

# Gastrointestinal parasites in shelter dogs in Khorasan Razavi province, Iran: prevalence and mini review in Iran and some neighboring countries

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Article Info	Abstract
<b>Article history:</b> Received: 05 August 2024 Accepted: 12 September 2024 Available online: 15 August 2025	<p>Dogs serve as definitive or intermediate hosts for some protozoan and helminth parasites, some of which are of zoonotic, and others cause severe infectious diseases in other animals. The aim of this study was to determine the prevalence of intestinal parasites in shelter dogs in Khorasan Razavi province, Iran. A total of 323 fecal samples were randomly collected from shelter dogs in Mashhad and Neyshabur areas. All samples were then transferred to the Parasitology Laboratory and examined to detect intestinal protozoa and helminths using the formalin-ether technique. Out of the 323 fecal samples, 92 (28.48%) tested positive for intestinal parasites. The overall prevalence of intestinal parasites in shelter dogs in Mashhad and Neyshabur areas were 23.83 and 35.38%, respectively. Monospecific infection was found in 19.50% of dogs, while concurrent infection with two or more species was seen in 8.97% of dogs. The frequencies of the nine detected parasites were as follows: <i>Sarcocystis</i> sp. 12.38%, <i>Giardia</i> sp. 4.64%, <i>Cystoisospora</i> sp. 2.78%, <i>Hammondia Neosporalike</i> oocysts 2.16%, <i>Taenia</i> sp. 6.19%, <i>Toxascaris leonina</i> 7.43%, <i>Dicrocoelium dendriticum</i> 1.54%, <i>Toxocara canis</i> 0.92% and <i>Capillaria</i> sp. 0.30%. The results of this study showed the high frequency of intestinal parasites in shelter dogs. To control important zoonotic helminthic diseases such as echinococcosis and toxocariasis, it is recommended to eliminate stray dogs in cooperation with municipalities and veterinary departments in Iran. If stray dogs are transferred to shelters, they should receive regular treatment with effective anti-helminthic drugs.</p>
<b>Keywords:</b> Helminth Intestinal parasites Iran Protozoa Shelter dogs	

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## Introduction

Dogs are definitive hosts or reservoirs for some protozoan and helminth parasites that are causative agents of important zoonotic diseases and infectious diseases.<sup>1</sup> The agents of most zoonotic diseases, such as hydatidosis, coenurosis, toxocariasis, giardiasis, cryptosporidiosis, and cutaneous larva migrans, live in the canine intestine. Humans can be infected through the ingestion of eggs, cysts or oocysts via contaminated food water, hands, or inhalation of dust.<sup>2</sup> Hydatidosis is an endemic disease caused by the larval stages of *Echinococcus granulosus*. The prevalence of canine echinococcosis was reported to be 7.00 to 64.00% in stray dogs in Iran, with an estimated incidence rate of 1.27 in 100,000 population.<sup>3</sup>

Toxocariasis is another zoonotic disease considered endemic in Iran. Adult worms of *Toxocara* sp. live in the small intestine of definitive hosts including canids. The second-stage larvae of *Toxocara* sp. are the causative agents of visceral larva migrans and ocular larva migrans

in humans.<sup>4</sup> Studies in Iran have documented a prevalence of 1.90 to 60.00% in dogs.<sup>5,6</sup> Recently, dogs' hairs have been identified as sources of embryonated *Toxocara* eggs.<sup>7</sup>

Neosporosis has been recognized as one of the most important infectious diseases that causes abortion and monetary loss in dairy cattle. The dog is the definitive host of *Neospora caninum*, and oocysts are excreted in the dog's feces. Cattle become infected by consuming contaminated water and food. Infected dairy cattle can transmit *N. caninum* infection through the placenta to the fetus in every pregnancy.<sup>8</sup> High seroprevalence of *N. caninum* infection has been reported in dogs in Iran.<sup>9</sup>

The dog population in Iran has been estimated to range from 3.50 to 11.50 million, of which 70.00 to 90.00% are stray dogs.<sup>10</sup> Since stray dogs do not receive any antiparasitic treatment and can travel long distances to various locations, their feces can be considered a significant source of parasitic infections in both humans and animals. The overall prevalence of gastrointestinal parasites in dogs in Iran was approximately 57.89%.<sup>11</sup>

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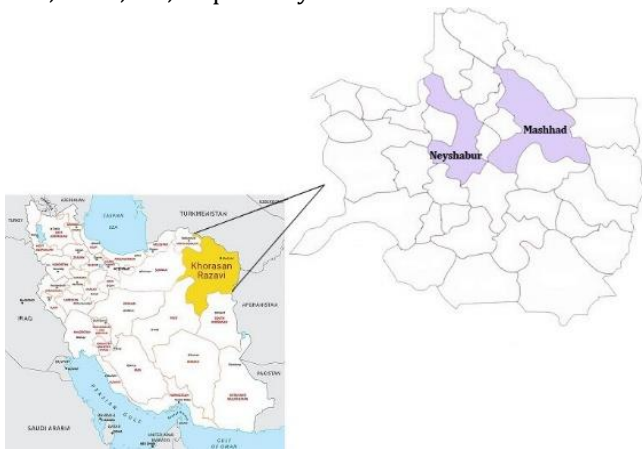
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Recently, in an effort to control zoonotic diseases associated with stray dogs, they have been collected and relocated to animal shelters in cooperation with municipalities in cities across Iran. Due to the high population of stray dogs in some animal shelters in Khorasan Razavi province, it is common for them to be infected with protozoan and helminth parasites.

The purpose of this study was to determine the prevalence of intestinal parasites in shelter dogs in the Mashhad and Neyshabur areas.

## Materials and Methods

**Study Area.** This research was conducted in three dog shelters in Mashhad and Neyshabur in Khorasan Razavi Province, located in northeastern Iran (Fig. 1). The areas extend from latitudes of 36°12'N to 37°36'N and longitudes of 58°37'E to 59°6'E. The climates of these areas are semi-arid, characterized by cold winters and moderate summers. Two shelters were located in the Mashhad area, while one shelter was in the Neyshabur area. The number of dogs living in each shelter was 560, 200, and 1,500, respectively.



**Fig. 1.** Map of Khorasan Razavi province shows Mashhad and Neyshabur cities, where fecal samples were collected.

**Table 1.** Prevalence of protozoa and helminths in shelter dogs.

Parasites	Number of infected feces (%)		
	Mashhad (n = 193)	Neyshabur (n = 130)	Total (n = 323)
<b>Protozoa</b>			
<i>Sarcocystis</i> spp.	17 (8.80)	23 (17.69)	40 (12.38)
<i>Giardia</i> spp.	11 (5.69)	4 (3.07)	15 (4.64)
<i>Cystoisospora</i> spp.	4 (2.07)	5 (3.84)	9 (2.78)
<i>Hammondia</i> , <i>Neospora</i> , like oocyst	1 (0.51)	6 (4.61)	7 (2.16)
<b>Total Protozoa</b>	<b>29 (15.02)</b>	<b>31 (23.84)</b>	<b>60 (18.57)</b>
<b>Helminth</b>			
<i>Toxascaris leonina</i>	10 (5.18)	14 (10.76)	24 (7.43)
<i>Taenia</i> spp.	11 (5.69)	9 (6.92)	20 (6.19)
<i>Toxocara canis</i>	1 (0.51)	2 (1.53)	3 (0.92)
<i>Capillaria</i> spp.	1 (0.51)	0 (0.00)	1 (0.30)
<i>Dicrocoelium dendriticum</i>	4 (2.07)	1 (0.76)	5 (1.54)
<b>Total Helminth</b>	<b>25 (12.95)</b>	<b>22 (16.92)</b>	<b>47 (14.55)</b>
<b>Total</b>	<b>46 (23.83)</b>	<b>46 (35.38)</b>	<b>92 (28.48)</b>

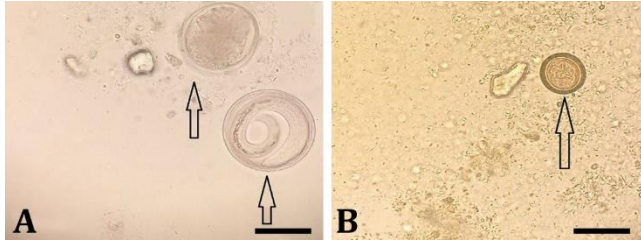
**Collection and examination of samples.** From October 2021 to June 2022, 323 fecal samples were randomly collected from stray dogs in dog shelters. Fresh fecal samples were individually picked up from each shelter dog, placed in plastic bags, and then transferred to parasitology laboratory. The formalin-ether concentration technique was used to examine trophozoites, cysts of intestinal protozoa, and eggs and larvae of helminths in the feces. In brief, a mixture of 1.00 g feces was mixed with 10.00 mL of water and filtered through double-layer wet gauze. The mixture was then centrifuged at 2,000 rpm for 2 min in a conical tube to sediment it. The supernatant was removed, and 7.00 mL of 10.00% formalin and 3.00 mL of ether were added to the sediment. The tube was sealed with a rubber stopper, shaken for 1 min, and centrifuged again at 2,000 rpm for 2 min. After discarding three layers of supernatant, the sediment was extracted with a pipette and placed on a glass slide. Wet mount slides were microscopically examined to detect eggs and/or oocysts at 100× and 400× amplifications.<sup>12</sup>

**Statistical analysis.** Data between study areas were analyzed using the *Chi-square* test by SPSS Software (version 26.0; SPSS, Inc., Chicago, USA). The *p*-value less than 0.05 was statistically significant.

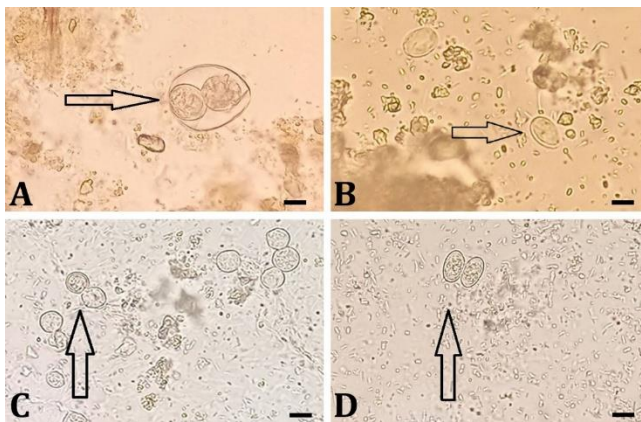
## Results

The overall prevalence of intestinal parasites in shelter dogs in the Mashhad and Neyshabur areas was 23.83 and 35.38%, respectively (Table 1). The frequency of nine parasites in shelter dogs in Mashhad area was as follows: *Sarcocystis* spp (oocyst/sporocyst) 8.80%, *Giardia* spp. 5.69%, *Cystoisospora* spp. 2.07%, *Hammondia Neospora* like oocysts 0.51%, *Taenia* spp. 5.69%, *Toxascaris leonina* 5.18%, *Dicrocoelium dendriticum* 2.07%, *Toxocara canis* 0.51%, *Capillaria* spp. 0.51%. In Neyshabur area, eight parasites were identified in shelter dogs: *Sarcocystis* spp. (oocyst/sporocyst) 17.69%, *T. leonina* 10.76%, *Taenia* spp. 6.92%, *Giardia* spp. 3.07%, *Isospora* spp. 3.84%,

*Hammondia Neospora* like oocysts oocysts 4.61% and *T. canis* 1.53% (Figs. 2 and 3, Table 1), ( $p > 0.05$ ). Monospecific infections were found in 19.50% of dogs, while mixed infections with two or more species were found in 8.97% of dogs (Table 2).



**Fig. 2.** Figures of the intestinal helminth eggs were identified in shelter dogs. **A)** Embryonated and unembryonated eggs of *Toxascaris leonina*, **B)** Egg of *Taenia* spp. (Bars = 50.00  $\mu$ m).



**Fig. 3.** Figures of the intestinal protozoa were identified in shelter dogs. **A)** Oocyst of *Isospora* spp., **B)** Cyst of *Giardia* spp., **C)** Oocyst of *Sarcocystis* spp., and **D)** *Hammondia Neospora* like oocysts, (Bars = 10.00  $\mu$ m).

**Table 2.** Prevalence of single and mixed gastrointestinal parasite infections in shelter dogs

Parasites	Number of infected feces (%)		
	Mashhad (n = 193)	Neyshabur (n = 130)	Total (n = 323)
<i>Sarcocystis</i> spp.	8 (4.14)	12 (9.23)	20 (6.19)
<i>Toxascaris leonina</i>	5 (2.59)	7 (5.38)	12 (3.71)
<i>Taenia</i> spp.	8 (4.14)	3 (2.30)	11 (3.40)
<i>Giardia</i> spp.	6 (3.10)	1 (0.76)	7 (2.16)
<i>Cystoisospora</i> spp.	3 (1.55)	3 (2.30)	6 (1.85)
<i>Dicrocoelium dendriticum</i>	3 (1.55)	1 (0.76)	4 (1.23)
<i>Hammondia, Neospora-like</i> oocyst	1 (0.51)	2 (1.53)	3 (0.92)
<i>Sarcocystis</i> spp. + <i>Giardia</i> spp.	3 (1.55)	3 (2.30)	6 (1.85)
<i>Taenia</i> spp. + <i>Sarcocystis</i> spp.	2 (1.03)	3 (2.30)	5 (1.54)
<i>Taenia</i> spp. + <i>T. leonine</i>	1 (0.51)	3 (2.30)	4 (1.23)
<i>T. leonina</i> + <i>Sarcocystis</i> spp.	3 (1.55)	1 (0.76)	4 (1.23)
<i>Sarcocystis</i> spp. + HNLO	0 (0.00)	2 (1.53)	2 (0.61)
<i>Cystoisospora</i> spp. + HNLO	0 (0.00)	1 (0.76)	1 (0.31)
<i>Toxocara. canis</i> + <i>T. leonine</i>	0 (0.00)	1 (0.76)	1 (0.31)
<i>T. canis</i> + <i>Giardia</i> spp.	1 (0.51)	0 (0.00)	1 (0.31)
<i>T. leonina</i> + <i>Cystoisospora</i> spp.	0 (0.00)	1 (0.76)	1 (0.31)
<i>T. canis</i> + <i>Sarcocystis</i> spp.	0 (0.00)	1 (0.76)	1 (0.31)
<i>T. leonina</i> + <i>Sarcocystis</i> spp. + HNLO	0 (0.00)	1 (0.76)	1 (0.31)
<i>T. leonina</i> + <i>Capillaria</i> spp. + <i>Cystoisospora</i>	1 (0.51)	0 (0.00)	1 (0.31)
<i>D. dendriticum</i> + <i>Sarcocystis</i> spp. + <i>Giardia</i> spp.	1 (0.51)	0 (0.00)	1 (0.31)
<b>Total</b>	<b>46 (23.83)</b>	<b>46 (35.38)</b>	<b>92 (28.48)</b>

HNLO: Hammondia, Neospora, like oocyst.

## Discussion

In Iran, many studies have been conducted to determine the prevalence of parasite infections using different copro-logical examinations. The results of these studies have been summarized in Table 3. The highest prevalence of helminth eggs (97.70%) was detected in fecal samples of dogs in Mazandaran province<sup>13</sup> and the lowest prevalence (6.70%) was in Hamadan Province.<sup>14</sup> In this study, 92 (23.48%) of dog shelters were infected with different parasite species. The highest prevalence of helminthic parasites was *Taenia* eggs (7.43%), followed by *Taenia* eggs (9.28%), with the lowest prevalence being *Capillaria* spp. eggs (0.30%). The frequency of *Taenia* eggs in this study was relatively higher compared to similar studies conducted in Kermanshah, Kerman, Ardabil, West Azerbaijan, and Zaman provinces,<sup>14-18</sup> but lower than those in Khuzestan, Hamadan, Mazandaran, and Khuzestan provinces.<sup>2,19-21</sup> The difference in results could be related to many risk factors such as the dog's lifestyle, diet, use of anti-helminths, sampling methods, laboratory examination techniques or the climate of the province. Although copro-microscopic examination can detect taeniid eggs, it cannot distinguish *Echinococcus* eggs. Thus, in hydatid cyst endemic areas such as Iran, the detection of taeniid eggs in canine fecal samples demands prompt anthelmintic therapy and caution in handling and disposal of feces. The *T. canis* eggs, which cause visceral toxocarosis, were detected 0.92% of dog fecal samples. The result was consistent with a study conducted on stray dogs in Kermanshah province.<sup>14</sup> Other studies have showed a higher frequency of *T. canis* infection compared to *T. leonina* in dogs in Mazandaran, Kerman, Hamadan and

West Azerbaijan provinces.<sup>15,19</sup> The *T. canis* is the main agent of visceral toxocariasis in humans, with a study indicating the larva migrans of *T. leonina* in the lungs of mice.<sup>22</sup> Thus, further investigation is needed to assess the likelihood of visceral toxocariasis due to *T. leonina* in Iran.

In the current study, low infection rates of *Capillaria* spp. and *D. dendriticum* were detected in fecal samples. Most studies also obtained similar results regarding *Capillaria* sp. Infection.<sup>2,14,16,20</sup> Only one study reported a relatively higher infection rate in Mazandaran province.<sup>19</sup> Other studies reported the frequency of *D. dendriticum* within the range of 0.70 to 14.00% after examining fecal samples of dogs.<sup>2,14,18,20</sup> Since dogs may have eaten infected liver with *Dicrocoelium*, they need to repeat the copro-microscopic examinations after a few days.

The results of intestinal protozoa frequency among Iranian dogs are also shown in Table 3. In the present study, 32.19% of fecal samples were infected with intestinal protozoa. Among intestinal protozoa, *Sarcocystis* spp. had the highest infection rate (12.38%) and NHOL had the lowest infection rate (2.16%). Dogs are the definitive host of many *Sarcocystis* species that become infected by ingesting intramuscular tissue from herbivorous animals as intermediate hosts and eventually shed sporulated tetrazoic sporocysts in their feces. In Iran, a high prevalence of *Sarcocystis* sp. infection has been reported in small and large ruminants.<sup>23</sup> Therefore, it is not surprising that the prevalence of sporocyst shedding was high in fecal samples of dogs. The low infection rate of NHOL was consistent with the results of previous research in this area.<sup>1</sup> There are only a few reports of *N. caninum* oocysts shedding by naturally infected dogs in the world.<sup>8</sup> Because the morphology of *N. caninum* and *Hammondia heydorni*

oocysts is very similar, a PCR method is needed to identify each in fecal samples.<sup>8</sup>

Our results show a relatively high prevalence of *Giardia* cyst infection (4.64%) compared to 0.57 to 12.70% in different areas of Iran (Table 3). The prevalence of canine *Giardia* infection depends on diagnostic methods, immune status, animal age and lifestyle, and the examined area's weather.<sup>8,24</sup> Furthermore, in shelter conditions with a high population of dogs, contaminated environments, and continuous introduction of new dogs, a high prevalence of *Giardia* cyst infection usually occurs in shelter dogs.

The infection rate of *Cystoisospora* oocysts in this study was determined to be 2.78% of fecal samples of dogs. Similar results were reported in previous studies conducted in this area<sup>1</sup> and other provinces in Iran.<sup>14,25</sup> Other studies have detected a low frequency of *Isoospora* oocysts in fecal samples of dogs in Iran.<sup>2,17,18</sup> The difference in the frequency of *Isoospora* infection depends on the health status of the shelter dogs.

The frequency of different gastrointestinal parasites among dogs in neighboring countries is also shown in Table 4. Few studies have been conducted on the detection of both helminths and protozoans in neighboring countries. Studies in these countries have typically detected the prevalence of intestinal helminths. The most common protozoa and helminth species in these countries are *Cystoisospora* spp., *Giardia* spp., *Sarcocystis* spp., *T. canis*, *T. leonina*, *Taenia* spp., and hookworm. Similar protozoa and helminth species with different prevalence have been reported in infected dogs in neighboring countries. Differences in the results of these studies may be due to the climatic region, fecal sample size, diagnostic methods, and the dog's lifestyle.

**Table 3.** Previous coprological studies on gastrointestinal parasites in dogs of Iran.

Parasites	Regions	Owned/Stray	Sample number	Percentage	References
<b>Protozoa</b>					
<b><i>Sarcocystis</i> spp.</b>	Kermanshah	Both	311	6.70 - 7.20	14
	Zanjan	Owned	450	7.30	18
	Chenaran	Both	77	17.00	2
	Mashhad	Owned	174	6.20	1
<b><i>Giardia</i> spp.</b>	Kermanshah	Both	311	6.70 - 12.70	14
	Zanjan	Owned	450	1.30	18
	Hamadan	Both	1,500	3.70 - 7.80	20
	Hamadan	Owned	210	0.95	5
	Kerman	Stray	98	7.14	15
	Mashhad	Owned	174	0.57	1
	Orumieh	Owned	206	2.60	17
<b><i>Cystoisospora</i> spp.</b>	Kermanshah	Both	311	6.70 - 12.70	14
	Zanjan	Owned	450	1.60	18
	Hamadan	Both	1,500	6.40 - 22.40	20
	Chenaran	Both	77	1.00	21
	Mashhad	Owned	174	5.10	1
<b><i>Blastocystis</i> spp.</b>	Orumieh	Owned	206	1.45	17
	Kermanshah	Both	311	2.40 - 18.30	1
<b><i>Hammondia, Neospora, like oocyst</i></b>	Hamadan	Both	1,500	0.60	20
	Mashhad	Owned	174	2.20	1

Table 3. Continued.

Parasites	Regions	Owned/Stray	Sample number	Percentage	References
<b>Helminth</b>					
<i>Dipylidium caninum</i>	Kermanshah	Both	311	3.30 - 4.30	14
	Hamadan	Both	1,500	6.70 - 12.20	20
	Mazandaran	Owned	100	10.00	19
	Chenaran	Both	77	1.00	2
<i>Mesocestoides spp.</i>	Hamadan	Both	1,500	0.60	20
<i>Taenia spp.</i>	Kermanshah	Both	311	9.30 - 9.40	14
	Khuzestan	Owned	167	26.40	21
	Zanjan	Owned	450	5.60	18
	Hamadan	Both	1,500	10.50 - 17.40	20
	Mazandaran	Owned	100	24.00	19
	Kerman	Stray	98	1.40	15
	Chenaran	Both	77	18.00	2
	Dasht-e-Moghan	Owned	59	3.40	16
	Mashhad	Owned	174	6.80	1
	Orumieh	Owned	206	0.97	17
<i>Toxocara spp.</i>	Khuzestan	Owned	167	13.20	21
	Zanjan	Owned	450	1.80	18
	Chenaran	Both	77	25.00	2
	Orumieh	Owned	206	9.70	17
<i>Toxocara canis</i>	Kermanshah	Both	311	7.50 - 9.40	14
	Hamadan	Both	1,500	22.10 - 41.80	20
	Hamadan	Owned	210	1.90	5
	Mazandaran	Owned	100	27.00	19
	Kerman	Stray	98	4.30	15
	Dasht-e-Moghan	Owned	59	16.90	16
<i>Toxascaris leonina + Toxascara.</i>	Mashhad	Owned	174	11.46	1
	Kermanshah	Both	311	20.80 - 27.60	14
	Hamadan	Both	1,500	5.20 - 18.60	20
	Mazandaran	Owned	100	4.00	19
	Kerman	Stray	98	1.14	15
	Chenaran	Both	77	29.00	2
<b>Hookworm</b>	Dasht-e-Moghan	Owned	59	18.60	16
	Kermanshah	Both	311	18.30 - 33.70	14
	Hamadan	Both	1,500	8.30 - 8.70	20
	Mazandaran	Owned	100	6.00	19
	Chenaran	Both	77	1.00	2
	Dasht-e-Moghan	Owned	59	1.70	16
<b>Stroglylid type</b>	Orumieh	Owned	206	13.10	17
	Mashhad	Owned	174	2.80	1
<i>Capillaria spp.</i>	Kermanshah	Both	311	0.80 - 1.70	14
	Hamadan	Both	1,500	0.80	20
	Mazandaran	Owned	100	5.00	14
	Chenaran	Both	77	1.00	2
	Dasht-e-Moghan	Owned	59	1.70	16
<i>Trichuris spp.</i>	Kermanshah	Both	311	0.80 - 1.70	14
	Hamadan	Both	1,500	0.00 - 2.30	20
	Zanjan	Owned	450	0.20	18
	Mazandaran	Owned	100	0.20	19
	Dasht-e-Moghan	Owned	59	1.70	16
<i>Dicrocoelium dendriticum</i>	Kermanshah	Both	311	0.80 - 3.30	14
	Hamadan	Both	1,500	6.70 - 12.20	20
	Zanjan	Owned	450	0.70	18
	Chenaran	Both	77	14.00	2
<i>Fasciola spp.</i>	Kermanshah	Both	311	0.80 - 2.20	14
	Dasht-e-Moghan	Owned	59	1.70	16

**Table 4.** The Prevalence (%) of gastrointestinal parasites in dogs in neighboring countries.

Countries	Intestinal protozoa										Intestinal helminths										References
	<i>Sarc.</i>	<i>Giardia</i>	<i>Iso</i>	<i>HNLO</i>	<i>Diplydium</i>	<i>Meso.</i>	<i>Taenia</i>	<i>Toxocara</i>	<i>Toxascaris</i>	<i>Hook worm</i>	<i>Strong.</i>	<i>Capillaria</i>	<i>Trichuris</i>	<i>Dicrocoelium</i>	<i>Fasciola</i>						
Türkiye	1.30	1.90	5.10	0.00	0.00	0.00	1.30	5.10	1.30	9.60	0.00	0.00	0.00	0.00	0.00	26					
	0.00	16.50	14.50	0.00	0.50	0.00	0.50	18.00	0.50	7.50	0.00	0.00	0.00	0.00	0.50	27					
	*	*	*	*	0.00	0.00	17.70	16.82	12.78	0.22	0.00	0.00	2.69	0.00	0.00	28					
	*	*	*	*	3.20	0.00	0.00	12.90	16.30	3.20	0.00	3.20	1.30	3.20	0.00	29					
	*	*	*	*	0.00	0.00	2.90	20.30	38.40	2.30	0.00	0.00	0.60	0.00	0.00	30					
Iraq	12.60	11.50	21.40	0.00	0.00	2.90	21.90	1.40	0.74	5.20	0.00	0.00	1.60	3.30	0.00	32					
	0.00	4.30	6.50	0.00	0.00	0.00	0.00	62.40	0.00	7.50	0.00	0.00	9.70	0.00	0.00	33					
	0.00	5.20	9.30	0.00	16.70	0.00	13.70	0.00	0.00	0.00	1.60	0.00	0.00	1.90	0.00	34					
Pakistan	*	*	*	*	0.00	0.00	11.20	15.50	1.30	3.90	0.00	1.30	0.00	0.00	0.00	35					
	*	*	*	*	11.80	0.00	6.57	10.50	1.31	3.94	0.00	1.31	0.00	0.00	0.00	36					

*Sarc.*: Sarcocystis, *Meso.*: Mesocostoides, *Strong.*: Strongyloides, *HNLO* = *Hammondia*, *Neospora-like* oocyst. \* = not studied.

Based on the results obtained, it can be concluded that the level of helminthic and protozoan infection is relatively high in shelter dogs. To control zoonotic parasites associated with dogs, shelter dogs should be fed cooked foods, and anthelmintic drugs should be prescribed regularly under a veterinarian's supervision.

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### Conflict of interest

The authors declare that they have no competing financial interests or personal relationships that could have influenced the work reported in this paper.

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