

Prevalence of gastrointestinal helminth parasites of dogs and associated risk factors in Adama Town, Central Ethiopia

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Abstract

A cross-sectional study was conducted from November 2013 to April 2014 with the objectives of estimating the prevalence of helminth parasites of dogs and associated risk factors in Adama. Standard fecal flotation and sedimentation techniques were used to identify parasite ova. Accordingly the prevalence of gastrointestinal helminth parasites of dogs was found to be 82.03% (95% CI, 77.8-85.7). Helminth species identified were *Ancylostoma* spp, *Dipylidium caninum*, *Toxocara canis*, *Strongyloides stercoralis*, *Echinococcus granulosus*, *Trichuris vulpis*, *Taenia* spp and *Toxascaris leonina*. *Ancylostoma* spp were the most frequent and *T. leonina* was the least abundant parasite observed with prevalence of 40.1% and 0.26%, respectively. The prevalence of helminth parasites was significantly higher ($p > 0.05$) in young (91.4%) than adult (76.6%) dogs. Thin dogs had significantly higher ($p > 0.05$) overall prevalence (92.8%) than fat dogs (67.7%). Non-confined dogs had higher prevalence (92.5%) than partially confined (83.1%) and fully confined (64.5%) dogs, the difference being statistically significant between the non-confined and fully confined categories ($p < 0.05$). Among the three frequently observed parasites *T. canis* had significantly higher prevalence in young dogs. Poor body condition and degree of dog's home confinement were associated with *Ancylostoma* spp ($p < 0.05$); while prevalence of *D. caninum* was not affected by any of the risk factors considered. Sex and breed of dogs had no significant effect on prevalence both at the overall and individual parasite levels ($p > 0.05$). The presence of these parasites with the observed abundance and subsequent contamination of the environment by parasite ova and larvae is of public health importance. Strategic treatment of young dogs at the earliest possible age and responsible dog ownership with proper housing management were forwarded as recommendation.

Keywords: Adama, *Ancylostoma* spp, Helminth parasites, Risk factors, *Toxocara canis*, Zoonoses

<http://dx.doi.org/10.4314/evj.v19i2.1>

Introduction

The dog is the first domesticated animal with long history of existence with humans. The long existence has brought not only close friendship between the two, it also brought close contact between dogs and other domesticated animals. This co-existence has resulted in the transmission of disease agents directly or one or more animal species serving as important intermediate host for parasites of dogs (Morand *et al.*, 2014). Apart from their effects on health of dogs, some of the parasites cause ill health and severe economic loss in other domestic species that serve as intermediate hosts for some of parasites of dogs (Achenef Melaku *et al.*, 1999; Abebe Fromsa and Yilma Jobre, 2012; Kassahun Asmare *et al.*, 2014). Moreover, some of the disease causing agents in dogs are zoonotic, causing human suffering, hospitalization and in some cases loss of life. The most commonly known such diseases in Ethiopia include rabies and hydatidosis (Hagos Biluts *et al.*, 2006; Asefa Deressa *et al.*, 2010).

Dogs are reservoirs for many zoonotic helminth parasites such as *Echinococcus granulosus*, *Ancylostoma caninum*, *Toxocara canis*, *Strongyloides stercoralis*, *Dypilidium caninum*, *Trichuris vulpis* and *Toxascaris leonina*. A postmortem study conducted by Yacob Hailu *et al.* (2007) reported high prevalence of nematode parasites of dogs particularly those of *A. caninum* (70%), *T. canis* (45%), *Spirocerca lupi* (23.5%) and *T. vulpis* (5%) all except *S. lupi* being zoonotic parasites. Similar studies conducted in major Ethiopian towns such as Ambo, Bahir Dar, Gondar and Hawassa, demonstrated the presence of these zoonotic parasites affecting large proportion of dogs (Endrias Zewduet *et al.*, 2010; Eleni Awoke *et al.*, 2011; Dejene Gebreselasie *et al.*, 2013; Tadiwos Abere *et al.*, 2013). Studies also identified lack of public awareness on parasitic zoonoses from dogs (Endrias Zewdu *et al.*, 2010; Dejene Gebreselasie *et al.*, 2013). Majority of dogs in Ethiopia are managed as free roaming and it was observed that these dogs harbor the largest burden of parasites. The presence of large number of stray and non-confined dogs with high prevalence of zoonotic parasites that contaminate the environment in the absence of public awareness of such risks is greatly concerning. Therefore, continuous studies across the country and continuous awareness creation through empirical evidences are required to initiate sufficient public interest in responsible dog ownership. However, so far only few accessible published studies on gastrointestinal parasites of dogs are available as compared to diseases of livestock (Yacob *et al.*, 2007; Endrias Zewduet *et al.*, 2010). The objective of the current study is therefore to identify and estimate the prevalence of gastrointestinal parasites of dogs in Adama town, central Ethiopia.

Materials and Methods

Study area

The study was conducted in Adama town, Eastern Shewa Zone of Oromia Regional State, central Ethiopia. Adama is located between 8° 33' to 8° 36'N latitude and 39° 11' 57" to 39° 21' 15"E longitude, 100Kms southeast of Addis Ababa on the main highway that links the capital to eastern Ethiopia and the port of Djibouti. Adama has an altitude of 1622 meters above sea level. Adama receive an average rainfall of approximately 600-1150mm with temperature range of 19-22°C (Adama City Administration, 2005).

Study animals

Dogs of all age group and both sexes were selected using systematic random sampling method from dogs brought to Adama veterinary clinic for treatment and vaccination. The first and fourth days of the week were purposively selected for those were days when maximum numbers of dogs were brought to the clinic for vaccination. On each visit 6-10 dogs were sampled from 25-45 dogs that visit the clinic regardless of their disease status. Animal bio-data such as age, sex and breed; animal management i.e, degree of dog's house confinement were recorded.

Study design and sample size

A cross-sectional study was conducted from November 2013 to April 2014 on 384 dogs. The sample size was determined by a formula for estimation of single proportion for simple random sampling given by Thrusfield (2005). Since there was no previous study, the sample size was determined by using 50% expected prevalence and 5% desired absolute precision at 95% confidence interval.

Sampling and sample processing

Fecal samples were collected per rectum and processed within few hours and examined using floatation and sedimentation techniques (Foreyt, 2001). When it was not possible to process within such time; formalin was used to preserve the samples. A sample was considered positive when at least one parasite egg was present. Parasite ova morphology observed under 10X stage objective were characterized according to Hendrix (2012) and classified to the level of genera or species.

Statistical analysis

The data obtained from coprological examinations was analyzed by using Stata version 11.0 (STATA, 2009). Prevalence was calculated by dividing the number of dogs harboring any helminth parasite by the total number of dogs examined. The logistic regression analysis was used to assess association of dog helminthosis with different risk factors including sex, age, breed, body condition and housing management (degree of dog's confinement). Age was classified as young for dogs of up to one year, and adult for those above one year. History and phenotypic characteristics such as hair type, size and stature were used to classify breed types. Body condition score (BCS) on scale of 1-5 (very thin, thin, ideal, fat, obese (Baldwin, 2010)) was used to collect data on the dogs' physical condition. For ease of data analysis however, dogs with BCS of less than 3 were considered thin and hence 'poor'; those with BCS of 3 were considered ideal and hence labeled as 'normal' and those with BCS above 3 were considered overweight hence labeled as 'fat'. Housing management was classified as 'confined' for those dogs that are not allowed to go out of their owner's premises; 'partially-confined' for dogs released during some time of the day; and 'non-confined' for those that are free to roam around during any time of the day and return to homestead any time. In all the analysis, confidence level was held at 95% and estimated differences were considered significant at $p < 0.05$.

Result

Out of 384 dog fecal samples examined, 315 (82.03%) were found to harbor at least one species of parasites. In this study 8 parasite species were identified based on their egg morphology. *Ancylostoma* spp were the most commonly identified parasites while *T. leonina* was the least abundant (Table 1). All the parasites except *Taenia* spp were zoonotic.

Table 1: Gastrointestinal parasite of dog identified in Adama from November 2013 to March 2014 (N=384).

Parasite	No. Observed	Prevalence (%)
<i>Ancylostoma</i> spp.	154	40.10
<i>Dipylidium caninum</i>	91	23.70
<i>Toxocara canis</i>	45	11.72
<i>Strongyloides stercoralis</i>	21	5.47
<i>Echinococcus granulosus</i>	21	5.47
<i>Trichuris vulpis</i>	18	4.69
<i>Taenia</i> spp	2	0.52
<i>Toxascaris leonina</i>	1	0.26

The actual composition of the parasites in the study area showed that 283 (89.8%) of the dogs had mono-parasitic infections, while the rest 32 (10.2%) had mixed infection of two or more parasites (Fig. 1).

Minor= 2 *Taeniaspp* and 1 *Toxoascarisleonina*

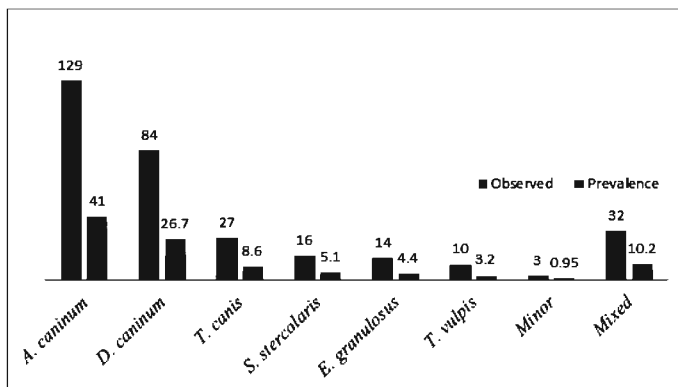


Figure 1. Relative composition of helminth parasites of dogs identified in Adama town

Prevalence of dog helminth parasites in relation to risk factors

Univariable and multivariable logistic regression analysis of the presumed risk factors showed that only age, body condition and degree of dogs' home confinement were significantly associated with the overall prevalence of parasites ($p < 0.05$). Sex and breed had no significant effect ($p > 0.05$) on the prevalence of GI helminth parasites of dogs (Table 2).

Table 2: Multivariable logistic regression analysis of risk factors in Adama Town.

Variables	Level	Proportion (%)	Odds ratio	95% CI	ρ -value
Age	Young (n=144)	91.4			
	Adult (n=244)	76.6	3.7	1.8-7.4	0.000
Body condition	Fat (n=124)	67.7			
	Normal (n=149)	85.9	1.6	0.65-3.96	0.302
	Poor (n=111)	92.8	3.9	1.6-9.2	0.002
Confinement	Complete (n=76)	64.5			
	Partial (n=201)	83.1	2.8	1.2-6.7	0.018
	None (n=107)	92.5	5.5	2.2-13.7	0.000

The three major parasites identified in this study were analyzed with respect to putative risk factors. Accordingly *T. canis* was the only one to be significantly associated ($p < 0.05$) with age; young dogs were more likely to be affected than adult ones. Poor body condition and being non-confined were more likely to be associated with prevalence of *Ancylostoma* spp (Table 3). No statistically significant association was observed between *D. caninum* and the considered risk factors. Sex has no significant association ($p > 0.05$) with any of the parasites considered.

Table 3: Logistic regression analysis result for risk factors with major dog helminthes.

Major parasite	Risk factors	Risk factor category	Prevalence (%)	ρ -value	OR	95%CI	OR
Ancylostoma spp.	Age	Young (n=144)	42.1	0.537	1.14	0.75-1.7	
		Adult (n=244)	38.9				
	BCS	Fat (n=124)	27.4	0.014	1.7	1.1-3.1	
		Normal (n=149)	39.6				
		Poor (n=111)	54.95				
	DC	Complete (n=76)	26.3	0.023	1.7	1.1-2.8	
Partial (n=201)		38.8					
None (n=107)		52.3					
<i>T. canis</i>	Age	Young (n=144)	20.0	0.000	3.3	1.7-6.4	
		Adult (n=244)	6.97				
	BCS	Fat (n=124)	12.1	0.751	0.88	0.4-1.92	
		Normal (n=149)	12.1				
		Poor (n=111)	10.8				
	DC	Complete (n=76)	19.7	0.758	0.88	0.4-1.97	
		Partial (n=201)	9.9				
		None (n=107)	9.3				
					0.865	0.93	0.45-2.1
				0.048	0.42	0.18-0.99	

OR=odds ratio, CI=confidence interval, BCS=body condition score, DC=degree of confinement

Discussion

Out of 384 dogs coproscopically examined in Adama town, 315 (82.03%) of dogs were found to be infected by at least one species of helminth parasites. Similar high prevalence of helminthosis of dogs were reported by previous studies in Ethiopia. Yacob Hailu *et al.* (2007) from dogs in Debre Zeit, Endrias Zewdu *et al.* (2010) from Ambo, Tadiwos Abere *et al.* (2012) from Bahir Dar and Dejene Gebreselasie *et al.* (2013) from dogs in Hawassa towns, reported high prevalence of 95%, 86.5%, 84.8% and 84.6% respectively. These super endemic levels of helminthosis in dogs in major towns in Ethiopia are testimonies for

widespread neglect for health concerns of dogs across the country. Some of the overlook could be attributed to lack of public awareness on the effect of these parasites on the health and welfare of dogs and human beings (Endrias Zewdu *et al.*, 2010; Dejene Gebreselasie *et al.*, 2013). Earlier studies conducted during the late 1980's and early to mid 1990's reported high prevalence of parasitic infections in dogs ranging from 98.3-100% in Debre Zeit, Wollaita Soddo and towns in Eastern Ethiopia (Muktar Rashid, 1988; Temesgen Samuel, 1990; Shihun Shimeles, 1994). This clearly marks the very little progress made over the last three decades with regard to dog health and management.

In the current study eight parasite genera/species were identified. *Ancylostoma* spp. were the most prevalent parasite recovered in the current study with prevalence of 40.1%. This result is in agreement with the results of most of the studies so far conducted in Ethiopia showing a trend that *Ancylostoma* spp being the most prevalent parasites of dogs (Muktar Rashid, 1988; Temesgen Samuel, 1990, Shihun Shmeles, 1994; Yacob Hailu *et al.*, 2007; Tadiwos Abere *et al.*, 2012; Zelalem Getahun and Mekonnen Addis, 2012; Dejene Gebreselasie *et al.*, 2013). The prevalence of this parasite in our study is in agreement with the reports of Endrias Zewdu *et al.* (2010), who reported prevalence of 35.7% with coproscopy and 50% with necropsy from dogs in Ambo town and 44.4% report from Bahir Dar by Zelalem Getahun and Mekonnen Addis, (2012). However, it is lower than the 70% necropsy findings of Yacob Hailu *et al.* (2007) and 78.9-84.6% coproscopical findings of Tadiwos Abere *et al.* (2012) in pet and stray dogs in Bahir Dar. The difference could be attributed to the sampling method, diagnostic technique employed and difference in ecological factors. Comparative study conducted in Brazil showed variability in the sensitivity of different diagnostic tests necropsy being more sensitive than coproscopy (Klimpel *et al.*, 2010).

Diplydium caninum was the second most prevalent parasite in our study with a prevalence of 21.7%. Our result is much lower than the 71% prevalence reported by Endrias Zewdu *et al.* (2010). However, it is in agreement with the 22.4% prevalence report of Zelalem Getahun and Mekonnen Addis in Dahir Dar and 29.9% and 29.7% prevalence reports from Hawassa and Bahir Dar towns by Dejene Gebreselasie *et al.* (2010) and Tadiwos Abere *et al.* (2012) respectively. The prevalence of this parasite is much higher than the 6.56% report by Guesh Negash *et al.* (2014) in Mekelle indicating variation in the prevalence of *D. caninum* in different geographical areas of the country which could in turn be associated with local conditions affecting the prevalence and distribution of arthropod vectors of the parasite.

Toxocara canis was the other frequently observed parasite in the current study accounting for 11.7% (95% CI, 8.7-15.4). This result is in agreement with the results of studies from Maracaibo in Venezuela (11.4%) by Ramirez-Barrios *et al.* (2004), Fortaleza in Brazil (8.7%) by Klimpel *et al.* (2010) and 7.9% in stray dogs in Durban, South Africa by Mukaratirwa and Singh (2010). Our result is also in agreement with the 17.3% and 21% prevalence report of Endrias Zewdu *et al.* (2010) and Yacobet *et al.* (2007) from Ambo and Debre Zeit towns respectively. Several studies conducted in Ethiopia however, reported higher prevalence of *T. canis* ranging from 32.8-39.8% from Hawassa and Bahir Dar towns (Zelalem Getahun and Mekonnen Addis 2012; Dejene Gebreselasie *et al.*, 2013; Tadiwos Abere *et al.*, 2013). The differences could be attributed to local ecological conditions, sample size, sampling method and age composition of dogs in the studies.

Other parasites reported in this study include *S. stercoralis* and *E. granulosus* with prevalence of 5.4% each. Similar studies conducted elsewhere in Ethiopia also identified these parasites with similar proportions. Our result agrees with reports of Zelalem Getahun and Mekonnen Addis (2012) on 8.6% prevalence for *S. stercoralis* from Bahir Dar town in north western Ethiopia and Endrias Zewdu *et al.* (2010) report of 8.6% prevalence for *E. granulosus* in Ambo town in central Ethiopia. These parasites are of huge zoonotic importance. Their existence and subsequent environmental contamination poses considerable economic and public health risks. Studies conducted in Hawassa and Yirgalem hospitals demonstrated the importance of *S. stercoralis* in humans in southern Ethiopia with prevalence ranging from 5-12%. The infection proportion being significantly higher in people with HIV/AIDS than those without (Amde Getaneh, *et al.*, 2010; Shimelis Assefa, *et al.*, 2009).

With respect to risk factors affecting dog's positivity for helminth parasites only age, degree of dog's house confinement and body condition of the dogs were found to be significant. Sex and breed of dogs had no association with prevalence of helminth parasites in this study. Young dogs were observed to have significantly higher prevalence of helminthes ($p < 0.05$) than their older counterparts. Such differences were observed by previous studies from Ethiopia (Zelalem Getaneh and Mekonnen Addis, 2012; Tadiwos Abere, *et al.*, 2013), Nigeria (Ugochukwu and Ejimadu, 1985) and Brazil (Oliveira-Sequeira, *et al.*, 2002). This could partially be due to the fact that parasite specific immunity is usually acquired with age or probably as consequence of single or repeated previous exposures (Ramirez-Barrios *et al.*, 2004).

The other important factor that was found to be associated with helminthosis in this study was dog management with respect to degree of house confinement. Dogs that roam freely had higher prevalence (92.5%) of helminthosis than dogs confined within the premises of their owners (64.5%). Similarly higher prevalence (97.34%) of helminthosis was documented for stray dogs in Hawassa as compared to confined dogs (69.6%) (Dejene Gebreselasie, *et al.* 2013). Dogs that freely move and scavenge around appear to have higher chances of coming in contact with contaminated environment.

Although the cause and effect of helminthosis and poor body condition could not be determined using the current study design, it was observed that dogs with poor body condition had significantly higher ($p < 0.05$) prevalence of helminth parasites than those with better body conditions. The 92.8% versus 67.7% prevalence in this study in dogs with poor body condition and overweight dogs is in agreement with the 97.3% versus 69.6% observations in similar categories in Hawassa town (Dejene Gebreselasie *et al.* 2013).

Analysis for association of any of the risk factors considered in this study with prevalence of the three major parasites indicated that age of dogs had significant association with *T. canis* infection; poor body condition and degree of dogs' house confinement were associated with *Ancylostoma* spp. while *D. caninum* was not associated ($p > 0.05$) with any of the factors. This finding is in agreement with Ugbomoiko *et al.* (2008) from Nigeria who observed an increasing trend in prevalence of gastrointestinal helminthosis with age except for *T. canis* where inverse relationship was observed. This finding is in line with the general observation that toxocarosis is a disease of young dogs (Taylor *et al.*, 2007). *Ancylostoma* spp. had significantly higher prevalence among dogs with poor body condition and free roaming dogs. This is in agreement with the findings of Tadiwos Abere *et al.* (2013). This could be because of the pathogenesis of the infection where it causes anemia with subsequent hypoproteinemia and demand for more protein than the dog can gain from feed sources resulting in cachexia and route of infection that require ingestion of L₃ or skin penetration from contaminated environment that is more likely to occur in dogs that have free access to contaminated areas (Taylor *et al.*, 2007).

The results of this study showed that helminthosis in dogs to a serious problem in Adama. Our study however has limitations that need to be taken into consideration that might have affected the true magnitude of the problem. These limitations include season, where only dry season was considered,

exclusion of some dogs, particularly, ownerless ones which might have under estimated and inclusion of some clinical cases because of the systematic random sampling method used, which might have an effect on the final prevalence estimate.

In conclusion our study revealed prevalence of helminth parasites in Adama to be 82.03%. Eight parasites species were identified. *Ancylostoma* spp., *D. caninum* and *T. canis* were the most prevalent parasites. The majority of the identified helminth parasites were of zoonotic importance. Young dogs, dogs with poor body condition and those allowed straying from households were significantly affected by gastrointestinal parasites. Therefore, public awareness should be created on the importance of deworming young dogs at the earliest possible age and keeping dogs housed and properly fed to avoid straying. As this work was limited in its scope to only gastrointestinal helminthes and in time, only to the dry period of the year, a detailed epidemiological study is required to understand the complete picture of canine parasitism in the study area.

Acknowledgements

We would like to express our sincere gratitude to professionals at Adama Veterinary Clinic and Assela Regional Veterinary Laboratory for their material and technical support. We are also grateful to all dog owners in Adama for their willingness and collaboration.

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