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Prevalence of gastrointestinal helminths and management practices for dogs in the Greater Accra region of Ghana

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Abstract

Toxocariosis and ancylostomosis remain the most important parasitic infections affecting companion animals worldwide and pose a risk to animal and human health. Information on these infections in dogs in Ghana is inadequate. A cross sectional study was undertaken to determine the occurrence of gastrointestinal helminths infections and management practices of dogs in the Greater Accra Region (GAR) of Ghana. Faecal samples were obtained from 380 dogs from communities in 11 out of 16 districts in the GAR. Coprological examination of the samples was performed using the modified McMaster technique. Management practices for control of helminths in dogs were assessed through questionnaire interviews of the dog owners. Most dogs (70.7%) were kept for security reasons and were not housed (61.8%). Prevalence of gastrointestinal helminths was 62.6%. Hookworm eggs were found in 178 (46.8%) dogs, *Toxocara canis* eggs in 22

(5.8%) and mixed infections of hookworms and *T. canis* in 38 (10.0%). *Dipylidium caninum* was found in 51 (13.4%) dogs, while *Isospora* species was in 33 (8.5%) dogs. Most households (68%; 133/194) of the sampled dogs had at least a child below the age of 5 years. Hookworm, *T. canis* and *D. caninum* were the zoonotic gastrointestinal helminths prevalent in dogs in the study area. Lack of housing for dogs creates ideal conditions for infection and spread of the zoonotic parasites.

Keywords: Dogs, Gastrointestinal helminths, Greater Accra region, Management practices, Ghana

1. Introduction

Pet dogs and cats have been associated with more than 60 zoonotic diseases of which, helminthosis, takes on significant public health and veterinary importance globally (Eguía-Aguilar et al., 2005; Sager et al., 2006). Toxocariosis and ancylostomosis are reported to remain the most important parasites affecting companion animals worldwide (Traversa, 2012). Some canine helminths are documented to cause significant clinical diseases such as hydatidosis, visceral and cutaneous larva migrans in humans (Thompson et al., 1986). Dog ownership is considered to be a risk factor for the occurrence of *Ancylostoma caninum* induced eosinophilic enteritis, an emerging zoonotic infection (McCarthy and Moore, 2000).

Samuel et al. (2001) estimates that 36% of dogs in the United States harbour helminths of public health importance. *Toxocara canis* infection rates in Western Europe are estimated at 3.5 to 34% (Overgaauw, 1997; Lee et al., 2010). In Africa, prevalence of helminth infections ranges from 67.2% in Tanzania (Muhairwa et al., 2008), 72.5% in Nigeria (Mahmuda et al., 2012), 89.3% in Ethiopia (Mekbib et al., 2013) to 91.4% in Gabon (Davoust et al., 2008). However, information on these parasites in dogs in Ghana is scant.

Ghana has a population of owned dogs of about one million, excluding the numerous unowned and stray dogs that roam the streets in some communities (VSD, 2009). Dogs (both owned and stray) are allowed to roam streets and every open space (including playgrounds for children) unhindered. Pet keeping, particularly dogs in urban homes has become a common trend in Ghana around cities largely due to security concerns. Knowledge of the type of gastrointestinal helminths in dogs in a particular area is important to identify the zoonotic risk in the prevention and control of infections. The aim of this study was to determine the prevalence of gastrointestinal helminth infections and management practices of dogs in the Greater Accra Region (GAR) of Ghana.

2. Materials and methods

2.1. Study area and sample size

The study was conducted in the GAR, the second most populous administrative regions in Ghana (Ghana Statistical Service, 2012)¹ with the highest estimated population density of owned dogs of about 35/km² (VSD, 2009). A minimum sample size of 384 dogs was arrived at, using a maximum prevalence of 50%, in the absence of published data on the prevalence of helminth infections in dogs in Ghana. A total of 380 dogs were sampled.

2.2. Selection of dogs and sampling

In ensuring a geographically representative sampling, the region was clustered into three, based on the local administrative divisions of the region, namely districts, municipalities and metropolis (MMDs). The GAR has 5 districts, 9 municipalities and 2 metropolises (MMDs). Samples were obtained from MMDs in proportion to GAR population density. Dogs sampled were drawn from veterinary clinics, community dogs whose owners were available at the time of sampling and willing to have their dogs sampled, and hunting dogs. The dogs were classified according to the purpose for which they were kept, namely companionship, security, breeding and hunting dogs. A hunting dog was one that was actively involved in hunting at the time of the study. A dog's status was classified as apparently healthy if it did not exhibit any clinical signs of illness at the time of sampling. Dogs aged 6 months and below were considered puppies, 7 to 12 months as young adults and above 12 months as adults. Demographic characteristics of the dogs including age, sex, breed were assessed.

2.3. Faecal sample processing

Faecal samples were obtained directly from the rectum of each dog, with a gloved finger, once they were restrained. The samples were transported in a cool box to the laboratory. Coprological examination, preservation and clinical diagnosis were performed using the modified McMaster technique described in the MAFF manual (1986) and by Urquhart et al. (1996). In the laboratory, each faecal sample was examined physically first for the presence of adult worms, larvae or tapeworm segments. This was followed by microscopic examination for parasite eggs and oocysts. Identification of parasite eggs was done according to the morphological characteristics and keys as outlined by Sousby (1982) and MAFF manual (1986).

¹ www.statsghana.gov.gh/docfiles.2010phc. Accessed on May 20, 2013.

2.4. Management practices survey

Information on the management of dogs was assessed through the administration of a questionnaire to 204 dog owners who consented to be interviewed. The questionnaire focused on management practices such as feeding, housing, helminths control and awareness of parasitic zoonosis from dogs to man. The dog owners' demographics and level of education were also assessed.

2.5. Data analysis

Exploratory data analysis was carried out to obtain descriptive statistics. Categorical variables, such as anthelmintic treatment, and type of housing were compared using Chi square test while the student t-test was used in analysis of quantitative variables. Data entry and analysis was done in Epi InfoTM (version 7.1.2).

2.6. Ethical clearance

Permission was obtained from the Veterinary Services Directorate in Ghana. Individual consent was obtained from the dog owners prior to sample taking on their dogs and administration of the questionnaires.

3. Results

3.1. Characteristics of sampled dogs

A total of 380 dogs, mostly males (260; 68.4%) were sampled. These were drawn from 11 out of 16 MMDs in the GAR of Ghana. The age of the dogs ranged from one month to 14 years with a median of 12 months. Fifty seven percent (219) of the dogs were above 12 months of age, 98 (25.8%) were young adults and 63 (16.6%) were puppies. They were kept for security (216; 56.9%), hunting (103; 27.1%), companionship 32 (8.4%) and breeding 29 (7.6%) purposes (Table 1). Mongrels (249; 65.5%) and crossbreeds (71; 18.6%) dominated the dogs sampled. Others were Alsatis (19; 5.0%), Boerboel (16; 4.2%), Doberman (9; 2.3%) and Rottweiler (6; 1.6%). Poodle, (4; 1.1%), Great Danes (3; 0.8%), Mastiff (1; 0.3%), Terrier (1; 0.3%) and Maltese (1; 0.3%) were in smaller proportions.

3.2. Prevalence of gastrointestinal helminths

A total of 238 out of 380 dogs were infected with gastrointestinal helminths, giving an overall prevalence of 62.6%. Hookworm eggs were found in 178 (46.8%) samples, mixed-species infection (hookworm and *Toxocara canis* combined) in 38 (10.0%) and *T. canis* in 22 (5.8%). *Isospora* spp were found in 33 (8.5%) samples. Hookworm infection was most prevalent in dogs aged 12

Table 1. Type of housing, sources of dogs, purpose for dog keeping and prevalence of gastrointestinal helminths in the Greater Accra region of Ghana.

Variable	Total sampled	No ¹ (%)	Number infected	Prevalence (%) of helminths	P-values
Purpose for dog keeping	380				
Hunting		103 (27.1)	89	86.4	P < 0.001
Security		216 (56.8)	128	59.2	P < 0.001
Companionship		32 (8.4)	11	34.4	P = 0.003
Breeding		29 (7.6)	10	34.4	P = 0.134
Source of dogs	349 ²				
Street vendors		148 (42.4)	124	83.8	P < 0.001
Commercial		116 (33.2)	38	32.8	P = 0.003
Friends		85 (24.4)	47	55.3	P < 0.001
Housing of dogs	380				
Free range		235 (61.8)	177	75.3	P < 0.001
Wooden house		98 (25.8)	46	46.9	P = 0.023
Concrete floor		33 (8.7)	8	24.2	P = 0.045
Free within walled house		14 (3.7)	7	50.0	P = 0.024

¹No = Number of dogs in the category.

²Owners of remaining 31 dogs unsure of the source of dogs.

months and above, although it was present across all ages (Table 2). Adult tapeworms, *Dipylidium caninum*, was found in fifty one (40.8%) of the dogs aged 12 months and above.

The overall age-specific prevalence (Table 2) among the helminth infected dogs showed that puppies were more infected (54; 85.7%; P = 0.021) than young adults (59; 60.2%) and adults (125; 54.1). Out of 60 dogs infected with *Toxocara* spp (singly or in combination with hookworms), 32 (53.3%) were puppies (P < 0.001). The median eggs-per-gram (EPG) of faeces for hookworm was 500 (range 200–65,600) and 160 for *Toxocara canis* (range 100–1,500).

3.3. Management of dogs

A total of 204 dog owners were interviewed from 194 households. They were mostly men (163; 80%), with forty nine percent (100) aged between 30 to 40 years and only 12 (5.8%) were above 60. Their levels of education ranged from primary school (51; 25%), junior high (21; 10.2%), senior high (48; 23.5%) to tertiary (77; 38%), with only 6 (2.9%) of them not having formal education.

Table 2. Age-specific prevalence of and types of helminth infection in dogs from the Greater Accra region of Ghana.

Age	Total number sampled n=380	Total number infected (Overall prevalence)	Age-specific and types of helminth infection				Overall Age-specific prevalence
			Hookworm	Toxocara	Mixed infection ⁴	Adult tapeworm ⁵	
Puppy ¹	63 (16.6%)	54 (14.2%)	22 (40.7%)	16 (29.6%)	16 (29.6%)	12 (22.2%)	54 (85.7%)
Young adult ²	98 (25.8%)	59 (15.5%)	43 (72.8%)	6 (10.1%)	10 (16.9%)	9 (15.2%)	59 (60.2%)
Adult ³	219 (57.6%)	125 (32.9%)	113 (90.4%)	0	12 (9.6%)	51 (40.8%)	125 (54.1%)

¹ Puppy: <6 months old.

² Young adults: 6–12 months old.

³ Adults: >12 months old.

⁴ Mixed infection: Hookworm and ascarids.

⁵ Adult tapeworm: Dogs that had tapeworms in addition to hookworm and ascarids.

The median number of dogs per household was 3 (range 1–20). Thirty nine percent (148) of the dogs came from households that had other animals such as cats, sheep, goats, fowls and grasscutters (Greater cane rats). One hundred of these dogs (67.6%) were infected with helminths (Table 2), as compared to 48 (32.4%) of those without other animal species, however, this was not statistically significant ($P > 0.05$).

3.3.1. Housing of dogs

More than half of the dogs (235; 61.8%) were free range and roamed about in the communities (Table 1). Only 33 (8.7%) were kept in concrete houses that were easy to clean and disinfect. A few (14; 3.7%) were kept free within walled houses. Seventy five percent (177) of the free range dogs were significantly infected as compared to the dogs free within walled houses (50%; 7; $P = 0.024$), wooden structures (46%; 46.9; $P = 0.023$) and concrete floors (8; 24.2%; $P = 0.045$).

3.3.2. Source and purpose of dogs

Thirty nine percent (148) of the dogs were purchased from street vendors, commercial breeders (116; 33.2%) and friends (85; 24.4%) (Table 1). The dogs bought from the street vendors were significantly infected with helminths (83.5; $P = 0.001$) as compared to those obtained from friends (55.3%; $P < 0.001$) and commercial breeders (32.8%; $P = 0.003$).

A significant association was observed in the prevalence of dogs kept for the various purposes (Table 1). The hunting dogs were more infected (89; 86.4%; $P = 0.001$) as compared to those for kept security (128; 59.2%; $P = 0.001$), breeding (11; 34.4%; $P = 0.003$) and companionship (10; 34.4%; $P = 0.134$).

3.4. Anthelmintic treatment and regime

Only 104 (50.9%) kept record of the last anthelmintic treatment of their dogs. Of this number, 87 (83%) administered anthelmintic to the dogs within 3 months of sampling. Thirty six percent of the treated dogs remained infected, although this was not statistically significant ($P = 0.4435$).

Broad-spectrum anthelmintics were commonly used. Praziquantel-pyrantel-febantel combination was used by 43 (41.3%) of the dog owners, followed by ivermectin 30 (28.8%), albendazole 22 (21.1%), and niclosamide-levamisole combination 9 (8.6%). All (100%) of the dog owners admitted introducing newly acquired dogs straight into home without prior anthelmintic treatment.

Sixty nine percent (133) of the household had children below the age of 5 years. Sixty percent (80) of these household had at least a dog that was infected with

helminths ($P = 0.021$). Seventy seven percent (150) of children from the households with infected dogs played with the dogs. On the knowledge about potential zoonotic risk of parasites associated with contacts with dogs, only 13 (6.3%) responded in the affirmative.

4. Discussion

The findings of this study revealed a high prevalence (62.6%) of gastrointestinal helminths of zoonotic importance, namely hookworms, *Toxocara* and *Dipylidium* in the GAR, previously not published in literature in Ghana. It is noteworthy that the high prevalence was recorded in owned and supposedly cared for dogs. The prevalence of hookworm and *T. canis* in this study was lower than 67.1% reported in Tanzania (Muhairwa et al., 2008) and 72.5% in Nigeria (Mahmuda et al., 2012) and 89% in Ethiopia (Abere et al., 2013). The lower prevalence in this study could be as a result of sampling of owned dogs in the study area. It is suspected that the prevalence could be higher given the number of stray and unowned dogs in the study area. However, prevalence of 62.6% was much higher than a maximum of 34% reported from Western Europe (Overgaauw, 1997) and 36% in the United States (Samuel et al., 2001). This could have been due the tropical conditions in the African countries which were conducive for the development, survival and transmission of infective stages of the parasites.

The presence of hookworm and *Toxocara* in this study is significant due to their zoonotic implications. Several syndromes have been ascribed to *Toxocara* species, and these include visceral larva migrans, ocular larva migrans, covert toxocariosis and some neurological and atopic symptoms (Overgaauw and van Knapen, 2013). Visceral larva migrans is reported to be more frequent in children aged 1–3 years (Overgaauw and van Knapen, 2013). This study found that 69% of the owners' households had children below the age of 5 years, out of which 60% had dogs infected with helminths. The presence of children below the age of 5 years in such households could be a source of concern, since they were more at risk if exposed to contaminated environment. This could be compounded by the fact that only 6.3% of the dog owners were aware of the zoonotic risk of parasites in dog keeping. The low awareness of dog owners to the zoonotic risk agrees with report by Mekbib et al., (2013), who also found that 99.2% of dog owners in Ethiopia were not aware of the zoonotic risk of parasites.

Hookworm infection was found in forty seven percent of the dogs sampled. Eosinophilic enteritis in man has been associated with *Ancylostoma caninum* (Walker et al., 1995). This was noteworthy given the fact that a high number of the dogs were not housed and were more likely to be infected by hookworm and

ascarids. With only 9% percent of the dogs being kept for companionship and less likely to harbor helminths, the role of care for these dogs is only accentuated. The free access of the dogs, particularly to public places, due to lack of housing, could make an infected dogs an important source of transmission and contamination of the environment, other animals and man.

Dipylidium caninum, a zoonotic tapeworm was found in 13.1% of the dogs. Dogs, cats and wild carnivores are the definitive hosts, although man becomes occasional host Adam et al. (2006). Given that most households, where dogs were sampled from, had children below the age of 5 years, the presence of this parasite is of public health importance, particularly to children. Children are noted for being more likely to be infected with dipylidiasis than adults (Molina et al., 2003). Therefore, in households where infected dogs and young children live in close proximity, the risk of infection is greater.

The age of the dogs sampled, 61% of which were above 12 months of age, could have had an influence on the prevalence of ascarids (10% and 5.7% for mixed and single infection, respectively), since ascarid infections are more prevalent in dogs younger than 6 months of age (Overgaauw and van Knapen, 2013).

In this study, we have found hookworms, *Toxocara* and *Dipylidium* as three zoonotic helminths infecting dogs and prevalent in the Greater Accra region of Ghana. The high prevalence was found in dogs bought from street vendors, not housed and kept for hunting and security purposes. Although a good number of the dog owners were educated up to the tertiary level, very few knew the zoonotic parasitic risk associated with dog keeping. Awareness creation on helminth infection in dogs among dog owners is recommended.

Declarations

Author contribution statement

Sherry A.M. Johnson: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Daniel W. Gakuya: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Paul G. Mbutia: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data.

John D. Mande: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Ndichu Maingi: Analyzed and interpreted the data.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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