

Research Note

Helminth burden in stray cats from Thessaloniki, Greece

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Summary

To get an overview on the prevalence of intestinal helminths, between 2010 and 2012, fecal samples from 215 stray cats from area of Thessaloniki, Greece, were tested by coprological methods. From the total number of fecal samples examined, 55.8 % were infected with at least one intestinal parasite and 16.3 % had co-infection. Five different parasite species were found. The most prevalent helminth was *Dipylidium caninum* (39.53 %), followed by *Toxocara cati* (18.14 %), *Ancylostoma* spp. (11.63 %), *Taenia taeniaeformis* (8.37 %) and *Toxascaris leonina* (0.93 %). The results showed that *A. tubaeforme* and *T. taeniaeformis* were more prevalent in males, while *D. caninum*, *T. cati* and *T. leonina* in female cats, without statistical significance. The prevalence of *Ancylostoma* spp. and *T. cati* were significantly higher in young cats (< 1 year old) than in adults (> 1 year old). The most common association was between *D. caninum* and *T. cati*.

Keywords: intestinal helminths; stray cats; Greece

Introduction

Due to the high social and public health importance, cats have been intensively studied for their role as carriers of *Toxoplasma gondii* (Lappin, 2010). However, the importance of cats as reservoirs for zoonotic helminths has been neglected in most countries. Like most carnivores, cats are hosts to a great diversity of parasitic helminths, some of them being of great zoonotic importance (e.g. *Toxocara*, *Ancylostoma*, etc.). The parasitic burden in cats is dependent on various factors, among which the type of husbandry (stray, feral, shelter, household), outdoor access, environment (urban or rural), season, administration of antiparasitic treatment, geographical area or factors related to population parameters (age, sex, breed) (Mircean *et al.*, 2010).

Due to various factors, stray cats are more exposed to a higher infective parasitic pressure than other cat categories and pose an immense risk to human health (Labarthe *et al.*, 2004). Previous studies have usually recorded a high prevalence of parasites in stray and feral cats (McColm and Hutchison, 1980; Nichol *et al.*, 1981; Calvete *et al.*, 1998; Changizi *et al.*, 2007; Abu-Madi *et al.*, 2008; Schuster *et al.*, 2009).

Limited data is available on the helminth burden in cats from Greece (Haralampidis, 1977). Despite the recent increase in the number of stray dogs and cats due to various social and economic factors (Karanikola *et al.*, 2012) no studies have aimed to assess the potential impact on the public health. The purpose of our paper was to evaluate the helminth burden of stray cats in a highly populated urban area of Greece.

Materials and methods

Between September 2010 and September 2012, fecal samples from 215 stray cats were examined for the presence of intestinal helminths. All cats were collected with traps from different parts of Thessaloniki area, Greece, by various animal welfare societies for neutering. No information about their accurate age and about previous anthelmintic treatments was available. The age was estimated according to the condition of the teeth. All cats were housed for 1 – 2 days before and 2 days after the surgery. During this interval, fresh fecal specimens were collected individually. The fecal samples were examined for parasitic elements by sodium chloride flotation followed by light microscopy. For statistical purposes, the cats were grouped according to their gender (48 males, 167 females) and age (76 less than one year old, 139 more than one year old). Frequency, prevalence and its 95 % confidence interval was calculated for each parasitic species, including co-infections as well

Table 1. Prevalence of digestive helminths in fecal samples of stray cats from Thessaloniki, Greece, by gender and age

Endoparasites	Females			Males			Juvenile			Adult			Total		
	n	%	95%CI	n	%	95% CI									
<i>Ancylostoma tubaeforme</i>	16	9.6	5.6-15.1	9	18.8	8.9-32.6	14	18.4*	10.5-29.0	11	7.9	4.0-13.7	25	11.6	7.7-16.7
<i>Dipylidium caninum</i>	69	41.3	33.8-49.2	16	33.3	20.4-48.4	28	36.8	26.1-48.7	57	41	32.7-49.7	85	39.6	33.0-46.4
<i>Toxocara cati</i>	34	20.4	14.5-27.3	5	10.4	3.5-22.7	24	31.6*	21.4-43.3	15	10.8	6.2-17.2	39	18.1	13.2-24.0
<i>Toxascaris leonina</i>	2	1.2	0.1-4.3	0	0	0.0-7.4	0	0	0.0-4.7	2	1.4	0.2-5.1	2	0.9	0.1-3.3
<i>Taenia taeniaeformis</i>	12	7.2	3.8-12.2	6	12.5	4.7-25.2	7	9.2	3.8-18.1	11	7.9	4.0-13.7	18	8.4	5.0-12.9
Overall prevalence	99	59.3	51.4-66.8	21	43.8	29.5-58.8	43	56.6	44.7-67.9	77	55.4	46.7-63.8	120	55.8	48.9-62.6

Legend: n – no. of positive samples; % – prevalence; CI – confidence interval.* $p < 0.05$

Table 2. Number of cats with one or more helminth species

Endoparasites	At	Dc	Tc	Tl	Tt	At-Dc	At-Tc	At-Tl	At-Dc-Tc	At-Dc-Tt	At-Tl-Tt	At-Dc-Tl	At-Dc-Tc-Tt	Dc-Tc-Tt
No. cats	11	55	16	1	2	3	1	8	5	2	2	8	4	
Prevalence (%)	5.1	25.6	7.4	0.5	0.9	1.4	0.5	3.7	2.3	0.9	0.9	3.7	1.9	

Legend: At – *Ancylostoma tubaeforme*; Dc – *Dipylidium caninum*; Tc – *Toxocara cati*; Tl – *Toxascaris leonina*; Tt – *Taenia taeniaeformis*

as for each host category. The difference of prevalence among groups was statistically analysed by chi-squared independence test. A p value of <0.05 was statistically significant. All statistical analysis was performed using the EpiInfo 2000 software.

Results

From the total of 215 fecal samples examined for digestive helminths in stray cats, 55.8 % (120/215) were infected with at least one intestinal parasite and 16.3 % (35/215) had co-infections. Five different helminth species were found. The most prevalent helminth was *Dipylidium caninum* (39.6 %), followed by *Toxocara cati* (18.1 %), *Ancylostoma tubaeforme* (11.6 %), *Taenia taeniaeformis* (8.4 %) and *Toxascaris leonina* (0.9 %) ($p < 0.0001$) (Table 1). The overall prevalence of helminths with zoonotic potential (*A. tubaeforme*, *T. cati* and *D. caninum*) was 53.5 % (115/215; 95 % CI 46.6 – 60.3). The results showed that *A. tubaeforme* and *T. taeniaeformis* were more prevalent in males, while *D. caninum*, *T. cati* and *T. leonina* in female cats, without statistical significance (Table 1). *Toxocara cati* and *A. tubaeforme* were more prevalent in juvenile cats than in adults ($p < 0.05$).

Mixed infections with two helminth species were found in 21 cats (9.8 %; 95 % CI 6.1 – 14.5) and with three species in 14 cats (6.5 %; 95 % CI 3.6 – 10.7). The most common association was between *D. caninum* and *T. cati* (3.7 %; 8/215) (Table 2).

Discussion

The results of the present study show that stray cats in Thessaloniki area are harboring few parasitic helminths species, but with relatively high prevalence, mainly in the case of zoonotic species.

Among the three zoonotic species identified, the highest threat to human health is posed by *Toxocara cati* (Bowman *et al.*, 2002). Although the human larval toxocarosis caused by *T. cati* is less common than the one produced by *T. canis*, its public health impact cannot be neglected. Several studies reported *T. cati* as the most common feline helminth parasite (Mircean *et al.*, 2010; Barutzki and Schaper, 2011; Capári *et al.*, 2013). Definitive hosts for *T. cati* are felines and included: cat (*Felis catus*), wild cat (*F. silvestris*), serval (*F. serval*), lynx (*Lynx lynx*) and others (Okulewicz *et al.*, 2012). Cats can be infected by the ingestion of infective eggs, by the ingestion of a mouse containing larvae, or by the transmammary infection of kittens (Bowman *et al.*, 2002). A similar prevalence with that from Greece was observed in other European countries such as Hungary (17.4 %) (Capári *et al.*, 2013), Romania (20.3 %) (Mircean *et al.*, 2010), central Italy (22.2 %) (Riggio *et al.*, 2013), Germany (27.1%) (Becker *et al.*, 2012), northern Italy (33.1 %) (Spada *et al.*, 2013). Lower prevalence was reported in Finland (5.4 %) (Näreaho *et al.*, 2012). Higher prevalence of *T. cati*, was reported in India (59.3 %) (Borthakur and Mukharjee, 2011), Spain (55.2 %)

(Calvete *et al.*, 1998) and, also, in Greece (66.7 %) (Haralampidis, 1977).

The most common hookworm of cats in Europe is *Ancylostoma tubaeforme* (Bowman *et al.*, 2002). As in the case of *T. cati*, the prevalence of *A. tubaeforme* can be correlated with age, being more prevalent in juvenile than in adult cats, the same correlation being also observed by Shukla *et al.* (2006). A similar prevalence of *A. tubaeforme* with that from the current study was reported in Romania (10.1 %) (Mircean *et al.*, 2010) and in northern Italy (7.2 %) (Spada *et al.*, 2013), while in Spain was noticed a higher prevalence (29.3 %) (Calvete *et al.*, 1998).

Dipylidium caninum is by far the most common tapeworm of domesticated dogs and cats (Bowman *et al.*, 2002). Although human dipylidiasis has been rarely reported, the parasite presents public health significance. Infections with this tapeworm may occur if fleas containing the infective cysticercoid stage are ingested by humans (Bowman *et al.*, 2002). The cestode *D. caninum* was estimated to be the most prevalent endoparasites (39.6 %) in tested stray cats from the present study. Also, the prevalence of *D. caninum* obtained in Greece was higher than in other European countries, 0.2 % in Romania (Mircean *et al.*, 2010), 1.2 % in northern Italy (Spada *et al.*, 2013), 2.9 % in central Italy (Riggio *et al.*, 2013) and 20.7 % in Spain (Calvete *et al.*, 1998). From Dipylidiidae, *Diplopylidium nölleri* was found commonly in Greece, being reported by Haralampidis (1977) in 71 of 123 cats.

Although not zoonotic, the other two parasitic helminths identified in our study, *T. leonina* and *T. taeniaeformis*, can be often pathogenic to cats.

Infections with *T. leonina* have been demonstrated in several surveys on cat, but with a lower prevalence compared to *Toxocara* (Parsons, 1987). The definitive hosts for *T. leonina* are both feline and canine species (Okulewicz *et al.*, 2012). Cats become infected by ingesting either the eggs or rodents that contain the larvae of *T. leonina* (Bowman *et al.*, 2002). The rate of infection with *T. leonina* in our study was similar with that reported by Näreaho *et al.* (2012) in Finland (0.2 %) but lower than that reported in Hungary (7.2 %) (Capári *et al.*, 2013) or Poland (10 %) (Ładczuk and Balicka-Ramisz, 2010).

Taenia taeniaeformis is the only species of *Taenia* typically reported from the domestic cat around the world (Bowman *et al.*, 2002). The prevalence of *T. taeniaeformis* was relatively high (8.4 %) compared with some previous studies (2.7 % in Romania by Mircean *et al.* 2010) but similar to others (8.6 % in Spain by Calvete *et al.*, 1998). Unusually high prevalences of *T. taeniaeformis* were noticed in Qatar (75.8 %) (Abu-Madi *et al.*, 2010) and India (70.4 %) (Borthakur and Mukharjee, 2011).

All endoparasites which infect stray cats may contribute considerably to the contamination of environment, public parks, playgrounds and sandpits with zoonotic parasites and therefore have to be considered a public health problem (Szabová *et al.*, 2007; Becker *et al.*, 2012). Moreover, contact of infected stray cats with household cats can be an additional risk factor. Our results show the great im-

portance of stray cats as reservoirs for parasites with zoonotic potential in Greece.

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