

Zoonotic gastrointestinal helminths from pets in Ethiopia: A literature review published from 2000-2019

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Abstract

Introduction: Gastrointestinal helminths are one of the most neglected tropical diseases and our close contact relation with pet animals puts us in the worst risk of parasitism with zoonotic helminths.

Objectives: To briefly present some literature data concerning zoonotic gastrointestinal helminths burden in humans and animals, its prevalence in pets, potential risk factors and ways of proper control and prevention measures.

Methods: Systematic review of all published scientific pieces of evidence on zoonotic gastrointestinal helminths in pets from 2000-2019 in different parts of Ethiopia were addressed.

Results: The overall prevalence was 64 to 85.6% and at species level 0 to 61% for dog Tapeworm, 32 to 76% for dog Hookworm, and 17 to 61.5% dog/cat was recorded. Ascarids and other major zoonotic helminths were reviewed from different studies conducted on pets in Ethiopia. The potential risk factors associated with gastrointestinal helminths zoonosis from pets were lack of pets' health care (deworming), existence of abundant stray dogs with more than 90.7% of parasitism and lack of community awareness on dog parasitism with zoonotic potential on public health. Regular deworming program for pets, counseling and community educations on how to manage dogs and to minimize close humans-pets contact were reviewed, as control measures.

Conclusion: This literature review provided a brief overview on the consequence of zoonotic gastrointestinal helminths in pets and humans, trend analysis in pets and its potential associated risk factors as well as ways of possible control measures. Further studies, collaboration, and coordination among multi-discipline, community awareness creations and dog population management (registration of owned dogs to eliminate stray one) were suggested.

Keywords: Gastrointestinal, helminths, pets, review.

Introduction

Pet zoonoses is a broad term used to describe communicable diseases from pet animals to humans and vice versa. Currently, the issue of zoonotic diseases is getting global attention to improve human well-being through multidisciplinary disease control activity at the animal-human-environment interface. Gastrointestinal helminths zoonosis is classified under neglected tropical disease and transmission from pets is a major public health problem with little or no attention in Ethiopia (WHO 2011).

Pets and humans have a close relationship because of numerous uses of pets for entertainment, guarding, racing and fighting, hunting, commercial purposes and food (Patricia and Bruno 2005). Their ever-present distribution has resulted especially, in dogs and cats unforeseen participation in sharing over 60 parasite species. However, most pet owners do not know that their pets may carry worms capable of infecting people.

Several helminthic parasites of dogs and cats may be transmitted to humans, namely roundworm (*Toxocara* species), dog whipworm (*Trichuris vulpis*), hookworms (*Ancylostoma* species), dog tapeworm (*Echinococcus granulosus*), and flea tapeworm

(*Dipylidium caninum*). The infection of humans with *Dipylidium caninum* occurs only via swallowing the intermediate host, the flea. Other zoonotic parasites from pets include *Strongyloides stercoralis* and *Taenia* species (Schantz 2002; Macpherson 2005; Endrias et al. 2010; Degfu et al. 2011). In Ethiopia, lack of community awareness and deworming of pets were major factors for the spread and zoonotic transmission of gastrointestinal helminthic parasite (Jones et al. 2011; Yimer et al. 2019) and there was no systematic review report on zoonotic gastrointestinal helminthic parasite from pets. Therefore, this paper aim to present available literature data concerning Zoonotic gastrointestinal helminths burden in humans and animals, its prevalence in pets, potential risk factors and ways of proper control and prevention measures.

Materials and Methods

Literature review on zoonotic gastrointestinal (GI) helminths from pets in different parts of Ethiopia were searched for all available published articles in English from May 1, 2000 through May 30, 2019. The overall prevalence and range of species and potential risk factors of GIH were addressed. The general overview

of this parasite and possible control measures were also addressed accordingly.

Results

Prevalence of Zoonotic GI Helminthic Parasites from Pets' in Ethiopia: The overall prevalence, study area and wide range of species that have been studied in the area of zoonotic GI helminths from pets in various parts of Ethiopia, are summarized hereunder. Summary of reports of helminths infection of pets from different parts of Ethiopia are indicated in Table 1. In the Illubabor zone, Legesse (2001) examined 221 civet cats from 29 civet cats farms to determine the management, production and health problems of civet cats in captive. Their result indicated 83(68.6%),

68(57.1%) and 88 (72.7%) civet cats positive for nematode, cestodes, and protozoa, respectively. *Ancylostoma caninum* (40.5%) were the most frequent among helminths detected in their study. In and around Debre Zeit, Yacob et al. (2007) examined 100 fecal samples and 20 dogs' necropsy to determine the frequency of GI nematode infections of dogs. The microscopical examination revealed 32% infection with *Ancylostoma caninum* followed by *Toxocara canis* (21%), *Spirocerca lupi* (7%) and *Trichuris vulpis* (3%), while postmortem examination showed 70, 45, 23.5 and 5% infection, respectively.

Table 1: A summary on prevalence and major risk factors of zoonotic GI helminth Species from pets in Ethiopia within 2000-2019

Study area	Sample size and source	Prevalence (%)							Major risk factor	Reference
		Ac	Tc	Eg	Dc	Ts	Tv	Ss		
Illubabor	221 Faecal	40.5	18						Lack of community awareness and deworming of pets	Legesse(2001)
Debre Zeit	100 Faecal	32	21				3		Lack of community awareness and deworming of pets	Yacob et al. (2007)
Ambo	20 PM	70	45				5			
	70 Faecal	35.7	17.1	8.57	25.6			14.3	High number of stray dogs, lack of community awareness and deworming of pets	Endrias et al. (2010)
Jimma	52 PM	50	17.3	17.3	71.2		3.8	40.4	Lack of community awareness and deworming of pets	Degefu et al. (2011)
	334 Faecal	58.8	25.8		25.8	18.3	0.6		High stray dogs, lack of community awareness and deworming of pets	Jones et al. (2011)
Wondo-Genet	269 Faecal	73.9	53.9		46.8	69.5	70.3		Lack of community awareness and deworming of pets	Paulos et al. 2012
	13 PM	53.8	61.5	61.5	76.9	9.2	53.8	46.1	Poor body condition and degree of dog's home confinement	Toler et al. (2015)
Hawassa	455 Faecal	49.9	25.1	8.4	39		3.3	58	Lack of community awareness and deworming of pets	Yimer et al. (2019)
Adama	384 Faecal	40.1	11.7	5.47	23.7	.52	4.69	5.47		
Hosanna	261 Faecal	49	34			4.2	1.9	2.6		
	5 site, 25soil	42.8	57.1			14.3	57.1	14.3		

Ac=*Ancylostoma caninum*, Tc = *Toxocara canis*, Dc= *Dipylidium caninum*, Tv = *Trichuris vulpis*, Eg = *Echinococcus granulosus*, Ss = *Strongyloides stercoralis*, PM= postmortem inspection and Ts= *Taenia species*

In Ambo, Endrias et al. (2010) reported gastrointestinal helminth infection prevalence of 86.54% and 52.86% using postmortem and coprological examination in dogs, respectively. The coproscopical examination revealed 35.7% infection with *Ancylostoma caninum* followed by *Dipylidium caninum* (25.57%), *Toxocara canis* (17.14%), *Strongyloides stercoralis* (14.29%) and *Echinococcus granulosus* (8.57%). On the other hand, 86.54% of the necropsied dogs were found positive for one or more species of adult parasites and the specific species found were *Dipylidium caninum* (71.15%), *Ancylostoma caninum* (50%), *Strongyloides stercoralis*(40.38%), *Toxocara canis* (17.3%), *Echinococcus granulosus* (17.3%), *Trichuris vulpis* (3.8%) and *Spirocerca lupi* (1.9%).

In Jimma town, Degfu et al. (2011) examined 334 dogs to determine the occurrence and prevalence of zoonotic gastrointestinal helminth parasites in household dogs. Among the dogs examined, helminth parasite infection was detected in 215 (64.4%) dogs,

and the species of helminth parasites found with their relative frequencies were: *Ancylostoma caninum* (58.8%), *Toxocara canis* (25.8%), *Dipylidium caninum* (25.8%), *Taenia* spp. (18.3%), *Toxocara leonina* (16.8%) and *Trichuris vulpis* (0.6%).

Jones et al. (2011) examined 269 fecal samples and 13 necropsy of dog and also used questionnaire survey on 50 households to estimate the prevalence of dog gastrointestinal parasites and risk perception of zoonotic infection by dog owners in Wondo Genet, Southern Ethiopia. Their results indicated that although 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 *Mesocostoides* (84.6%). Other intestinal worms in dogs were *Toxocara canis* (53.9%), *Trichuris vulpis* (70.3%) and *Ancylostoma caninum* (73.9%). In Hawassa town, (Paulos et al. 2012) examined 455 fecal sample of dog with the aims of determining the

prevalence of intestinal helminths of dogs and evaluating owner's awareness about zoonotic dog parasites. The result revealed that *Strongyloides stercoralis* (58%), *Ancylostoma caninum* (49.9%), *Dipylidium caninum* (39%), *Toxocara canis* (25.1%), *Echinococcus granulosus* (8.4%) and *Trichuris vulpis* (3.3%), and only 13.2% were free of the above helminths. In Hosanna town, Yimer et al. (2019) reported GI helminth infection prevalence of 71.6%, 17.62% and 71.4% using coprological & geo-helminths examination in dogs, humans and environment, respectively. The coproscopical examination in dog revealed 49% infection with *Ancylostoma caninum* followed by *Toxocara canis* (34%), *Toxocara leonine* (7.2%), *Taenia species* (4.2%), *Strongyloides stercoralis* (2.6%) and *Trichuris vulpis* (1.9%). On the other hand, 71.4% of the geo-helminths study site were found positive for one or more eggs of parasites and the specific species found were *Toxocara species* (57.1%), *Trichuris* (57.1%), *Ancylostoma caninum* (42.8%), *A. lumbricoides*

(42.8%), *Strongyloides stercoralis* (14.3%) and *Taenia species* (14.3%).

The general overview of this parasite burden in Pets and Humans from available literatures indicated that pets can harbor a wide range of parasites with zoonotic potential like Hookworm, Roundworm (toxocariasis), dog Tapeworm (hydatidosis) and many others. These parasites can affect pets sub-clinically and their stool excretes are known potential hazards to environmental egg contamination; thus, causing immuno-compromised to be more vulnerable.

In humans, percutaneous penetration of *A. caninum* can induce further symptoms of visceral larva migrans; and toxocariasis can cause permanent visual, neurologic, or tissue damage including hydatidosis in liver and different parts of human tissue are summarized below: The epidemiology of Helminthiasis and its zoonotic transmission depends on the general risk factors of parasite factors, host health risk to humans especially in young ones and environmental factors (Macpherson 2005) (Figure 1).

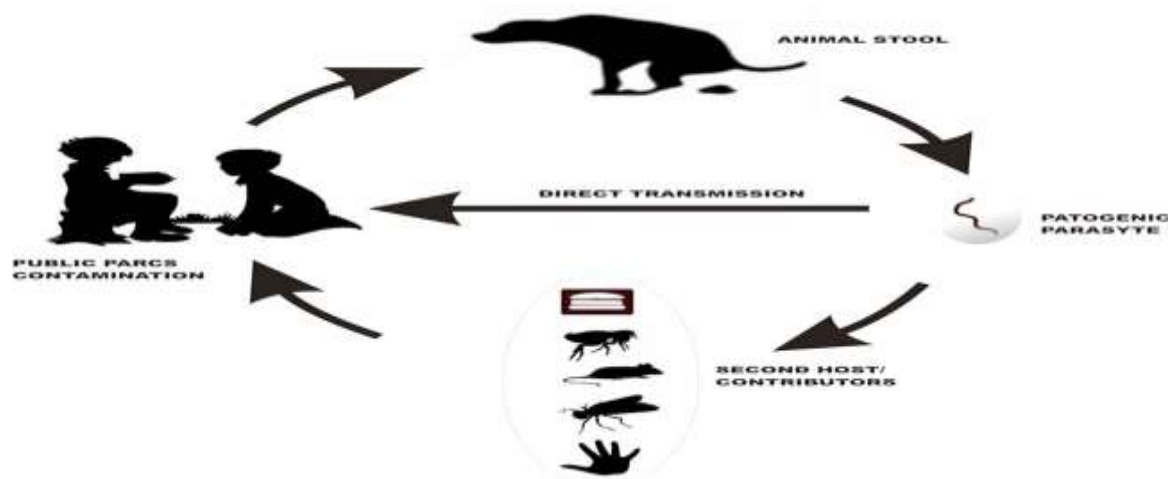


Figure 1: Ways of transmission of zoonotic parasites from dogs.
Source: (Haxhiraj et al. 2012)

Hookworm: Hookworm eggs are excreted from infected canine or feline intestine in faeces and develop into free living larvae in soil. Infective larvae survive in moist, dark, cool microenvironments. They penetrate bare skin and transmission is associated with occupational and recreational contact (example walking barefoot) with contaminated, shaded, sandy soils, frequented by dogs and cats, in warm moist climates (Kuma and Smith 2000). Young pets like puppies and kittens acquire hookworm infections (*A. caninum*, *A. braziliense* and *A. tubaeforme*) through

ingestion of or skin penetration by infective larvae or from infective larvae passed in their dam's milk (*A. caninum*) (Burke and Roberson 1985). In humans, percutaneous penetration of *A. caninum* and *A. braziliense* infective larvae leads to Cutaneous Larva Migrans Syndrome (Figure 2) and its larval migrations are characterized by the appearance of progressive, intensely pruritic, linear eruptive lesions, which are usually more extensive with *A. braziliense* infections. *A. caninum* larvae may also penetrate into deeper tissues and induce symptoms of visceral larva migrans

or migrate to the intestine and induce an eosinophilic enteritis (Landmann and Prociw 2003; Caumes 2006).

Ascarids: The route of transmission and infection of *Ascarids* can be transplacental and transmammary transmission of *T. canis*; puppies are usually born with or acquire ascarid infections early in life (Burke and Roberson 1985). Larval stages of *Toxocara canis* and *Toxocara cati* are common intestinal roundworms of dogs and cats, respectively and frequently infect humans worldwide. *Toxocara* eggs are passed unembryonated in the feces of these animals, become infectious under ideal conditions of temperature and humidity after two to six weeks and can remain infective in the soil for many years favoring accidental transmission to people (Schantz 1989; Overgaauw 1997a). The signs and symptoms of Toxocariasis seen in humans are determined by the tissues or organs

damaged during larval migration. Organs commonly affected are the eye, brain, liver, and lung, where infections can cause permanent visual, neurologic, or other tissue damage. The common dog ascarid, *T. canis*, has long been recognized as a cause of larva migrans syndromes in children. The cat ascarid, *T. cati*, can also cause disease in humans; although, for reasons partly related to the defecation habits of cats, it causes infection less frequently (Kazacos 2000). Toxocariasis can result in a variety of syndromes with different clinical manifestations. Two commonly described syndromes, visceral larva migrans and ocular larva migrans, can include abdominal pain, hepatomegaly, persistent eosinophilia, visual impairment, and retinal scarring (Schantz 1989; Overgaauw 1997a).



Figure 2: Clinical effects of toxocariasis and hookworms in man.
Source: (Schantz 1989)

Echinococcosis: Echinococcosis/hydatidosis is a zoonotic parasitic disease caused by the dog tapeworm *Echinococcus* and its larval stage, the hydatid cyst. This parasite is found worldwide and causes serious public health problems in certain parts of the world (Schantz 2002). In addition, there are economic losses from the condemnation of affected organs. Echinococcosis is a cyclozoonosis that requires two vertebrate hosts to maintain the life cycle. Humans can accidentally become intermediate hosts by ingesting the eggs of the tapeworm. While most cysts develop in the liver and lungs, other organs and tissue may also become affected (Soulsby 1982). The adult *Echinococcus* is considered to be rather harmless to the definitive host (dog), except when it occurs in large numbers, which may cause severe enteritis. Post-mortem examination is the most reliable method of diagnosis (Gasser et al. 1990). In humans, the hydatid cyst is normally well tolerated until its development results in pressure on adjacent tissue or organs. The cyst may also burst into the peritoneal or thoracic cavity, which can cause anaphylactic shock or give rise to many new cysts (FAO 1982).

Strongyloides: *S. stercoralis* is a nematode that is sometimes referred to as the human threadworm.

While humans are the principal hosts, pets can also be infected and act as reservoirs for human infection. It is found worldwide and favors warmer tropical and subtropical climates. Worms can be free-living in the soil or live in a host. There are numerous reports of *S. stercoralis* in the faeces of dogs, most from tropical and subtropical regions, with reported prevalence's of larvae in faeces ranging from 0% to 58% (Itoh et al. 2009; Paulos et al. 2012).

It is possible that *S. stercoralis* is under diagnosed because of infrequent and low - level shedding of larvae and the rare use of techniques that would detect larvae (Itoh et al. 2009; Weese et al. 2011). Human infections usually result from the penetration of infective larvae through the skin, after contact with soil contaminated with human and dog faeces. Direct contact with faeces containing infectious larvae and fecal – oral infection can also occur. Hyper infection syndrome occurs as a result of “accelerated autoinfection” from filari form larvae. This is a rare but potentially devastating syndrome that can occur in immunocompromised individuals, particularly people with HIV/AIDS, Tuberculosis and young ones (Macpherson et al. 2000b; Weese et al. 2011).

Trichuris: The most important feature regarding infection with *Trichuris* is the longevity of the eggs in the environment; up to five years, survival has been recorded in a humid and warm climate. Once *Trichuris* eggs have been passed, under optimal conditions they will only reach infectivity in three to four weeks, hence removal of all faeces frequently will avoid environmental contamination and re-infection (Dunsmore and Shaw 1990). *Trichuris vulpis* species have been discovered in the intestinal tracts of humans, sometimes producing severe signs of intestinal disease and diarrhea. Now, it could be expected that humans infested with these 'animal-specific' whipworms of dog would be immune suppressed people (HIV-ADIS patients and elders), people on farms, and children of animal owners (Macpherson et al. 2000b).

Dipylidium: The definitive hosts of *Dipylidium* include dogs, cats and wild carnivores; humans are Occasional hosts. Flea (*Ctenocephalides canis* (dog flea) and *Ctenocephalides felis* (cat flea).) and biting lice (*Trichodectes canis*), and the dog and cat become infected through the ingestion of these intermediate hosts. Adult tapeworms cause little harm in dogs and cats (Bowman et al. 2003) and prevention of infection is by keeping pets free of fleas (Molina et al. 2003).

Potential Risk Factors Associated with GI Helminths Zoonoses from Pets: Systematic animal diseases surveillance, monitoring and control have not been addressed well in almost all developing countries including Ethiopia as part of an effort to reduce the heavy socio-economic cost of the major diseases endemic to or threatening the region (Malgor et al. 1996). The major risk factors affecting epidemiology of helminthiasis can be classified broadly as parasite factors, host factors and environmental factors (Thrusfield 2005). The host risk factors associated with GI helminths zoonoses dissemination are those pets including puppies and kittens; pregnant and nursing pets are at highest risk for these infections, and therefore responsible for most of the environmental contamination and human diseases (Duwel and Strasser 1978). Population at risk of this zoonotic helminth includes immune-compromised elderly people, young children, people with HIV-infection, pregnant women and people with specific occupational health risk such as farmers, kennel workers and hunters. (Kazacos 2000). Yimer et al. (2019) determined risk factors for the spread of parasitic zoonoses among dog owners and their living environment in Hosanna, Ethiopia. The high environmental egg contamination (71.14%) as risk factor for human infection and awareness gap, lack of proper care for dogs and allowing them to interact with

wild animals and stray animals, their faeces and contaminated soil as well as too close dog-human contacts, may increase the risk of transmission. Results of Jones et al. (2011) in Ethiopia indicated that 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. Studies reveal that in stray dogs around 90.7% of them were infected with at least one intestinal helminthic parasite.

Pfukukenyi et al. (2010) reported that in Zimbabwe the proportion of pet owners who knew helminths as zoonoses in dogs (21.3%) and cats (1.1%) was low compared to rabies (95.7%) with ancylostomosis (4.3%) and toxocariasis (2.1%) being the specific parasitic zoonoses known to occur in dogs and toxoplasmosis (2.1%) in cats. More than 50% of the pet owners indicated that veterinarians never discussed the potential hazards of zoonoses or discussed it only when asked and 33% indicated that veterinarians initiated discussion of the subject whenever zoonoses were diagnosed in pets. Over 90% of the pet owners indicated that veterinarians should discuss zoonoses with them. *Toxocara* seroprevalence differed by sex, age, poverty level, geographic location, pet ownership, household crowding and education. Persons > 20 years of age who reported being involved in soil occupation, such as farming and agriculture, had a seroprevalence of 25.5% compared with 13.5% for those persons not involved in these types of occupations (Won et al. 2008).

Control and preventive measures for GIH Zoonoses from Pets: In general as a control measure, first attention should be given to prevent parasites and control basic biosecurity, secondly appropriate sanitation/ hygiene practices should be applied that include cleaning and disinfecting animal areas as needed, hand washing and eating or drinking not in animal facilities, and finally early diagnosis and treatment of both people and animals needed to be practiced (Knobel et al. 2008). Pet owner and community education has a key role to control the burden of zoonotic GIH parasites in pets and humans. Awareness of parasitic zoonoses, including clinical manifestations in people and particularly children, should be created as a minimum in the medical profession through information brochures. Cooperation between the medical and veterinary profession should be encouraged wherever possible and its benefits underlined in case of zoonoses. Pet owners should be informed about the potential health

risks of parasitic infection, not only to their pets but also to family members and all people living within the action radius of their pets. Regular deworming or joining “pet health-check programmes” should be made clear to the general public by veterinary surgeons, veterinary nurses and other animal health professionals (e.g. by wearing clear coloured fobs associated with a calendar year). Responsible dog and cat ownership can remove public health concerns (ESCCAP 2010; Yimer et al. 2019)

Discussion

In general helminths parasites are categorized under neglected tropical diseases (NTD) (WHO 2011), of these particularly zoonotic gastrointestinal helminths are well known in developed countries with their high hazardous potentials on public health and pet animals from its direct and indirect transmission (Schantz 2002). In our scenario, this literature review report has shown us inadequate awareness by community and no deworming practice of pets. The environmental egg contamination status is also another alarming effect from the pet by excretion of eggs and attention in needed pets to minimize the risk of parasitism in humans. The overall minimum and maximum prevalence of GIH in this review were 64.4% and 85.4% in Jimma and Ambo by Degfu et al. (2011) and Endrias et al. (2010), respectively. The common species with highest and lowest prevalence were *Ancylostoma caninum* and *Toxocara leonine*, respectively (Table 1). This is due to lack of community awareness and no deworming activities of pets being exercised (Jones et al. 2011). But, there are a variety of anthelmintic drugs available that are safe and effective against ascarids, hookworms, and other intestinal helminths of dogs and cats (Schantz 2002). Anthelmintic treatments are most effective when they are initiated early and targeted at pets especially to the high risk groups. For instance, the risk of infections from trans-placental and trans-mammary transmission of ascarids and hookworms could be prevented through prophylactic treatment of pregnant pets.

The risk of infection in humans can be either directly or indirectly zoonotic transmission and it is difficult to predict, based solely on the pets’ clinical presentation. But it needs advanced diagnostic laboratories. Thus, this literature review can’t show the prevalence of larva migration and tissue damage including to eyes and hydatid cyst in different tissues such as liver of humans. In Ethiopia, due to lack of advanced diagnostic setup, the magnitude of larva migration and tissue damage is not addressed. But from geo-helminths examination point of view the risk of infection through environmental egg

contamination(71.14%) problem from dogs indicated high prevalence and needs to be given attention to have safe living environment (Yimer et al. 2019).

Conclusions

This literature review provides a brief overview on zoonotic GIH consequences in pets and human, trend analysis in pets and its potential associated risk factors as well as ways of possible control measures. Further studies, collaboration and coordination of multidiscipline, community awareness creations and dog population management policy (registration of owned dogs to eliminate stray one) are suggested.

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