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CASE STUDY

GASTROINTESTINAL HEALTH PARASITES OF DOMESTIC DOGS IN JOS NORTH, PLATEAU STATE NIGERIA: A FAECAL EXAMINATION STUDY

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Abstract

Dogs are the most common pet animals worldwide. They may harbor Toxocariasis which remains the most important parasitic infection affecting dogs and pose a risk to animal and human health. There is inadequate information on the risk of this infection on dogs in Jos, Jos North LGA of Plateau State, Nigeria. Thus, a baseline study was undertaken from January 2019 to March 2020 to determine the preva-lence of zoonotic gastrointestinal parasite of domestic dogs brought for routine clinical treatment in the Jos University Veterinary Teaching Hospital, Jos Plateau State. A total of 321 faecal samples collected randomly from dogs were processed and examined for helminthes eggs using modified Kato-Katz technique.The overall prevalence of gastrointestinal helminthes was 50.01%. *Toxocara canis* was the most frequently observed gastrointestinal helminthes parasites with a preva-lence of 30.63%, while prevalence of 9.68% was recorded for a mixed infection of *Toxocara canis,* and *Ancylostoma caninum*, 1.88% was obtained for *Diphylidium caninum* and 7.81% for the single infec-tion of *Ancylostoma caninum* respectively. During the study period, the occurrence of gastrointestinal helminthes based on monthly dis-tribution were; January recorded the highest Prevalence of 35.48%mixed infection(polyparasitism) followed by February (20.00%) in the single infection(monoparasitism) of *Ancylostoma caninum* and March (20.00%) in *Ancylostoma caninum* occurrence. The lowest occurrence was recorded in (16.6%), followed by June-July (4.04%) then October and September, gave a high prevalence of 33.33% in patterns in *Diphy-lidium caninum*infections. *Toxocara canis* infection was age dependent showing a decreasing prevalence with age of host. *Toxocara canis, Ancylostoma caninum* and *Dipylidium caninum* were the zoonotic gastrointestinal helminthes prevalent in dogs in the study area. This study provides a baseline data and evidence that Zoonotic infection is prevalent in dogs in the study area, therefore, the need to educate the residents of Jos Metropolis on the danger of close association or companion with their dogs.

Keywords: Zoonotic gastrointestinal parasites; dogs; Toxocara canis; Ancylostoma caninum;Dipylidium caninum.

1 | INTRODUCTION

Zoonotic infections can be defined as infections of animals that are naturally transmissible to humans (Goldsmid, 2005). In Nigeria, occurrences of these zoonotic parasitic infections have been reported widely in dogs with differences in prevalence depending on the geographical location (Magaji *et al.,* 2007; Ogbaje *et al.,* 2015; Chanding *et al.,* 2018, Karaye *et al.,* 2018)), in this regard, dogs are considered as a public health concern, as they may harbor various pathogens and often spread the infection to humans through their association as companion or domestic animals (Berret *et al.,* 2017). The transmission of zoonotic agentscould be through indirect contact with animalsecretions and excretions, infected water andfood, and through direct contact with theanimal (Lappin, 2002).Intestinal helminths are among the most common pathogenic agents encountered in dogs, especially in newly whelped or neonates and cause pathologies in the intestine (Blagburn *et al.,* 1996). Some of the most important and well-known human zoonotic helminthic diseases are, toxocariasis or visceral larva migrans, ancylostomitidosis or cutaneous larva migrans, tungiasis, hydatid disease as well as emerging and re-emerging infections such as cryptosporidiosis and giardiasis (Heukelback *et al.,*2003; Akao and Ohta, 2007 and Ugbomoiko *et al.,*2008), species of nematodes like, (trichinellosis), cestodes (cysticercosis, echinococcosis) and trematodes (schistosomiasis) (Deplazes *et al.,* 2011). Others include intestinal capillariasis, anisakidosis, eosinophilic enteritis, oesophagostomiasis and gnathostomiasis (Stojeeviae *et al.,* 2010).

Toxocara canis is the causative agent of toxocariasis and its one of the most common gastrointestinal helminthes living in the intestines of domestic and stray dogs (Ogbaje *et al.,* 2015). It has been reported in nearly all parts of the world with prevalence of up to 100% in some population of puppies (Overgaauw, 1997). Transmission of toxocariasis occurs in different ways depending upon the age and management of dogs. Adult dogs become infected with T. canis through ingestion of infective eggs or infective larvae in tissue of paratenic hosts such as mice, birds, pigs, earthworms and others (Maqboolet *al.,*1998). Various surveys conducted worldwide indicate that prevalence of Toxocara spp. infection in canid definitive hosts ranged from 86-100% in puppies and 1-45% in adult dogs (Dai *et al.,*2009; Soriano *et al.,*2010; Overgaaw and Van-Knapen, 2013 and Schar *et al.,*2014)

The clinical symptoms of Toxocariasis caused by *T. cati* and *T. canis* frequently impacts young cats and dogs from birth to 1 year old, entailing respiratory signs (coughing due to pulmonary larval migration), general failure to thrive (retarded growth, emaciation, debilitated body coat and arthralgia) and intestinal disorders (alternating diarrhea and constipation, pot-belly and vomiting). Death is rare but has been reported in severe cases as a result of obstruction of the intestine or ulceration and perforation on the intestinal wall (Macpherson, 2013; Lee *et al.,* 2014 and Lotsch *et al.,*2017).

In Nigeria, gastrointestinal helminthes parasites of dogs are currently endemic in 20 of the 36 States (Uwemedino *et al.,*2014; Christopher *et al.,*2015). Some of the emerging infections are due to the prevailing socio-economic conditions in Nigeria which have made it difficult for many dog owners to adequately provide food, shelter and basic health needs for their dogs. These have resulted in increased number of dogs scavenging for food on the streets and increasing the risk of human infection among the communities.

The present study attempts to determine and provide information on the diagnosed parasitic conditions of owned dogs harboring *Toxocara canis* and other potential public health significance intestinal parasites in Jos North LGA of Plateau, Nigeria in a bid to add to the existing information as well as to the knowledge of the epidemiology of parasitic disease of dogs to the persons residing in this areas.

Supplementary information The online version of this article contains supplementary material, which is avail-able to authorized users.

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2 | MATERIAL AND METHODS

This study was carried out at the Veterinary teaching hospital of the Faculty of Veterinary Medicine, University of Jos, Plateau State, North-Central Nigeria.The University of Jos is geographically located in Jos North Local Government Area which covers an area of 291 square kilometers with a population of 429,300 at the 2006 census (NBS, 2012). Plateau State on the other hand, covers an area of 27,147 square kilometers and is one of the largest States in Nigeria. It is almost centrally located between Latitude 80° 24°N and Longitude 80´32´and 100°38´east of the Greenwich meridian. The State has a high altitude ranging from approximately 1,200 to a peak of 1,829 meters above sea level. Plateau State has a near temperate climate with an annual rainfall of between 131.75cm to 146 cm and an average annual temperature ranging between 16.3°C and 28.1°C. It records a mean relative humidity of between 46.9% and 51.3% (NBS, 2012; Bolajoko *et al.,* 2016). The major ethnic groups on the Plateau are Anaguta, Afizere and Berom, Miango and Tarok; other settlers include, Hausa, Yoruba, Igbo, etc.

3 | STUDY DESIGN

A total of 321 samples obtained from different breeds of dog (Caucasian, Rottweiler, Alsatians, cross breed and Nigerian indigenous) were collected and analyzed. The dogs comprised of clinically healthy and clinically sick animals. The sampling was conducted from January 2019 to March 2020. The owners of the dogs were approached and the purpose for the sampling was explained, after which their cooperation was sought for the collection of faecal sample and questions were asked the dog owners to obtain information as regards the approximate age, sex, mode of life, breed type and disease related knowledge of the owners. These information therefore, gave the bases for the classification of the dogs.

4 | FAECAL SAMPLE COLLECTIONS AND PROCESSING

Sterile forceps were inserted into the rectum of the dogs and transferred into sterile, sample bottles which were properly labeled with each dog's identification number (ID), age and sex. The faecal samples collected were first examined physically for larvae, adult worms and tapeworm eggs before transferring some quantity into the sample bottles. The faecal samples were immediately analysed in the parasitology laboratory of the Department of Parasitology and Entomology, University of Jos, for processing and the recovery of helminth eggs. Faecal samples were processed for microscopic examination for helminth eggs by modified Kato-Katz technique (Forrester and Scott, 1990). Briefly, the faecal samples were first homogenized by shaking vigorously to form a paste using a clean glass rod,were after a small portion of the sample was sieved through double-ply gauze to remove debris and rough materials. The filtrate was centrifuged at 2500 rpm for 5 min, the supernatant decanted and the tube was allowed to stand for 2 min. 41.7 mg of the sediment delivered by Kato-Katz template was taken onto a degreased glass slide and covered with a cellophane strip soaked overnight in 50% solution of glycerol-malachite green. Slides were examined for helminth eggs under a light microscope. Observed helminth ova in 41.7 mg of sieved stool were identified using known structural and morphometric features (Bowman, 1990). In addition to qualitative diagnosis, indirect measure of helminth intensity was obtained by counting eggs and expressed as eggs/gram of faeces (EPG) by multiplying the number of eggs counted with a factor of 24 (Katz *et al.,*1972).

Statistical analysis

For the statistical analysis of the data, the animals were grouped by age (above 4 years, below 2 years between 2 to 3 years old), Breed type (local and exotic), month of sampling (January to march, 2020)the overall prevalence for all parasites and the particular prevalence of each helminth were determined. Data generated were analyzed using descriptive statistics (frequency and percentage) and chi square test of SPSS 20 for windows, version 17 (Chicago, Illinois, USA) to determine the effect between categorized

variables of parasite, year, age and breed in association with the occurrence of parasites.

5 | RESULTS

TABLE 1: Table1. Prevalence of Toxocara canis relative to the age ofdogs presented to the university of Jos teaching hospital from January 2019 toDecember 2019. Table1. Prevalenceof Toxocara canis relative to the ageof dogs

Parasites	Above 4 years	Below 2 years	2 to 3 years	Total
Ancylostoma caninum and *Toxocara canis*	6(19.35%)	13(41.94%)	12(38.71%)	31(9.96%)
Ancylostoma caninum	4(16.00%)	13(52.00%)	8(32.00%)	25(7.81%)
Diphylidium caninum	3(50.00%)	1(16.67%)	2(33.33%)	6(1.88%)
No Parasite seen	30(18.87%)	87(54.72%)	42(26.42%)	156(49.69%)
Toxocara canis	26(26.26%)	44(44.44%)	29(29.29%)	99(30.94%)
X^2 =8.807	df= 8	P= 0.3588		

TABLE 2: Table2. Prevalence of Toxocara canis relative to the breeds ofdogs presented to the university of Jos teaching hospital from January 2019 to December2019.

Parasites	Bull Mastiff	Alsatians	Caucasians	Indigenous	Cross	Total
Ancylostoma caninum and *Toxocara canis*	7 (22.58%)	5 (16.13%)	1 (3.23%)	11 (35.48%)	7 (22.58%)	31 (9.69%)
Ancylostoma caninum	4 (16.00%)	6 (24.00%)	1 (4.00%)	10 (40.00%)	4 (16.00%)	25 (7.81%)
Diphylidium caninum	3 (50.00%)	0 (0.00%)	0 (0.00%)	1 (6.67%)	2 (33.33%)	6 (1.88%)
No Parasite seen	25 (15.72%)	31 (19.50%)	22 (13.84%)	49 (30.82%)	32 (20.133%)	159 (49.69%)
Toxocara canis	14 (14.14%)	25 (25.25%)	13 (13.13%)	30 (30.30%)	17 (17.17%)	99 (30.94%)
X^2 =15.039	df= 16	P= 0.5218				

TABLE 3: Table 3: Prevalence of Toxocara canis relative to the months ofthe year presented to the university of Jos teaching hospital from January 2019to December 2019.

Parasites	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
Ancylostoma caninum and *Toxocara canis*	11 (35.48%)	5 (16.13%)	5 (16.13%)	3 (9.68%)	0 (0.00)	2 (6.45%)	0 (0.00%)	1 (3.23%)	0 (0.00%)	0 (0.00%)	3 (9.68%)	1 (3.23%)	31 (9.69%)
Ancylostoma caninum	3 (12.00%)	5 (20.00%)	5 (20.00%)	2 (8.00%)	2 (8.00%)	1 (4.00%)	0 (0.00%)	1 (4.00%)	3 (12.00%)	1 (4.00%)	0 (0.00%)	2 (8.00%)	25 (7.81%)
Diphylidium caninum	2 (33.33%)	0 (0.00%)	0 (0.00%)	1 (16.67%)	1 (16.67%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	2 (33.33%)	0 (0.00%)	6 (1.88%)
No parasite seen	44 (27.67%)	27 (16.98%)	12 (7.55%)	13 (8.18%)	10 (6.29%)	6 (3.77%)	6 (3.77%)	10 (6.29%)	9 (5.66%)	5 (3.14%)	9 (5.66%)	7 (4.40%)	159 (49.69%)
Toxocara canis	30 (30.30%)	9 (9.09%)	14 (14.14%)	11 (11.11%)	2 (2.02%)	4 (4.04%)	4 (4.04%)	6 (6.06%)	1 (1.01%)	8 (8.08%)	7 (7.07%)	3 (3.03%)	99 (30.94%)
X^2 = 49.658	p= 0.4070	df= 48											

In total, 321 faecal samples were analyzed and results showed that the dogs were infected with one or more helminth species. Eggs of three helminth species comprising two nematodes and one cestode were identified.

As depicted in Table1 above, the prevalence of Toxocara canis was highest in dogs less than 2 years of age followed by those that are between 2 to 3 years of age, then the least prevalence was recorded in dogs that are 4 years and above. There was no significant difference (P>0.05) in the overall prevalence of Toxocara canis infection in dogs that are less than 2 years (44.44%, 54.72%, 16.67%, 52.00%, 41.94%), Dogs within the age brackets of 2 to 3 years (22.29%, 26.42%, 33.33%, 32.00%, 38.71%) and those above 4 years (26.26%, 18.87%, 50.00%, 16.00%, 9.35%) respectively.

The prevalence of Toxocara canis was significantly higher in (Nigerian Indigenous dogs) breed (30.30% , 30.82%, 16.67%, 40.00% and 35.48%) than the exotic breeds Bullmastif (14.14%, 15.72%, 50.00%, 16.00%, 22.50%), Alsatian (25.25%, 19.50%, 0.00%, 24.00%, 16.13%), Caucassian (13.13%, 13.84%, 0.00%, 4.00%, 3.23%) and least prevalence was recorded in the Cross breed (17.17%, 20.13%, 33.33%, 16.00% and 22.58%) respectively. Although, there was no significant difference recorded in the overall groups (P>0.05).

The prevalence of Toxocara canis infection was higher in January (30.30%, 27.60%, 33.33%, 12.00%, 35.48%) followed by march (11.11%, 18.18%, 16.67%, 8.00%, 9.68%), April (11.11%, 18.18%, 16.67%, 8.00%, 9.68%), Febuary (9.09%, 16.98%, 0.00%, 20.00%, 16.13%), August (6.06%, 6.29%, 0.00%, 4.00%, 3.23%) November (8.08%, 7.40%, 33.33%, 8.00%, 9.68%), December (7.07%, 4.40%, 0.00%, 8.00%, 3.23%) The least prevalence was recorded in the months of May (2.02%, 6.29%, 0.00%, 8.00%, and 0.00%), June (4.04%, 3.77%, 6.00%, 4.00%, and 6.45%) and July (0.00%, 4.00%, 0.00%, 3.77%, and 4.04%) respectively. Based on the trend of infection within the months, there was no significant difference recorded from January to December.

6 | DISCUSSION

This study provides the first assessment of the common zoonotic helminthes namely, Toxocara canis, hookworm (Ancylostoma caninum) and Dipylidium caninumparasites in dogs presented at the Veterinary teaching hospital Jos, Jos North Plateau State. These helminthes, as shown in Table 1, are more prevalent among young puppies of less than two years of age.The observed zoonotic parasites in this study, has already been reported in different studies and at different locations within Jos (Pam et al., 2015; Chanding et al., 2018, Karaye, et al.,2018) and in other geographical regions in Nigeria (Sowemimo and Asaolu, 2008; Ugbomoiko et al.,2008; Odeniran and Ademola, 2013; Christopher et al.,2015).The high prevalence of ascarid infections in puppies is in accordance with the transmission pattern of the parasite, which is mainly by transplancental, percutaneous and transmammary routes; acquired age-dependent immunity may be caused by repeated exposure which could have been the reason why the older dogs had less infection (Pereckiene et al., 2007; Othman, 2011).A similar study by Sowemimo and Adenniyi, (2017) however reports that parasite species which are not transmitted to dogs at early age, do not elicit a specific immune response and so there is an increased infection rate in older dogs.

Polyparasitism (*Toxocara canis*and *Ancylostoma caninum*) with more than one parasite species of dogs was also observed in this study and this is similar to other reports on the occurence of these two parasites as the most prevalent helminthes parasite in Nigerian dogs (Adamu, *et al.,* 2012; Mustapha, *et al.,* 2016; Idika, *et al.,* 2017; Karaye *et al.,* 2018). Also, Dicou *et al.,*(2017),reported that common occurrence of co-infections by intestinal helminthesis possible and might be as a result of a heavy environmental contamination, suggesting that animals (and people in the case of zoonotic parasites) sharing the same habitat are at high risk of infection.The presence of infective eggs or larvae in the environment has a crucial role among the different routes of transmission of dog intestinal nematodes in both humans and animals. In fact, human beings become infected by canine *Toxocara* species and

Ancylostoma spp. most frequently through contaminated soil (Traversa, 2012).

Toxocara canis is one of the helminth observed in this study with a high prevalence rate. *Toxocara canis* is the causative agent of toxocariasis and its one of the most common gastrointestinal helminthes living in the intestines of domestic and stray dogs (Ogbaje *et al.,* 2015) and it is still a seriously notifiable public health issue, particularly due to its intricate transmission routes (Rubinsky-Elefant, *et al.,*2010). It has been reported in nearly all parts of the world with prevalence of up to 100% in some population of puppies (Overgaauw, 1997). Transmission of toxocariasis occurs in different ways depending upon the age and management of dogs. Adult dogs become infected with *T. canis* through ingestion of infective eggs or infective larvae in tissue of paratenic hosts such as mice, birds, pigs, earthworms and others (Maqbool *et al.,*1998).

Dipylidium caninum is a zoonotic tapeworm that was recovered among the dog gastrointestinal parasites in all the variables. Dogs, cats and wild carnivores are the definitive hosts of these tapeworms, although, occasionally man can be an accidental host (Adam *et al.,* 2006). The presence of this parasite in the study area is of public health importance, particularly to children. Children have been reported to be more likely infected with dipylidiasis than adults (Molina *et al.,*2003). Owing to their adventurous nature as children love to put objects picked on the floor directly into their mouth for tasting, eating soil, or fruits from the floor not washed and being in the vicinity of dogs and cats, they are considered as a substantial risk group regarding toxocariasis (Zibaei*et al.,* 2007; Macpherson, 2013).

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The disparity in prevalence of intestinal parasite observed among local, cross and exotic breeds of dogs in this study may be associated with density and species composition of parasites observed. It may also reflect the degree of environmental contamination and inequalities in the health care services between urban and rural areas as well as differences in handling and health care by the dog owners resulting in the reduction of intestinal parasite burden. It is also worthy of note that exotic and cross breed dogs which usually serve as pets or security dogs, are usually acquired at high costs and their keepers invest in deworming and other routine treatments. Conversely, the prevalence of gastric helminthes in local dogs could be attributed to the lack of inadequate care they receive as compared to the exotic ones (Sowemimo & Ayanniyi, 2017; Ola-Fadunsin, 2018); these dogs are usually allowed to roam about to fend for themselves and treatments are often administered only when the owner observes some changes in the animal behavior or helminth segments in its faeces.

Meanwhile, investigation on the monthly distribution of gastrointestinal helminths revealed that all the cestodes and nematodes species were present all year round among all the observed variables. A steady increase in number was observed from January – April; which coincided with period of extreme dry season(early and late). However, a gradual decline in parasite abundance was noticed from May – August, a period characterized by high rainfall similar findings were reported in North-eastern Nigeria (Konto *et al.,* 2014), North-central Nigeria (Karaye *et al.,* 2020), as well as Ibadan (Olaifa *et al.,* 2017). It has been established that during the dry season, we presume this is the period some of the climatic factors are optimal for the proliferation of the etiology agent; hence favouring helminth nematodes multiplication and spread. Besides, the environmental stress experienced during the dry season might exert a negative influence on the immune system of the host, thereby increasing the likelihood for infection to occur.

Since no previous data were available regarding the treatment history or signalment of the dogs from which faecal samples were examined, additional factors could be influencing the data, that is, it is possible that the percentage of dogs and puppies in presented to the clinic is not the true representation of the population of dogs in the study area and that some animals were coming as follow up cases thereby influencing prevalence. It is also possible that seasonal usage of dewormers for the prevention in some parts of the Jos, could be lowering prevalence during the wet months of the year.

7 | CONCLUSION

In conclusion, this study has revealed that the three gastrointestinal helminth parasites identified i.e *Toxocara canis*, *Ancylostoma caninum* and *Dipylidium caninum* are zoonotic parasites which are common in Jos, Jos North LGA of Plateau State and all classes of dogs are affected, with high prevalence which constitutes a public health problem in the study area. Hence, interventive measures are necessary to reduce the risk of transmission of parasites from dogs to humans and that public education on the proper care of dogs including veterinary care, personal hygiene by dog owners and handlers, are recommended and prevention of zoonotic parasitic diseases are of great importance in the study area.

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