

Full Length Research Paper

Prevalence of dog gastrointestinal parasites and risk perception of zoonotic infection by dog owners in Wondo Genet, Southern Ethiopia

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Gastrointestinal parasites in dogs that inhabit in close proximity to humans have been shown to increase the risk of infection to humans, especially those living in rural areas. This study was conducted to estimate the prevalence of gastrointestinal helminth species found in partially owned/stray dogs and the potential impact these infection rates had on the surrounding communities in Wondo Genet, Southern Nations and Nationalities Region of Ethiopia. Coprological and postmortem examination and questionnaire survey were the methods used. A structured questionnaire on 50 households was designed to gather information on dog ownership, management and related risks. Randomized collection of 269 fecal samples was taken and analyzed using the Kato-Katz methodology to determine intestinal helminth infection rates. Postmortem examination was done on 13 stray dogs to determine the presence of adult worms. Very few households (22%) were aware that canine parasites could be transmitted to humans but none of them could provide correct information on the mode of transmission. None of the dog owners had treated their dogs using anthelmintics. Almost all owners had fed their dogs' raw carcass of a dead animal and condemned offals. Necropsy of 13 stray dogs revealed 90.7% of them were infected with at least one intestinal helminth parasite. No trematodes were found in the intestine of these dogs. The following cestodes were identified: *Echinococcus granulosus* (61.5 %), *Taenia pisiformis* (74.7%), *Taenia hydatigena* (69.2%), *Taenia ovis* (30.8%), *Dipylidium caninum* (46.8%) and *Mesocestoides* (84.6%). Other intestinal worms in dogs were *Toxocara canis* (53.9%), *Tirchuris vulpis* (70.3%) and *Ancylostoma caninum* (73.9%). Most helminths were recovered from the second intestinal segment. The findings showed that the high levels of ignorance among community members about canine parasites and transmission coupled with significant infection rates among the dogs in the community show that immediate action needs to be taken to decrease infection rates in dogs and to raise education levels of the community about zoonotic diseases.

Key words: Dog, helminthes, intestinal parasites, prevalence, Wondo Genet, zoonoses.

INTRODUCTION

Companion animals, such as dogs, act as definite hosts for many intestinal parasites, some of which are responsible for several zoonotic diseases (Dalimi and Mobedi, 1992; Schantz, 1994; Schantz and Kramer, 1995; Eslami and Hosseini, 1998). The close association

between dogs and humans is responsible for the high endemicity of some of these zoonotic diseases. Although zoonotic parasites can cause significant morbidity in all groups of the human population, they are of particular importance in vulnerable groups, such as children, the elderly, and the immunocompromised (Abo-Shehada, 1989). Among a number of zoonotic parasites that infect dogs, *Toxocara canis* and *Ancylostoma caninum* are of particular importance to humans (McManus, 2006).

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Other zoonotic parasites include *Echinococcus granulosus* as well as emerging and re-emerging infections caused by *Cryptosporidium* spp. and *Giardia* spp. *T. canis* does not normally establish intestinal infections in humans, but migrating larvae can cause visceral larva migrans (VLM), ocular larva migrans (OLM) or both. These can seriously compromise the health of children (Larrieu et al., 2001). *A. caninum* had been reported as a parasite of humans causing a disease called eosinophilic enteritis (Prociv and Croese, 1990).

The role of dogs as companion animals and the close relationship between humans and dogs, although offering significant benefits to many people, also represent a potential public health risk, since natural transmission of parasitic infections from dogs to humans may occur, directly or indirectly via environmental factors. All kinds of dogs (owned and stray dogs) are involved in transmission, even if the particular implication of each population is not clearly established (Vanparijs et al., 1991; Shimelese, 1994).

Several studies of canine intestinal parasites have been reported in many other parts of the world (Lightner et al., 1978; Okaeme, 1985; Overgaauw, 1997; Oliveira-Sequeira et al., 2002; Totkova et al., 2006). However, such a report is scanty in Ethiopia, which is essential for development of control measures in animal and public health. Cystic echinococcosis (CE) is a major endemic disease of public health important in various parts of the country due to the close association between dogs, livestock and humans (Kebede et al., 2009). The aim of this investigation was to determine the prevalence and intensity of gastrointestinal parasites of dogs in Wondo Genet, a peri-urban community in south Ethiopia.

MATERIALS AND METHODS

Study area

Wondo Genet is known for its hot springs and is surrounded by primary Ethiopian forests. It is located southeast of Shashemene in the Sidama zone of the Southern Nations Nationalities and Peoples' Region, with a latitude and longitude of 7° 1' 0" N, 38°35' 0" E and an elevation of 1723 meters (Ali, 2007). Wondo Genet has an estimated total population of 5,792. It is one of the highly densely populated areas of the country (CSA, 2008). In the area, animal husbandry is the main production system where cattle, sheep, goats and equines are the species of animals found.

Study design

Questionnaire survey

A total of 50 questionnaires were administered to household members of the community in Wondo Genet. A structured questionnaire was prepared in local language and a pilot test to assay the questionnaire was performed. The questionnaire was designed to gather information on dog ownership, feeding of dogs, treatment for dogs, the extent of awareness on dog parasites, control measures taken, the occupation of the dog's owner and other related factors. The participants were selected based on simple random sampling.

Fecal sampling

Fecal samples were collected randomly from 269 stray dogs. Information was obtained on the approximate age, sex, and mode of life of each dog. Fecal samples were placed in clean 30 ml bottles. About 10 g of feces from each dog were mixed thoroughly with 10% aqueous formaldehyde for preservation. Samples were examined for parasite eggs in the laboratory by means of the modified Kato-Katz procedure (Hendrix, 2003). Each parasite egg was identified using established structural and morphometric criteria (Soulsby, 1982).

Postmortem examination

This was conducted on thirteen stray adult male dogs in Wondo Genet destined for euthanasia. An abdominal cut was made in each animal and the intestine was tied from the pyloric and anal ends and collected in a bag. Bags were stored in an icebox and carried to the laboratory within 3 h. The carcasses were burned in the field to ensure that there was no contamination of the environment. In the laboratory, each intestine was divided into four pieces of equal length. Each piece was cut longitudinally and soaked in 0.15 M phosphate buffer saline (PBS, pH 7.2) for 5 min. The mucosal lining was gently scraped with a spatula into clean glass dishes and the collected intestinal contents were allowed to settle in 1000 ml conical Nalgene graduates (Nalge, Rochester, USA). Following several washes with PBS, aliquots were examined under a dissecting microscope. The preparation, staining and mounting of helminths were carried out as described by Meyer and Olsen (1980). Identification of intestinal helminths was based on keys and descriptions by Yamaguti (1961), Benbrook (1963), Yorke and Moplestone (1969), Anderson (1992), and Khalil et al. (1994). Identification of various *Taenia* sp. was based on stained specimens and comparison of scoleces and various types of proglottids as well as on morphometric measurements of small and large hooks of armed rostellum (Soulsby, 1982).

Statistical analysis

Statistical tests were performed using SPSS 11.0 (SPSS Inc., Chicago, Illinois, USA). Chi-squared tests were used to study the relationship between parasite prevalence and host age and sex. Percentage of frequency was calculated by dividing the number of animals harboring any helminth by the total animals examined. The chi-square (χ^2) test was used to assess difference in frequency of the helminths between the sex and age groups. In all cases, 95% confidence intervals and $P < 0.05$, were set for significance.

RESULTS

Questionnaire survey

Very few owners (22%) were aware that canine parasites could be transmitted to humans. Of these owners, 60% reported that tapeworms (*D. caninum*), and hydatids (*E. granulosus*) were zoonotic agents, followed by roundworms (*Toxocara*). Of the owners who were aware of the potential for transmission of parasites from dogs to humans, none of them could provide correct information on the mode of transmission. None of the dog owners had treated their dogs using anthelmintics in their life time. However, 24% reported treatment of dogs using traditional preparations. None of the owners reported removal

Table 1. Knowledge and attitudes of dog owners regarding potential zoonotic disease in the traditional communities of Wondogenet, south Ethiopia.

Variable	{No (%)}
Dog ownership	
One dog	18 (36)
Two or more dogs	32(64)
Occupation of owners	
Farmer with no education	50(100)
Reasons for keeping dogs	
Hunting	2(4)
Look after livestock	41(82)
No specific reason	7(14)
Housing of dogs	
Confined to dog house on compound	-
Share the same house with the owners and livestock	50(100)
Feeding of dogs	
Condemned offals	28(56)
Condemned offals and human food	22(44)
Usual place of defecation of dogs	
Within the house premises and in grazing areas	50(100)
Do children play with dogs	
Yes	50(100)
No	-
Dog owners' perception of diseases transmitted by dogs	
Serious	6(12)
Not serious	28(56)
Do not cause any disease	16(32)
What are the main parasitic diseases of dogs	
<i>Taenia</i> species (Kosso locally)	28(56)
<i>Toxocara canis</i>	22(44)
Treatment for dogs	
No at all	38(76)
Use traditional preparations	12(24)

of their dog's feces. Almost all owners had fed their dogs' raw carcass of a dead animal and condemned offals (Table 1).

Fecal sampling

The overall infestation of dogs with gastrointestinal (GI) parasites was 90.7% (CI 24.4–33.1%) and 100% based on coproscopy and postmortem examination, respectively.

GI helminth parasites of dogs identified based on fecal examination were: *Taenia* spp., *A. caninum*, *Tirchuris vulpis*, *Toxocara canis*, *Dipylidium caninum* and *Strongyloides stercoralis* (Table 2). Infection with only one species of parasite was more common (73.6%) than infection with two (69.1%), three (57.2%) or four (34.9%) species (Table 3). Overall frequency of infection with GI helminthes in dogs and frequency in different sex and age groups obtained by coproscopical examination is described in Table 4.

Table 2. Intestinal parasites diagnosed in the faeces of 269 dogs and their respective prevalence in Wondo Genet, south Ethiopia.

Parasite	Positive {No. (%)}
<i>Taenia spp</i>	201(74.7)
<i>Ancylostoma spp</i>	199(73.9)
<i>Protozoa spp</i>	180(66.9)
<i>Tirchuris vulpis</i>	189(70.3)
<i>Toxocara canis</i>	145(53.9)
<i>Dipylidium caninum</i>	126(46.8)
<i>Strongyloides stercoralis</i>	124(46.1)
<i>Protozoa spp</i>	105(39.0)

Table 3. Concurrent intestinal helminth species of dogs identified based on coproscopy and postmortem examination in Wondo Genet, southern Ethiopia.

Number of helminthes	Coproscopy (n = 269)		Postmortem (n = 13)	
	No. infected	{% (95% CI)}	No. infected	{%(95%CI)}
One helminth species	198	73.6(44.2 – 54.3)	2	15.4
Two helminth species	186	69.1(10.0 – 16.9)	4	30.8
Three helminth species	154	57.2(2.7 – 7.1)	5	38.5
Four or more helminth species	94	34.9(0.0 – 2.9)	2	15.4

Table 4. Overall frequency of infection with GI helminthes in dogs and frequency in different sex and age groups obtained by coproscopical examination.

Variable	No. examined	No. (%) infected	χ^2 (P-value)
Sex of dogs			
Male	141	123(87.2)	0.113
Female	128	121(94.5)	
Total	269	244(90.7)	
Age of dogs (Month)			
0-6	36	24(66.7)	7.6
7-11	73	70(95.9)	
> 12	160	150(93.8)	
Total	269	244(90.7)	

Postmortem examinations

Out of 13 male adult dogs examined, all of them (100%) harbored one or more GI helminthes. Of these, 84.6% were infected with two or more GI helminthes (Table 4). Based on postmortem examination, dog gastrointestinal helminthes identified were: *Echinococcus granulosus*, *Taenia hydatigena*, *Taenia ovis*, *Ancylostoma caninum*, *Tirchuris vulpis*, *Toxocara canis* and *Dipylidium caninum*. The study revealed that *Taenia spp.* was more prevalent followed by nematodes (Table 5). The dogs used for postmortem examination were adult (age greater than one year) males, no comparison was made between sex and age groups.

DISCUSSION

The present study provides qualitative estimates of parasites in dogs in Wondo Genet area, south Ethiopia. The results show that gastrointestinal helminth species were abundant, and that prevalence of infection was very high. The knowledge and perception of dog owners regarding zoonotic diseases transmitted by pets was insufficient.

The parasites reported in this study have been previously documented in dogs throughout the world (Senlik et al., 2006), with a pronounced difference in prevalence and density between regions. In our study the coproscopical and postmortem examinations revealed the frequency of gastrointestinal helminth infestation of dogs to

Table 5. Intestinal parasites of 13 adult male dogs identified based on postmortem examination in Wondo Genet, south Ethiopia.

Parasite	Positive (No. (%))
<i>Echinococcus granulosus</i>	8 (61.5)
<i>Taenia hydatigena</i>	9 (69.2)
<i>Taenia ovis</i>	4 (30.8)
<i>Ancylostoma caninum</i>	7 (53.8)
<i>Tirchuris vulpis</i>	7 (53.8)
<i>Toxocara canis</i>	8 (61.5)
<i>Dipylidium caninum</i>	10 (76.9)
<i>Mesocestodes</i>	11 (84.6)

be 90.7 and 100%, respectively. There was no significant difference in the results obtained between the two techniques. The slight difference observed could be due to the fact that coprological examinations may not detect the immature parasites, which are unable to lay eggs. However, the overall frequency rate thus obtained on coprological examination is in agreement with previous works in Turkey (Senlik et al., 2006), Netherlands (Nobel et al., 2004), and in Greece (Haralabidis et al., 1988) but a lower frequency rate was recorded in Santa Catarina (Blazuius et al., 2005) and in Nigeria (Ugochukwu and Ejimadu, 1985). The discrepancy in the overall frequency rates reported in various countries could be attributed to the difference in health care and animal management practices followed in different countries.

The difference in the frequency of the nematode infections between countries is possibly due to the differences in climatic factors required for the biology of the parasites, veterinary facilities and public awareness to take care of the dogs. During the survey, it was noted that a large number of dogs scavenge at abattoirs and at butcher shops and those kept indoors are also frequently fed uncooked offal that are not in good hygienic condition. It is also common to find animal cadaver thrown into street where dogs communally feed on, which could be a suitable media for transmission of the parasites.

This potential for human zoonotic disease has rarely been addressed in control programs in Ethiopia and other low income countries. Considering the high prevalence of gastrointestinal helminth infections found in dogs, and the close bonds in which dogs live together with people, the risk of transmission of these parasites to humans seems to be obvious. For example, *Toxocara* infection in humans may cause visceral larva migrans, in severe cases leading to blindness (Taylor, 2001), and dog hookworm infections put humans at risk for cutaneous larva migrans which is endemic in many resource-poor communities (Heukelbach et al., 2005).

The prevalence detected in our study differs from those of Hailu et al. (2007) who recorded 51% based on coproscopy and nearly similar result on postmortem examination. The recorded high prevalence of

gastrointestinal parasites of dogs in Wondo Genet area may be due to lack of access to veterinary services and poor awareness of the owners. Our data shows that the majority of dogs never or rarely received antiparasitic treatment during their puppy stage, and only few people were aware of the zoonotic potential of dog parasites.

The diagnostic technique of parasites done in this study, based on the morphological characteristics of ova under light microscope, has the disadvantage that it fails to distinguish *E. granulosus* from other Taenidae. Thus, *E. granulosus*, a major zoonotic parasite of livestock and dogs in Ethiopia (Kebede et al., 2009) may be highly prevalent as it is indicated in the postmortem examination. The fact that dogs enjoy unrestrained association with humans, scavenge for food in an environment contaminated with faecal material of potential intermediate hosts and feed on offal of slaughtered livestock in abattoirs (Jones et al., 2011) makes transmission of zoonotic parasitic diseases predictable in the setting studied.

In general, the trend in prevalence, density and species composition of parasites observed in this study may reflect the degree of environmental contamination and inequalities in the health care service between urban and rural areas. In particular, *T. canis*, *A. caninum* and *D. caninum* are zoonotic parasites constituting public health problems in the study areas.

Conclusion

The study shows the presences of different nematode species in a single host as well as high frequency of these parasites in the study area suggestive of serious attention due to pathogenic impact of the parasites. In addition, parasites of importance for human health were highly prevalent in Wondo Genet area dogs and that intervention measures are necessary to reduce the risk of transmission of parasites from dogs to humans. Interventions should focus on health education provided to dog owners, strategic deworming of dogs using broad-spectrum anthelmintics and the establishment of a program based on zoonotic diseases, have paramount importance. Moreover, further epidemiological studies should be conducted seasonally in different regions of the country.

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REFERENCES

- Abo-Shehada MN (1989). Prevalence of *Toxocara* ova in some schools and public grounds in northern and central Jordan. *Ann. Trop. Med. Parasitol.*, 83: 73-75.

- Anderson RC (1992). Nematode parasites of vertebrates: Their development and transmission, 1st edition, CAB International University Press, Cambridge, UK, p. 578.
- AliM (2007). Recreation Use Value of Wondo Genet Wetland Ecosystem, Ethiopia. MSc Thesis, Department of Forest Resources Management at Faculty of Forest Sciences of the Swedish University of Agricultural Sciences (SLU), Umea, p. 66.
- Benbrook EA (1963). Outline of parasites reported from domesticated animals in North America, 6th edition, Iowa State University Press, USA, p. 186.
- Blazuius RD, Emerick S, Prophiro JS, Romao PR, Silva OS (2005). Occurrence of protozoa and helminths in fecal samples of stray dogs from Itapema City Santa Catarina. Rev. Soc. Bras. Med. Trop., 38: 73-74.
- CSA (2008). Central Statistical Agency of Ethiopia. Annual report.
- Dalimi A, Mobeidi I (1992). Helminth parasites of carnivores in North Iran. Ann. Trop. Med. Parasitol., 86: 395-397.
- Eslami A, Hosseini SH (1998). *Echinococcus granulosus* infection of farm dogs of Iran. Parasitol. Res., 84: 205-207.
- Hailu Y, Ayele T, Fikru R, Basu AK (2007). Gastrointestinal nematodes in dogs from Debre Zeit, Ethiopia. Vet. Parasitol., 148: 144-148.
- Haralabidis ST, Papazachariadou MG, Koutinas AF, Rallis TS (1988). A survey on the prevalence of gastrointestinal parasites of dogs in the area of Thessaloniki Greece. J. Helminthol., 62: 45-49.
- Hendrix CM (2003). Laboratory Procedures for Veterinary Technicians 4th edition, Mosby, Inc., USA, p. 364.
- Heukelbach J, Walton SF, Feldmeier H (2005). Ectoparasitic infestations. Curr. Infect. Dis. Rep., 7: 373-80.
- Jones O, Kebede N, Kassa T, Tilahun G, Macias C (2011). Occurrence of bovine hydatidosis and evaluation of its risk to humans in traditional communities of Southern Region of Ethiopia. EJHD (In press).
- Kebede N, Mitiku A, Tilahun G (2009). Hydatidosis of slaughtered animals in Bahir Dar Abattoir, Northwestern Ethiopia. Trop. Anim. Healthc. Prod., 41: 43-50.
- Khaliil LF, Jones A, Bray RA (1994). Keys of the cestode parasites of vertebrates. CAB International, Wallingford, UK, p. 751.
- Larriou E, Costa MT, Cantoni G, Alvarez R, Cavagion L, Labanchi JL, Bigatti R, Araya D, Herrero E, Alvarez E, Mancini S, Cabrera P (2001). Ovine *Echinococcus granulosus* transmission dynamics in the province of Rio Negro, Argentina, 1980-1999. Vet. Parasitol., 98: 263-272.
- Lightner L, Christensen BM, Beran GW (1978). Epidemiologic findings on canine and feline intestinal nematode infections from records of the Iowa State University Veterinary Clinic. J. Am. Vet. Med. Assoc., 172: 564-567.
- McManus DP (2006). Molecular discrimination of taeniid cestodes. Parasitol. Int., 55: 31-37.
- Meyer MC, Olsen OW (1980). Essentials of parasitology. 5th edition, Brown, Dubu-due, Iowa, USA, p. 298.
- Nobel WE, Robben SR, Dopfer D, Hendrix WM, Boersema JH, Fransen F, Eysker M (2004). Infections with endoparasites in dogs in Dutch animal shelters. Tijdschr. Diergeneeskd., 129: 40-44.
- Okaeme AN (1985). Zoonotic helminths of dogs and cats at New Bussa, Kainji Lake area, Nigeria. Int. J. Zoonoses, 12: 238-240.
- Oliveira-Sequeira TC, Amarante AF, Ferrari TB, Nunes LC (2002). Prevalence of intestinal parasites in dogs from Sao Paulo State, Brazil. Vet. Parasitol., 3: 19-27.
- Overgaauw PA (1997). Prevalence of intestinal nematodes of dogs and cats in The Netherlands. Vet. Q., 19: 14-17.
- Prociv P, Croese J (1990). Human eosinophilic enteritis caused by dog hookworm *Ancylostoma caninum*. Lancet, 335: 1299-1302.
- Schantz PM (1994). Of worms, dogs, and human hosts: continuing challenges for veterinarians in prevention of human disease. J. Am. Vet. Med. Assoc., 204: 1023-1028.
- Schantz P M, Kramer MH J (1995). Larval cestode infections: cysticercosis and echinococcosis. Curr. Opin. Infect. Dis., 8: 342-350.
- Senlik B, Cirak VY, Karabacak A (2006). Intestinal nematode infections in Turkish military dogs with special reference to *Toxocara canis*. J. Helminthol., 80: 299-303.
- Shimeles S (1994). The prevalence of gastrointestinal helminths of dogs in Debre Zeit Area. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Ethiopia.
- Soulsby EJJ (1982). Helminthes, arthropods and protozoa of domesticated animals. The English Language Book Society and Bailliere Tindall, London, UK, p. 809.
- Taylor MR (2001). The epidemiology of ocular toxocarasis. J. Helminthol., 75: 109-18.
- Totkova A, Klobusicky M, Holkova R, Friedova L (2006). Current prevalence of toxocarasis and other intestinal parasitoses among dogs in Bratislava. Epidemiol. Mikrobiol. Immunol., 55: 17-22.
- Ugochukwu EI, Ejimadu KN (1985). Studies on the prevalence of gastro-intestinal helminths of dogs in Calabar, Nigeria. Int. J. Zoonoses., 12: 214-218.
- Vanparijs O, Hermans L, Van-Der Flaes L (1991). Helminthes and protozoan parasites in dogs and cats in Belgium. Vet. Parasitol. 38: 67-74.
- Yamaguti S (1961). Systema Helminthum, Volume 3: The nematodes of vertebrates. Interscience publishers Inc., New York, Parts I & II. p. 1261.
- Yorke W, Maplestone PA (1969). Nematode parasites of vertebrates, 3rd edition, Hafner, New York, p. 316.