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Full Length Research Paper

Gastrointestinal helminthes of dogs and owners' perception of dogs parasitic zoonoses in Hawassa, Southern Ethiopia

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The prevalence of gastrointestinal helminthes in dogs was investigated by faecal examination from 860 dogs employing direct smear, simple flotation and sedimentation techniques. A structured questionnaire was also completed by 476 owners to assess the public awareness of zoonotic helminthes transmitted by dogs. Of the 860 dogs examined 768 (89.3%) were found to be positive for different types of helminth eggs. The following helminthes, with their respective prevalence, were diagnosed: *Strongyloides* species (60.1%), *Ancylostoma* species (52.2%), *Dipylidium* species (40.6%), *Toxocara* species (23.3%), *Echinococcus* species (5.8%) and *Trichuris* species (4.9%). The prevalence of gastrointestinal helminthes were significantly affected by age (P < 0.001), sub-city (P < 0.05) and confinement types (P < 0.001). Higher prevalence of gastrointestinal helminthes was recorded in younger dogs less than one year of age (95.6%, CI = 93.1 to 98.2). Free-roaming and semi-confined dogs were harboring significantly higher prevalence of helminthes (100%) than strictly confined dogs (62.6%, CI = 56.5 to 68.7). The present study reported that 99.2% of dog owners were not aware of the zoonotic parasite transmitted by dogs and 88.2% of them never used anthelmintics for treatment of their dogs. The high prevalence of gastrointestinal helminth parasites of dogs and lack of owners' awareness in Hawassa indicates a potential risk to human health. Thus, serious attention by the veterinarians, municipality of the town and public health service to increase awareness of their potential threat to human health is desirable.

Key words: Helminth, dogs, prevalence, zoonoses, Hawassa.

INTRODUCTION

Dogs serve as companion animals and have probably closest contact with man (Macpherson et al., 2000). The number of dogs in Ethiopian households is increasing and many families keep one or more dogs either as hunting or guard dogs. Increased numbers of dogs are seen around abattoirs, butcher shops, market places and streets (Yacob et al., 2007). Due to their closest contact with man (Robertson et al., 2000; Traub et al., 2002), gastrointestinal helminthes of dogs may be a threat to human health (Palmer et al., 2008; Dai et al., 2009) and also pose as a threat to the host: lowered resistance, retarded growth and reduced feed efficiency (Soulsby, 1982).

Free-roaming dogs are domestic dogs that are not confined to a yard or house. They have long caused major public-health problems and animal-welfare concerns in many countries (Slater, 2001). The ubiquitous problem of stray dogs in urban areas emphasizes the need to diagnose, treat and prevent zoonoses including parasitic nematodes. In Ethiopia, very few studies have been completed on (Yakob et al., 2007; Endrias et al., 2010) gastrointestinal helminthes in dogs especially in the central part of the country. Hence, there is scarcity of

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information regarding the prevalence of gastrointestinal helminthes and risk factors associated with helminth infections in the study population. Therefore, the purpose of this study was to estimate the prevalence of gastrointestinal helminthes of dogs, to identify the species of parasites and risk factors associated with helminth infections in the study population, and to assess public awareness of parasitic zoonoses transmitted by dogs in Hawassa town.

MATERIALS AND METHODS

Study area and population

The study was conducted from October 2010 to June 2011 in Hawassa, capital of the Southern Nation Nationalities People Regional State, located at an elevation of 1708 m above sea level, and between 06° 74' to 06° 8' N latitude and 38° 40' to 38° 44' E longitude. Both sexes and all age groups of dogs in Hawassa town were included in the study. For simplicity, dogs up to one year of age were grouped as young while those older than one year as adults dogs.

Sampling and sample size

To estimate the prevalence of gastrointestinal helminthes of dogs in Hawassa town 860 dogs were selected by systematic random sampling technique. The selected dogs were classified into free-roaming, semi-confined and confined based on whether they were confined or semi-confined to owner's property or homeless. The sample size for each sub-city was determined by considering 95% prevalence of gastrointestinal nematodes reported in central Ethiopia (Yacob et al., 2007). The study considered 95% level of significance (Thrusfield, 2007).

Study design

Coproscopic examination

Fecal samples were collected from 860 dogs from different sub-cities in Hawassa town and transported to the parasitology laboratory, Hawassa University School of Veterinary Medicine. The samples were examined using direct smear, simple flotation and sedimentation techniques (Hendrix, 2003; Chauhan and Agarwal, 2006). The eggs were identified based on the general characteristics described by Hendrix (2003) and Soulsby (1982).

Questionnaire for survey

The dog owners completed a semi-structured questionnaire concerning their dog's confinement types, cleaning dog's house, food source, awareness of parasitic zoonoses transmitted by dog and treatment with anthelmintics.

Data management and analysis

Data were organized, edited and analyzed using the STATA software, version 11.0 (STATA corp., College Station, TX). Descriptive statistics were used to calculate the prevalence and proportions. Chi-square test and logistic regression analysis were used to assess the association between the prevalence of dogs' gastrointestinal helminthes and the considered risk factors.

RESULTS

Prevalence of dog helminthes

Among the 860 dogs examined, 768 (89.3%) were found to be positive for gastrointestinal helminthosis. *Strongyloides* species (95% CI 56.8 to 63.4) was the most prevalent helminth infecting dogs in Hawassa, which was followed by *Ancylostoma* species (95% CI 48.9 to 55.5). Of the infested dogs, 25% (215), 37% (318), 22.3% (192), 4.5% (39) and 0.6% (5) were infested with a single, two, three, four and five species of parasites, respectively. The most commonly encountered dog parasites and their frequencies are shown in Table 1.

Risk factors for dog gastrointestinal helminthosis

There was a significant difference in the overall prevalence of gastrointestinal helminthes between the different age groups (χ^2 = 14.37, P < 0.01), among sub-cities (χ^2 = 14.37, P < 0.05) and confinement types or management (χ^2 = 257.92, P < 0.01). Gastrointestinal parasites were more frequent in young dogs, under one year of age. A significant difference was observed among the confinements types/management, and free-roaming and semi-confined dogs were more frequently infected (Table 2).

Helminth species versus risk factors

The prevalence of *Ancylostoma* species, *Strongyloides* species and *Toxocara* species significantly varied among the type of management or confinement (χ^2 = 288.31, χ^2 = 217.0 and χ^2 = 125.51, respectively, P < 0.01). The lowest prevalence of these parasites was recorded in confined dogs (95% CI = 4.4 to 16.8, 17.5 to 28.0 and 3.7 to 10.1, respectively) and the highest in free-roaming dogs (95% CI = 79.1 to 88.1, 77.8 to 87.1 and 40.9 to 53.0, respectively). Young dogs, less than one year of age, were significantly infected by higher prevalence of *Toxocara* species (χ^2 = 243.17, P < 0.01 and 95% CI for young dogs 52.3 to 65.5 and adult 6.2 to 10.6) (Tables 3 and 4).

In free-roaming dogs, significantly higher prevalence of *Echinococcus* spp. was observed than in the confined and semi-confined (χ^2 = 13.12, P < 0.05 and 95% CI for free-roaming dogs 6.6 to 14.0, semi-confined 2.1 to 6.4 and confined 1.0 to 5.5) (Table 5).

DISCUSSION

The overall prevalence of gastrointestinal helminthosis recorded was 89.3%, which is comparable to the report of Endrias et al. (2010) and Yacob et al. (2007) from central

Table 1. Prevalence of gastrointestinal helminth parasites of dogs (n = 860) in Hawassa.

Helminth parasites	Number of positive dogs	Prevalence (%)	95% CI
Nematodes			
Ancylostoma spp.	449	52.2	48.9-55.5
Strongyloides spp.	517	60.1	56.8-63.4
Toxocara spp.	200	23.3	20.4-26.1
Trichuris spp.	42	4.9	3.4-6.3
Cestodes			
Dipylidium spp.	349	40.6	37.3-43.9
Echinococcus spp.	50	5.8	4.2-7.4
Overall parasites	768	89.3	87.2-91.4

Table 2. Prevalence of dogs' gastrointestinal helminthosis and the putative risk factors.

Risk factor	Examined number	Prevalence (%)	95% CI	χ^2	P-value
Sex					
Male	688	89.4	87.1-91.7	0.04	0.85
Female	172	88.9	84.2-93.7		
Age					
Young (< 1 year)	251	95.6	93.1-98.2	14.37	<0.01**
Adult	609	86.7	84.0-89.4		
Sub-city					
Misrak	130	94.6	90.7-98.5	14.15	0.03*
Addis-Ketema	130	83.1	76.6-89.6		
Bahil-Adarash	130	84.2	77.6-90.7		
Mehal	120	92.5	87.8-97.2		
Menaharia	120	90.8	85.6-96.0		
Tabor	120	90.8	85.6-96.0		
Haik dar	120	89.2	83.6-94.8		
Confinement					
Free-roaming	262	100	-	257.92	<0.01**
Semi-confined	352	100	-		
Confined	246	62.6	56.5-68.7		

**Highly significant (P < 0.01), *Significant (P < 0.05).

Ethiopia. Eguia-Aguilar et al. (2005) and Martinez-Moreno et al. (2007) reported that more than 50% of exa-mined dogs were infected with helminthes in Mexico City and Cordoba, respectively. Relatively lower preva-lence of dogs' gastrointestinal helminthes reported from various areas (Tylkowska et al., 2010; Balassiano et al., 2009; Palmer et al., 2008; Pullola et al., 2006; Barutzki and Schaper, 2003). The differences in health care given to dogs' and the management practice in the different geographical areas attributed to the variation in the prevalence of dogs' gastrointestinal helminthes. Treat-ment of dogs with anthelmintic at least once a year results in very lower prevalence (Pullola et al., 2006). Of the total examined and positive dogs, 72% were infected with multiple species, which is in a general agreement with report of Endrias et al. (2010) from Ambo, Ethiopia.

Strongyloides species was the most prevalent parasite infecting dogs in Hawassa (60.1%) followed by *Ancylostoma* species (52.2%). On the other hand, *Ancylostoma* species was the most prevalent helminth in Ambo (Endrias et al., 2010) and Debre-Zeit (Yacob et al., 2007).

With this study, the gastrointestinal helminth infection was more frequent in younger (χ^2 = 14.37, P < 0.01) and in free-roaming (χ^2 = 257.92, P < 0.01) dogs. The higher level of infection in free roaming dogs was in line with the

Table 3. Linear logistic regression analysis of confinement types and nematode infection.

Nematode species	Management type/confinements		
	Confined	Semi-confined	Free-roaming
Ancylostoma species[a]			
OR	1	9.0	35.3
95% CI	8.4-16.8	51.3-61.7	79.1-88.1
X^2		288.31	
P-value		0.000	0.000
Strongyloides species[a]			
OR	1	7.8	15.9
95% CI	17.5-28.0	64.8-74.4	77.8-87.1
X^2		217.0	
P-value		0.000	0.000
Toxocara species[a]			
OR	1	2.8	11.9
95% CI	3.7-10.1	13.1-21.0	40.9-53.0
X^2		125.51	
P-value		0.000	0.000
Trichuris species[b]			
OR	1	2.1	6.7
95% CI	0.04-3.2	1.5-5.2	6.3-13.6
X^2		20.51	
P-value		0.000	0.000

NB: a = all significantly varied, b = only confinement versus free-roaming and semi-confinement versus free-roaming significantly varied.

Table 4. Linear logistic regression analysis of age and sex, and nematode infection.

Nematode species	Age		Sex	
	Young	Adult	Male	Female
Ancylostoma species[a]				
OR	1.3	1	1	1.2
95% CI	51.2-65.5	46.1-54.1	41.3-56.3	49.3-56.8
X^2	3.80			0.98
P-value	0.052			0.323
Strongyloides species[a]				
OR	1	1.1	1	1.4
95% CI	53.3-65.5	56.5-64.3	46.0-61.0	58.1-65.4
X^2		0.08		3.89
P-value		0.772		0.048*
Toxocara species[a]				
OR	15.9	1	1.3	1
95% CI	52.3-65.5	6.2-10.6	20.6-34.0	19.1-25.4
X^2	243.17		1.94	
P-value	0.000**		0.164	
Trichuris species[b]				
OR	1.7	1	1.3	1
95% CI	3.7-9.9	2.5-5.7	2.3-9.3	3.1-6.2
X^2	2.57		0.38	
P-value	0.109		0.528	

NB: **Highly significant (P < 0.01), *Significant (P < 0.05).

Table 5. Linear logistic regression analysis of risk factors and cestodes infection.

Risk factor	*Dipylidium* species			*Echinococcus* species		
	OR	95% CI	P-value	OR	95% CI	P-value
Age						
<One year	1	33.4-45.5		1.3	3.7-9.9	0.447
Adult	1.1	37.1-45.0	0.662	1	3.6-7.2	
Sex						
Female	1	28.3-46.4		1	4.1-7.6	
Male	1.3	38.2-45.6	0.127	1	2.3-9.3	1
Confinements						
Confined	1	12.0-21.3		1	1.0-5.5	
Semi-confined	3.3	34.4-44.6	0.000**	1.3	2.1-6.4	0.529
Free-roaming	9.1	58.7-70.3	0.000**	3.4	6.6-14.0	0.003**[b]

NB: **Highly significant (P < 0.01), b = no significant difference only between confined and semi-confined.

observation of Komatangi (2005) and Dada et al. (1979). Free-roaming dogs had been more prone to infection due to direct and frequent contact with other dogs and their excrement and environmental contamination. Generally, no one takes care of the health of free-roaming, and no anthelmintic treatment is given in their life. Hence, once a dog is infected with certain parasite, then it remains in shedder of the eggs and contaminant of the environment for long period of time. The observed higher prevalence of gastrointestinal helminth infection in younger dogs was in a general agreement with the report of Oliveira-Sequeira et al. (2002) and Palmer et al. (2008). This higher prevalence in young dogs could be associated with their immature immune system (Bowman et al., 2003) and the transmammary transmission mode of the *Ancylostoma* species and *Toxocara* species (Urquhart et al., 1996).

Among the considered risk factors, age (P < 0.01), sub-city (P < 0.05) and confinement type significantly (P < 0.01) affected the overall prevalence of gastrointestinal helminthes. *Toxocara* species predominate in younger dogs (χ^2 = 243.17, P < 0.01), which is in line with the reports from various areas (Yacob et al., 2007; Fontanarrosa et al., 2006; Pullola et al., 2006; Eguia-Aguilar et al., 2005; Oliveira-Sequeira et al., 2002). This could be associated when a bitch, once infected, usually harbor sufficient larvae to infect all her subsequent litters even if it never again encounters the infection. Trans-mammary infection of the suckling pups and once patency is established in the bitch, to contamination of the environment with eggs (Urquhart et al., 1996).

The prevalence of *Dipylidium* species significantly varied among the confinement types (χ^2 = 126.69, P < 0.01), but the prevalence of *Echinococcus* species in free-roaming dogs varied from confined and semi-confined dogs (χ^2 = 13.12, P < 0.01). This is mainly associated with the fact that the free-roaming dogs do not receive any type of health care and frequently infested with fleas and lice. Living as free-roaming could give chance for free movement and wandering, which is a risk of greater chance of direct contact with contaminated environments. These conditions increase the pressure infection in freely wandering dogs.

Most of the dog owners in Hawassa had awareness only about rabies public health importance, but not zoonotic helminthes transmitted by dogs (Table 6). That is why there was improper disposal outside of residences compound and open garden, of dogs faeces practiced by 94.3% of the people. Also 88.2% of them never used anthelmintics for treatment of dog helminthosis. These conditions are associated with increased contamination of the environment with helminth eggs that passed in faeces of infected dogs. From such environment, free-roaming and semi-confined dogs get the infection and hence higher prevalence of helminthosis encountered in dogs. So there is great risk of human infection, especially children playing in the open garden, by the zoonotic parasites and the exposure of human being, children, is proportional to the extent of environmental contamination (Eguia-Aguilar et al., 2005; El-Shehabi et al., 1999).

Conclusion

The prevalence of dogs' gastrointestinal parasites in Hawassa town is very high, suggesting the absence of health care given for dogs and increased number of free-roaming dogs. There was almost no owners' awareness of the dogs' parasitic zoonoses and this was manifested by the improper disposal of dogs' faeces. These have had a significant impact on the epidemiology of the gastrointestinal helminthes of dogs and a serious public health problem. All kind of dogs, confined and free-roaming, plays a role in transmission of zoonotic parasites transmitted by dogs. *Ancylostoma* species, *Strongyloides* species, *Toxocara* species, *Dipylidium*

Table 6. Summary of dogs' management and owner's perception of zoonotic diseases.

Factor	Frequency	Percentage
Housing		
Free in the compound	171	35.9
Tied or confined in 'kennel'	305	64.1
Frequency of cleaning		
Every day	21	4.4
Every week	214	44.9
Every month	11	9.2
Not at all	197	41.4
Disposal of dog's faeces		
Outside of the compound	226	47.5
In the open garden	223	46.8
Buried	19	4.0
Dumped in the toilet	8	1.7
Food source		
Household leftover	273	57.4
Raw animal product	140	29.4
Both	63	13.2
Tendency of cooking meat for dogs		
Yes	28	5.9
No	448	94.1
Public health risk awareness		
No	21	4.4
Only about rabies	451	94.7
Gastrointestinal helminthes	4	0.8
Awareness and use of anthelmintics		
No	420	88.2
Yes	56	11.8

species and *Echinococcus* species are the most relevant in terms of their zoonotic potential. But data on human infection with these parasites in the study area are lacking. Hence it requires serious attention towards this problem by the veterinarians, municipality of Hawassa town and public health service in order to reduce the level of helminthes infestation and protect the public health. Public education of the dogs' health care and other management practices should be instilled. Also, monitoring free-roaming dogs could play a key role in the controlling and reducing the prevailing problem. Further epidemiological study should be conducted to investigate the rate of seasonal infection and the level of environmental contamination.

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