

## Prevalence of *Toxoplasma Gondii* and *Toxocara Canis* Antibodies among Owners of Dogs and Cats in Ekiti State Nigeria

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### ABSTRACT

Zoonoses are still a serious public health concern since the number of homeless animals, particularly dogs and cats, is increasing. As the causative agents of human toxoplasmosis and toxocariasis, respectively, *Toxoplasma gondii* and *Toxocara canis* are significant zoonotic agents from an epidemiological perspective. We have ascertained the seroprevalence of *T. gondii* and *T. canis* antibodies among dog and cat owners by a cross-sectional study. Between May and July of 2024, serum samples were taken from 185 owners in Ekiti State, Nigeria. Using an enzyme-linked immunosorbent test (ELISA), the pet owners' sera were collected. The seroprevalence of IgM and IgG antibodies for *T. gondii* was 3.8% and 9.4%, respectively, in dogs, whereas the IgG antibody seroprevalence for *T. canis* was 7.5%. Additionally, our seroprevalence findings indicate that dog owners may be more susceptible to contracting *T. gondii* and *T. canis* infections, especially if they are female owners. Dog owners in Ekiti State, Nigeria, have significant levels of anti-*T. gondii* and anti-toxocara antibodies, suggesting a possible zoonotic risk. In order to mitigate the risk of *T. gondii* and *T. canis* environmental contamination, it is recommended that dogs and cats have appropriate deworming, be leashed, and have their waste cleaned up. These steps should aid in preventing the morbidity that these two different but extremely adaptable parasites produce in humans.

**KEYWORDS:** Prevalence, *Toxoplasma gondii*, *Toxocara canis*, Dogs and Cats owners, Ekiti State

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### INTRODUCTION

A great deal has been achieved in mitigating and preventing parasite illnesses. Nevertheless, a lot of parasites continue to be a major source of illness and death in pets and can endanger the environment and general public health (Bowman, 2009). Toxoplasmosis and toxocariasis, a significant zoonotic parasite illness brought on by the helminth *Toxocara canis* and the opportunistic protozoan *Toxoplasma gondii*, are two of these parasitic diseases. Nearly all domesticated, wild, and human animals are susceptible to infection by these parasites (Dubey and Beattie, 2010; Montoya and Liesenfeld, 2004). The protozoan parasite *Toxoplasma gondii* is excreted in cat feces as environmentally resistant oocysts that sporulate after 1-4 days and become infectious. Oocysts have a months-to-year

infectious lifespan. One of the main ways that humans contract *T. gondii* is by the intake of contaminated soil (Jones *et al.*, 2008). Nematode parasites of dogs and cats are called *Toxocara canis*. After a few weeks in the environment, the adult stages of *Toxocara* spp. become infectious and shed their eggs in the feces. The adult stages of the parasites live in the small intestine of dogs and cats. For months or even years, *Toxocara* species eggs can survive in the soil (Jones *et al.*, 2008). The most common pets are dogs and cats, which are also very important to people's everyday lives (Dantas-Torres and Otranto, 2014). Dogs and cats are also very beneficial to people's physical and mental health (McConnell *et al.*, 2011). Infectious eggs are consumed by humans, frequently as a result of close interaction with animals (Khademvatan *et al.*, 2013). The modes of infection for both

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parasites are similar and include eating raw or undercooked meat, raw or contaminated fruits and vegetables, viscera contaminated with oocysts shed by infected cats (*T. gondii*), or eggs removed by dogs (*T. canis*) (Araújo *et al.*, 2018). With an overall global prevalence of 36% for toxoplasmosis (Rahmanian *et al.*, 2009) and 19% for toxocariasis (Rostami *et al.*, 2019), both diseases have been strongly linked to low socioeconomic situations (Dubey *et al.*, 2021).

This study, therefore, aimed to investigate prevalence of *Toxoplasma gondii* and *Toxocara canis* antibodies in owners of Dogs and Cats in Ekiti State.

## MATERIALS AND METHODS

Ekiti State is situated entirely within the tropics. It is located between longitudes 40°51' and 50°451' East of the Greenwich meridian and latitudes 70°151' and 80°51' north of the Equator. It lies south of Kwara and Kogi State, East of Osun State and bounded by Ondo State in the East and in the south, with a total land Area of 5887.890sq km. Ekiti State has 16 Local Government Councils. By 1991 Census, the population of Ekiti State was 1,647,822 while the estimated population upon its creation on October 1st 1996 was put at 1,750,000 with the capital located at Ado-Ekiti. The 2006 population

census by the National Population Commission put the population of Ekiti State at 2,384,212 people.

## Samples size

Blood samples were collected from 185 household dog and cat owners using purposive sampling method between May 2024 and July 2024, and the sera stored at -20 °C. The sample size was representative of all individuals in the study area. The inclusion criteria for the study subjects was the residence in the study area, agreeing to participate in the study by signing the Informed Consent document (IC), allowing blood collection, and being at least 18 years of age. The project was approved by the Federal teaching hospital Ethics Committee (Araújo *et al.*, 2018).

## Serological Tests

Sera were separated by sample centrifugation at 3000 rpm for 5 min and then kept at -20° C until analysis. Anti-Toxoplasma antibodies (IgG and IgM) concentrations were measured by enzyme-linked immunosorbent assay (ELISA) (IgG and IgM: Trinity Biotech Captia, USA). In addition, all sera were examined by Toxocara IgG-ELISA test (IBL, International GmbH, Hamburg, Germany) and Toxocara Western blot test (LDBIO Diagnostics, Lyon, France) for confirmation (Khademvatan *et al.*, 2014).

## RESULTS

**Table 1: Socio-demographic Characteristics of the Animals' Owners**

	Dog (n=160)	No Examined (%) Cat (n=25)
<b>Age (yrs)</b>		
>10	0	0
11-20	07(4.4)	01(4.0)
21-30	56(35.0)	09(36.0)
31-40	42(26.3)	03(12.0)
41-50	26(16.3)	04(16.0)
51-60	21(13.1)	05(20.0)
61-70	08(5.0)	03(12.0)
<b>Sex</b>		
Male	113(70.6)	20 (80.0)
Female	47 (29.4)	05 (20.0)
<b>Location</b>		
Rural	51(31.9)	07(28.0)
Urban	109(68.1)	18(72.0)
<b>Ethnicity</b>		
Yoruba	100(62.5)	09 (36.0)
Igbo	50 (31.3)	05 (20.0)
Hausa	10 (6.2)	11 (44.0)
<b>Level of Education</b>		
No Education	35 (21.8)	05(20.0)
Primary	30 (18.7)	08(32.0)
Secondary	70 (43.7)	06 (24.0)
Tertiary	25(15.6)	06(24.0)
<b>Marital Status</b>		
Single	23(14.4)	4(16.0)
Married	90(56.3)	9 (36.0)
Widowed	27(16.8)	10(40.0)
Divorced	20 (12.5)	02 (8.0)

Table 1 shows socio-demographic distribution of the respondents. Ages of respondents range from 20 to 70 years

with a mean of age 39 years, (SD = 13.491). Majority of them were males (70.62%) while the age bracket 21-30 years had

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the highest participant (35.0%). Nearly all (62.5%) of the respondents were Yoruba, the predominant religion was Christianity (43.8 %) and only 15.6% had more than secondary school education. One hundred and nine (68.1%)

urban dwellers took part in the study, while 51 (31.8 %) of the respondents came from the rural areas. On their marital status, 14.4 % were single.

**Table 2: Prevalence of *Toxoplasma gondii* and *Toxocara canis* in relation to the IgM and IgG antibodies positivity of the animals' owners**

<u>Toxocara</u>	<b>Dog Owners' samples(n=160)</b>			<b>Cat Owners' Samples(n=25)</b>		
	<u>Anti-Toxoplasma</u>	<u>Anti-Toxoplasma</u>	<u>Anti-Toxocara</u>	<u>Anti-Toxoplasma</u>	<u>Anti-Toxoplasma</u>	<u>Anti-Toxoplasma</u>
	<u>IgM</u>	<u>IgG</u>	<u>IgG</u>	<u>IgM</u>	<u>IgG</u>	<u>IgG</u>
Positive	15(9.4)	6(3.8)	12(7.5)	0(0.0)	0(0.0)	0(0.0)
Negative	145(90.6)	154(96.2)	148(92.5)	25(100.0)	25(100.0)	25(100.0)

Table 2 shows respondents seroprevalence for Anti-*Toxoplasma gondii* antibodies and Anti-*Toxocara canis* antibodies. It revealed that out of 160 dog owners tested for Anti-*Toxoplasma gondii* IgM antibodies, Anti-*Toxoplasma gondii* IgG antibodies and Anti-*Toxocara canis* IgG

antibodies, 15(9.4%), 6(3.8%) and 12(7.5%) were positive respectively. Also, all the 25 Cat owners tested for Anti-*Toxoplasma gondii* IgM antibodies, Anti-*Toxoplasma gondii* IgG antibodies and Anti-*Toxocara canis* IgG antibodies were negative 25(100.0%).

**Table 3: Socio-demographic characteristics of Dogs' owner of *Toxoplasma gondii* and *Toxocara canis* in relation to Ig M and Ig G antibodies positivity**

<b>Socio-demographic</b>	<b>Anti- Toxoplasma</b>	<b>Anti- Toxoplasma</b>	<b>Anti-Toxocara</b>
<b>Characteristics</b>	<b><u>IgM</u></b> <b>(n=15)</b>	<b><u>IgG</u></b> <b>(n=6)</b>	<b><u>IgG</u></b> <b>(n=12)</b>
<b>Age (yrs)</b>			
> 10	0	0	0
11-20	0	0	0
21-30	0	2(33.3)	1(8.3)
31-40	0	0	4(33.3)
41-50	3(20.0)	1(16.7)	2(16.7)
51-60	6(40.0)	0	0
61-70	6(40.0)	3(50.0)	5(41.7)
<b>Sex</b>			
Male	5(33.3)	3(50.0)	3(33.3)
Female	10(66.7)	3(50.0)	9(66.7)
<b>Location</b>			
Rural	8(53.3)	4(66.7)	6(50.0)
Urban	7(46.7)	2(33.3)	6(50.0)
<b>Ethnicity</b>			
Yoruba	13(86.7)	3(50.0)	8(66.7)
Igbo	2(13.3)	2(33.3)	3(25.0)
Hausa	0	1(16.7)	1(8.3)
<b>Level of Education</b>			
No Education	5(33.3)	3(50.0)	7(58.3)
Primary	4(26.7)	0	4(33.3)
Secondary	2(13.3)	3(50.0)	1(8.4)
Tertiary	4(26.7)	0	0
<b>Marital Status</b>			
Single	4(26.7)	0	3(25.0)
Married	8(53.3)	4(66.7)	6(50.0)
Widowed	2(13.3)	0 (0)	2(16.7)
Divorced	1(6.7)	2(33.3)	1(8.3)

In table 3 the participants were divided into 7 groups based on their age (> 10, 11-20, 21-30, 31-40, 41-50, 51-60 and 61-70 years). The anti-toxoplasma IgM antibodies were 0 %, 0 %, 0 %, 0 %, 20 %, 40 % and 40 % respectively and for anti-toxoplasma IgG antibodies were 0 %, 0 %, 33.3%, 0 %, 16.7

%, 0 % and 50 % respectively, and anti-toxocara IgG were 0 %, 0 %, 8.3 %, 33.3 %, 16.7 %, 0 % and 41.7 %. Anti – toxoplasma IgM and anti- toxocara IgG antibodies were more prevalent in females than males with 66.7 % and 66.7 % respectively while anti- toxoplasma IgG antibodies had the

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same the same prevalence of 50 %. For the location anti-toxoplasma IgM and IgG for rural were 53.3 % and 66.7 % and for urban were 46.7 % and 33.3 % respectively, while anti-toxocara IgG antibodies for rural was 50 % and 50 % for urban. Yoruba had the highest anti toxoplasma IgM and IgG (86.7 % and 50.0 % respectively) while anti-toxoplasma IgG antibodies was 66.7 %. Participants with no education had the highest prevalence rate of anti-toxoplasma IgM and IgG (30.0 % and 50.0 % respectively) and 58.3 % for anti-toxocara IgG antibodies. The married participants had the highest prevalence rate of anti-toxoplasma IgM and IgG (53.3 % and 66.7 % respectively), while anti-toxoplasma IgG antibodies was 50.0 %.

### DISCUSSION

Despite the significance of toxoplasmosis and toxocariasis for humans, the World Health Organization classifies both infections as neglected tropical diseases (Hotez *et al.*, 2010). The illnesses are less obvious in less developed countries like Nigeria. To find out how common toxoplasmosis and toxocariasis antibodies are among dog and cat owners, very few research has been done. The seroprevalence for anti-*Toxoplasma gondii* antibodies and anti-*Toxocara canis* antibodies in this study showed that anti-*Toxoplasma gondii* IgM antibodies, anti-*Toxoplasma gondii* IgG antibodies and anti-*Toxocara canis* IgG antibodies, 15(9.4%), 6(3.8%) and 12(7.5%) respectively. The overall seroprevalence of *T. gondii* and *T. canis* is consistent with global estimates, which range from 1% to 100% (Furtado *et al.*, 2011). The findings align with research on 6.7% from Korea (Shin *et al.*, 2009), 12.3% from China (Xiao *et al.*, 2010), 22.5% from the United States (Jones *et al.*, 2001), 42.0% from Iran (Rahmanian *et al.*, 2020), 28.3% from Thailand (Nissapatorn *et al.*, 2011), and 23.9% from certain Nigerian regions (Kamani *et al.*, 2009). According to Henriquez *et al.* (2009), it is less than 67% in Brazil, 68% in Germany, and much less than 80% in the Netherlands, as well as 98% in some areas of France (Silveira *et al.*, 1988). Although the cause of this variation in prevalence across the globe is unclear, Furtado *et al.* (2011) proposed that it could be due to variations in environmental and socioeconomic factors, such as dietary patterns and health-related behaviors, overall hygiene standards, host susceptibility, geographic location (geolatitude), and soil humidity (Otu- Bassey *et al.*, 2023). Furthermore, contact with dogs and cats is a known risk factor for human infection due to their potential for contaminating public areas with parasite eggs and oocysts (Fakhri *et al.*, 2018; Torrey and Yolken, 2013). It is also likely that similarity in the routes of transmission of both parasites, which include the ingestion of food/soil infected with oocysts of *T. gondii* (Goldstein *et al.*, 2008) and embryonated eggs of *Toxocara* spp. or consumption of undercooked or raw infected meat, might be one of the factors favoring the co-infection. Given that cats are the definitive host of *T. gondii* and play a crucial role in

the parasite's transmission to humans, a link between owning a cat and elevated seropositivity of *T. gondii* is expected. Cats are typically kept as pets or utilized as rodent control in the areas under study. *T. gondii* infections in cats occur when they feed on rodents or birds that are infected. Millions of environmentally resistant oocysts are then excreted in cat feces, endangering both human and animal health (Jones *et al.*, 2009). According to earlier research, having cats at home raises your chance of contracting *T. gondii* (Elsheikha, 2008). Nevertheless, dogs are a dead-end intermediate host and do not generate *T. gondii* oocysts, therefore they may be viewed as having less significance in the zoonotic transmission of *T. gondii*. But by a process known as coprophagia, dogs are able to consume oocysts from cat feces, which enter their stomach and exit the body intact and even alive (Schares *et al.*, 2005). Certain canines have an inclination to roll in smelly materials like cat faeces. Because of their behavior, dogs have the potential to inadvertently contaminate the environment and infect humans by ingesting oocysts from their fur when they are caressing them (Wei *et al.*, 2018).

In this study *T. gondii* and *T. canis* antibodies prevalence increases with age (table 3). This could be as a result of exposure of the people that may have been infected primarily when they were young, and younger persons may have been as likely to be exposed to *T. gondii* and *T. canis* in recent years as older persons were when they were young. Cats and dogs both defecate in soil and humans ingest soil through pica behaviors, especially during childhood, or inadvertently when soil gets on their hands during work or play. The cats' propensity to hide their waste in the sand or below ground further supports it. It can persist for several months or even years after it sporulates. Additionally, when the rainy season arrives, the oocysts' capacity to float around provides them greater opportunity to spread, potentially contaminating other things like food and drinking water (Subrata *et al.*, 2015). Research has indicated that *T. gondii* and *T. canis* oocysts and eggs are frequently found in the soil of public parks and private backyards. Gardening, soil contact, and inadequate hand hygiene have been identified as risk factors for *T. gondii* and *T. canis* infection. Additionally, elderly individuals may have had a higher likelihood of being exposed to *T. gondii* in undercooked meat during their childhood (Jones *et al.*, 2008). The results of this study showed that female dog owners had greater rates of *T. gondii* and *T. canis* infection than male owners. In most homes, women are in charge of cleaning the litter boxes and disposing of the waste from dogs and cats. The unhealthy behavior in this discussion was engaging in high-risk occupations without wearing protective gear, such as gardening, farming, raising livestock, and other tasks requiring frequent contact with soil, which increased the risk of contracting toxoplasmosis and toxocariasis. The study also supported a publication by Prandota (2010) that suggested animal research could account for women's higher loads. In the early stages of *Toxoplasma* infection, male mice's spleens

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produce more interferon-gamma (IFN) than female mice's. Male mice that have high levels of IFN and tumor necrosis factor-alpha are better able to respond to *T. gondii* infections and manage the parasite's growth.

Participants with less than a high school education were more likely to be seropositively exposed to *T. gondii* and *T. canis*. This could be due to increased manual labor-related soil contact or repeated exposure to contaminated environments, as lower education levels are associated with lower knowledge, comprehension, and appropriate behavior. According to the findings of a study by Liu *et al.*, 2009 a poor level of education increases the chance of contracting toxoplasmosis.

The prevalence of antibodies is higher in rural than urban regions, probably due to increased contact with soil. Olusi *et al.* (1996) linked the region's high seroprevalence of toxoplasmosis to the consumption of dog meat and rats in a previous investigation. According to Samuel *et al.* (2021) the southwest zones had a higher exposure rate than other ethnic groups and geopolitical zones because these and other characteristics were commonly practiced there.

Dogs and cats should be kept indoors, not permitted to hunt, and not fed undercooked meat due to the environmental contamination caused by *T. gondii* and *T. canis*. By covering sand boxes, washing raw fruits and vegetables that may have come into contact with soil, and washing their hands after gardening or other soil-related activities, people can avoid contracting *T. gondii* and *T. canis* infections from soil. Dog owners in Ekiti State, Nigeria, have significant levels of anti-*T. gondii* and anti-toxocara antibodies, suggesting a possible zoonotic risk. In order to mitigate the risk of *T. gondii* and *T. canis* environmental contamination, it is recommended that dogs and cats have appropriate deworming, be leashed, and have their waste cleaned up. These steps should aid in preventing the morbidity that these two different but extremely adaptable parasites produce in humans.

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