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Presence of *Toxocara* Eggs on the Hairs of Dogs from Southwest Nigeria

Oluyomi Abayomi Sowemimo* **and Olalekan Opeyemi Ayanniyi**

Department of Zoology, Obafemi Awolowo University, Ile- Ife, Osun State, Nigeria

***Corresponding author:** Oluyomi A. Sowemimo, Department of Zoology, Obafemi Awolowo University, Ile- Ife, Osun State, Nigeria, Tel: +2348034425965; E-mail: yomi_showemimo@yahoo.com

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Abstract

The close contact between dogs and humans poses a high risk of exposure to *Toxocara canis* eggs which can lead to Visceral Larva Migrans (VLM) syndrome. The aim of the study was to assess whether the hair of domestic dog in Nigeria was contaminated with eggs of *T. canis*, a zoonotic parasite. Samples of hair from 267 dogs of different ages comprising local and exotic breeds were collected from the neck, back and anal regions between April 2015 and February 2016 at Ile –Ife and Ibadan, Southwest Nigeria. Eggs were recovered from the hair using a previously standardised detection method. Eggs were found on the hair of 48 (18.0%) dogs. A total of 188 *T. canis* eggs were recovered from the hair of infected dogs. None of the eggs found were embryonated. 62.5% of the infected were under one year of age. As no domestic dogs which were positive from hair samples had negative faecal samples, this indicates that the presence of *T. canis* eggs in hair is probably due to self-contamination. As T. *canis* eggs were found on the hair of domestic dogs, direct contact with dogs may be a potential risk factor for transmission of *T. canis* eggs to humans.

Keywords: *Toxocara canis*; Dog; Direct; Contact; Eggs; Zoonosis; Nigeria

Introduction

Toxocara canis is one of the most common gastrointestinal parasites of domestic dogs and other canids. Infected dogs can shed large number of eggs into the environment causing infection in other dogs and in paratenic hosts including small mammals and humans [1]. The presence of potentially infective eggs of *T. canis* in the environment is one of the key routes of transmission to humans [2].

The most widely recognised source of human infection is the ingestion of contaminated food, water and soil. Children in their first decade of life are the most vulnerable due to their geophagic behaviour and mouthing of contaminated objects which is further linked to high risk of exposure at playground contaminated with dog faeces [3]. In addition infection can also occur following ingestion of partial or whole paratenic host such as raw livers of domestic animals such as chicken, ducks, rabbits, sheep and cattle [4,5] and ingestion of raw vegetables or fruits [6,7].

Direct contact with dogs that harbour a patent *Toxocara* infection is usually not considered a risk, because the eggs need to mature 3-6 weeks before they are infective [8-10]. Another proposed mode of transmission in recent studies is contact with embryonated eggs on a dog's hair [11-16].

Various surveys conducted worldwide indicate that prevalence of *T. canis* in canid definitive host ranged from 86%-100% in puppies and 1%-45% in adult dogs [17-20]. In Nigeria, studies have revealed high prevalence of *T. canis* with values of 80% in puppies [21] and 33.8%-41.7% in adult domestic dogs [22-24]. The seroprevalence of toxocariasis in human population has been reported to fluctuate between 2.2% and 92.8% depending on countries, study groups age and socio-cultural level [25]. There are only two studies reported so far in Nigeria, and the prevalence of the recent study was reported to be 86.1% [26].

Wolfe and Wright [11] stated that if eggs could embryonate on the hair of a dog, direct contact with dogs could be seen as an additional route of transmission. Recent studies from different parts of the world have reported presence of both unembryonated and potentially infective eggs on the hair of dogs [8,12,13,27]. Currently, there is dearth of information regarding the presence of *T. canis* eggs in the coat of Nigerian dogs.

The aim of this present study was to investigate whether *Toxocara* eggs were present on the hair of domestic dogs sampled from different locations within Southwest Nigeria as well as to determine their developmental stage and related with the animals' characteristic such as age, sex, breed type.

Materials and Methods

Sample collection and egg detection

Reconnaissance visits to identify 500 dog-owning households in Ilesa and Ibadan, Southwest Nigeria were carried out between January and March 2015 for exploratory discussion on the purpose of the study. Based on proximity and geographic location, a total of 267 dogs were sampled from different locations within Ilesa and Ibadan between April 2015 and February 2016. The age and sex of each dog was recorded. The dogs were classified into puppies (age ≤ 6months), young dogs (age 7-12 months) and adults (>12 months). Dog hair samples from local breeds (African Shepherd) and exotic breeds (Alsatian, Mongrel, and Rottweiler) were used in the present study.

The hair samples were taken from three different locations on the dog's body; the neck, back and anal region. Each hair was taken using a scissors which was washed thoroughly with hypochlorite solution between each hair sample taken. Each of the three hair samples taken from the dog was placed in individual re-sealable labelled with dog's

ID number. The name, age, sex, breed type and site location of each dog was recorded. Each dog was also assigned with an identification number (ID). Hair samples were weighed and the weight ranged from 0.06-0.96 g. Besides collecting hairs, faeces from 79 dogs were also collected into clean, sterile 5 ml specimen bottles and processed using modified Kato-Katz technique [28] and then examined for *T. canis* eggs.

Eggs were recovered from the hair using the technique described by Wolfe and Wright [11] with some modification. Each hair sample was added 300 ml distilled water with one or two drops of Tween 40, which separates any eggs from the hair. The samples were mixed in a homogeniser (Mod: TH-220 Omni, International Marietta, GA, USA) for 3 mins, they were then poured onto a 250 µm sieve. The samples were then washed under dripping water while on the sieves, and the sediment collected was transferred to centrifuge tubes. They were then centrifuged at 1500 rev for 10 mins, the supernatant was decanted and the remaining sediment with a drop of distilled water was collected using Pasteur Pipette and transferred onto clean microscope slides. The sediments were examined under a light compound microscope at X100 magnification to identify the *T. canis* eggs. The eggs were classified into two groups; unembryonated and embryonated.

Statistical analysis

Data were expressed as the prevalence of *Toxocara* eggs on the hair, the mean eggs per gram of hair (epg) ± SEM (Standard Error of Mean). The Chi-square (χ^2) test was used to test the existence of associations between the categorical variables (age of the dogs, sex, breed type and mode of life) and the prevalence of *T. canis* on the hair. The effect of factors affecting the presence of the *T. canis* eggs was performed using the univariate logistic regression model. All data were analysed using SPSS version 17.

Results

A total of 801 hair samples were examined from 267 dogs over a period of 10 months. Toxocara eggs were found on the hair of 48 (18.0%) dogs of which 62.5% were under one year of age (Table 1). In 62 (7.7%) of the hair samples, *T. canis* eggs were found fixed to the hair. Among the 48 infected dogs, 11 (22.9%) were puppies, 19 (39.6%) were young dogs and 16 (37.5%) were adults. The sex ratio of infected dogs was 25 males (52.1%) and 23 females (47.9%). Among the infected dogs, Thirty-six (75%) were of local breeds (African Shepherd) and 12 (25%) were exotic breeds while 34(70.8%) were free-roaming dogs and14 (29.1%) were kennelled.

Age group	Number examined	Number infected	% infected	Number of eggs recovered	Mean ± SEM
0-6	74	11	14.9	32	2.80 ± 1.37
7-12	85	19	22.4	86	5.65 ± 1.81
>12	108	18	16.7	70	9.36 ± 4.12
	267	48	18.0	188	6.36 ± 1.81
SEM: Standard Error of Mean					

Table 1: Number of *T. canis* eggs on hair from 48 infected dogs.

A total of 188 *T. canis* eggs were collected, 32 eggs (17.0%) from puppies, 86 eggs (45.7%) from young dogs and 70 eggs (37.2%) from adult dogs. All the *T. canis* eggs were unembryonated. The average number of eggs found on positive hair samples was 3.9 (1-34) and recalculated to egg per gram (epg) of hair as 6.36 (2.1-375.0) The mean epg number found on egg-positive puppies was 2.80 (2.82-92.3), for egg-positive young dogs was 5.65 (2.08-113.3) and for egg-positive adults 9.36 (2.94-375). The number of eggs found on the hair from different parts of the dog's body is shown in Table 2.

	Hair location			
	Neck	**Back**	**Anus**	**Total**
Number of egg positive hair samples	22	23	17	62
Total eggs recovered	95	58	35	188

Table 2: Summary of egg numbers taken from each hair sample of the infected dogs.

The statistical analysis showed that there were significant differences between free-roaming and kennelled dogs ($p<0.05$) and between local breeds (African shepherd) and exotic breeds ($p<0.05$) regarding the presence of *T. canis* on dogs/hair samples. However, there were no significant differences among the age group and between genders ($p>0.05$) (Table 3).

Effect		**Number examined**	**% infected**	**Chi-square**	**P-value**
Age group	0-6	74	14.9		

	7-12	85	22.4	1.716	0.424
	>12	108	16.7		
Sex	Male	144	18.7	0.081	0.77
	Female	123	17.4		
Mode of Life	Free -roaming	139	24.5	8.264	0.004
	Kennel	128	10.9		
Breed type	Local	148	24.3	9.071	0.003
	Exotic	119	10.1		

Table 3: Chi-square values and significance levels for *Toxocara* eggs per gram (epg) of hair.

Faecal samples were collected from 79 dogs of which 16 (20.3%) were positive for T. canis eggs. All dogs with eggs on the hair were observed to have eggs in their faeces (Table 4).

Age group	Number examined	Number of egg positive sample	Sample with eggs in faeces		Sample with eggs on hair		Samples with eggs in both faeces and hair	
			Number	%	Number	%	Number	%
0-6	74	9	5	55.5	7	77.7	3	33.3
7-12	85	7	5	71.4	4	57.1	2	28.6
>12	108	6	6	100	2	33.3	2	33.3
	267	21	16	76.2	13	61.9	7	33.3

Table 4: Toxocara eggs in faeces and hair of 79 dogs.

Discussion

In this study, *T. canis* eggs were found in 18.0% of dogs' hair samples examined. This result is comparable to the 21.56% and 19.16% prevalences reported by two authors [13,29] respectively. The prevalence obtained in this study is lower than those reported in previous studies [8,11,15]. In the Turkish study, a higher prevalence of 49% in a mixture of stray and owned dog was reported [15]. Wolfe and Wright [11] and Roddie et al. [12] reported higher prevalences of 25% and 67% of dogs harbouring eggs in their coats, respectively. These higher prevalences may be as a result of the focus upon stray dogs in the two studies with a mixture of stray and owned dogs being sampled by Wolfe and Wright [11] and only stray dogs by Roddie et al. [12]. The higher prevalence in stray dogs is most likely attributable to the lack of anthelminthic treatment, contact with soil and grooming given to these animals.

It has been reported that age is not related with the contamination of Toxocara eggs of the hair [11,12,30] or in other words the eggs on the hair can be seen in all age groups but that it is more common in less than one year old [9,13,14,29]. The results of the present study suggested that young and adult dogs are more likely to harbour *T. canis* eggs on their hair than puppies. A similar finding was reported by Oge et al. [16]. It has been reported that young and adult dogs are susceptible to Toxocara infection, even if they have been previously infected as puppies [31]; and young and adult dogs may still pose a risk to human health. In this study, both sexes seemed to have similar resistance to Toxocara infections. Previous studies by different authors [12,13,16,27,29,30] reported no significant difference in the prevalence between genders.

Studies on the dog breed effect on parasite prevalences are limited. In this study, the prevalence of *T. canis* in dog's hair samples was significantly higher in local breeds than in exotic breeds. A similar finding was reported by Anene et al. [32] where prevalences and intensities of different parasite infections were significantly higher in local breeds and their crosses than in exotic breeds. Another author [33] reported that the prevalence of most parasites was similar for dogs of mixed- breed and for dogs of a defined-breed, except for *Cystoisospora* spp. and *T. canis*, which showed a significantly higher prevalence in mixed-breed dogs.

In the present study, the highest number of eggs was recovered from the neck, followed by the back, while the lowest number was recorded in the anal region. This trend could be explained by the dog's playing behaviour resulting in increased soil contact [8]. Other behaviour such as scent rolling could also be responsible for increase contact with soil.

In this study, we found no embryonated eggs on the hair of domestic dogs. This finding was similar to that of some previous studies that also reported no embryonated eggs [8,9]. A study by Devoy Keegan and Holland [34] found that if unembryonated T. canis eggs can develop fully on the hair under controlled conditions, then these developed eggs would pose a risk. However, some studies have

reported embryonated eggs on the hair of dogs which suggested that direct contact with dogs may be important risk factor [13,15,16, 29].

Conclusion

Although soil contamination with Toxocara eggs is significantly responsible for human toxocariasis, ingestion through direct contact with dog has been suggested as an alternative route of transmission for this zoonosis. This study has confirmed the presence of *T. canis* eggs in the hair of domestic dogs from Ibadan and Ilesa, Southwest Nigeria. Hence, direct contact with these dogs such as petting may pose risk especially to the children and more dangerous than soil contamination for the transmission of toxocariasis in humans. Education of the public about zoonotic potential of *T. canis*, the prevention of environmental contamination with dogs' faeces, reduction of the stray dog and the use of anthelminthic and animal hygiene can help to prevent cases of visceral larva migrans (VLM) in humans.

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