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Intestinal nematode infections in Turkish military dogs with special reference to *Toxocara canis*

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Abstract

The prevalence and potential zoonotic risk factors of intestinal nematodes of military working dogs, which are used for different military purposes, were assessed. Faecal samples from 352 defined-breed Turkish military dogs were investigated and 107 (30.4%) dogs were found to be infected with one or two nematode species. The following nematodes, with their respective prevalences, were diagnosed in the faecal samples: *Toxascaris leonina* (21.8%), *Toxocara canis* (13.3%), *Trichuris vulpis* (2.9%) and *Uncinaria stenocephala* (1.2%). *Toxocara canis* infections were more frequently seen in puppies (0–6 months old). The prevalence of *T. canis* was significantly higher in male than in female dogs and also higher in dogs which were exercised daily than in those without exercise. The highest prevalence was found in Belgian malinois breed dogs. *Toxocara canis* infections were not influenced by the floor type of the kennels (i.e. concrete or soil floor). There was no difference in the occurrence of *T. canis* infection when the last anthelmintic treatment was carried out less or more than 3 months prior to sampling. It is suggested that *T. canis* infected military dogs would be a threat not only for dog trainers but also for military personnel, notably during national and international operations.

Introduction

Dogs can harbour a variety of intestinal parasites which cause pathology to their hosts and some of them can also infect humans. For example, the dog roundworm *Toxocara canis,* the causative agent of the zoonotic disease toxocariasis is one of the most common parasites of domestic dogs worldwide (Haralabidis *et al.*, 1988; Coggins, 1998; Minnaar *et al.*, 2002; Barutzki & Schaper, 2003; Ramirez-Barrios *et al.*, 2004). Various studies have shown that well-cared-for dogs (e.g. show, racing or police dogs) are also infected with different types of intestinal nematodes including *T. canis* (Jacobs & Pegg, 1976; Jacobs & Prole, 1976; Pegg, 1978; Robinson *et al.*, 1989).

In Turkey, the main dog population consists of non-owned stray dogs and to a lesser extent owned urban/rural dogs (personal communication, Ministry of Agriculture and Rural Affairs). On the other hand, there are military working dogs of defined breeds, which were bred and trained by the Turkish army. Because of the relatively high level of veterinary care Turkish military dogs can also be classified as well-cared-for dogs. Although a number of studies (Doganay & Oge, 1993; Aydenizoz, 1997; Umur & Arslan, 1998; Senler *et al.*, 2003) on the prevalence of endoparasites in dogs in Turkey have been reported, none of them were conducted on populations of military dogs.

The present study was designed to determine the prevalence and potential risk factors of intestinal nematodes, in particular *T. canis*, in well-cared for military dogs in Turkey.

Materials and methods

Dog maintenance

This study was conducted at the Gemlik Military Veterinary School and Training Centre in Bursa, Turkey,

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which is the major centre of the Turkish Army in which dogs are bred and trained for military purposes.

A total of 352 defined-breed dogs (162 males and 190 females) were examined. The dogs belonged to eight breeds: German shepherd (144), Labrador retriever (62), Belgian malinois (46), pointer (33), Doberman pinscher (25), Irish setter (24), Kangal Turkish shepherd (13), golden retriever (5).

Dogs were divided into the following four age groups: 0 to 6 months (puppy) (32), 7 to 12 months (116), 13 to 24 months (88) and more than 24 months (116). All dogs were pedigree animals and feed on commercial dry food. One hundred and forty-nine (42.3%) dogs had been exercised daily (range 4–6 h) on soil or grass floor areas.

While adult dogs were individually housed, puppies were group-housed. The average number of puppies per kennel was 5. The floor of the indoor living areas of the dogs was of concrete (83.8%) or soil (16.2%). The daily cleaning process of concrete floors was performed using high pressure tap water, whereas in the kennels with soil floors, faeces were removed in situ.

Anthelmintic treatment

Puppies were dewormed 5–8 times during the first 6 months of their life. The age of first pup deworming was 2 weeks, whereas adult dogs were dewormed 4 times per year. Additionally, all bitches were treated with ivermectin or doramectin on days 45 and 55 of pregnancy.

The following active ingredients were used for deworming: febantel, levamisole, tetramisole, piperazine, niclosamide, ivermectin, doramectin, praziquantel + pyrantel + oxantel combination and praziquantel + pyrantel + febantel combination.

Faecal samples and laboratory procedures

Faecal samples collected in the kennels were less than 12 h old (puppies were temporarily individually housed for faecal sampling), stored in labelled polythene bags and refrigerated until transported to the laboratory. Faecal examination was performed using a flotation technique with saturated sodium chloride solution (sp. gr. 1.20) as the medium (Vanparijs *et al.*, 1991; Hendrix, 1998). Nematode eggs were identified on the basis of the morphological characteristics (Foreyt, 2001).

Statistical analyses

The prevalence of nematode infections (especially *T. canis*) was evaluated relative to host age, sex, breed, training, structure of kennel floor and the last anthelmintic treatment prior to faecal sampling. Statistical analyses were conducted using the chi-square or Fisher's exact test. All statistical calculations were performed using the Graphpad Instat Software V2.02 programme (LSU Medical Center).

Results

Nematode eggs detected in the faeces of 352 dogs and their prevalence is presented in table 1. A total of 107 (30.4%) faecal samples were positive for intestinal nematodes. *Toxascaris leonina* was the most common (21.8%), followed by *Toxocara canis* (13.3%), *Trichuris vulpis* (2.9%) and *Uncinaria stenocephala* (1.2%). Thirty-one dogs (8.8%) had mixed infections with two nematode species (table 1).

The prevalence of *T. canis* in different breeds is presented in table 2. The highest prevalence (34.7%) was found in the Belgian malinois breed. While no statistically significant difference was observed in the prevalence of *T. canis*-infection among four breeds (German shepherd, Labrador retriever, pointer and Irish setter), the infection rate in the Belgian malinois breed differed significantly from those in German shepherd, Labrador retriever and Irish setter breeds ($P < 0.001$).

Table 3 shows the prevalence of *T. canis* in relation to different factors: As to the host age, young dogs (< 12 months old) were more frequently infected than older ones. Thus, the highest prevalence of *T. canis* was observed in the 0–6 month age group ($P < 0.0001$). Male dogs were found to be more frequently infected (19.7%) than females (7.8%) ($P < 0.005$). *Toxocara canis* infections were found significantly ($P < 0.0001$) higher in daily exercised dogs (25.5%) than in those not exercised (4.4%) (table 3). No significant relationship was found between the frequency of *T. canis* infections and the structure of kennel floors. In addition, there was no significant difference in the occurrence of *T. canis* infection when the last anthelmintic treatments were carried out less or more than three months prior to the sampling.

Discussion

The present results indicate that even with a relatively high level of care, including veterinary attention, military dogs frequently harbour intestinal nematodes. The prevalence of helminth infections in military dogs in Turkey is similar to that encountered in well-cared-for dog populations in Belgium (Vanparijs *et al.*, 1991), lower than that found in Jamaica (Robinson *et al.*, 1989) and higher than those in the UK (Jacobs & Pegg, 1976; Pegg,

Table 1. Prevalence of single and multiple infections with common intestinal nematodes in 352 military dogs in Turkey.

Nematodes	No. of infected dogs	Prevalence (%)
Toxocara canis	20	5.7
Toxascaris leonina	49	13.9
Trichuris vulpis	5	1.4
Uncinaria stenocephala	2	0.6
Toxocara canis + *Toxascaris leonina*	26	7.3
Toxocara canis + *Trichuris vulpis*	1	0.3
Toxascaris leonina + *Trichuris vulpis*	2	0.6
Trichuris vulpis + *Uncinaria stenocephala*	2	0.6
Total	107	30.4

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Table 2. Prevalence of *Toxocara canis* in military dogs of different breeds in Turkey.

Breed	*n*	No. of infected dogs	Prevalence (%)
German shepherd	144	14	9.7[a]
Labrador retriever	62	10	16.1[a]
Belgian malinois	46	16	34.7[b]
Pointer	33	6	18.1[ab]
Doberman pinscher	25	–	–
Irish setter	24	1	4.1[a]
Kangal Turkish shepherd	13	–	–
Golden retriever	5	–	–

[a,b] Values with different letters in the same column are significantly different, $x^2 = 19.563$, df = 4, $P < 0.001$.

1978). However, the observed prevalence is lower than that recorded for stray dogs in Turkey previously described by Tinar *et al.* (1989), Doganay & Oge (1993) and Umur & Arslan (1998).

In most studies carried out on well-cared-for dogs, *T. canis* was the commonly identified canine helminth. The prevalence of *T. canis* in military dogs found in the current study is similar to that recorded in police dogs in the UK (Pegg, 1978) but higher than that seen in show dogs (Jacobs & Pegg, 1976). Although in the present study the prevalence of *T. canis* was not abnormally high, the high worm fecundity and resistant eggs in the environment (Jordan *et al.*, 1993) result in environmental contamination, with eggs being cumulative therefore representing a higher risk of human infection than suggested by the infection rate of dogs.

In the present study, a host age of < 12 months was determined to be a significant risk factor associated with *T. canis*. The highest infection rate occurred in the youngest animals (< 6 months old) possibly as a result of intra-uterine or transmammary infection. This finding is in consistent with data of other authors (Overgaauw & Boersema, 1998; Fok *et al.*, 2001; Antolóv *et al.*, 2004; Ramirez-Barrios *et al.*, 2004). Experimental studies performed on *T. canis* in helminth-naive dogs showed development of non-specific resistance to intestinal infection with increasing age (Greve, 1971). Male sex appeared to be a risk factor and higher prevalences of *T. canis* were observed in males compared with females. This observation agrees with that of Kirkpatrick (1988), Hoskins *et al.* (1982) and Oliveira-Sequeira *et al.* (2002) who showed that *T. canis* infections tend to be more common in male dogs. Hormonal factors and sex-associated behaviour (e.g. roaming) may be the factors involved (Kirkpatrick, 1988).

In recent studies, comparisons of defined-breed with mixed-breed dogs have shown that the prevalence of *T. canis* was significantly higher in mixed-breed dogs (Oliveira-Sequeira *et al.*, 2002; Ramirez-Barrios *et al.*, 2004). An explanation for this finding is that most dogs of defined-breed were from responsible owners and are generally the target of greater care, such as the regular administration of anthelmintic drugs (Oliveira-Sequeira *et al.*, 2002). All dogs in the current study were

Table 3. Prevalence of *Toxocara canis* in military dogs in Turkey, relative to host age, sex, exercise, kennel floor structure and anthelmintic treatment.

Category	*n*	No. of infected dogs	Prevalence (%)
Age (months)			
0–6	32	10	31.2[a]
7–12	116	31	26.7[a]
13–24	88	3	3.4[b]
> 24	116	3	2.5[b]
		$x^2 = 45.929$, df = 3, $P < 0.0001$	
Sex			
Male	162	32	19.7[a]
Female	190	15	7.8[b]
		$x^2 = 9.628$, df = 1, $P < 0.005$	
Training type			
Daily exercise	149	38	25.5[a]
No exercise	203	9	4.4[b]
		$x^2 = 31.176$, df = 1, $P < 0.0001$	
Structure of kennel floor			
Concrete	295	44	14.9 n.s.
Soil	57	3	5.2 n.s.
		Fisher's exact test, $P > 0.05$	
Last anthelmintic treatment			
0–3 months before sampling	79	9	11.3 n.s.
> 3 months before sampling	273	38	13.9 n.s.
		Fisher's exact test, $P > 0.05$	

[a,b] Values with different letters in each category are significantly different.
n.s., not significant.

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defined-breed animals and *T. canis* eggs were found significantly more frequently in the Belgian malinois breed than in other breeds, suggesting that this breed is more susceptible to *T. canis*. However, it should be noted that *T. canis* infected Belgian malinois dogs are the litters of four bitches (data not shown). Therefore, the higher frequency of *T. canis* infections may be a consequence of infected bitches, which may have transmitted the infection to their offspring via the intra-uterine or transmammary route.

As in the data reported by Overgaauw & Boersema (1998), no significant relationship was found between the prevalence of *T. canis* infections and factors such as the time of the last anthelmintic treatment prior to sampling and the structure of kennel floors. Because of the difficulties involved in cleaning soil floor kennels, it would be expected that dogs would be more frequently infected with *T. canis* than those living on concrete floors. However, the daily removal of faeces from the soil floor of kennels seems a good preventive measure against *T. canis* infections. The prevalence of *T. canis* was significantly higher in trained than untrained dogs. As no removal of faecal deposits from the training area (soil floor) was practised, infected animals may contaminate the training areas, and this constitutes a source of new infections for other dogs. Additionally, the close contact between the trainer/soldier and the dog during the exercises posses the risk of transmission of toxocariasis. A recent survey has shown that *T. canis* eggs are present in the hair of 25% of examined dogs and it has been suggested that dogs infected with *T. canis* may infect humans by direct contact (Wolfe & Wright, 2003).

Furthermore, it should be noted that military working dogs are deployed in various army units in Turkey after completion of the main training period (8–12 months of age) at the training centre. On the other hand, these trained dogs were also deployed in international military operations (e.g. UN peacekeeping efforts) where they might have contact with other military personnel, thereby posing a risk of infection with *T. canis*.

The presence of infected dogs should therefore make the military veterinarian and trainer aware of the continuing need for regular deworming using effective anthelmintics with emphasis on young animals up to 12 months old. Even with a relatively low infection rate of approximately 13% dogs should never be neglected, because of the daily shedding of many thousands *Toxocara* eggs into the environment. To reduce the risks for zoonotic infection with *T. canis*, dog trainers and other military personnel should undertake strict personal hygiene measures, especially after dog and soil contact.

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