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Exploring Possible Causes Linked to the Recent Upsurge in Toxoplasmosis Cases in Sudan's North Kordofan State

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Abstract

Purpose: Toxoplasmosis is a prevalent parasitic ailment that has been detected in a wide range of warm-blooded organisms, encompassing both domesticated animals and human hosts. This study aimed to investigate potential risk factors associated with the increasing incidence of toxoplasmosis in North Kordofan State, Sudan.

Methodology: This descriptive investigation was undertaken in El-Obeid, North Kordofan State, Sudan, between January and March of 2024. Around 155 samples were acquired from women who had undergone miscarriages or had a prior history of miscarriage. A venous blood sample was collected from every participant in order to perform serological analyses, such as ICT and ELISA.

Results: The study group had a prevalence rate of 11.6% for Toxoplasma infection. The positive instances were evenly distributed across all age groups. The highest number of positive cases were observed among individuals with secondary education, followed by those with basic education and university education, accounting for 44.4%, 27.8%, and 16.7%, respectively. The majority of positive cases, accounting for 94.4%, have reported "cat contact." The odds ratio (95% confidence interval) for cat contact in toxoplasmosis is 7.7766 (1.0023 to 60.3384), with a p-value of 0.05

Unique Contribution to Theory, Policy and Practice: Toxoplasmosis exhibits a high prevalence throughout the North Kordofan state of Sudan, maybe contributing to the heightened incidence of miscarriage within the region. The primary mode of transmission of infection is through contact with cats.

Keywords: *Toxoplasmosis, Toxoplasma Gondii, miscarriage, Sudan*

Introduction

Toxoplasma gondii, an intracellular protozoan, causes zoonotic toxoplasmosis in both animals and humans. In healthy, immunocompetent people, 50% of infections are asymptomatic. Infections, on the other hand, can result in a self-limiting, mild, nonspecific illness characterized by malaise, fever, sensitive lymphadenopathy, headache, lethargy, and a maculopapular rash [1, 2]. Congenital infections are a common cause of multidomain neurodevelopmental disorders in children. Several structural brain anomalies result in neurodevelopmental delays, cerebral palsy, epilepsy, and neurosensory dysfunction [3]. Congenital toxoplasmosis (CT) has the potential to present with significant organ symptoms, notably retinochoroiditis, and can persist throughout an individual's lifespan [4].

Toxoplasma gondii affects about one-third of the world's population. Consuming contaminated water and food, especially undercooked meat, contact with domestic or wild feline feces, and transplacental transmission during pregnancy [5]. The global prevalence of *Toxoplasma gondii* antibodies ranges from 7% to 51%. Climate, culture, dietary trends, behavioral patterns, personal hygiene practices, and culinary customs vary across nations and races, affecting the occurrence rate. Various risk factors. These include eating raw or undercooked meat, touching cats or cat litter, eating unwashed raw vegetables and fruits, and drinking contaminated water and milk [6].

Literature Review

Abortion and congenital malformations result from *T. gondii* infection. Congenital toxoplasmosis can cause abortion, neonatal death, or fetal abnormalities [7, 8]. Unfortunately, there is a lack of available data from Sudan pertaining to toxoplasmosis, despite the fact that a significant incidence of the disease is observed in the daily practices of women seeking abortions. Hence, the primary objective of this study was to investigate additional risk variables associated with the increasing incidence of toxoplasmosis in the North Kordofan State of Sudan.

Materials and Methods

This descriptive study was conducted in El-Obeid, North Kordofan State, Sudan, from January to March 2024. About 155 samples from miscarriage women or women with a history of abortion were collected. Participants were randomly selected, disregarding their age or other demographic criteria, using a basic random procedure. We intentionally created a questionnaire to collect information in this regard. Each respondent provided a venous blood sample for serological testing, which included ICT and ELISA.

Data Analysis: The obtained data were analyzed using the computer software SPSS version 20 (Chicago, USA.). Frequencies, percentages, and cross-tabs were calculated. Considering the 95% confidence interval and chi square test were calculated, a P value < 0.05 will be considered statistically significant.

Informed Consent: Each participant was asked to sign a written ethical consent before the interview.

Ethical Approval: The proposal was approved by HREC at MRCC. Ethical Approval Number: HREC 0008/MRCC.3/24.

Results

This study investigated 155 women aged 18 to 49, with an average age of 34 years. The majority of patients were over 40 years old, followed by 31-35, 26-30, and 36-40, accounting for 42 (27%), 33 (21%), and 29 (19%), respectively. The age distribution was comparable across urban and rural residents. The majority of patients had a secondary level of education, followed by basic and university, with 80 (51.6%), 34 (22%), and 29 (19%), respectively. As shown in Table 1 and Figure 1, the vast majority of the patients were housewives, accounting for 133 (86%).

Table 1. Distribution of the study population by demographic characteristics

Variable	Urban	Rural	Total
Age			
< 25 years	8	10	18
26-30	13	20	33
31-35	12	21	33
36-40	12	17	29
41+	16	26	42
Total	61	94	155
Education			
illiterate	1	7	8
Basic	14	20	34
Secondary	26	54	80
University	17	12	29
Postgraduate	3	1	4
Total	61	94	155
Occupation			
House wife	53	80	133
Teacher	5	2	7
Farmer	0	9	9
Others	3	3	6
Total	61	94	155

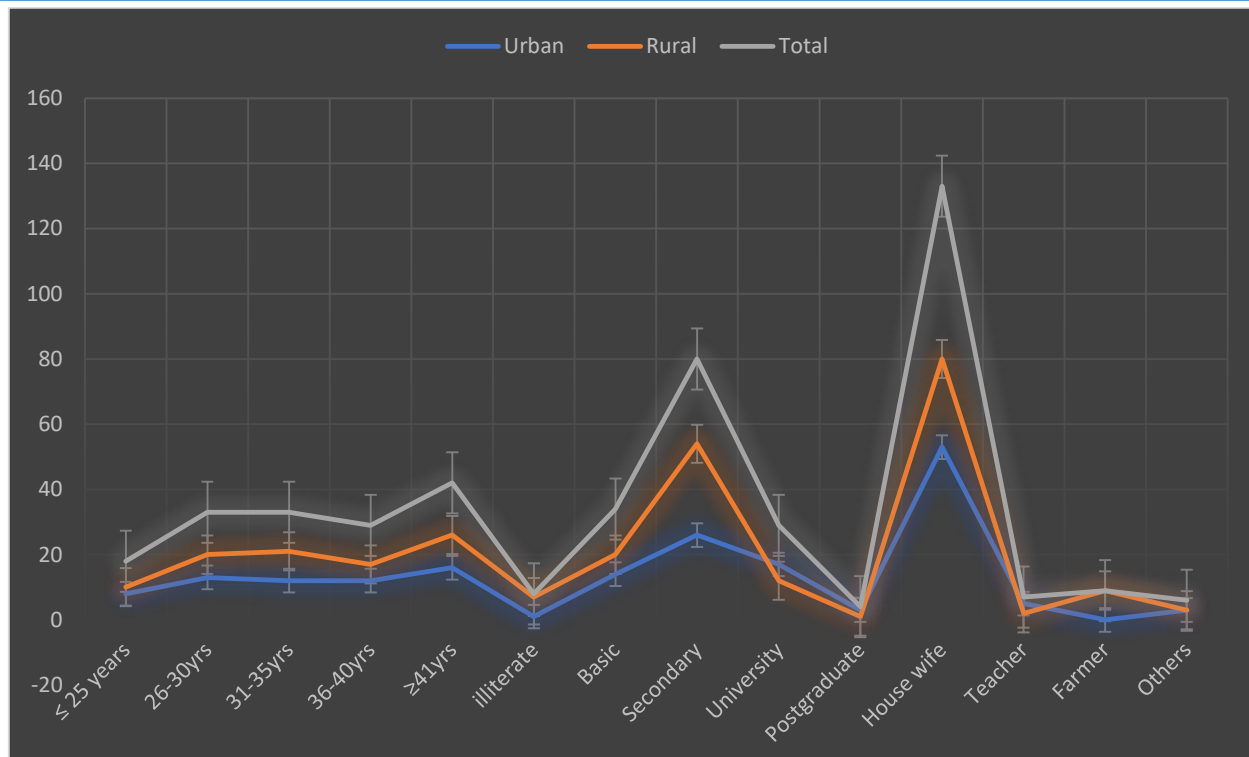


Figure 1. The study population by demographic characteristics

The prevalence of Toxoplasma infection in the study group was 18/155 (11.6%). The distribution of positive cases was similar across all age groups. Individuals with secondary education accounted for the majority of positive instances, followed by those with basic and university education, accounting for 8/18 (44.4%), 5/18 (27.8%), and 3/18 (16.7%), respectively. Table 2 shows that the majority of infected persons in this study were housewives (94.4%), with 10/18 (55.6%) in the urban population. However, the proportions within various age groups differ, as seen in Figure 2.

Table 2. Toxoplasma infection status by demographical features

Variable	Negative	Positive	Total
Age			
≤25 years	15	3	18
26-30	29	4	33
31-35	29	4	33
36-40	26	3	29
≥41	38	4	42
Total	137	18	155
Education			
illiterate	7	1	8
Basic	29	5	34
Secondary	72	8	80
University	26	3	29
Postgraduate	3	1	4
Total	137	18	155
Occupation			
House wife	117	16	133
Teacher	7	0	7
Farmer	8	1	9
Others	5	1	6
Total	137	18	155
Residence			
Urban	51	10	61
Rural	86	8	94
Total	137	18	155

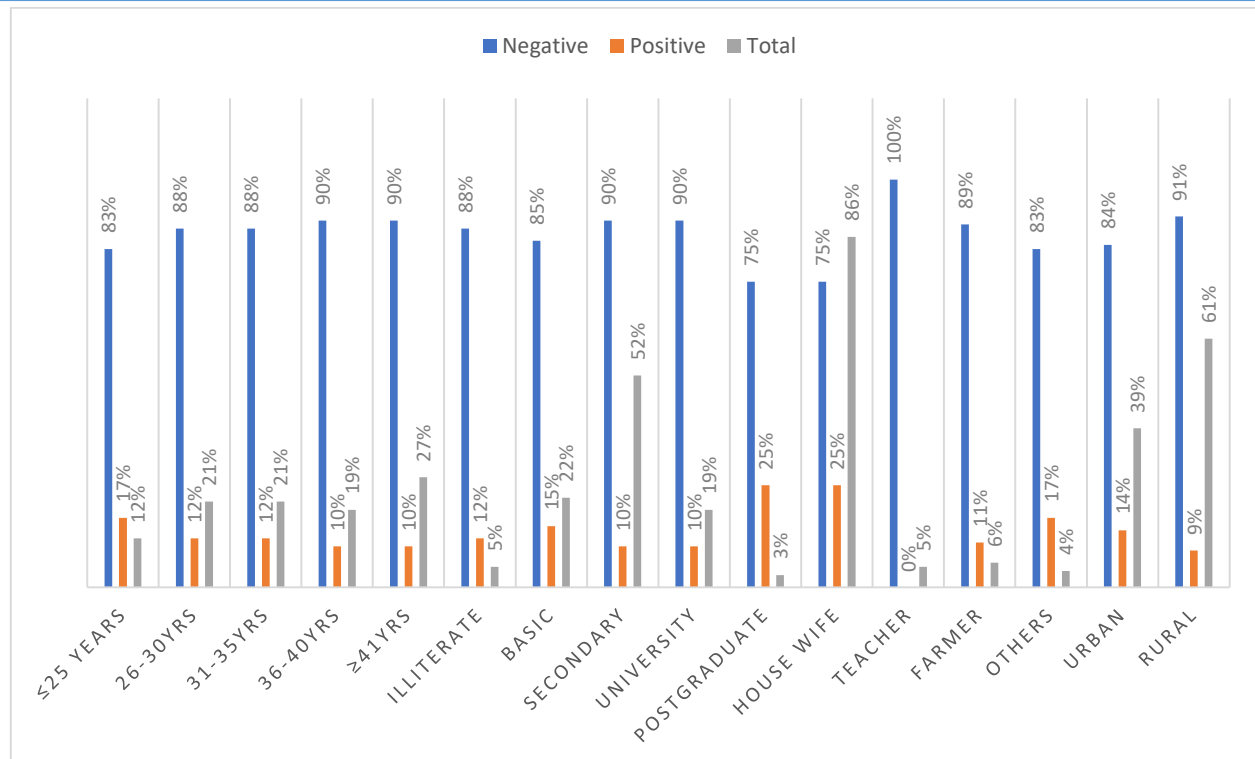


Figure 3. Toxoplasma infection status by demographical characteristics

The majority of positive cases, 17/18 (94.4%), have declared "cat contact." The risk of cat contact in toxoplasmosis is represented by the odd ratio (OR) and 95% confidence interval (95%CI); OR (95%CI) = 7.7766 (1.0023–60.3384), $P = 0.05$. Approximately 12/18 (66.7%) of the infected individuals reported eating cooked meat. The probability of transmission even in cooked meat is RR (95% CI) = 1.0122 (0.4548 to 2.2525), $P = 0.9764$; see Table 3 and Figure 3.

Claiming "sometimes eating uncooked meat" was associated with only one positive patient.

Table 3. Distribution of the infection status by transmission

Variable	Negative	Positive	Total
Cat contact			
No	43	1	44
Yes	94	17	111
Total	137	18	155
Sometimes eating uncooked meat			
No	126	17	143
Yes	11	1	12
Total	137	18	155
Eating Cooked Meat			
No	26	6	32
Yes	111	12	123
Total	137	18	155

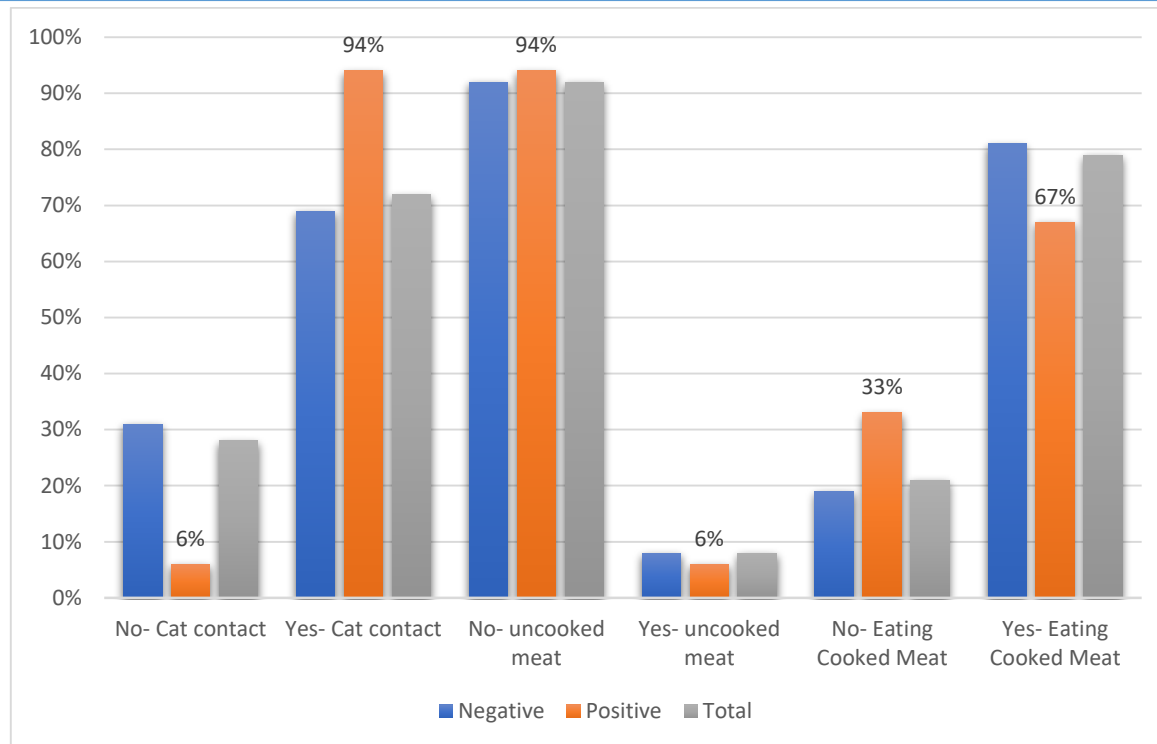


Figure 3. Infection status by transmission

Discussion

The current investigation has demonstrated that 11.6% of women who had undergone abortions were infected with toxoplasmosis. Infectious factors account for approximately 10-30% of miscarriages, with *Toxoplasma gondii* infections accounting for 5% of early abortions and 66% of late abortions. The underestimation of abortion incidence may occur, nevertheless, due to the low rates of diagnostic testing for infections during pregnancy [9, 10]. In contrast to previous research in this area, however, the prevalence in this study appeared to be quite low. The prevalence of anti-*T. gondii* IgG antibodies was estimated to be 33% (95% CI: 17%–49%) in women with a history of abortion and 43% (95% CI: 27%–60%) in women with a current abortion, according to random-effects estimates [11].

Sudanese researchers examined blood group phenotypes as risk factors for toxoplasmosis and correlated the disease's frequency with other risk factors. Toxoplasmosis prevalence among pregnant women who tested positive for *T. gondii* with IgG but not IgM was 41% (82 out of 200). The infection was more common in women with blood group type AB 5 (55.6%) than in AB women. The lowest frequency was 35.5% for blood group B11. People who have had direct cat interaction may eat undercooked meat. Additionally, soil-related risks like working in a garden without gloves, eating unwashed vegetables and fruits, and mishandling food were associated with 70 (82.4%) positive cases, 59 (65.6%) positive cases, 58 (77.3%) positive cases, 73 (55.7%) positive cases, and 70 (73.7%) positive cases. The statistical study of *Toxoplasma gondii* infection and risk factors differed greatly [12].

According to our study, there was no significant link between age and developing a disease. According to the age of the subjects, the prevalence of *T. gondii* IgG grew. The age groups with the lowest seroprevalence were preschoolers (1–5), followed by those aged 6–12 with 2.5%, 13–19 with 8.2%, 20–34 with 15.7%, 35–64 with 29.8%, and 65 and older with 46.8% ($p = 0.001$) [13]. The prevalence of the infection rose significantly from 20% in the 18–29 age group to 77% in the 70–79 age group [14].

Cat contact increases toxoplasma risk, according to research. The intimate connection between cats and humans in urban settings fascinated us, so we investigated the presence of these parasites in stray and domesticated cats and their potential health effects on owners. A study collected 132 feces samples from feral cats, 33 from domestic cats, and 33 blood samples from their owners. *T. gondii* prevalence was determined by examining the B1 gene in stray and home cat feces and cat owners' blood. *T. gondii* genotypes were also established by multilocus genotyping of the BTUB, GRA6, SAG3, and APICO loci. *Toxocara* spp. were identified by examining their ribosomal DNA's second internal transcribed spacer (ITS-2) in cat excrement and human blood. In addition, human serum samples were tested for *Toxocara* IgG. The B1 gene amplification showed that many stray cats, home cats, and cat owners have *T. gondii*. The multilocus sequence analysis found genotype I of *T. gondii* in stray cats and genotype II in household cats and cat owners. ITS-2 amplification revealed a 47.0% incidence of *T. cati* infection in stray cats but none in domestic cats' excrement or cat owners' serum. Human serum did not contain *Toxocara* IgG. The decreased prevalence of *T. gondii* in stray or household cats compared to cat owners shows that close contact with infected cats has little impact on human toxoplasmosis. However, the widespread infection of stray cats with *T. cati* can lead to environmental pollution through egg excretion and human infection via soil or water. Urban management planning must incorporate public health education. This will ensure that there is frequent urban cat deworming and healthcare worker training to prevent, control, and treat these diseases [15].

The consumption of raw or undercooked meat did not have any impact on this study. Consuming uncooked or undercooked food from infected intermediate hosts can lead to a *Toxoplasma gondii* infection in humans. Research has demonstrated that *T. gondii* can infect ruminants and birds in the region, suggesting their potential role in transmitting the parasite to humans through meat consumption [16].

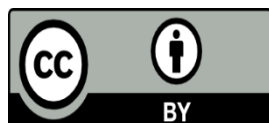
In conclusion, toxoplasmosis is widespread in the North Kordofan state of Sudan, potentially linked to the higher incidence of abortion in the region. Contact with cats primarily causes the transmission of infections.

Recommendations: Awareness should be raised towards contacting cats, and other means of transmission. Additional research in this context is considered essential for managing infections in the area.

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