

A Study of the Prevalence of Toxocariasis in Samarra City and its Relationship to Some Physiological Parameters

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Abstract: This study was conducted from the beginning of September 2024 to June 2025 to investigate the incidence of toxocariasis in Samarra. Two hundred blood samples were collected from different age groups (15-50 years) from the Samarra General Hospital laboratory for both sexes. A questionnaire was also completed, including age, gender, occupation, residential location, and animal ownership. Results using the ELISA-TES IgG technique showed that the overall infection rate with toxocariasis was 9%. A relationship was also found between toxocariasis infection and age, gender, educational level, and animal ownership. The highest infection rate was recorded in the 45-41 age group, reaching 16.66%, while the highest infection rate among females was in the 45-41 age group, reaching 16.66%. Males in the 41-45 age range also had an infection rate of 11.11%, with the uneducated group having the highest rate at 33.33% and those who owned dogs and cats having the highest rate at 18.84%, while the group without dogs and cats had the highest rate at 3.81%. The statistical analysis's findings showed that there were significant differences at the $p < 0.05$ and $p < 0.01$ probability levels.

On the other hand, the results of the current study showed a significant decrease at $p < 0.01$ in the levels of antioxidants, namely, catalase and superoxide dismutase, in samples positive for the ELISA test compared to the control group. Catalase levels in patients reached 9.9 ± 1.57 pg/ml, compared to 15.26 ± 1.62 pg/ml in the control group. Superoxide dismutase levels in patients reached 168.48 ± 5.29 pg/ml, compared to 188.19 ± 10.58 pg/ml in the control group.

Keywords: Toxocariasis, antioxidants, parasite spread

Introduction:

A zoonotic parasitic disease that is common throughout the world is toxocariasis (1). Humans are mainly infected in tropical and subtropical regions of the world by the larvae of *Toxocara*, specifically *T. canis* and *T. cati* (2). The nematodes *T. canis* and *T. cati*, which parasitize the intestines of dogs and cats, respectively, are the means of infection. Human transmission is mostly caused by worm egg contamination of the soil. Infection happens, especially in young children (2-7 years old), who are vulnerable to infection by eating undercooked meat and contaminated infectious eggs found in the soil, and Eating unsterilized fruits and vegetables contaminated with eggs transmitted through the feces of infected dogs and cats. The eggs then hatch in the front part of the small intestine and penetrate the intestinal mucosa, then migrate through the intestine to move to various organs of the body such as the liver, lung, heart, brain, eye, and muscles through the bloodstream (3). Common clinical symptoms of visceral larva migrans (VLM) in toxocariasis are weakness, itchy skin, rash, wheezing, abdominal pain, eosinophilia, increased serum IgE levels, fever, anorexia, headache, vomiting, lethargy, sleep and behavioral disturbances, and pharyngitis,

Lung infection, cough, limb pain, cervical adenitis, and hepatomegaly (4). Ocular larva migrans (OLM) can lead to vision loss and visual field defects (5).

Visceral larva migrans (VLM), ocular larva migrans (OLM), covert toxocariasis, and neurotoxocariasis are the four clinical manifestations of toxocariasis (6). Clinical signs of larval migration to different human tissues and organs include VLM and OLM.

Consumption of undercooked meat, unsterilized fruits and vegetables, urban and rural environmental circumstances, and dog and cat ownership all affect the occurrence rate, which differs among individuals in different parts of the nation (7). Understanding the complexities of pathogen transmission, especially the different factors that could affect infection dynamics, is becoming more and more important. These comprise internal characteristics like gender, age, marital status, heredity, and standard of living, as well as environmental elements like location and season (8).

Methodology:

1. Sample preparation:

This study was conducted from the beginning of September 2024 to June 2025. 200 blood samples were collected from both sexes and different age groups (15-50 years) from patients attending Samarra General Hospital. 2.5 cc of blood was placed in laboratory tubes devoid of any substance and left at room temperature for 15 minutes to allow the blood to clot. The samples were then placed in a centrifuge at 3,500 rpm for 10 minutes to isolate the serum. The serum was transferred to Eppendorf tubes and kept frozen at -20°C until testing. In an effort to investigate the epidemiology of Toxocariasis in Samarra city, data was gathered from people using an existing questionnaire. This data included name, age, gender, occupation, place of residence, animal ownership, and disease status. Tests were conducted at private labs, while samples were gathered in the Samarra General Hospital laboratory.

Procedures:

1-2: IgG immunoglobulin test

According to the CT method from SunLong Biotech, performed using an ELISA device

2-2: Superoxide dismutase (SOD) test

According to the CT method from Cloud Clone Crop, performed using an ELISA device

3-3 Statistical Analysis

The results were statistically analyzed using a t-test at a probability level of 0.05 and 0.01 (9).

Results and Discussion

4-1- Overall Incidence

The study was conducted to detect the prevalence of toxoplasmosis in Salah al-Din Governorate, in various areas of Samarra District, from the beginning of September 2024 to June 2025. The study results showed that the incidence of toxoplasmosis reached 9% of the examined individuals, from different age groups ranging from 15 to 50 years of both sexes and from different regions, using the ELISA-IgG test.

Table (1) the total percentage of people infected with Toxocariasis

Age	Tested samples	Positive ratio	%
15-50	200	18	9

The 9% overall infection incidence across all age groups in the Samarra region of the Salah al-Din Governorate is regarded as one of the high rates of toxoplasmosis transmission in Iraq when compared to other studies conducted under similar climatic conditions (hot and dry). This study's findings are consistent with Study (12), which found that the highest rate—6.81 percent—was

found in the Baiji area of Salah al-Din Governorate. Additionally, it is consistent with Study (13), which found that the highest infection rates were found in the cities of Tikrit and Baiji, reaching 23.9% each, and in the Salah al-Din Governorate's Al-Alam district, reaching 17.9%. While it differed with study (10) as it showed the highest infection rate of 10.63%, 9.67% recorded in the rural areas in the Al-Siniyah district and the Amerli district in the Al-Tawz district, respectively, in Salah Al-Din Governorate. It also did not agree with (11) as it recorded the highest rate in the Al-Dhuluiyah district in Salah Al-Din Governorate, amounting to 2.99%.

Living in rural areas is itself a major risk factor associated with *Toxocara* seropositivity. Even in developed countries, there are high rates of *Toxocara* prevalence among young people in rural communities, and the presence of infection with this parasite is inversely proportional to family income, which may create social and cultural conditions that are more conducive to toxocariasis (14).

A study in Brazil showed the highest seroprevalence rate of toxocariasis, 82.7% (15). In a study by (16), residents of rural areas did not show an increased risk of infection compared to those living in urban areas. The risk of human infection may be related to close contact with soil contaminated with *Toxocara* eggs in rural areas. Thus, work activities may impose continuous exposure to soil-borne infection (15).

Serological positive did not correlate with residential location, and the investigation demonstrated that there was no habit of eating raw meat from pets or game animals, which lowers the risk of acquiring toxoplasmosis through animal consumption (17). The study found no correlation between raw meat consumption and toxoplasmosis in Brazil, nor between serological positivity and residential location (18). Studies have shown an association between serological positivity and the consumption of untreated water, with the drinking water source being a risk factor for *Toxocara* seropositivity (19). In addition, toxocariasis has been included in the top list of waterborne parasitic diseases in the Middle East, highlighting the importance of drinking water sources and sanitation facilities to reduce disease transmission (20).

Epidemiology according Age

The study, using IgG ELISA, revealed that 18 out of 200 (9%) patients, aged 15-50, of both sexes were serologically positive, indicating contact with the toxoplasmosis parasite. The highest infection rate in this study was found in the 45-41 age group, reaching 16.66% for both groups. The lowest infection rate was found in the 35-31 age group, reaching 0%, as shown in Table (2). This suggests ongoing exposure to *Toxocara* infection, which results in a high concentration of living larvae that release their antigens into the body. This indicates that toxocariasis is still spreading widely, which is concerning in the majority of the world. The current study's findings are consistent with the study of (21) if the age group of 49-59 years old had the greatest infection rate (27.5%) and the age group of 27-37 years old had the lowest rate (10.7%).

(11) recorded the highest infection rate in the age group 48-58 years, reaching 29.62%, and the lowest infection rate in the age group 16-25 years, reaching 16.07%, but it differs from the study of (12), which recorded the highest infection rate in the age group 15-5 years, reaching 16.1%, and the lowest rate in the age group 27-37 years, reaching 14.2%, and (13), which recorded the highest infection rate in the age group 37-47 years, reaching 23.943%, and the lowest rate in the age group 26-36 years, reaching 20.93%.

According to study (22) *Toxocara* antibody seroprevalence rises with age. This phenomenon was thought to be caused by the number of years that people have spent in a highly contaminated environment overall, possibly as a result of recurring infections, which in turn causes antibodies to persist. While (24) showed that there is a relationship between infection and age, and that the reason for this difference is not precisely determined, it may be due to behavioral differences and daily lifestyle that produce many opportunities for exposure to infection through contact in a polluted environment, eating raw meat, and unsterilized fruits and vegetables. This is consistent with study (23). Study (24) concluded that the probability of a positive serum increases with age. In Iran, the

incidence rate reached 3.8-1.39% in the age group 47-57 years (25). Interpretation of seroprevalence information is still difficult due to the use of different cut-off titers by researchers and the relationship between the infection titer level and clinical signs of the disease. In northern Greece, the seroprevalence in children was 4.1%, in northern India, the seroprevalence in adults was 6.4%, and in western Iran, the seroprevalence was 8.8%. In contrast to the high prevalence of toxocariasis in temperate countries, such as Ireland (31%), Argentina (39%), and Spain (28.6%)(15), these low rates could be explained by the hot, dry climate, which prevents the infectious potential of Toxocariasis eggs (26). When interpreting serological data, care must be taken because the presence of people who do not exhibit disease symptoms yet test positive for the serum indicates that the infection does not always present with clinical symptoms.

Table (2) Percentage of people infected with Toxocariasis according to age groups

Age	Tested samples	Positive ratio	%
20-15	35	2	5.71%
25-21	22	2	9.09%
30-26	30	4	13.33%
35-31	16	0	0%
40-36	38	4	10.52%
45-41	24	4	16.66%
50-46	35	2	5.71%
total	200	18	9%

3 -Epidemiology by Gender

The results of the current study demonstrated a relationship between toxocariasis infection and the gender of infected individuals. The overall infection rate among females was 17.39%, higher than that of males, which reached 6.49%. The highest infection rate among females was in the 45-41 age group, reaching 33.33%, and the lowest rate was in the 35-31 age group, reaching 0%. As for males, the highest infection rate was recorded in the 30-26 age group, reaching 12%, and the lowest rate was in the 35-31 and 25-21 age groups, reaching 0%. Table (3) shows the relationship between age groups and gender of those infected with toxocariasis.

Table 3: The correlation between the gender and age categories of Toxocariasis patients

Number of female samples and percentages ♀			♂ Number of samples and male ratios			Age
%	Positive ratio	Tested samples	%	Positive ratio	Tested samples	
%14.28	1	7	%3.57	1	28	20-15
%33.33	2	6	%0	0	16	25-21
%20	1	5	% 12	3	25	30-26
0 %	0	7	%0	0	9	35-31
%16.66	1	6	%9.37	3	32	40-36
%33.33	2	6	%11.11	2	18	45-41
%11.11	1	9	% 3.84	1	26	50-46
%17.39	8	46	%6.49	10	154	المجموع total

The results of this study did not correspond with the findings of (21) (12) that showed no significant differences between males and females with regard to toxoplasmosis infection, but they were in line with the findings of (13) (11) that shown substantial disparities between infection and gender. The study by (10) shown that the contact with the contaminated environment and the fact that both sexes are susceptible to infection since they live in the same conditions led to a higher infection rate in females than in males. Moreover, both sexes are susceptible to toxocariasis at comparable rates due to the similarities of the places under study and the contaminants that surround them. However,

other research has demonstrated that gender was not a significant risk factor for toxocariasis infection, and that male and female incidence rates were equivalent, suggesting that exposure levels were comparable for both sexes (28). (29) stated that males were more susceptible to infection than females, perhaps due to work activities. In another study, both males and females were at risk of infection from ingesting *Toxocara* eggs through the soil, perhaps from working in outdoor wildlife activities and following poor hygiene habits (15).

Epidemiology by educational level

The current results, based on the educational level of the study samples, showed that the highest infection rate was among the uneducated, reaching 33.33%, and the lowest infection rate was among university students, reaching 3.15%. The results of the statistical analysis showed significant differences between infection and educational level at a significance level of $0.01 \geq P$, as shown in Table (4).

Table (4)) Percentage of people with toxocariasis by educational level

Educational level	Tested samples	Positive ratio	%
Primary school	19	2	%10.52
Intermediate study	28	2	%7.14
Preparatory	37	4	%10.81
Under-graduate	95	3	%3.15
Un educated	21	7	%33.33
total	200	18	9%

The current study's findings align with (12), which found that the rate of toxoplasmosis infection was highest among the ignorant group (11.10%) and lowest among the preparatory stage (3.30%). They also accord with what (10) discovered in the Salah al-Din Governorate's Tikrit, surrounding areas, and neighboring districts, which had the highest toxoplasmosis infection rate among the illiterate group (12.82%). They also agree with what (21) found, as it recorded the highest rate of infection with toxoplasmosis among the uneducated group in the city of Kirkuk, reaching 27%, and the lowest rate among the university stage, reaching 6.6%. It also agrees with what was reached by (11) in the city of Al-Dhuluiyah, as it recorded the highest infection rate among the uneducated group, reaching 33.33%, and the lowest rate within the primary stage, reaching 21.9%. While it differed with study (13), as it recorded in the city of Tikrit, Al-Alam district, and Baiji district in Salah al-Din Governorate the highest infection rate of toxoplasmosis within the primary stage, reaching 25.2%, and the lowest rate within the intermediate stage, reaching 13.20%.

Even in industrialized nations like the United States, toxocariasis has historically been linked to low educational attainment. In Brazil, greater education was found to be protective against *Toxocara* exposure among homeless individuals (15). Low socioeconomic position and educational attainment are risk factors for toxocariasis, but they may also raise the risk of toxocariasis (30).

4- Epidemiology by Animal Ownership

The results of the current study demonstrated a relationship between animal ownership (dogs and cats) and age. The highest infection rate was recorded in the group that owned animals, reaching 18.84%, and the lowest infection rate was recorded in the group that did not own animals, reaching 3.81%. (Table 4)

Table (5) Relationship between age group and animal ownership among those infected with toxocariasis

%	Positive ratio	Tested samples	Age	
25 %	3	12	20-15	animal ownership
%14.28	1	7	25-21	
30 %	3	10	30-26	
%0	0	4	35-31	
%25	2	8	40-36	
%6.66	1	15	45-41	
%23.07	3	13	50-46	
%18.84	13	69	المجموع	
%5.88	1	17	20-15	Not owning animals
%5.26	1	19	25-21	
%6.66	2	30	30-26	
%0	0	18	35-31	
% 0	0	10	40-36	
% 4.54	1	22	45-41	
%0	0	15	50-46	
% 3,81	5	131	total	

According to several researchers, people who own animals or have close contact with them are at risk of contracting VLM because the eggs that become lodged in their bodies can infect them. Since the group that owns animals (dogs and cats) had the highest infection rate (13.90%) and the group that does not own animals had the lowest rate (1.22%), the current study's findings are in line with those of (12). It also agrees with what was reached by (21), as the highest infection rate was recorded in the group that owns animals, reaching 28%, and the lowest rate in the group that does not own animals, reaching 17.5%. It also agrees with what was reached by (13) as the highest infection rate was recorded within the group that owns animals, reaching 24.8%, and the lowest infection rate in the group that does not own animals, reaching 19.59%. It also agrees with what was reached by (11), as the highest infection rate was recorded in the group that owns animals, 26.47%.

The infection rate for the group without pets was 18.58%. Nevertheless, this study's findings contradict those of study (10), which found no connection between infection and dog or cat ownership. The percentage of people who own dogs and cats was 6.12%, whereas the greatest infection rate was 7.55% among those who do not. There is a correlation between contact with dogs and cats and toxocariasis infection. It was discovered that persons with a history of contact with dogs and cats were more likely than those without to contract Toxocara.

The presence of eggs on animal hair may also be a potential route of infection, as in some homes, dogs and cats are kept for various purposes and are not given complete treatments and vaccinations, and their feces are not removed. When dogs and cats are touched repeatedly, the probability of infection with toxocara increases (25). A study (31) confirmed that feces and hair samples taken from dogs contain Toxocara eggs, and letting dogs and cats roam freely is often a reason for the spread of eggs, as contact with dogs and cats is already another risk factor associated with toxocara, especially in young people. Researchers believe that the greater number of stray dogs and cats may increase the degree of environmental contamination with Toxocara eggs (32). Soil contamination with eggs is the main source of transmission of infection in humans, and the rate of soil contamination is linked to the number of dogs and cats of different ages (33).

Laboratory Test Results for Samples Positive for ELISA

1-5 Antioxidant Tests

1-1-5 Catalase (CAT) Enzyme Level

The results of the current study showed an increase in catalase levels in samples positive for ELISA compared to the control group. The percentage of infected patients was 9.9 ± 1.57 pg/ml compared to the control group's levels of 15.26 ± 1.62 pg/ml. The results of the statistical analysis showed significant differences at a 0.01 ($P \geq 0.01$), as shown in Table 6.

Table 6: Catalase enzyme concentration level (CAT) for people with toxocariasis and the control group

Catalase	CAT Mean \pm SD	Significant Differences
Patients	9.9 ± 1.57 pg/ml	**
Controls	15.26 ± 1.62 pg/ml	

The mark (**) indicates a significant difference at the $p \geq 0.01$ level.

This study's findings are in line with those of (34), (35), and (36), who reported that oxidative alterations caused a substantial drop in catalase levels in individuals infected with *Toxocara*, *Strongyloides*, and *Schistosoma*. This study's findings contradict those of (37), (38), who suggested that the body's reaction varies based on the parasite kind, immunological stage, and infection severity, meaning that this drop may not always be permanent or noticeable. Low levels of the enzyme catalase in people infected with *Toxocara* spp. and some other parasitic worms indicate an imbalance between oxidative stress and antioxidant defenses in the body. Catalase is an important enzyme produced by cells to protect tissues from the damaging effects of hydrogen peroxide (H_2O_2), which accumulates as a result of metabolic processes and immune activation.

Tissue parasite infections, like those caused by *Toxocara*, cause the immune system to generate a lot of reactive oxygen species (ROS), which raises H_2O_2 levels. Oxidative stress levels increase when catalase is absent or present in low amounts, which leads to cell damage and the degradation of tissues like the liver and lungs, particularly in cases of persistent infections. As a result, measuring catalase is a crucial signal for determining the degree of oxidative stress and how parasite infection affects the internal balance of cells.

Superoxide Dismutase (SOD) Levels

The results of the current study showed an increase in the level of superoxide dismutase in the serum samples positive for the ELISA test compared to the control group. The percentage of levels in the infected group was 168.48 ± 5.29 pg/ml compared to the control group's levels of 188.19 ± 10.58 pg/ml. The results of the statistical analysis showed significant differences at a significance level of 0.01, as shown in Table 7.

Table 7: Superoxide Dismutase (SOD) Levels in People with Toxocariasis Compared to the Control Group

Superoxide Dismutase	SOD Mean \pm SD	Significant Differences
Patients	168.48 ± 5.29 pg/ml	**
Controls	188.19 ± 10.58 pg/ml	

The mark (**) indicates a significant difference at the $p \geq 0.01$ level.

The current study supports the findings of study (35) that SOD deficiency has detrimental effects on infections caused by *Toxocara* and *Schistosoma*, while study (36) shown that *Strongyloides* significantly inhibits antioxidant systems, including SOD. (37) showed a noteworthy reduction in SOD in individuals with *Ascaris* and *Toxocara* infections. The current study's results are inconsistent with those of other studies, which found that SOD levels were nearly normal in patients with chronic *Schistosoma* and that some cases of *Toxocariasis* did not show a significant decrease in

SOD (38). Low levels of the enzyme superoxide dismutase (SOD) in people infected with *Toxocara spp.* and other parasitic worms are evidence of oxidative stress disorder resulting from excessive production of free radicals. SOD acts as the first line of defense in the antioxidant system, converting toxic superoxide radicals (O₂⁻) to less harmful hydrogen peroxide (H₂O₂), which is then processed by enzymes such as catalase.

The migratory larvae of tissue parasites like *Toxocara* cause a potent immunological reaction that strains the antioxidant defense system and depletes SOD by producing an excessive amount of free radicals. Numerous investigations have demonstrated that a reduction in SOD exacerbates oxidative stress, resulting in chronic inflammation and cell damage, especially in liver and lung tissue. This hypothesis is supported by three studies, which show that while decreased SOD is a biomarker of the degree of oxidative stress brought on by parasitic infection, its persistence without compensation may cause long-term tissue damage that plays a role in the emergence of chronic diseases.

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