Tehran University of Medical Sciences Publication
http://tums.ac.ir

Iran J Parasitol

Open access Journal at
http://ijpa.tums.ac.ir

Iranian Society of Parasitology
http://isp.tums.ac.ir

Original Article

Gastrointestinal Helminthic Parasites of Stray Cats (*Felis catus*) in Northwest Iran

***Enayat Darabi [1], Eshrat Beigom Kia [1,2], Mehdi Mohebali [1,2], Iraj Mobedi [1], Farzaneh Zahabiun [1], Zabiholla Zarei [3], Mahya Khodabakhsh [4], Khadijeh Khanaliha [1]**

1. *Department of Medical Parasitology and Mycology, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*
2. *Center for Research of Endemic Parasites of Iran (CREPI), Tehran University of Medical Sciences, Tehran, Iran*
3. *Meshkin-Shahr Station, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*
4. *Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran*

Received 20 Mar 2021
Accepted 06 Jun 2021

Keywords:
Gastrointestinal helminths;
Toxocara mystax;
Stray cats;
Zoonotic;
Iran

***Correspondence**
Email: Enayatdarabi@gmail.com

Abstract

Background: Stray cats are considered an important source of various human and animal diseases, particularly diseases of parasitic helminths. We aimed to investigate the distribution of zoonotic species of gastrointestinal helminths in stray cats in Meshkin-Shahr district in Ardabil Province in the northwest of Iran.

Methods: The gastrointestinal tract of 104 stray cats from villages of Meshkin-Shahr district were provided during 2014-2015. Each gastrointestinal tract was cut into distinct sections, including esophagus, stomach, small intestine, and large intestine, and each section was examined separately for detection of helminths. Helminths were collected and then identified at the species level after clearing and staining.

Results: Overall, 88 out of 104 cats (84.6%) were found to be infected with at least one gastrointestinal helminth. The rate of infection for each species was as follows: *Toxocara mystax* (syn. *cati*) (49%), *Taenia taeniaeformis* (44.2%), *Joyexiella pasqualei* (32.7%), *Dipylidium caninum* (23.1%), *Rictularia cahirensis* (4.8%), and *Physaloptera praeputialis* (4.8%). Among these parasites, only *Ph. praeputialis* was collected from the stomach, all other helminths were collected from the small intestine.

Conclusion: The results demonstrate a high infection rate of stray cats with zoonotic helminths. The presence of zoonotic species in stray cats, particularly *T. mystax,* has public health importance.

Introduction

Cats can facilitate the transmission of helminth parasites to other hosts through the discharge of eggs into public environments (1), they act as carriers, reservoirs, and definitive hosts for many zoonotic intestinal parasites (2). The increasing number of free-roaming cats in areas of human settlements increases the risk of soil, food, and water contamination by the eggs of the parasites, and this in turn, increases the risk of parasitic infections in humans, and other animals. Different population groups, including farmers, gardeners, and children who have frequent exposure to materials contaminated with cat feces are considered as high-risk groups for many species of parasitic helminths (3). Parasites are one of the most common gastrointestinal diseases in domestic cats.

Stray cats act as a potential reservoir of helminth parasites, particularly in rural areas (2). Some of these parasites transmitted by free-roaming cats are of zoonotic importance, and they are responsible for several diseases, including toxocariasis (4). Many species of cestodes, nematodes, and acanthocephalans have been reported from the intestine of stray cats in different countries. Some of these parasites were identified as zoonotic, infecting both humans and animals.

Among zoonotic nematodes, *Toxocara mystax* (syn. cati) is considered the most common intestinal helminths found in the gastrointestinal tract of cats (1). The growing population of cats in urban areas and their free roaming to find food have increased human contact with these animals. This has also led to an increased rate of contamination of environmental sources, as well as the risk of transmission of zoonotic parasites (5). Due to the close association between cats and humans and the increased risk of transmission of zoonotic diseases, investigating the distribution of intestinal parasites in cats in each geographical area would be of valuable public health importance. Several epidemiological surveillance studies in Iran have reported that feral/stray and domestic cats are hosts of various parasites (3,6–9). However, no similar study has been undertaken in Meshkin-Shahr in Ardabil Province in the northwestern part of Iran. Therefore, we aimed to determine the distribution of zoonotic gastrointestinal helminths in stray cats.

Materials and Methods

Study area

Meshkin-Shahr district is located in the northern part of Ardabil Province (Fig. 1) with an elevation of 1490 m above sea level (Coordinates: 38°23'56"N 47°40'55"E). The district is mountainous with moderate climate. Forty-two percent of the population in this region settle in urban areas, whereas the remaining 58% are considered as rural and nomadic populations.

Sampling

In this cross-sectional study, the gastrointestinal tracts of 104 stray cats were examined for infection with helminth parasites. The cats were collected from different villages in the study area from July 2014 to May 2015, and their potential infection with feline *Dirofilaria* was investigated (10). The alimentary tracts of the cats were preserved in 70% ethanol alcohol and provided for the current study. The sex and age (two age groups ≤ 2.5 years old and > 2.5 years) data of each cat were recorded. The process of the removal of the helminths and their identification were performed in the Helminthology Laboratory, Department of Medical Parasitology and Mycology, School of Public Health, Tehran University of Medical Sciences, Iran.

The study was approved by the Ethics Committee of the Tehran University of Medical Sciences, Iran with the ethical code No: IR-TUMS-VCR-REC-25287.

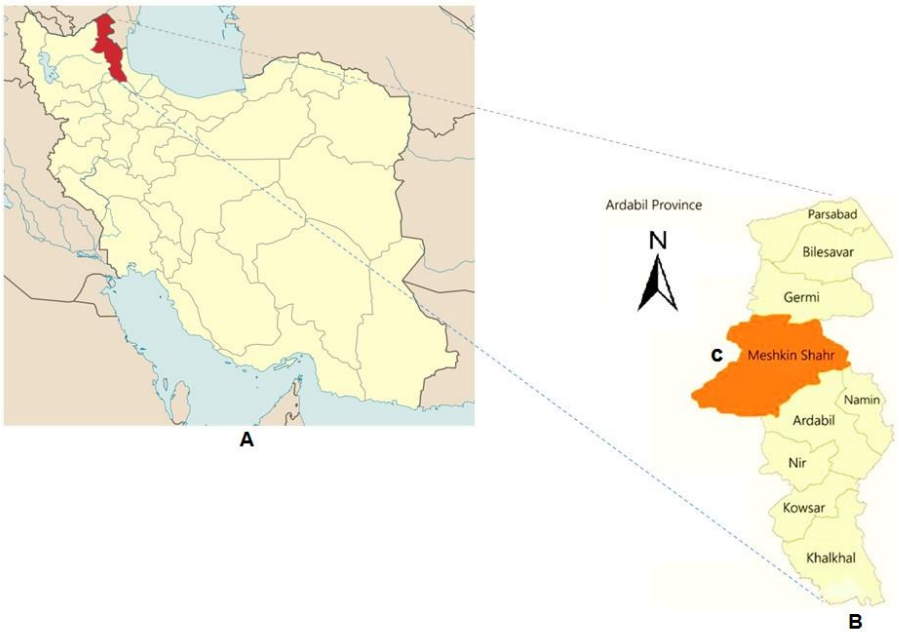

Fig. 1: The study area; A: Map of Iran; B: Ardabil Province; C: Meshkin-Shahr

Helminths identification

The gastrointestinal tract of each cat was washed and then cut into distinct sections, including esophagus, stomach, small intestine, and large intestine. Each organ was separately examined for the presence of helminths, both in the contents of the gut and in scraping of the mucosa. Screening of the contents were carried out under a stereomicroscope. After removal and water washing of the helminths, they were processed for morphological description.

The collected nematodes were temporarily cleared and mounted in lacto phenol. Tapeworms were mounted and stained with alum-carmine (11). Using an optical microscope, all helminths were identified at the species level according to valid identification keys (12,13).

Data analysis

SPSS software version 18 (Chicago, IL, USA) was used to determine the significant relationship between rate of helminthic infection and sex and age groups of the cats. *P* value <0.05 was considered statistically significant, with a confidence interval of 95%.

Results

The present study included 48 male and 56 female cats, which were examined for gastrointestinal helminths. In total, 88 cats out of the 104 cats (84.6%) were infected with at least one helminth. The rates of infection in the male and female cats were 85.4% (41 cats) and 83.9% (47 cats), respectively. There was no statistically significant correlation between sex of the cats and the rate of gastrointestinal helminth infection.

The rate of infection in the cats ≤ 2.5 years old (n = 44) was 88.6% (39 cats), whereas the rate was 81.7% (49 cats) in the cats > 2.5 years old (n = 60). No significant association was found between the age of the cats and infection rate.

In the present study, six species of intestinal helminths were identified in the stray cats: three species belonged to nematodes, including *T. mystax, Rictularia cahirensis,* and *Physalop-*

tera praeputialis, and the other three species belonged to Cestoda, including *Taenia taeniaeformis, Joyexiella pasqualei*, and *Dipylidium caninum*. Among these helminths, only *P. praeputialis* was collected from the stomach, all the other species were collected from the small intestine.

The distribution of each species of the gastrointestinal helminths are illustrated in Table 1, based on the sex and age groups of the cats. The most frequent species were *T. mystax* (49%), followed by *T. taeniaeformis* (44.2%) and *J. pasqualei* (32.7%).

Table 1: Gastrointestinal helminths of stray cats, according to their sex and age, in Meshkin-Shahr, Ardabil Province, and Northwest Iran during 2014-2015

		Male cats (n = 48)		***Female cats (n = 56)***		***Total N(%)***
	Age group Helminth species	≤ 2.5 years N(%)	> 2.5 years N(%)	≤ 2.5 years N(%)	> 2.5 years N(%)	
Nematodes	*Toxocara mystax*	11 (44)	12 (52.2)	17 (47.2)	11 (55)	51 (49)
	Rictularia cahirensis	2 (8)	1 (4.3)	1 (2.8)	1 (5)	5 (4.8)
	Physalopterapraeputialis	1 (4)	1 (4.3)	1 (2.8)	2 (10)	5 (4.8)
Cestodes	*Taeniataeniaeformis*	9 (36)	14 (60.9)	17 (47.2)	6 (30)	46 (44.2)
	Joyexiellapasqualei	3 (12)	11 (47.8)	10 (27.8)	10 (50)	34 (32.7)
	Dipylidiumcaninum	9 (36)	5 (21.7)	8 (22.2)	2 (10)	24 (23.1)

The range and mean worm burden in the cats are presented in Table 2, according to the sex and age groups of the cats. As shown in the Table 2, the worm burden of *T. mystax* ranged from 1-19 (average of 4.3) in male cats and 1-18 (average of 4.8) in female cats. The values of the mean burden of *T. taeniaeformis*, *J. pasqualei*, and *D. caninum* were found to be higher in female cats than that of males. Based on age group of the cats, the values of the mean worm burden of *T. mystax* and *J. pasquale* were higher in the age group ≤ 2.5 years, whereas *T. taeniaeformis* and *D. caninum* had the higher worm burden in the age group > 2.5 years old.

Table 2: The range and mean worm burden for the different species of gasterointestinal helminths found in 104 stray cats in Meshkin-shahr, Ardabil province, northwest of Iran

		Sex of cats				***Age of cats***			
	Worm burden	Males N = 48		Females N = 56		≤2.5 years N = 44		> 2.5 years N = 60	
	Helminth species	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Nematodes	*T. mystax*	1-19	4.3	1-18	4.8	1-18	4.9	1-19	3.9
	R. cahirensis	1-3	1.7	2	2	1-3	2	1-2	1.5
	P. praeputialis	1-3	1.5	2-10	6.7	3-10	7	1	15
Cestodes	*T. taeniaeformis*	1-7	2.3	1-12	3.4	1-6	2.3	1-12	3.6
	J. pasqualei	1-12	6.1	2-17	8.4	5-17	8.8	1-13	6.6
	D. caninum	1-13	6.1	1-14	7.3	1-13	6.1	2-14	7.9

Discussion

Helminth parasitic zoonosis, particularly due to *T. mystax* infection, is of great public health importance. The present study investigated the infection of cats with gastrointestinal helminth parasites. The overall prevalence in the study area was 84.6%. This result of high infection rate is similar to that of other studies conducted in some regions of Iran, such as Mashhad (88.46%) (7), Ahvaz (86.4%) (3), and north of Iran (90%) (9). The infection rate of cats with helminth species was reported to be 89.7% in Spain (14), and 89.6% in Brazil (15). In our study area, the prevalence of gastrointestinal worms was slightly higher in male (85.4%) compared with female cats (83.9%); however, the difference was not significant. A similar finding has also been reported in a previous study (16).

Based on the results presented herein, no significant correlation was found between age group of cats and infection rate. It is worth mentioning that comparison of the diversity and frequency of the gastrointestinal helminths in one study with other studies is difficult due to the differences in laboratory methods, geographical conditions, and the usage of anthelmintic. Geographic variation in relative parasite abundance might be associated with many factors such as climatic differences, landscape, relative abundance of alternate host species, and the demographic of sample population (17).

In the present study, *T. mystax* (49%) was found to be the most predominant species of gastrointestinal helminths, whereas *R. cahirensis* (4.8%) and *P. Praeputialis* (4.8%) were the least frequent species. There are also reports of the presence of *T. mystax* infection in stray cats in some other areas of Iran (3,8,18,19). Khademvatan et al. reported that 45% of stray cats were infected with *T. mystax* in Ahvaz in the South Western part of Iran (3). Another study conducted in the north of Iran (Sari) reported a prevalence of 44% for *T. mystax* in stray cats (19). However, low infection rate of *T. mystax* has been reported in some areas of Iran such as Kashan (13.3%) (18) and Zanjan (8%) (8). Additionally, a study reported a prevalence of 62.5% for *T. mystax* in cats in Turkey (20), and an infection rate of 48.2% in adult cats was reported from Estonia, (21). The wide distribution of ascarids (i.e., *T. mystax*) is likely to be associated with their ecology and biology, such as lactogenic transmission and egg resistance, resulting in an increase in the transmission of this nematode among appropriate hosts (22). Paratenic hosts are considered to play a key role in the distribution of ascarids. Moreover, a higher infection rate of *T. mystax* can be associated with appropriate environmental conditions, such as optimal temperature and higher humidity (8,23). On the other hand, *Toxocara* eggs are strongly resistant to various environmental conditions and can persist for many years. Children are the most exposed population to toxocariasis due to poor hygiene conditions and geophagia, as well as onychophagia (5). Soil contamination with *Toxocara* spp. eggs accounted 5.8%-63.3% in some parts of Iran (Ahvaz, Shiraz, Esfahan), indicating a high risk of infection in children (3,6,24).

The burden of *T. mystax* in female cats in the present study ranged from 1-18 helminths per cat, with a mean burden of 4.8 worms. In addition, the burden of *T. mystax* in male cats ranged from 1-19 helminths per cat, with a mean burden of 4.3 worms. The mean intensity of *T. mystax* reported in some parts of Iran by previous studies ranged from 3 worms per cat in the north of Iran (9) to 6.52-10.25 in Shiraz in the southern part of Iran (25,26). The distribution of *T. mystax* eggs in the environment should be taken into consideration as soil contamination has great importance in the transmission of infection to human and paratenic hosts (25).

T. taeniaeformis was the second most prevalent helminth identified in the present study. This species was collected from cats harboring mixed infections with other gastrointestinal

helminths, including *D. caninum, Ph. praeputialis, J. pasqualei,* and *R. cahirensis*. Therefore, cats may play an important role as a reservoir of these infections. The prevalence rate of *T. taeniaeformis* in our study was 44.2%. There are controversial reports on the prevalence of this species in different geographical areas, perhaps because of the existence of intermediate hosts and the effects of environmental and bioclimatic factors. The prevalence rate of *T. taeniaeformis* in the present study was found to be higher than that recorded in some regions of Iran, including Shiraz (12.3%) and Mashhad (9.6%) (6,7). In contrast, its prevalence was found to be higher in Azerbaijan (60%) in comparison with other infection rates reported in the country (27). Studies in other countries have also reported a low prevalence of *T. taeniaeformis* among cats, including the Netherlands (3%) (28), Nigeria (9.6%) (29), Belgium (20%) (30), and Germany (22%) (31).

Based on our data presented herein, 23.1% of cats were infected with *D. caninum*. The prevalence rate of this species was 49.5% in Shiraz (6), 46% in Mashhad (7), 18.5% in Ilam (32), and 28% in Sari (19). The presence of *D. caninum* in cats suggests the ingestion of an infected flea or louse harboring infective cysticercoid. Regarding the zoonotic potential of this intestinal helminth, the high prevalence of *D. caninum* can encounter people with risks of infection.

In the present study, 32.7% of the cats were infected with *J. pasqualei*. The prevalence rates of this species in cats reported from Shiraz, in the southern part of Iran (34.3%) (24) and Ahvaz, in the southwest of Iran (6%) (3). In other parts of the world, the prevalence of *Joyexiella* infection has been reported to be 50% in Turkey (20) and 55.2% in Spain (14). The prevalence rate of this species was lower in our study as compared to these two studies conducted in Turkey and Spain. Little information is known on the biological cycle of *J. pasqualei*. However, the relative prevalence may be associated with the key role of paratenic or intermediate hosts such as rodents (14). *P. praeputialis* had a lower rate of infection (4.8%) in the present study in comparison with a study conducted in Shiraz, which reported a prevalence of 44.6% for *Physaloptera* sp. (6) However, 10% of cats were infected with *P. Praeputialis* (3).

The rate of *R. cahirensis* infection in cats was 4.8%, however, another study reported a prevalence of 52.2% for *Rictularia* in stray cats from Kashan (18).

Conclusion

Some of the parasites found in the present study, particularly *T. mystax,* are of great public health importance. This species is responsible for different zoonotic diseases such as visceral larva migrans and ocular larva migrans. Therefore, it seems necessary to develop appropriate strategies for preventing and improving the control of parasitic infections of cats in the study area. Further investigations are also required to evaluate the occurrence of feline helminth parasites in other parts of the country and to clarify the epidemiology of the zoonotic parasites.

Acknowledgements

This study was financially supported by Tehran University of Medical Sciences (Project No: 93-03-27-25287). It was the project of the first author Enayat Darabi, Ph.D. student of School of Public Health, Tehran University of Medical Sciences.

Conflict of interest

The authors declare that there is no conflict of interest.

References

1. Sowemimo OA. Prevalence and intensity of gastrointestinal parasites of domestic cats in

Ode Irele and Oyo communities, Southwest Nigeria. JPVB. 2012; 4(1):7-13.
2. Hasslinger MA, Omar HM, Selim MK. incidence of helminths in stray cats in Egypt and other Mediterranean countries. Vet Med Rev. 1988;59(1):76-81.
3. Khademvatan S, Abdizadeh R, Rahim F, et al. Stray cats gastrointestinal parasites and its association with public health in Ahvaz City, South Western of Iran. Jundishapur J Microbiol. 2014; 7(8): e11079.
4. Schantz PM. *Toxocara* larva migrans now. Am J Trop Med Hyg.1989; 41(3 Suppl):21-34.
5. Blaszkowska J, Wojcik A, Kurnatowski P, et al. Geohelminth egg contamination of children's play areas in the city of Lodz (Poland). Vet Parasitol. 2013; 192(1-3):228-33.
6. Zibaei M, Sadjjadi SM, Sarkari B. Prevalence of *Toxocara cati* and other intestinal helminths in stray cats in Shiraz, Iran. Trop Biomed. 2007; 24(2):39-43.
7. Borji H, Razmi G, Ahmadi A, et al. A survey on endoparasites and ectoparasites of stray cats from Mashhad (Iran) and association with risk factors. J Parasit Dis. 2011; 35(2):202-6.
8. Esmaeilzadeh M, Shamsfard M, Kazemi A, et al. Prevalence of protozoa and gastrointestinal helminthes in stray cats in Zanjan Province, north-west of Iran. Iran J Parasitol. 2009;4(3):71–5.
9. Changizi E, Mobedi I, Salimi-Bejestani M, et al. Gastrointestinal Helminthic Parasites in Stray Cats (*Felis catus*) from North of Iran. Iran J Parasitol. 2007;2(4):25–9.
10. Khodabakhsh M, Malmasi A, Mohebali M, et al. Feline dirofilariosis due to *Dirofilaria immitis* in Meshkin shahr district, northwestern Iran. Iran J Parasitol. 2016;11(2):269–73.
11. Ash LR OT. Gastrointestinal Helminthic Parasites in Stray Cats (*Felis catus*) from North of Iran. Iran J Parasitol. 2007;2(4):25–9.
12. Yamaguti S. Systema Helminthum. vol. III, The Nematodes of Vertebrates. New York Intersci. 1962.
13. Yamaguti S. Systema Helminthum. Vol. II. The cestodes of vertebrates. Systema helminthum.1959:860.
14. Calvete C, Lucientes J, Castillo JA, et al. Gastrointestinal helminth parasites in stray cats from the mid-Ebro Valley, Spain. Vet Parasitol. 1998;75(2–3):235–40.
15. Labarthe N, Serrão ML, Ferreira AMR, et al. A survey of gastrointestinal helminths in cats of the metropolitan region of Rio de Janeiro, Brazil. Vet Parasitol. 2004;123(1–2):133–9.
16. Malloy WF, Embil JA. Prevalence of *Toxocara* spp. and other parasites in dogs and cats in Halifax, Nova Scotia. Can J Comp Med. 1978;42(1):29–31.
17. Hoopes JH, Polley L, Wagner B, et al. A retrospective investigation of feline gastrointestinal parasites in western Canada. Can Vet J. 2013;54(4):359–62.
18. Arbabi M, Hooshyar H. Gastrointestinal parasites of stray cats in Kashan, Iran. Trop Biomed. 2009;26(1):16–22.
19. Sharif M, Nasrolahei M, Ziapour SP, et al. *Toxocara cati* infections in stray cats in northern Iran. J Helminthol. 2007;81(1):63–66.
20. Yaman M, Ayaz E, Gül A, et al. Investigation of helminth infections of cats and dogs in the Hatay province. Turkiye Parazitol Derg. 2006;30(3):200–204.
21. Talvik H, Moks E, Mägi E, et al. Distribution of *Toxocara* infection in the environment and in definitive and paratenic hosts in Estonia. Acta Vet Hung. 2006;54(3):399–406.
22. Giannelli A, Capelli G, Joachim A, et al. Lungworms and gastrointestinal parasites of domestic cats: a European perspective. Int J Parasitol. 2017;47(9):517–28.
23. Gamboa MI. Effects of temperature and humidity on the development of eggs of *Toxocara canis* under laboratory conditions. J Helminthol. 2005;79(4):327–31.
24. Jamshidi S, Meshki B, Meshki M. A study of helminthic infection of gastrointestinal tract in stray cats at urban areas in Isfahan. J Vet Res. 2002; 57(2): 25-27
25. Mikaeili F, Mirhendi H, Hosseini M, et al. *Toxocara* nematodes in stray cats from Shiraz, Southern Iran: Intensity of infection and molecular identification of the isolates. Iran J Parasitol. 2013;8(4):593–600.
26. Sadjjadi SM, Oryan A, Jalai AR, et al. Prevalence and intensity of infestation with *Toxocara cati* in stray cats in Shiraz, Iran. Vet Arh. 2001;71(3):149–57.
27. Hajipour N, Imani Baran A, Yakhchali M, et al. A survey study on gastrointestinal parasites of stray cats in Azarshahr, (East Azerbaijan province, Iran). J Parasit Dis. 2016;40(4):1255–

60.
28. Robben SR, le Nobel WE, Döpfer D, et al. Infections with helminths and/or protozoa in cats in animal shelters in the Netherlands. Tijdschr Diergeneeskd. 2004;129(1):2–6.
29. Umeche N, Ima AE. Intestinal helminthic infections of cats in Calabar, Nigeria. Folia Parasitol (Praha). 1988;35(2):165–8.
30. Vanparijs O, Hermans L, van der Flaes L. Helminth and protozoan parasites in dogs and cats in Belgium. Vet Parasitol. 1991;38(1):67–73.
31. Schuster R, Kaufmann A, Hering S. Investigations on the endoparasite fauna of the domestic cat in eastern Brandenburg. Berl Munch Tierarztl Wochenschr. 1997;110(2):48–50.
32. Abdi J, Asadolahi K, Maleki M H, et al. Prevalence of Helminthes Infection of Stray Dogs in Ilam Province. Arch Adv Biosci. 2013; 4 (2): 47-50.