




## Gastrointestinal helminths in dog feces surrounding suburban areas of Lower Dir district, Pakistan: A public health threat

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### Abstract

Data on environmental contamination of the parasites of zoonotic importance is scarce in Pakistan. Soil contamination with feces of dogs hide infective stages of the parasite represents a health-risk to humans. This study was aimed to assess the eggs of gastrointestinal parasites of stray dogs and household dogs in lower Dir district, Pakistan with special consideration to those that can be spread to humans. One hundred and fifty two stool specimens from (stray dogs=90 and household dogs=62) were collected. The helminth eggs were processed by direct smear method and centrifugation techniques and identified by microscopic examination. Of the total examined dogs 26.8% (n=41 /152) were found to be infected with one or more intestinal parasites. The intestinal helminths detected were *Dipylidium caninum* (n=18, 11.8%), followed by *Toxocara canis* (n=16, 10.5%), *Taenia* spp., (n=10, 6.57%) *Ancylostoma caninum* (n=6, 3.94%), *Toxascaris* spp., *Capillaria* spp., and *Trichuris vulpis* (n=2, 1.31% each) in order of their prevalence. Pattern of infection revealed that 27 (65.8%) dogs have single, 13(31.7%) double and 1(2.43%) triple infection. The stray dogs were highly infected 34.4% (n=31) than house hold dogs 16.1% (n=10). The prevalence of infection with intestinal parasites was significantly different among these two groups (p = 0.0097). This study highlight a severe environmental contamination by frequent parasitic stages infectious to humans. There is a higher risk of zoonotic transmission from dogs which indicate an immediate need for the controlling of these parasites and educating the public to take wise action relating to the parasites and pets.

**Keywords:** contamination, diagnosis, environmental, parasitism, zoonosis.

## Helminths gastrointestinais em fezes de cães que vivem em áreas suburbanas do distrito de Lower Dir, Paquistão: uma ameaça à saúde pública

### Resumo

Dados sobre a contaminação ambiental dos parasitas de importância zoonótica são escassos no Paquistão. A contaminação do solo com fezes de cães, as quais escondem as fases infecciosas do parasita, representa um risco à saúde dos seres humanos. Este estudo teve como objetivo avaliar os ovos de parasitas gastrointestinais de cães de rua e domésticos no distrito de Lower Dir, no Paquistão, com especial atenção para aqueles que podem ser transmitidos aos seres humanos. Foram recolhidos 152 espécimes de fezes de cães, dos quais 90 eram de rua e 62 eram domésticos. Os ovos de helmintos foram processados por método de esfregaço direto e técnicas de centrifugação e identificados por exame microscópico. Do total de cães examinados, verificou-se que 26,8% (n = 41/152) estavam infectados com um ou mais parasitas intestinais. Os helmintos intestinais detectados foram *Dipylidium caninum* (n = 18; 11,8%), seguido por *Toxocara canis* (n = 16; 10,5%), *Taenia* spp. (n = 10; 6,57%), *Ancylostoma caninum* (n = 6; 3,94%), *Toxascaris* spp., *Capillaria* spp. e *Trichuris vulpis* (n = 2; 1,31% cada) em ordem de prevalência. O padrão de infecção revelou que 27 (65,8%) cães tinham infecção simples, 13 (31,7%), duplas, e 1 (2,43%), tripla. Os cães de rua estavam altamente infectados (34,4%; n = 31) do que os cães domésticos (16,1%; n = 10). A prevalência de infecção por parasitas intestinais foi significativamente diferente entre esses dois grupos (p = 0,0097). Este estudo destaca uma grave contaminação ambiental por frequentes fases parasitárias infecciosas para humanos. Existe um risco maior de transmissão zoonótica de cães, o que indica uma necessidade imediata do controle desses parasitas, além de educar o público quanto à tomada de medidas relativas aos parasitas e aos animais de estimação.

**Palavras-chave:** contaminação, diagnóstico, meio ambiente, parasitismo, zoonose.

## 1. Introduction

Dog plays an important role in the transmission of zoonotically important parasites to human beings. Dog feces are the main pollution source when not regularly removed. Furthermore, vehicular traffic, as well as the wind, can help in spreading pathogens present in dog feces, contaminating food which may later be a source of infection (Smith, 1995). Parasite eggs can also be carried into human houses if adhered to shoes or animals' paws. Additionally, arthropods and other environmental factors, as the rain, air and wind may also play a vital role in this context (Morey, 2006).

Environmental contamination with dog feces harboring various infective stages of parasites such as eggs, larvae or oocysts act as a leading source of infection to live-stock and human (Bentounsi et al., 2009). Hydatidosis and toxocariasis, are considered as serious public health concern (Alvarez-Rojas et al., 2014). Being a reservoir host for a large number of parasites dogs share these pathogens between pets and humans (Duscher et al., 2015). Human can be infected through the ingestion of eggs, cysts or oocysts via contaminated food-stuffs or water, hands, inhalation of dust, and/or by penetration of larvae through the skin (Lee et al., 2010).

Dogs are definitive hosts for quite a large number of parasites for which other animals may become intermediate hosts and some of the parasites like *Giardia lamblia*, *Toxocara canis*, *Cryptosporidium* spp, *Ancylostoma duodenale*, *Echinococcus granulosus*, *Dipylidium caninum*, and *Toxoplasma gondii* (Nicolle and Manceaux, 1908) can be transmitted to human from dogs (Overgaauw et al., 2009; Xhaxhiu et al., 2011). These diseases cause direct and indirect losses to the health of humans and their animals.

In Pakistan domestic dogs have got comparatively greater attention for deworming as compared to stray dogs. This lack of attention leave the stray dogs at higher risk of getting infected with parasites of great medical importance. Study conducted on dogs is almost always on domesticated ones and the results of these studies are biased as the stray dogs are not represented.

A small number of reports are available on the infection risk of dogs to humans living in rural and suburban areas in Pakistan. Most of these communities have a large number of free roaming domestic dogs with little access to veterinary care. These dogs have frequent contact with other animals, their faeces, and a variety of refuse and food-stuffs that contain zoonotic agents, which promotes infection with a variety of zoonotic agents and subsequent human exposure. The aim of this study was to evaluate the

occurrence of zoonotic gastro-intestinal parasites of dogs from two breeds in lower Dir district Pakistan.

## 2. Material and Methods

Present research was carried out in suburban areas of district lower Dir, Khyber Pakhtunkhwa, Pakistan from March to August 2017. Lower Dir district is located 34.9161° N, 71.8097° E.

Faecal samples of stray dogs (n=90) and house hold dogs (n=62) were collected from walking areas of the animals around human populations. The collected samples were kept in sterilised plastic bottles and 10% formalin was added just enough to dip the feces. All the samples were brought to Laboratory of Parasitology, Department of Zoology, University of Malakand, for parasitological assessment.

The samples were first checked with naked eye for any adult stage of the parasites and then these were prepared for microscopic examination. A small portion of the sample was taken and a drop of liquid was added to it. For examining any cystic stage of a protozoan parasite the normal iodine solution was added while helminth eggs were generally observed in normal saline preparation. The slide was covered with cover slip and examined under the microscope. All the parasites found were identified through existing morphological keys. An animal was considered positive if only one parasite species was found in the fecal sample (Blagburn, 2014).

The data was analysed by applying the statistical software "Graph Pad Version 5". The p value less than 0.05 was considered to be statistically significant.

## 3. Results

Present study demonstrate the presence of seven helminth species in dogs of two breeds. The overall prevalence of infection with intestinal helminth parasites was 26.8% (Table 1 and 2). The most frequently observed intestinal helminth parasites were *Dipylidium caninum* (Linneus, 1758) 13.3% (n=12) and 9.67% (n=6), *Toxascaris canis* 15.5% (n=14) and 3.22% (n=2), *Taenia* spp 11.1% (n=10) and 0% (n=0), *Ancylostoma caninum* 4.44% (n=4) and 3.22% (n=2), *Toxoascaris* spp 2.22% (n=2) and 0% (n=0), *Capillaria* spp 0% (n=0) and 3.22% (n=2), *Trichuris vulpis* 2.22% (n=2) and 0% (n=0) in stray dogs and house hold dogs respectively (Table 3). Eggs count per gram (mean ± SE) in feces of dogs have shown in Table 4.

A total of 152 (n=90 from stray dogs and 62 from house hold dogs) faecal samples were examined. Out of the examined only 26.8% (n=41) were positive

**Table 1.** Prevalence of parasites found in dog fecal samples collected in lower Dir district, KPK, Pakistan.

Parameters	Stray dogs	House hold dogs	Total (%)
Total samples examined	90	62	152
Total samples positive	31(34.4%)	10(16.1%)	41(26.8)
Total samples negative	59 (65.5%)	52(83.8%)	111(73.0)

**Table 2.** Association of parasites: monoparasitism and polyparasitism among two breed of dogs (stray dogs and household dogs (n=number of dogs infected)).

Type of infection	No. of species	Species associated	Stray dogs	House hold dogs	Total
Mono-parasitism	1 species	<i>Toxocara canis</i>	6	0	6
		<i>Capillaria</i> spp.	0	2	2
		<i>Ancylostoma caninum</i>	2	1	3
		<i>Dipylidium caninum</i>	6	5	11
		<i>Taenia</i> spp.	5	0	5
<b>Total mono-parasitism</b>			<b>19</b>	<b>8</b>	<b>27</b>
Poly-parasitism	2 species	<i>T. canis</i> + <i>A. caninum</i>	2	1	3
		<i>Toxascaris canis</i> + <i>Dipylidium caninum</i>	3	1	4
		<i>Trichuris vulpis</i> + <i>Taenia</i> spp.	2	0	2
		<i>Toxoscaris</i> + <i>Taenia</i> spp	2	0	2
		<i>Toxocara canis</i> + <i>D. caninum</i>	2	0	2
			<b>11</b>	<b>2</b>	<b>13</b>
	3 species	<i>Toxocara canis</i> + <i>D. caninum</i> + <i>Taenia</i> spp.	1	0	1
			<b>1</b>	<b>0</b>	<b>1</b>
Total poly-parasitism			12	2	14
Total of infected dogs			31	10	41

**Table 3.** Prevalence of parasites in faeces of stray dogs and house hold dogs in Lower Dir district, KPK, Pakistan.

Parasites	Stray dogs	House hold dogs	Total (%)
<i>Dipylidium caninum</i>	12 (13.3)	6(9.67)	18(11.8)
<i>Toxocara canis</i>	14(15.5)	2(3.22)	16(10.5)
<i>Taenia</i> spp.	10(11.1)	0	10(6.57)
<i>Ancylostoma caninum</i>	4(4.44)	2(3.22)	6(3.94)
<i>Toxoascaris</i> spp	2(2.22)	0	2(1.31)
<i>Capillaria</i> spp.	0	2(3.22)	2(1.31)
<i>Trichuris vulpis</i>	2(2.22)	0	2(1.31)
Total infected	44(48.8)	12 (19.3)	56 (36.8)
Total examined	90	62	152

**Table 4.** Eggs count per gram (mean  $\pm$  SE) in feces of dogs in lower Dir district, KPK, Pakistan.

Parasites	Stray dogs	House hold dogs	Total (%)
<i>Dipylidium caninum</i>	6.75 $\pm$ 3.40	17.1 $\pm$ 5.30	25.3 $\pm$ 10.6
<i>Toxocara canis</i>	11.7 $\pm$ 6.41	20.5 $\pm$ 16.2	25.8 $\pm$ 12.7
<i>Taenia</i> spp.	19.2 $\pm$ 7.0	00	22.8 $\pm$ 8.28
<i>Ancylostoma caninum</i>	23.5 $\pm$ 7.98	32 $\pm$ 18.3	17.6 $\pm$ 5.16
<i>Toxoascaris</i> spp	50.5 $\pm$ 23.3	0	14 $\pm$ 0
<i>Capillaria</i> spp.	00	13.5 $\pm$ 4.94	18.5 $\pm$ 6.3
<i>Trichuris vulpis</i>	30.5 $\pm$ 4.94	00	15.2 $\pm$ 7.77

for the presence of gastro-intestinal parasitic forms. The prevalence of parasites found in two breeds of dogs were 34.4% in stray dogs and 16.1% in house hold dogs respectively (Table 1).

Regarding the number of parasites species detected in each sample, 27 dogs (17.7%) were infected with a single parasite species, thirteen (8.55%) were infected with two parasite species and only one dog (0.65%) was infected with three parasite species (Table 2).

Seven species of helminth parasites were detected, including 5 species of nematodes and 2 species of cestodes. Stray dogs were found highly infected than house hold dogs. *D. caninum*, *T. canis*, *Taenia* spp., *Ancylostoma caninum*, *Toxascaris* spp., *Capillaria* spp., and *T. vulpis* were investigated (Table 3). All the reported species were found in stray dog except *Capillaria* spp., similarly, *Taenia* spp., *Toxascaris* spp., and *T. vulpis* were not found in house hold dogs (Table 3).

**Table 5.** Prevalence (%) of intestinal parasites of dogs relative to host age, sex and breed.

Category	Number examined	Number infected	%	P value (at 95% CI)
Stray dogs				
Age				
Adults	47	31	34.4	0.1301 (-16.67 to 62.67)
Sub-adults	43	13	14.4	
Total	90	44	48.8	
Sex				
Male	55	29	32.2	0.2002 (-29.52 to 75.52)
Female	35	15	16.6	
Total	90	44		
House hold dogs				
Age				
Adults	42	8	12.9	0.1596 (-24.06 to 74.06)
Sub-adults	20	3	4.83	
total	62	11	17.7	
Sex				
Male	37	7	11.2	0.0544 (-1.174 to 51.17)
Female	25	4	6.45	
Total	62	11		

CI stand for confidence interval.

Older dogs were more infected than younger ones. The male dogs in both the breeds were more infected than females. No significant difference ( $p < 0.05$ ) for ages, sex and breeds (Table 5).

#### 4. Discussion

Information regarding prevalence of gastro-intestinal parasite of dog and their environmental contamination is very limited in Pakistan. Stray dogs were observed more parasitized (34.4%) than house hold dogs (16.1%). Parasitic contamination levels are comparable with earlier studies conducted on dog faecal samples in countries such as: Nigeria 33.9% (Ogbaje et al., 2015); Poland 37.4% (Szwabe and Błaszczowska, 2017). In different parts of the world the prevalence rate was higher than the present study as: Cuba 44.3% (Puebla et al., 2015); Nepal 46.7% (Satyal et al., 2013); Kandy district 90% (Perera et al., 2013). The prevalence documented in Mexico 26.5% (Chable et al., 2015; Bangladesh 22.4% (Mahmud et al., 2014; Iran 19.1% (Kohansal et al., 2017) was lower than all other studies conducted. Helminths reported in this study may be transmittable through the consumption of uncooked vegetables irrigated by water polluted by human feces and/or ingestion of faecally contaminated soil (Adanir and Tascl, 2013).

*Dipylidium caninum* is also called the double pore tapeworm. This tapeworm was the most frequent parasite (11.8%) living in the intestines of stray dogs as well as in house hold dogs in present study. Our findings were matching to the study conducted in Spain 13.2% (Martinez-Moreno et al., 2007). The highest prevalence 73.3% of this nematode was

reported in Australia (Jenkins and Andrew, 1993) and Iran 64.4% (Sowemimo and Asaolu, 2008) while the lowest rate of prevalence was noted in Nigeria 0.2% (Sowemimo and Asaolu, 2008); Hungary 1% (Fok et al., 2001); Australia 0.2% (Bugg et al., 1999); Spain 2.5% (Causape et al., 1996); Venezuela 2.37% (Ramirez-Barrios et al., 2004). *Dipylidium caninum* has also been reported by Wong, (Wong, 1955) while (Narasimham et al., 2013) reported this infection in a male child for the first time in India.

*Toxocara canis* is also called the dog round worm has world wide in distribution with great zoonotic importance. *Toxocara canis* (10.5%) was the second most frequent parasite species in current study. The prevalence was meet with studies conducted in Tanzania 13.7% (Swai et al., 2010); Nigeria 9.6% (Sowemimo and Asaolu, 2008). The highest prevalence of this nematode was reported in Canada 43.5% (Seah et al., 1975); Hungary 24.7% (Fok et al., 2001); Spain 29.2% (Martinez-moreno et al., 2007); Galapagos Islands 16.5% (Gingrich et al., 2010). This nematode was reported in low rate of prevalence in Australia 1.7% (Bugg et al., 1999); Belgium 4.6% (Claerebout et al., 2009); Spain 3.7% (Causape et al., 1996). Toxocariasis is prevalent in tropical and developing countries of the world (Glickman and Magnaval, 1993). The life cycle of this nematode is completed in dog. Humans acquire infection as accidental hosts. Toxocariasis occurs primarily in young children, who get *Toxocara* eggs through contact with soil contaminated by the faeces of dogs that carry the parasite. Occasionally, adults who eat clay become infected. After the eggs are swallowed, larvae hatch in the intestine wall and are spread through the blood stream and causes visceral *larva migrans* or toxocariasis (Dickson, 2003).

*Taenia* sp. (6.57%) the third most frequently prevalent parasite in present study. This finding is relatively matching with the study conducted in Spain 11% (Martinez-Moreno). However this cestode is relatively low in prevalence in other parts of the world as in Tanzania 0.4% (Swai et al., 2010); Hungary, 2.8% (Fok et al., 2001); Belgium 0.2% (Claerebout et al., 2009); Spain 2.5 (Causape et al., 1996). *Taenia* spp is one of the meat born pathogenic helminth parasites of human in origin. *Taenia saginata* has also been reported to be infected human in Pakistan as 0.4% Arshad et al. (2019) Karachi; 9.70% Khan et al. (2019) Swat; 8.98% Khan et al. (2017) Swat. This disease causes heavy economic losses with enormous health and social implications in endemic communities of the world.

*Ancylostoma caninum* is the most common and pathogenically important hookworm of dog. This was 3.94% in present study findings. This finding was meet with the findings conducted in Spain 6.2% (Causape et al., 1996). Higher prevalence of this nematode was in Australia 100% (Jenkins and Andrew, 1993; Galapagos 57.7% (Gingrich et al., 2010); Tanzania 57% (Swai et al., 2010); Australi 22.1% (Bugg et al., 1999); Nigeria 17.9% (Sowemimo and Asaolu, 2008). The lowest rate of prevalence was documented in Hungary 8.1% (Fok et al., 2001).

*Toxascaris* spp and *Capillaria* spp each were 1.3% in present findings. Spain 2.5% These parasites were reported 2.5% and 7.3% by (Causape et al., 1996) in Spain and (Fok et al., 2001) in Hungary respectively. *Trichuris vulpis* 1.3% in present investigation. Canada 0.7% (Gaunt and Carr, 2011); Nigeria 0.5% (Sowemimo and Asaolu, 2008); Spain 1.66% (Martiz-Moreno); Australia 80% (Jenkins and Andrew, 1993); Spain 3.7% (Causape et al., 1996); United states 1.2% (Little et al., 2009).

Present study demonstrated 65.8% as single infetion, this ratio agrees with the studies conducted in Venezuela 68.3% (Traversa et al., 2009); Tanzania 73.8% (SWAI et al., 2010); Canada 54.9% (Seah et al., 1975); Hungary 50% (Fok et al., 2001). The study conducted in Australia was showing the low rate of single infection which was 19% (Bugg et al., 1999). Of the examined samples 31.7% were found infected with 2 species of parsites in present resarch. This was agreed with the studies conducted in Canada 30.9% (Seah et al., 1975); Hungary 24% (Fok et al., 2001). Findings of all other studies showed low rate of infection with 2 species of parasites in the dogs studies as Tanzania 12.4% (Swai et al., 2010); Galapagos Islands 11.3% (Gingrich et al., 2010); Australia 6.4% (Bugg et al., 1999). The percent of dogs infected with 3 species of parasites were 2.43% in present investigation which was matching with the studies conducted in Australia 2.3% (Bugg et al., 1999); Galapagos 2.1% (Gingrich et al., 2010); the high prevalence of infection in the context of 3 species infection was in Hungary 26% (Fok et al., 2001); Canada 12.3% (Seah et al., 1975) while the lowest rate was noted in Tanzania 0.4% (Swai et al., 2010).

Differences in the results of all these surveys might be due to geographical location, environmental factors, sample size, diagnostic procedures and other stress factors

involved in parasite transmission. Higher prevalence rate in older dogs might be due to the freely mobile nature of the animal and might also be due to the low level of immunity of older dogs than young pups.

In conclusion, dog represent a potential public health risk, transmit infective form of parasites to humans. This study calls for the fact that stray dogs play a key role in environmental contamination than house hold dogs. Close contact of humans with untreated dogs, no deworming practices and the favourable climatic conditions are the survival factors of infective stages of dog helminth parasites. The general public and dog owners should be aware on the presence of dog parasites in their surroundings.

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