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INTESTINAL HELMINTH INFECTIONS AND ASSOCIATED RISK FACTORS IN DOGS OF DHAKA CITY, BANGLADESH

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Abstract: This study was conducted to determine the prevalence and related risk factors for intestinal helminth infections in companion and stray dogs from Dhaka, Bangladesh. In total 310 fecal samples were collected from companion dogs (206 samples) and stray dogs (104 samples) from Dhaka south city corporation (DSCC) and Dhaka North city corporation (DNCC) areas. Salt flotation and formol ether concentration techniques were used to process the fecal samples. The prevalence of intestinal helminth infections in stray and companion dogs in DSCC was 48.98% and 18.02%, respectively, while in DNCC, it was 7.27% and 15.79%. Ancylostomatids showed the maximum prevalence (18.37%) followed by *Toxocara canis* (14.28%). Intestinal parasitic infections were more prevalent among female companion dogs (17.24%) than males (16.89%). Dogs of pure or mixed breed were prone to parasitic infections (29.09%). Outdoor access (P=0.000) and irregular deworming (P=0.000) were potential risk factors for intestinal helminth infections in companion dogs. Helminth infections in dogs could be a major public health concern. Proper sanitation measures especially in DSCC areas are necessary to check this alarming issue.

Key words: Stray dog, companion, fecal samples, intestinal helminths, Bangladesh

INTRODUCTION

Dogs are one of the most popular animals and faithful companions. Besides, it is observed that a number of stray dogs adjoining human habitation. In Dhaka city, 18,585 free-roaming dog population was estimated (Tenzin *et al.* 2015). This cohabitation may make a route for the transmission of zoonotic parasites to humans. In developing countries, intestinal parasites are common occurrence in dogs (Perera *et al.* 2013). Helminth parasites could be transferred from dogs to humans through food and water that is contaminated with dog excreta or secretions or even with animal hair (El-Tras *et al.* 2011). Wind can help dispersal of helminth eggs. Helminth contaminated food may later be a source of infection (Gerba 2015). Parasite eggs can also be carried into human houses in the event that adhere to peoples' shoes or animals' paws

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(Panova and Usually, companion dogs get comparatively better attention for deworming as compared to stray dogs. Curi *et al.* (2017) found poor animal health management and dog's free-roaming habits as potential risk factors for parasitic infections. To decrease the health risk both in human and dog, it is necessary to study the epidemiology of zoonotic parasitic infections. Lack of proper surveillance and the unavailability of data about the existence of asymptomatic animal carriers both as companion and stray; may generate a risk to community health. Hence, this study was designed to investigate the prevalence, related risk factors of canine intestinal parasitic infections.

MATERIAL AND METHODS

Study area and population: This cross-sectional study was conducted in randomly selected areas of Dhaka south (23.7239°N 90.4085°E) and north city corporations (23.7859°N 90.4168°E) from May 2019 to January 2020. In total, 310 fecal samples from companion and stray dogs were collected. Among the 310 fecal samples, 206 samples were collected from companion dogs and 104 samples from stray dogs.

Dog fecal sample collection and processing: Fecal samples were collected at random without considering age and gender. Dogs, those kept in a family, were categorized as companion dogs. Dogs without any claimed owner and observed in streets and parks were considered as stray dogs. Dogs aged < one year were considered as puppies and aged more than one year were considered as adult (Wallis *et al.* 2018). Fecal samples from companion dogs were collected by house to house visits. Volunteers delivered wide mouthed screw capped pot to the companion owners to collect their companions fecal sample. Prior to providing the pots, the dog owners were well informed by the volunteers about the study. Fecal sample processing was completed following Wickramasinghe *et al.* (2020). Written consents were also obtained from the owners. From the companion owners, volunteers obtained the information viz., age, sex, breed, outdoor access and deworming practices. The volunteers and research assistants carefully recorded the places from where the samples were collected. Fecal samples of the stray dogs were collected from roadsides, parks, open fields and sealed in ziploc bags. All the samples were transported to the laboratory soon after collection and stored in 4 °C in refrigerator. Samples were processed applying salt floatation technique (MAFF 1977; Foreyt 1989) and formol ether concentration technique (Allen and Ridley 1970). Eggs of helminths were confirmed referring Soulsby (1982). Detection of at least one parasite egg per sample was considered positive (Lorenzini *et al.* 2007).

Questionnaire: The volunteers and research assistants provided questionnaire to the dog owners to collect data on age, sex, breed, deworming treatments and outdoor access of their companion dogs.

Data analysis: Obtained data in hardcopies were carefully entered into Microsoft Excel 2016. To perform statistical analyses, IBM SPSS, version 20.0 was used. Chi-square analysis was performed to find the associated risk factors. The presence of parasites was considered as dependent variable and the details such as age, sex, breed, habitat, outdoor access and deworming practices were considered as independent variables to obtain the P-value. $P < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

A total of 310 fecal samples (160 from DSCC and 150 from DNCC) were examined. In DSCC, 111 fecal samples were obtained from companion dogs and 49 from stray dogs. Altogether 20 samples from companion dogs and 24 samples from stray dogs were screened positive for at least one helminth parasite. Prevalence was higher in stray dogs (48.98%) than in companion dogs (18.02%) in DSCC areas. In DNCC, 15 (15.79%) samples were found positive from companion dogs and only 4 (7.27%) were screened positive from stray dogs (Table 1). The highest prevalence was of Ancylostomatidae (18.37%) followed by *Toxocara canis* (14.28%) in DSCC area among the stray dogs. In DNCC area, the highest prevalence was of Ancylostomatidae (7.31%) in companion dogs. Overall, prevalence was much lower in DNCC area (Table 1).

In this study, among 206 companion dogs, 148 were males and 58 were females. The females (17.24%) showed higher prevalence than males (16.89%) (Table 2). Puppies were 87 in number and 119 dogs were adults. Puppies showed less prevalence of helminths (15.48%) than the adults (18.79%) (Table 2). Samples were collected from 55 pure and mixed breed companion dogs, viz., Spitz (6), Labrador (3), Corgipoo (3), Labsky (3), American Eskimo (3), Chow Chow (3), Alaskan Malamute (3), Lhasa Apso (3), Doberman Pinscher (3), Boston terrier (2), Retriever (2), Pomeranian (2), German Shepherd (2), Maltese Shih Tzu (2), Rottweiler (2), Pomsky (1), Corgi (1), Chihuahua (1), Great Dane (1), Dorgi (1), Pitsky (1), Pyrenees (1), Pug (1), French bulldog (1), Goberian (1), Shorkie (1), Dachsunds (1) and Keeshond (1) and 151 dogs were of local breeds; mostly Indian Pariah dogs. Pure and mixed breeds showed higher prevalence (29.09%) than the local breeds (12.58%) (Table 2).

Prevalence of helminths was higher among the companion dogs of DSCC area (18.02%) than DNCC (15.79%) (Table 1). In this study, helminth prevalence was higher among the dogs who received irregular deworming drugs (31;

64.58%) than the dogs who received regular treatments (4; 2.53%) (P=0.000) (Table 2). The dogs who had only indoor access were found to be less infected (9; 5.39%) than the dogs who had both indoor and outdoor access (26; 66.67%) (P= 0.00) (Table 2). *T. canis* showed the peak prevalence among male (64.28%), adult (57.14%), local breed (57.14%) dogs of DSCC areas (57.14%). It was prevalent among the dogs who did not receive regular deworming treatment (92.86%) and had outdoor access (57.14%) (Table 3).

Table 1. Intestinal helminth infections in companion and stray dogs in Dhaka city (N=310)

Parasites	DSCC (n=160)		DNCC (n=150)	
	Companion (n=111)	Stray (n=49)	Companion (n=95)	Stray (n=55)
Toxocara canis	8 (7.21%)	7 (14.28%)	6 (6.31%)	2 (3.64%)
Ancylostomatidae	8 (7.21%)	9 (18.37%)	7 (7.37%)	1 (1.82%)
Trichuris vulpis	4 (3.60%)	3 (6.12%)	2 (2.10%)	1 (1.82%)
Toxascaris leonina	0	2 (4.08%)	0	0
Dipylidium canium	0	1 (2.04%)	0	0
Toxocara canis and *Trichuris vulpis*	0	2 (4.08%)	0	0
Total	20 (18.02%)	24 (48.98%)	15 (15.79%)	4 (7.27%)

Table 2. Risk factors of intestinal helminth infections in companion dogs in Dhaka city (N=206)

Variables	Categories	Total (%)	Positive (%)	OR	95% CI	*P-value*
Sex	Male	148 (71.84%)	25 (16.89%)	1.025	0.458-2.294	0.952
	Female	58 (28.15%)	10 (17.24%)			
Age	Puppy	87 (42.23%)	13 (15.48%)	1.291	0.610-2.732	0.503
	Adult	119 (79.28%)	22 (18.79%)			
Breed	Pure and mixed	55 (26.69%)	16 (29.09%)	0.351	0.165-0.746	0.005
	Local	151 (73.30%)	19 (12.58%)			
Deworming	Regular	158 (76.69%)	4 (2.53%)	70.206	22.108-222.948	0.000*
	Irregular	48 (23.30%)	31 (64.58%)			
Outdoor access	Indoor	167 (81.07%)	9 (5.39%)	35.111	13.637-90.399	0.000*
	Both	39 (18.93%)	26 (66.67%)			
Area	DSCC	111 (53.88%)	20 (18.02%)	0.853	0.410-1.777	0.671
	DNCC	95 (46.12%)	15 (15.79%)			

In earlier studies in Bangladesh, fairly high prevalence of parasites in dogs were observed (Sarder *et al.* 2007; Basu *et al.* 2010; Das *et al.* 2012; Barua *et al.* 2020). In this study, comparatively lower prevalence was found than the previous works mentioned. Most of the fecal samples were collected during rainy season in this study. Parasite eggs can get washed off in rainy season, as a consequence, low prevalence was recorded.

Table 3. Prevalence of intestinal helminth infections based on different variables in companion dogs in Dhaka city (N=206) (% within parasite species)

Parasite species	Sex		Age		Breed		Area		Deworming		Outdoor access	
	Male n (%)	Female n (%)	Puppy n (%)	Adult n (%)	Pure/mixed n (%)	Local n (%)	DSCC n (%)	DNCC n (%)	Regular n (%)	Irregular n (%)	Indoor n (%)	Outdoor access n (%)
Toxocara canis	9 (64.28%)	5 (35.71%)	6 (42.86%)	8 (57.14%)	6 (42.86%)	8 (57.14%)	8 (57.14%)	6 (42.86%)	1 (7.14%)	13 (92.86%)	6 (42.86%)	8 (57.14%)
Ancylostomatidae	11 (73.33%)	4 (26.67%)	5 (33.33%)	10 (66.67%)	7 (46.67%)	8 (53.33%)	8 (53.33%)	7 (46.67%)	2 (13.33%)	13 (86.67%)	3 (20.00%)	12 (80.00%)
Trichuris vulpis	5 (83.33%)	1 (16.67%)	2 (33.33%)	4 (66.67%)	3 (50.00%)	3 (50.00%)	4 (66.67%)	2 (33.33%)	1 (16.67%)	5 (83.33%)	0	6 (100%)
P- value	0.849		0.859		0.048*		0.922		0.000*		0.000*	

Rahman (1973) found at least one helminth from all the fecal samples collected from stray dogs from different localities of Bangladesh. In this study, altogether 28 helminth positive samples from stray dogs were detected; 24 (48.98%) from DSCC area and only 4 (7.27%) from DNCC. In DSCC areas, companion dogs showed lower prevalence (18.02%) than that of stray dogs (48.98%) (Table 1). Continuous exposure to infection and the lack of proper environmental hygiene, absence of anthelmintic treatments or proper vaccination may be the reasons behind the high prevalence of helminth infections among stray dogs. Open defecations in public places possibly trigger the spread of parasites. The high prevalence of helminth parasites in stray dogs consequently impose the chance of topsoil contagion through undiscerning defecation. Thick external layers of nematode eggs aid in protection from environmental issues (Galgamuwa *et al.* 2018; Suraweera *et al.* 2018). In DNCC areas, helminth prevalence was higher (15.79%) among companion dogs than in stray dogs (7.27%) (Table 1). It may be due to rise of temperature, pollution and global climate change and limited sample size.

In this study, the highest prevalence was recorded for Ancylostomatidae (18.37%) followed by *T. canis* (14.28%) among the stray dogs in DSCC. To develop into infective hookworm; shaded, sandy, and the damp soil is required (Brooker *et al.* 2004). In rainy season, soils in DSCC areas, particularly in roadsides are moist and shady due to water clogging. This could be a reason for the resulted prevalence of hookworm infections in dogs. In Sikkim, Mumbai and Delhi, hookworms were found to be the most occurring parasite in dogs (71.3%, 48.8% and 39.1%, respectively) (Traub *et al.* 2014). Papajová *et al.* (2014) randomly collected fecal samples from public areas in Trebišov and Veľké Kapušany, Slovakia. They found that the maximum frequent parasites were *Trichuris vulpis* (32.80%) followed by *T. canis (*28.10%) and Ancylostamatidae (22.00%) in Trebišov and Ancylostomatidae (45.20%) and *T. canis* (41.90%) in Veľké Kapušany. Ilić *et al.* (2021) found *T. canis* as the uppermost prevalent parasite in their study. In Bangladesh, stray dogs are found to be common in parks where children use to visit frequently. As *T. canis* is a zoonotic parasite, close contact with human may increase the chance of transfer of parasite to human.

In the present study, among the 49 fecal samples from stray dogs of DSCC area, only 2 (4.08%) fecal samples were screened positive for double infection with *T. canis* and *T. vulpis.* Katagiri and Oliveira-Sequeira (2008) found that dogs harboring monoparasite were more frequent (31.4%) than those harbouring two (18.5%), three (3.2%) or four (1.2%). The result supports the earlier reports from other countries (Mukaratirwa and Singh 2010; Itoh *et al.* 2015; Simonato *et al.* 2015; Torre *et al.* 2018; Saldanha-Elias *et al.* 2019).

Female companion dogs showed a little higher prevalence (17.24%) than the males (16.89%) (P=0.952) in this study (Table 2). Similar results were found by Razmi *et al.* (2006) and Endrias *et al.* (2010). Wickramasinghe *et al.* (2020) observed significantly higher parasitic infection in female dogs than males This could be explicated by the stress and endocrine issues which may reduce the immunity, consequently triggering dormant larvae in tissues (Calero-Bernal *et al.* 2019). Companion dogs of adult age showed higher vulnerability to gastrointestinal helminth infections compared to puppies. Ilić *et al.* (2021) found 78.10% of puppies were infected with parasites in public shelters followed by adult dogs (53.10%). In this study, *T. canis* showed higher prevalence among adults (57.14%) (Table 3) which contradicts with Hendrix *et al.* (1996). According to them, *T. canis* is capable of transplacental transmission and thus puppies can get this infection congenitally Therefore, the prevalence of *T. canis* is more common in puppies than in older dogs.

Pure and mixed breeds were found to be more prone to infection (29.09%) than local breeds (12.58%) (P=0.005) (Table 2). *T. vulpis* showed the highest prevalence (50.00%) among pure or mixed breed dogs (Table 3). This could be due to individual's immunity. Idika *et al.* (2017) found local breeds were more susceptible to acquire infection than the exotic breeds. Companion dogs who used to get regular antihelminthic drugs, among those prevalence was much lower (2.53%) than the dogs who received irregular drugs (64.18%) (P=0.000) (Table 2). Proper hygiene, regular deworming medication, vaccination and proper check-ups are vital to control helminthiases in dogs (Kołłątaj *et al.* 2012).

In the present study, the highest prevalence of helminths in companion dogs was observed in DSCC areas (Table 2). In DSCC areas, *T. vulpis* (66.67%) showed the maximum prevalence. In DNCC area, the highest prevalence was recorded for Ancylostomatidae (46.67%) (Table 3). Outdoor access of companion dogs was found as a serious risk for getting helminth infections (P=0.000) in the present study (Table 2). When the companion dogs rove outside the restricted home, they may search for small animals viz., rodents to hunt and may endorse collision with stray cats from which they may get infected. Furthermore, they may eat roadside carcasses, animals waste or human excreta. These sources may inflict parasitic infection upon them. This finding is similar with earlier findings (Katagiri and Oliveira-Sequeira 2008; Torre *et al.* 2018; Kidima 2019).

CONCLUSION

Nowadays, companion animals are inextricably linked with human life. Domestic dogs and human health is closely associated which is well-depicted by Wells (2007). Rabies is still a diseases of high community health significance.

Hence, timely screening the zoonotic diseases that humans may possibly get from dogs is necessary. The present research work finds low to moderate prevalence of helminths among stray and companion dogs. Though more works, combining greater dog population covering the whole country is a need to predict the whole scenario. Moreover, improved knowledge regarding companion animal health among the pet owners, nationwide better-quality veterinary services, maintenance of proper sanitation across the country are inevitable to control parasitic diseases in companion and stray animals.

ETHICAL APPROVAL

The handling of animals was performed in compliance with the current Bangladesh legislation (Cruelty to Animals Act 1920, Act No. I of 1920 of the Government of the People's Republic of Bangladesh). The experimental design was ethically approval by the Ethics Committee of the Faculty of Biological Sciences, University of Dhaka, Bangladesh. All the procedures used in this study adhere to the tenets of the Declaration of Helsinki. All the dog owners were clearly informed regarding voluntary involvement. Written consents were obtained from dog owners for sharing their companion dogs' data in the study.

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