Gastrointestinal helminths of stray dogs in Erzurum province: Prevalence and risk to public health

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ABSTRACT

Dogs play an important role in public health due to their close contact with humans. This study aimed to investigate the presence and prevalence of gastrointestinal helminths in stray dogs in Erzurum province. Gastrointestinal helminth eggs were detected in 190 out of 446 (42.6%) dog fecal samples collected in Erzurum. More specifically, taeniid eggs (17.71%, 79/446), *Toxocara canis* (16.82%, 75/446), *Toxascaris leonina* (12.78%, 57/446), *Linguatula* spp. (4.48%, 20/446), *Alaria* spp. (2.91%, 13/446), hookworms (2.69%, 12/446), spiny-headed worms (1.12%, 5/446), and *Trichuris* spp. (0.22%, 1/446) eggs were identified. These findings indicate zoonotic parasites to be common in stray dogs in Erzurum. The public health risk associated with the presence of these zoonotic parasites can be reduced through the regular deworming of stray dogs, the prevention of environmental contamination with dog feces, and the adequate enforcement of sanitation protocols.

Stray dogs play a critical role in the epidemiology of several parasitic infections known to pose a risk to human health due to their adaptation to human habitation (21). For instance, people face the danger of infection when gardens and public areas are contaminated with the feces of dogs infected with zoonotic agents (7). The zoonotic transmission can occur through direct contact, water consumption and/or contaminated food with dog feces, or direct contact with contaminated soil. Another significant risk factor for infection is pica, especially in children (12).

The most prevalent gastrointestinal (GI) helminths found in dogs are *Taenia* spp., *Dipylidium* spp., *Echinococcus* spp., *Toxocara* sp., *Toxascaris* sp., *Ancylostoma* spp., *Uncinaria* spp., *Capillaria* spp., and *Trichuris* spp. (9). Among these helminths, *Toxocara* sp., *Echinococcus* spp., and *Ancylostoma* spp. are particularly significant in both under-developed and developing countries due to the limited use of antiparasitic drugs, poor socio-economic conditions, and lack of education (16).

The present study aimed to determine the presence and prevalence of GI helminths, including zoonotic species, in stray dogs in Erzurum province. To gather the required data, the animal shelter run by Erzurum Metropolitan Municipality was visited periodically between October 2015 and February 2016. Sterilization, vaccination, and antiparasitic drug (praziquantel) administration are routinely performed for every dog brought to this shelter. The sampling schedule was planned by the antiparasitic drug administration protocol followed by the shelter's management. The antiparasitic drugs were individually administered to the dogs, and the fecal samples were collected 24 hours after the administration.

A total of 446 (female [n = 237], male [n = 209]; 0–6 months age group [n = 15], 6–12 months age group

[n = 39], >1 year age group [n = 392]) dogs' fecal samples were collected. The samples were picked up in individually numbered plastic bags. The bags were taken to the laboratory on the same day that the samples were collected. The fecal samples were stored at -80°C for seven days to eliminate the zoonotic agents' infectivity.

The fecal samples were examined to detect the presence of adult parasites and cestode proglottids. The observed helminth eggs were further investigated using a light microscope (Nikon Eclipse Ci, Japan) according to the Fulleborn flotation and Benedek sedimentation methods. Saturated saline solution (specific gravity: 1.45 g/mL) was used in the flotation method. The helminth eggs were identified based on established morphological criteria (22).

All the statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 20 software (SPSS Inc., Chicago, IL, USA). The chi-squared (χ^2) test was used to calculate the possible correlations between the dogs' age and sex and the presence of the different parasite species. A difference was considered statistically significant at $P<0.05$.

The microscopic examination revealed the presence of GI helminth eggs in 190 out of 446 (42.6%) fecal samples, including trematodes (2.91%), cestodes (21.97%), nematodes (32.5%), spiny-headed worms (1.12%) and pentastomids (4.48%). Moreover, the most prevalent helminth eggs were taeniid cestodes (17.71%, 79/446), followed by *Toxocara canis* (16.82%, 75/446), *Toxascaris leonina* (12.78%, 57/446), *Linguatula* spp. (4.48%, 20/446), *Alaria* spp. (2.91%, 13/446), hookworms (2.69%, 12/446), spiny-headed worms (1.12%, 5/446), and *Trichuris* spp. (0.22%, 1/446) (Table 1). In addition, adult *Mesocestoides* spp. (3.14%, 14/446), *Taenia* spp. (2.69%, 12/446), *Dipylidium caninum* (1.12%, 5/446), *Alaria* spp. (0.22%, 1/446), *T. canis* (0.22%, 1/446), and *T. leonina* (0.22%, 1/446) were identified macroscopically. The prevalence of *T. canis* was also determined by age (Table 2), which revealed that the 0–6 months age group was associated with a significantly higher prevalence than the 6–12 months and >1 age groups ($P<0.05$).

Table 1. Occurrence of gastrointestinal helminths in stray dogs.

	Trematode		**Cestode**		**Nematode**			**Others**			**Total**
	***Alaria* spp.**	**Taenidae**	***Dipylidium* spp.**	***Mesocestoides* spp.**	***T. canis***	***T. leonina***	**Hookworm**	***Trichuris* spp.**	**Spiny-headed worm**	***Linguatula* spp.**	
np/n (%)	13/446 (2.91)	79/446 (17.71)	5/446 (1.12)	14/446 (3.14)	75/446 (16.82)	57/446 (12.78)	12/446 (2.69)	1/446 (0.22)	5/446 (1.12)	20/446 (4.48)	190/446 (42.6)**

n: number of examined samples; np: number of positive samples; %: prevalence; **some animals suffered from mixed infections.

Table 2. Distribution of gastrointestinal helminth infections according to age and sex in stray dogs.

	Age			**Total**	**Sex**		**Total**
Helminth species	**0-6 Months (n = 15) np/%**	**6-12 Months (n = 39) np/%**	**>1 Ages (n = 392) np/%**	**n = 446 np/%**	**Female (n = 237) np/%**	**Male (n = 209) np/%**	**n = 446 np/%**
Alaria spp.	-	-	13/3.3	13/2.9	7/3	6/2.9	13/2.9
Taeniidae	-	8/20.5	71/18.1	79/17.7	45/19	34/16.3	79/17.7
T. canis	8/53.3*	14/35.9	53/13.5	75/16.8	43/18.1	32/15.3	75/16.8
T. leonina	-	3/7.7	54/13.8	57/12.8	26/11	31/14.8	57/12.8
Hookworm	-	-	12/3.1	12/2.7	5/2.1	7/3.3	12/2.7
Trichuris spp.	-	-	1/0.3	1/0.2	1/0.4	-	1/0.2
Spiny-headed worm	-	-	5/1.3	5/1.1	2/0.8	3/1.4	5/1.1
Linguatula spp.	-	-	20/5.1	20/4.5	9/3.8	11/5.3	20/4.5
Total	8/53.3	25/64.1	229/58.4	262/58.74**	138/58.23	124/59.33	262/58.74**

n: number of examined samples; np: number of positive samples; %: prevalence;
* $P<0.05$; **some animals suffered from mixed infections.

Due to their close relationship with humans, dogs serve as important reservoirs of many zoonotic agents of relevance to public health (11). In the present study; *Alaria* spp., *Dipylidium* spp., *Mesocestoide*s spp., taeniid cestodes, *T. canis*, hookworms, *Trichuris* spp., *Linguatula* spp., and spiny-headed worms were all observed.

Taeniasis is recognized as a problem regarding both veterinary medicine and human health because some *Taenia* species exhibit zoonotic potential. These species can affect human health due to being agents of cystic and alveolar echinococcosis (*Echinococcus* spp.), coenurosis (*T. multiceps* and *T. serialis*), and cysticercosis (*T. crassiceps*) (10). Erzurum is considered a highly endemic area for both cystic and alveolar echinococcosis. Studies conducted in the province have shown that cystic and alveolar echinococcosis are prevalent in humans (14), while cystic echinococcosis is prevalent in livestock (5). Moreover, coenurosis has been detected in cattle, which rarely serve as intermediate hosts (3), emphasizing the presence of this agent in the province. In prior studies conducted in Türkiye, taeniid eggs were detected in 2.8%–46.28% of fecal samples (8, 27). In the present study, taeniid eggs were detected in 17.71% of samples, indicating a prevalence higher than that previously observed in Erzurum (2.9%) (6). It is thought that the administration of antiparasitic drugs in this study and disuse in the previous study may have led to the difference in the prevalence rates in the study area. Although several studies have investigated the prevalence of canine dipylidiasis in Türkiye (0.89%–65%) (19, 24), this study represents the first report from Erzurum (1.12%). Additionally, in Türkiye, the prevalence of *Mesocestoides* spp. has been reported to vary between 1.66% and 12.5% (4, 26), although this is the first study to examine the presence of *Mesocestoides* spp. (3.14%) in stray dogs in Erzurum.

Toxocara canis is a soil-associated nematode that is recognized as the most common intestinal parasite in dogs and wild canids (15). Furthermore, it is known to cause visceral larva migrans and ocular larva migrans in humans. The prevalence of *T. canis* has been determined to be between 4.2% and 47.8% in Türkiye (13, 27). In a previous study conducted in Erzurum (2), *T. canis* eggs were detected in 35.29% of dog fecal samples and 64.28% of park soil samples. In the present study, *T. canis* was detected in 16.82% of the fecal samples. The prevalence of *T. canis* infections is highest in puppies and young dogs aged less than six months old (15). In this study, the *T. canis* positivity was statistically significant in the 0–6 months age group ($P<0.05$). It is thought that the decrease in the infection rate between the two studies is related to the ages of the sampled dogs. Most of the sampled dogs (431/446) were older than 6 months in this study.

Similar to *Toxocara* spp., canine hookworms (*Ancylostoma* spp. and *Uncinaria* spp.) are soil-associated nematodes that are transmitted via contact with contaminated soil. The prevalence of canine hookworms has been reported to range between 1.1% and 80% in Türkiye (24, 27). In this study, hookworms were detected in 2.69% of the fecal samples, which is by the finding of a previous study conducted in Erzurum (2.3%) (6). Moreover, the prevalence of *Trichuris* spp. in Türkiye has been reported to be between 0.6% and 4.02% (6, 26). In the present study, *Trichuris* spp. eggs were detected in 0.22% of the fecal samples, which is also in line with the finding of the study previously conducted in Erzurum (0.6%) (6).

Adult *Alaria* spp. can cause inflammation in the bowel or general intoxication in the final hosts (17). The larval stage (mesocercariae) of *Alaria* is a causative agent of infection in both humans and animals. The prevalence of *Alaria* spp. was determined to range from 1.9%–5% in dogs in Türkiye (21, 25). In the present study, it was found to be 1.12%, which is consistent with the finding of the earlier study conducted in Erzurum (2.9%) (6). The prevalence of *Linguatula* spp. in dogs in Türkiye was reported between 0.6% and 53.3% (19, 23). In this study, the prevalence of *Linguatula* spp. was observed to be 4.48%. A previous study involving dogs in Erzurum reported that *Linguatula* spp.'s prevalence was 8.33% with necropsy (1). The difference between the two Erzurum-based studies is considered likely due to methodological differences. There are no other studies concerning the presence of spiny-headed worms (acanthocephalans) in stray dogs in Türkiye aside from the present investigation (2.91%).

In conclusion, this study determined the presence and prevalence of zoonotic GI helminths in stray dogs in Erzurum province. The results suggest that stray dogs play a critical role in human health. Indeed, dogs represent an effective contact between urban and rural life when it comes to the transmission of zoonotic disease agents. The identified presence of zoonotic GI helminths in dogs highlights the importance of prevention and control studies in the province. In addition, the humans living in Erzurum should be informed about the importance of regularly deworming dogs, ensuring the proper management of the process, preventing environmental contamination with dog feces, and ensuring the appropriate enforcement of sanitation protocols.

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Conflicts of Interest

The authors declared that there is no conflict of interest.

Author Contributions

RK, MA, İB, EG, HA, and VD conceived and planned the experiments. RK and MA carried out the experiments. RK, MA, and VD contributed to sample preparation. RK, MA, İB, EG, HA, and VD contributed to the interpretation of the results. RK took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis, and manuscript.

Data Availability Statement

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Ethical Statement

This study was approved by Atatürk University Animal Experiments Local Ethics Committee (Approval no: 2015/27).

Animal Welfare

The authors confirm that they have adhered to ARRIVE Guidelines to protect animals used for scientific purposes.

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