Potential Spatial Diversity of Pathogenic Intestinal Parasites in Dog's Faecal Matter in Port Harcourt, Niger Delta: A Huge Source of Environmental Contamination Risk Outcome

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ABSTRACT

Dogs have become a huge part of some homes where they serve as pets or for security. Humans who have them as pets are drawn to them and when these dogs die, their owners are emotionally down. However, in some cases, little or no attention is paid to the health of these dogs as when infected, thus, they could serve as potent reservoirs and vectors of human parasites as they continue to litter their faeces on our environment unabated. This study investigated the presence of intestinal parasites in the faecal matter of domestic dogs and will also highlight the public health implications of poor faecal matter waste handling in our environment. A total of 80 pet dogs that had their owners' consent were randomly recruited, through a cross-sectional research design. Their stool samples were collected aseptically and assayed for gastrointestinal parasites using standard parasitological techniques. The result revealed that the prevalence of parasites using the diethyl ether sedimentation method was 25.1% and the presence of *Ancylostoma caninium* (21.3%) and *Toxocara canis* (3.75%) was recorded after microscopic examination. Female dogs were most infected making up 15% of the total prevalence while male dogs made up 10%. Dogs aged 2-4 years recorded the highest prevalence with 37.5% while

13.8% of those greater than 4 years were infected. Also, the English Bulldog recorded a higher prevalence of 8.75% in comparison to other species sampled. The presence of these parasites in pets poses a public health risk to their owners and the community at large. Proper hygiene and management of these pets and their faecal matter will reduce the risks of parasitic infections, even as our environment would be safe from the heavy burden of environmental contamination of biological waste of Dogs faecal matter

Keywords: Dogs, Public Health Risk, Pets, Faecal Matter, Parasitic Zoonotic Infections, Environmental Contamination

INTRODUCTION

In some developing countries such as Nigeria, dogs are used as pets. Their intelligence has made them valuable to humans for tracking, hunting, rescue mission, and guidance [1]. They have contributed to the emotional, social, and physical health of their holders, especially children [2]. Studies have reported higher self-esteem among children having dogs as pets [3]. As a result of their importance, some owners spend some money on keeping them healthy. Irrespective of their advantages, the close relationship between these pets and their owners as well the unsuitable behaviour and practices of humans, serve as risk factors for the transmission of parasitic infections as dogs are hosts to the infective stages of most human and dog parasites [4]. It is thus important that owners and keepers of animals understand the symptoms and types of parasites their pets could be infected with and the control measures, in order to reduce losses [5].

Zoonotic infections such as those that frequently infect the intestines of dogs and other domestic animals affect public health. These dogs serve as vectors of the parasites and examples of these intestinal parasites include *Giardia intestinalis*, *Taenia hydatigena, Crytosporidium* spp., *Toxocara canis* and *Entamoeba histolytica* [6]. These are known causes of diseases in children and adults [7]. A major feature of these parasites is their mode of transmission through the oral-faecal route which enables the shedding into the environment of their larvae, cysts or oocysts [8]. Transmission could thus be through contact with infected food or water, the dog, its excreta or secretion [2]. These indicate that dogs are a significant public health concern because they act as transmitters, carriers and reservoirs of these parasites [9]. The presence of parasites can lead to reduced performance and subsequently, loss of revenue for its owner.

In developing countries such as Nigeria, there is a paucity of policies implemented with regard to the health of pets and their relationship with the owner's and community's health. As a result, the prevalence of zoonotic parasites with public health importance to humans is generally high [10]. Most homes in Port Harcourt have dogs either as pets or for security purposes, some of which are allowed access into the house and bedding. This exposes humans, especially children to the risk of infection. Apparently, lack of awareness, environmental sanitation and hygiene has aided the transmission of these infections [2]. This work was thus aimed at determining the prevalence and diversity of intestinal parasites in the faecal matter of dogs in Port Harcourt, Nigeria. It is strongly expected that the findings from this study would promote robust advocacies for proper care of dogs and other emerging diseases from poor handling of the faecal matter of the dogs that tend to contaminate the environment hugely.

METHODOLOGY

Sample Location

The study was a cross-sectional study carried out on dogs from different parts of Port Harcourt. Port Harcourt is the capital city of Rivers State and home to several industries. Most homes harbours different species of dogs as pets or for security purposes. It is the home of oil and gas activities in Nigeria with many multi-national companies and large amount of immigrants from different parts of the world that came in for greener pasture activities.

Ethical approval

Ethical approval was obtained from the Rivers State University Teaching Hospital Laboratory Manager, where the practical assay was done. Also, verbal consent of the dog owners was obtained before the questionnaires were administered and dog faecal samples were collected respectively.

Sample Collection

The sample size was determined using the following formula:

$$\text{Sample size} = N = \frac{Z^2 P (1 - P)}{d^2}$$

N = sample size

Z = constant (1.96)

d = margin of error (5%) = 0.05

P = prevalence from a previous study = 0.055

$$N = \frac{1.96^2 (0.055)(1 - 0.055)}{(0.05)^2} = 79.8 \approx 80 \text{ samples}$$

The questionnaires were self-administered to the owners and after which the dog faecal samples were collected. Random dogs without owners and who were not properly taken care of were excluded from the study. Sterile-labelled sample bottles were given to the dog owners and instructions on how to collect fresh faecal samples were also given to them. The samples were immediately transported to the parasitology laboratory of River State University for analysis in an ice pack.

Laboratory Experimental (Examination)

Two methods were used to examine the samples, these were macroscopic and microscopic examinations.

Macroscopic examination: The stool samples were examined for their consistency, presence of blood, parasite, mucus and colour.

Microscopic examination using direct microscopy: A drop of normal saline was placed on the centre of the left half-glass slide and a drop of iodine was placed on the right half of the slide. Using an applicator stick, a small portion of the faecal matter was added to both saline and iodine smear and a cover slip were placed on them without air bubbles. The slide was examined under the 10x to focus and the 40x objective lens was used to identify the parasites respectively. Saline preparation identifies cysts, eggs, larvae, mobile parasites and trophozoites while iodine preparation identifies mainly cysts in a beautiful faction.

Saturated salt flotation technique: 8 ml of saturated salt solution was added to 1 g of centrifuged faecal matter in a 15 ml test tube. The tube was tightly capped and shaken vigorously to homogenize. This method was used to observe eggs and coccidia cysts in the faecal samples.

Diethyl ether sedimentation technique: This method was used to recover larvae, eggs and cysts from the faecal matter. Using an applicator stick, 1 g of faeces was emulsified in 4 ml of 10 % formol water in a screw cap tube and shaken properly. The mixture was sieved and the suspension was collected in a centrifuge tube and spun for 2 min at 2000 rpm. The applicator stick was used to transfer the sediment to a glass slide while the supernatant was discarded. The glass slide was examined using x10 and x40 objective lenses respectively.

RESULTS

The ages of the pets' owners sampled were ≥12 years, of which the majority were between 25-38 years (37.5%); 35-49 years made up 25%, 18-24 years 22.5%, ≥50 made up 13.8% and 12-17 years 1.3%. The female gender made up 52.5% while males made up 47.5%. With regards to education, those who had tertiary education accounted for 81.3%, secondary education 11.3%, non-formal education 6.3% and primary education 1.3%. Of the sampled population, 65% were married while 35% were single. Based on employment status, 43.8% were employed, 18.8% were students, 13.8% were students, 11.3% were unemployed, 8.8% were self-employed and 3.8% were retired (Table 1).

English bulldogs made up 27.5% of the total population sampled while boerboel, bowel, dazy, and Dobermann made up 1.3% of the sampled population, each. The frequency of female dogs sampled were 52.5% and male dogs were 47.5%. Nevertheless, Dogs aged 2-4 made up 32.5% of the sampled population, while those who were more than 4 years made up 13.8% (Table 2).

Using direct microscopy, a total parasite prevalence of 15% was observed with *Ancylostoma caninium* making up 12% and *Toxocara canis* making up 2.5%. When brine microscopy was used, a prevalence of 20.1% was recorded with *T. canis* making up 3.8% and *A. caninium* 16.3%. Diethyl-Ether Microscopy recorded *A. caninium* prevalence of 21.3% and *T. canis* prevalence of 3.75%, making a total prevalence of 25.1% (Table 3).

Dogs owned by males recorded 11.25% of *A. caninium* 2.5% of *T. canis* and a total prevalence of 13.7% while those owned by females had a total prevalence of 11.25%. Persons aged 18-24 years had a higher prevalence of parasites with 7.5% while those aged 12-17 had the least with 1.25%. Dogs whose owners had tertiary education had a high prevalence of 17.5%

while none was recorded for those with no formal education. Pets owned by single individuals had a higher prevalence of 12.5% compared with those who were either employed, retired or self-employed where a prevalence of 1.25% was recorded for each of them (Table 4).

Based on the species of dog, Dazy, Gun dog, and Hound dog recorded the least parasite prevalence with 1.25% each while English bulldog had a higher prevalence with 8.5%. Female dogs recorded a high prevalence of 15% while male dogs had 10%. Among dogs less than a year and those greater than 4 years, a lower prevalence of 5% was observed while those between 2-4 years had a prevalence of 8.75% (Table 5).

Table 1: Frequency Distribution and Correlation of Pet Owners' Biodata

Pet Owner's Biodata	Classification	Frequency	Percent	Correlation	p-value	Remark
Pet Owner's Age	12-17years	1	1.3	-.021	.853	N/S
	18-24years	18	22.5			
	25-34years	30	37.5			
	35-49years	20	25.0			
	50years & Above	11	13.8			
Gender	Female	42	52.5	-.121	.283	N/S
	Male	38	47.5			
Education	Non-Formal Education	5	6.3	.164	0.145	N/S
	Primary Education	1	1.3			
	Secondary Education	9	11.3			
	Tertiary Education	65	81.3			
Marital Status	Married	52	65.0	-.048	.671	N/S
	Single	28	35.0		.	
Employment Status	Employed	35	43.8	.077	498	N/S
	Not Employed	9	11.3			
	Partly Employed	11	13.8			
	Retired	3	3.8			
	Self Employed	7	8.8			
	Student	15	18.8			

N/S = Not significant $p > 0.05$, Sig = Significant $p < 0.05$

Table 2: Frequency Distribution of Pet Dog's Biodata.

Variable	Classification	Frequency	Percent
Pet type	Boreboel	1	1.3
	Bowel	1	1.3
	Bull Mastiff	2	2.5
	Caucasian	5	6.3
	Dazy	1	1.3
	Dobermann	1	1.3
	English Bull Dog	22	27.5
	German Shepherd	17	21.3
	Gun Dog	5	6.3
	Hound Dog	5	6.3
	Others	13	16.3
	Native Dog	4	5.0

	Rottweiler	3	3.8
Sex of Dog	Female	42	52.5
	Male	38	47.5
Age of Dog	1-2years	23	28.8
	2-4years	26	32.5
	Less than 1year	20	25.0
	Greater than 4years	11	13.8

Table 3: Prevalence Rate of Parasites using different Methods of Assay.

Method	Classification	Number Positive	Prevalence (%)
Direct Microscopy	*Ancylostoma caninium*	10	12.5
	Toxocara canis	2	2.5
	Total	**12**	**15**
Brine Microscopy	*Ancylostoma caninium*	13	16.3
	Toxocara canis	3	3.8
	Total	**16**	**20.1**
Diethyl-Ether Microscopy	*Ancylostoma caninium*	17	21.3
	Toxocara canis	3	3.75
	Total	**20**	**25.1**

Table 4: Prevalence Rate of Parasite based on Pet Owner's Biodata

Variable	Classification	*A. caninium*	Prevalence % *A. caninium*	*T. canis*	Prevalence of *T. canis*	Total No of Parasites	Total Prevalence
Sex	Female	8	10	1	0	9	11.25
	Male	9	11.25	2	2.5	11	13.75
	Total	**17**	**21.25**	**2**	**2.5**	**20**	**25**
Age	12-17years	1	1.25	0	0	1	1.25
	18-24years	4	5	2	1.25	6	7.5
	25-34years	5	2.5	0	0	5	6.25
	35-49years	4	5	0	0	4	5
	50years & Above	3	3.75	1	1.25	4	5
	Total	**17**	**17.5**	**3**	**2.5**	**20**	**25**
Education	Non Formal	0	0	0	0	0	0
	Primary	0	0	0	0	0	0
	Secondary	6	7.5	0	0	6	7.5
	Tertiary	11	13.75	3	2.5	14	17.5
	Total	**17**	**21.25**	**3**	**2.5**	**20**	**25**
Marital Status	Married	10	12.5	1	1.25	11	13.75
	Single	7	8.75	2	1.25	9	11.25
	Total	**17**	**21.25**	**3**	**2.5**	**20**	**25**

Employment	Employed	8	10	2	2.5	10	12.5
	Not Employed	1	1.25	0	0	1	1.25
	Partly Employed	3	3.75	1	0	4	5
	Retired	1	1.25	0	0	1	1.25
	Self Employed	1	1.25	0	0	1	1.25
	Student	3	3.75	0	0	3	3.75
	Total	**17**	**21.25**	**3**	**2.50**	**20**	**25**

Table 5: Specific Dog Species Prevalence Distribution pattern of Parasites

Variable	Classification	*A. caninium*	Prevalence % *A. caninium*	*T. canis*	Prevalence of *T. canis*	Total No of Parasite	Total Prevalence
Pet Type	Boreboel	0	0	0	0	0	0
	Bowel	0	0	0	0	0	0
	Bull Mastiff	0	0	0	0	0	0
	Caucasian	0	0	0	0	0	0
	Dazy	1	1.25	0	0	1	1.25
	Doberman	0	0	0	0	0	0
	English Bull Dog	6	7.5	1	1.25	7	8.75
	German Shepherd	1	1.25	1	1.25	2	2.5
	Gun Dog	1	1.25	0	0	1	1.25
	Hound Dog	1	1.25	0	0	1	1.25
	Others	3	3.75	0	0	3	3.75
	Native Dog	2	2.5	0	0	2	2.5
	Rottweiler	2	2.5	1	0	3	3.75
	Total	**17**	**2.25**	**3**	**2.5**	**20**	**25**
Sex of Pet	Female	11	13.75	1	1.25	12	15
	Male	6	7.5	2	1.25	8	10
	Total	**17**	**2.25**	**3**	**2.5**	**20**	**25**
Age of Pet	1-2years	4	5	1	1.25	5	6.25
	2-4years	6	7.5	1	1.25	7	8.75
	Less than 1year	3	3.75	1	0	4	5
	Greater than 4years	4	5	0	0	4	5
	Total	**17**	**2.25**	**3**	**2.5**	**20**	**25**

DISCUSSION

This study recorded a total parasite prevalence of 25.1% among the 80 dogs sampled. However, this is lower than the 54.9% and 47.2% reported in Nsukka and Enugu, respectively. It was also lower than the 59.3% reported by Adedoja, et al. [10] in Ilorin, 33.9% reported in Zaria and 49.1% in Ilesa [11,12].

These differences in prevalence could be linked with the sample size as the retrospective study in Enugu used a sample size of 263 while that of Zaria was 224. Also, most studies focus on stray dogs while the dogs sampled in this study had owners who took proper care of them. This prevalence is however in consonance with a 10-year retrospective study carried out in Maiduguri where an overall prevalence of 16.13% was reported [13]. Chiejina

[14] noted that in comparison with arid regions, humid climates favour the growth of the infective stage of certain helminths. According to Mundim, et al. [15], prevalence from different studies often differs as the region; conditions of living, age, and method of diagnosis also differ.

In consonance with the study by Idika, et al. [16], Sowemimo and Ayanniyi [12], Pam et al. [5], and Adedoja, et al. [10], this study also recorded the presence of *Ancylostoma caninium* and *Toxocara canis* which are intestinal helminths from the sampled dogs. Syndromes such as ocular larva migrans, visceral larva migrans and certain atopic and neurologic symptoms have been associated with *T. canis* infection [17]. Studies carried out in the United States of America reported that the presence of this intestinal parasite and others at ≥7% is considered a health threat, especially to children (32). This results from the shedding of several eggs into the environment daily causing contamination in the environment and subsequently, the children could ingest the eggs while playing [18,19].

Anchylostoma caninium. could be regarded as a common intestinal parasite of dogs as most studies report its presence in addition to other parasites. In agreement with studies by Moro, et al. [2] and Kutdang et al. [20] carried out in Rivers State and Jos, respectively, A. caninum recorded a higher prevalence of 21.3% in comparison with that of *T. canis*. Studies carried out in Calabar and Makurdi also reported a similar trend [21]. This is however, different from studies by Ugbomoiko, et al. [22], Szabova, et al. [23], and Amissah-Reynolds, et al. [24] who reported a higher prevalence of *T. canis* in Ilorin (Nigeria), Slovak Republic, and Ghana, respectively.

In this study, the female dogs were more infected than the males. This is similar to the report by Idika, et al. Sowemimo and Asaolu [25] and Awoke et al. [26] but in disparity with that of Anosike, et al. [27] and Sowemimo, et al. [12]. This difference in infection among the sexes has been linked to the influence of hormones on immunity including "peri-parturient relaxation immunity" in lactating and pregnant females [28].

In contrast to the study by Adedoja, et al. [10], where a lower infection rate was recorded among dogs aged 2-4 years, this study recorded a higher prevalence of 8.75% among dogs of the same age. Also, the high infection rate among females could have contributed to the 6.25% rate among pets aged 1-2 years as these often stay close to their mothers from when they are born until they are weaned. The higher prevalence among dogs ages 2-4 observed in this study is in contrast with the study by Sowemimo, et al. [12] who reported a higher prevalence among puppies below six months.

In disparity with previous studies, this one recorded a lower prevalence among native dogs (2.5%) while the English bulldog had the highest prevalence with 8.7%. Moro, et al. [2], Mukaratirwa, et al. [29], Sowemimo, et al. [12], and Anene et al. [30] reported a higher prevalence among local/native breeds in comparison with exotic ones such as the Rottweiler, English bulldog, Doberman). This difference could be due to the fact that the dogs are not stray dogs in comparison with previous ones and are cared for by their owners.

The Public Health implication of the community environmental contamination of the soil, farms and water bodies by the faecal matter from Dogs cannot be over-emphasised. Thus, the littering of dog faecal matter on our streets, gardens and compounds would certainly pose massive health challenges to the vulnerable and immune-compromised groups, who literally walk around their, homes, gardens and communities barefooted or without any source of protection on their feet. More importantly, are the children who crawl, play and feed from any food that falls on the ground as a habit of living in Africa among infants. It is no more a news that some larva stages of most of the zoonotic parasites can easily gain entry into the systemic part of the body by piercing through the skin, while the majority, at their cyst stage would potentially got into the body system through the faecal-oral route transmission mechanism.

However, the carriage and movement of the animal faecal matter by rainfall through the erosion run off into our farms for possible contamination of the soil, water bodies and vegetable gardens, of which most of the vegetables are best eaten fresh or half-cooked, so as to maximize its nutritional importance. This is another source of public health concern that calls for urgent attention to improve and sustain Dog faecal matter disposal management strategies in our region. The littering of Dogs' faecal matter at random in our environment would certainly increase the burden of myriad of zoonotic diseases in our communities, even in the midst of weak or absence of

functional health care facilities located close to the people in remote communities. Nevertheless, there is an urgent need for dog owners to build in them, the strategy, culture and attitude of packing the faecal matter of their dogs, even in public places, and making sure that they are appropriately disposed, so as to reduce the environmental contamination and its associated public health implications. Thus, it is firmly expected that this is another means of working towards the reduction of the prevalence of parasitic infections of zoonotic importance, in our remote communities across the world. This is another key step of keeping the environment healthy and green.

CONCLUSION

Dogs are useful to humans and contribute largely to their owners' emotional, social, and physical well-being. However, this study has shown that they could harbour different infective stages of zoonotic parasites of importance that could be transmitted to humans and cause serious infections. The close relationship between a pet dog and its owner poses a public health risk to the owner. Public awareness and environmental sanitation education on the need for proper sanitation and disease management among pets could help reduce the prevalence of parasites in pets and subsequently, transmission to humans, even as our environment would be free from littering from poor dog faecal matter disposal approach and its consequences

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