Giardia spp.	20 (1.3)
Entamoeba spp.	5 (0.3)
B. hominis	1 (0.1)
Helminthes	
T. canis	94 (6.3)
Taenia/Echinococcus spp.	44 (2.9)
T. leonine	39 (2.6)
D. caninum	30 (2.0)
Hookworm spp.	24 (1.6)
T. vulpis	4 (0.3)
U. stenocephala	1 (0.1)
Mesocystoides spp.	1 (0.1)
Capillaria spp.	1 (0.1)
A. caninum	1 (0.1)
Total	**306 (20.4)**

Table 2. Frequency of intestinal zoonotic parasites in stray and household dogs

Parasite	Dog		Fisher exact test	P-value
	Stray No. (%)	Household No. (%)		
Protozoa				
Isospora spp.	11 (6.4)	30 (22.4)	–	(<0.001)
Giardia spp.	15 (8.7)	5 (3.7)	–	(0.103)
Entamoeba spp.	4 (2.3)	1 (0.8)	–	–
B. hominis	1 (0.6)	0 (0)	–	–
Helminthes				
T. canis	38 (22.1)	56 (41.8)	–	(<0.001)
Taenia/Echinococcus spp.	30 (17.4)	14 (10.5)	–	(0.052)
T. leonina	32 (18.6)	7 (5.2)	–	(<0.001)
D. caninum	21 (12.2)	9 (6.7)	–	(0.124)
Hookworm spp.	14 (8.1)	10 (7.5)	–	(<1)
T. vulpis	4 (2.3)	0 (0)	–	–
U. stenocephala	1 (0.6)	0 (0)	–	–
Mesocystoides spp.	1 (0.6)	0 (0)	–	–
Capillaria spp.	0 (0)	1 (0.8)	–	–
A. caninum	0 (0)	1 (0.8)	–	–
Total	**172 (100)**	**134 (100)**	–	(<0.001)

Isospora spp., *T. canis*, and *T. leonina* were significantly different between household and stray dogs (P<0.05). Parasite frequency according to age group is shown in Table 3. The parasitic infection rate in the 2-7 year old dogs (59.5%) was higher than in other groups. Statistically significant differences were found between age and frequency of *Isospora* spp. (χ^2=24.423, degrees of freedom=2, P<0.001); *T. canis* (χ^2=37.961, d.f.=2, P<0.001), and *D. caninum* (χ^2=16.084, d.f.=2, P<0.001).

DISCUSSION

Most parasites identified in this copro-parasitological study are distributed worldwide, and *T. canis*, *Echinococcus granulosus*, *Giardia intestinalis*, and *Ancylostoma* species have been identified as important zoonotic agents. While control of stray and semi-domesticated dogs near human populations in urban environments is increasing, most people in rural areas live in the vicinity of uncontrolled household dogs. These conditions and other factors may contribute to an increased prevalence of zoonotic diseases in rural areas. In the study, the prevalence of intestinal parasites in dogs in Hamadan (20.4%) was relatively low compared with other parts of Iran, such as 29.2% in Khorasan Razavi (Razmi, 2009), 90% northen Iran city of Sari (Gholami *et al.*, 2011) and 66% in Chenaran County (Beiromvand *et al.*, 2013). This is likely due to the temperate mountainous climate, public health education, and increased health awareness among the inhabitants in Hamadan. Furthermore, these discrepancies may be related to differences in fecal examination techniques.

The prevalence of intestinal worms in dogs in the present study was 15.9%, similar to prevalence reported by studies in Switzerland (19.6%) (Sager *et al.*, 2006) and Brazil (23.2%) (Balassiano *et al.*, 2009). However the prevalence of intestinal protozoa (4.5%) was relatively low compared to Brazil (Balassiano *et al.*, 2009) and Spain (Martinez *et al.*, 2007), with 29.6% and 31.83% infection prevalences, respectively.

Table 3. Frequency of intestinal parasites in studied dogs according to age group

Parasite	Age group (year)			Total No. (%)	Chi-square	P-value
	<1 No. (%)	1 to 7 No. (%)	>7 No. (%)			
Protozoa						
Isospora spp.	2 (3.0)	25 (13.7)	14 (24.1)	41 (13.4)	24.423	<0.001
Giardia spp.	7 (10.6)	10 (5.5)	3 (5.2)	20 (6.5)	4.116	0.128
Entamoeba spp.	0 (0)	2 (1.1)	3 (5.2)	5 (1.6)	–	–
B. hominis	0 (0)	1 (0.6)	0 (0)	1 (0.3)	–	–
Helminth						
T. canis	25 (37.9)	56 (30.8)	13 (22.4)	94 (30.7)	37.961	<0.001
Taenia/Echinococcus spp.	13 (19.7)	14 (7.7)	17 (29.3)	44 (14.4)	0.643	0.725
T. leonina	4 (6.1)	34 (18.7)	1 (1.7)	39 (12.8)	–	–
D. caninum	4 (6.1)	20 (11.0)	6 (10.4)	30 (9.8)	16.084	<0.001
Hookworm spp.	9 (13.6)	14 (7.7)	1(1.7)	24 (7.8)	–	–
T. vulpis	1 (1.5)	3 (1.7)	0 (0)	4 (1.3)	–	–
U. stenocephala	0 (0)	1(0.6)	0 (0)	1 (0.3)	–	–
Mesocystoides spp.	0 (0)	1 (0.6)	0 (0)	1 (0.3)	–	–
Capillaria spp.	1 (1.5)	0 (0)	0 (0)	1 (0.3)	–	–
A. caninum	0 (0)	1 (0.6)	0 (0)	1 (0.3)	–	–
Total	**66 (100)**	**182 (100)**	**58 (100)**	**306 (100)**		

In our study, the general prevalence of intestinal parasites was significantly lower in strays (13.7%) than in household dogs (55.1%). This result is contradictory with similar studies conducted in the USA (Katagiri & Oliveira-Sequeira., 2008), Ethiopia (Tadiwos *et al.*, 2013), and another study in Iran (Razmi, 2009). In the rural areas of Hamadan, parasitic control of household dogs is rare. Many village household dogs live freely in and out of their homes. Thus, they not only contaminate the environment, but are also exposed to infections. In addition, there is no sanitary disposal of dog feces, which results in continuing and increasing environmental pollution. This means that parasitic agents are more likely to survive in the environment and infect household dogs. The prevalence of helminths in stray dogs in this study was less than in household dogs. Although this observation is in contrast to reports from a study in the USA (Katagiri & Oliveira-sequeira, 2008), these differences were not statistically significant; these findings, however, are concordant with studies in Italy (Riggio *et al.*, 2012) and Iran (Razmi, 2009). The higher prevalence of intestinal protozoa in household dogs in the present survey is similar to data obtained in the USA (Katagiri & Oliveira-sequeira, 2008) and Sri Lanka (Perera *et al.*, 2013). *Isospora* spp., *Giardia* spp., and *T. canis* were the most common parasites identified in dogs in Hamadan. These results are comparable with those of Finnish (Pullola *et al.*, 2006) and German (Barutzki, 2011) studies. *Toxocara* prevalence is directly related to economic and social poverty and is more common in developing countries such as Cuba (Sariego *et al.*, 2012). In Iranian studies, the prevalence of human toxocariasis is 5.3% in Hamadan (Fallah *et al.*, 2005) and 2.7% in Zanjan (Nourian *et al.*, 2008). According to Dalimi *et al.*, *Toxocara* is more common in rural areas of Iran (Dalimi *et al.*, 2006). In this study, *T. canis*, with 6.3% prevalence, was the dominant parasite identified. These results are in concordance with other studies in Iran (Dalimi *et al.*, 2006; Mirzaei & Fooladi, 2012), but other Iranian surveys have reported a much higher prevalence of 17.9 to 60% (Razmi, 2009; Gholami *et al.*, 2011).

Similar to our study findings, Anna *et al.* have shown that the prevalence rate of intestinal parasites in 1-7 year old dogs in Poland is higher than those of other age groups (Anna *et al.*, 2011). However, a German study found parasites to be more common in dogs under one year of age (Barutzki, 2003). This study showed a significant relationship between *T. canis* prevalence and age group, similar to the report of another study (Tadiwos *et al.*, 2013).

As morphological differentiation of *Taenia* and *Echinococcus* eggs in stool is impossible, the presence of any *Taenia* eggs in feces could be potentially dangerous to humans. In this study, the prevalence of *Taenia/Echinococcus* spp. eggs was 2.9%. This result is consistent with results of other surveys in Iran (1.4%) (Mirzaei and Fooladi, 2012) and other parts of the world such as Hungary (2.4-2.8%) (Fok *et al.*, 2001).

Our data indicate a *T. leonina* infection rate of 2.6%, consistent with a study in Alberta (Joffe *et al.*, 2011). However, a survey in Ethiopia (Hailu & Moti, 2011) as well as two studies in Iran (Beiromvand *et al.*, 2013, Dalimi *et al.*, 2006) reported higher infection rates of 16.8%, 29%, and 32.5%, respectively. *T. leonina* was the most prevalent in the 1 to 7 year old age group, consistent with a study conducted in the USA (Gates & Nolan, 2009). However, investigations in Sri Lanka (Perera, *et al.*, 2013) and the USA (Coggins, 1998) have reported that *T. leonina* to be more prevalent in dogs under 1 year of age. The low prevalence rate of *D. caninum* (2%) in this study was similar to data from Hungary (0.4-1%) (Fok *et al.*, 2001), but was much lower than the reported rates of 25.8% in Ethiopia (Hailu & Moti, 2011) and 36% in Northern Iran (Gholami *et al.*, 2011).

The prevalence of *Giardia* depends on factors such as age, environmental conditions, diagnostic procedures, location, and dog health. The global prevalence is 5.4 to 55.2% (Hamnes *et al.*, 2007) and the prevalence in patients and healthy dogs were reported to be between 5 and 15% (Tangtrongsup & Scorza, 2010). In the present study, 1.3% of dogs were infected with *Giardia*. This is similar to previous studies in Iran (0.68%) (Jafari *et al.*, 2008) and Argentina (1.3%) (Soriano *et al.*, 2010), but lower than prevalence reported by a Japanese study (23.4%) (Itoh *et al.*, 2011).

In conclusion, several species of parasites identified in this study, especially *T. canis*, can be transmitted to humans. Therefore, identification, control, and treatment of parasitic infections in dogs are of great importance. In villages with high numbers of stray dogs, people should be educated about the risk of infections transmitted from dogs.

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