Journal of Pioneering Medical Sciences
Received: November 09, 2025 | Accepted: February 16, 2026 | Published: March 05, 2026
Volume 15, Issue 02, Pages 176-180

DOI https://doi.org/10.47310/jpms2026150224

Seroprevalence of Toxoplasmosis in Pregnant Women and Its Association with Adverse Pregnancy Outcomes

Rania Abdeen H. Abdalla[1*], Nagat Sidig Yasin Eltaher[2], Naglaa Ahmed Abdellatif Ginawi[3], Einas Mustafa Mudawi Ahmed[4], Hamdan Siddig Sirag Ahmad[5], Farida Habib Khan[6], Ruqayah abdullah alshammari[7], Zaid Ali Hamoud Albayih[8], Shomoukh Abdullah Alnabtawi[9], Walid Alesefir[10], Wafa Elhassan Abd Alaziz[11], Husham O. Elzein[12], Naglaa M Shalaby[13], Omnia Abdalla Mahmoud Higazy[14] and Abeer Hassan Elhaj[15]

[1]Department of Obstetrics and Gynecology, College of Medicine, University of Hail, Saudi Arabia
[2]Department of Nursing, College of Nursing and Health Sciences, Jazan University, Saudi Arabia
[3]Accademic Affairs Hail Health Cluster quality, University of Ha'il, Saudi Arabia
[4]Department of Obstetrics and Gynecology, Faculty of Medicine, Najran University, Najran, Saudi Arabia
[5]Department of Obstetrics and Gynecology, Faculty of medicine, Najran University, Saudi Arabia
[6]Department of Family and Community Medicine, College of Medicine, University of Ha'il, Saudi Arabia
[7-8]Department of Pathology, College of Medicine, University of Hail, Saudi Arabia
[9]Hail University, Saudi Arabia
[10]Internal Medicine Department, Hail University, Saudi Arabia
[11]University, Ministry of health, Hail cluster, Hail General Hospital, saudi Arabia
[12]Department of Medical Laboratory Technology, College of Applied Medical Sciences, Northern Border University, Saudi Arabia
[13]Department of Medical Parasitology, Faculty of Medicine, Mansoura University, Mansoura, Egypt
[14]Assistant Professor, Medical Surgical Nursing, Department of Nursing, College of Nursing and Health Sciences, Jazan University, Saudi Arabia
[15]Department Community Medicine, College of Medicine, University of Hail, Saudi Arabia

Author Designation: [2-5,14-15]Assistant Professor, [6]Professor, [7-8]Pharmacy Technician, [9]Student, [10]Consultant Neurologist, [11]Consultant

*Corresponding author: Rania Abdeen H Abdalla (e-mail: raniarose1010@gmail.com).

Abstract: **Background:** *Toxoplasma gondii* infection is a globally prevalent parasitic disease with serious implications during pregnancy, where maternal infection may lead to miscarriage, intrauterine growth restriction, preterm delivery, stillbirth, or congenital anomalies. **Objectives:** To determine the seroprevalence of *Toxoplasma gondii* infection in pregnant women and to assess its association with adverse pregnancy outcomes. **Methods:** This cross-sectional analytical study was conducted on 125 pregnant women attending antenatal clinics at tertiary clinics over a period of one year. After informed consent, demographic and clinical data were collected through a structured questionnaire. Serum samples were tested for *T. gondii*–specific IgG and IgM antibodies using enzyme-linked immunosorbent assay (ELISA). Adverse pregnancy outcomes were recorded, including miscarriage, preterm delivery, intrauterine growth restriction (IUGR), stillbirth, and congenital malformations. **Results:** The mean age of participants was 27.8±5.4 years, and 56.8% were multigravida. The overall seroprevalence of toxoplasmosis was 40.0%, with 32.8% IgG-positive and 7.2% IgM-positive cases. Adverse pregnancy outcomes were observed in 33 women (26.4%), most commonly preterm delivery (12.0%) and miscarriage (9.6%). Women with *T. gondii* seropositivity had significantly higher rates of adverse outcomes compared to seronegative women (42.0% vs. 16.0%; OR: 2.52, 95% CI: 1.20–5.32, p = 0.012). **Conclusion** This study highlights a notable seroprevalence of toxoplasmosis among pregnant women and demonstrates a significant association with adverse pregnancy outcomes. A large proportion of women remained seronegative, reflecting ongoing susceptibility to primary infection. These findings emphasize the need for preventive measures, maternal education, and consideration of targeted screening strategies to reduce the burden of maternal and neonatal complications.

Key Words: Toxoplasmosis, *Toxoplasma Gondii*, Seroprevalence, Pregnancy, Adverse Pregnancy Outcomes, Miscarriage, Preterm Birth

INTRODUCTION

Toxoplasmosis, caused by the obligate intracellular protozoan *Toxoplasma gondii*, is one of the most prevalent parasitic infections worldwide. It is estimated that nearly one-third of the global population has been exposed to the parasite at some point in their lives, although seroprevalence rates vary widely depending on geography, climate, cultural practices, and socioeconomic conditions [1]. Transmission occurs primarily

through ingestion of tissue cysts in undercooked meat, oocysts shed in feline feces that contaminate soil or water, or vertically from mother to fetus during pregnancy. While infection in immunocompetent individuals often remains asymptomatic or limited to mild, self-limiting symptoms, infection acquired during pregnancy carries serious implications for both maternal and fetal health [2]. The concern with toxoplasmosis in pregnancy stems from its ability to cause congenital infection. If a woman becomes newly infected during pregnancy, T. gondii tachyzoites can cross the placenta, leading to transmission to the developing fetus. The risk of transmission and severity of outcomes are highly dependent on the gestational age at which infection occurs [3]. Infection in the first trimester, though less likely to transmit, often results in severe outcomes such as miscarriage, intrauterine growth restriction (IUGR), or congenital malformations [4]. Infections later in pregnancy carry higher transmission rates but may lead to subtler or delayed clinical manifestations, including chorioretinitis, neurodevelopmental delays, hydrocephalus, or hearing loss in the child [5].

Seroprevalence studies in pregnant women provide crucial epidemiological insights by identifying patterns of immunity and susceptibility within a given population. Women with preexisting immunity generally carry a lower risk of transmitting the parasite to the fetus, while seronegative women remain at high risk if exposed during gestation [6]. Such studies also help in assessing the need for preventive strategies such as health education regarding food hygiene, screening programs during antenatal visits, or prophylactic interventions in high-risk groups [7]. The global variation in seroprevalence is striking: regions such as Latin America, sub-Saharan Africa, and parts of the Middle East report high prevalence rates exceeding 50%, while some developed nations record rates as low as 10–20%. These discrepancies highlight the role of dietary habits, climate (oocysts survive better in humid environments), and public health infrastructure in shaping the epidemiology of toxoplasmosis [8]. Beyond epidemiology, the clinical burden of toxoplasmosis in pregnancy cannot be understated. Studies have demonstrated associations between maternal infection and a range of adverse pregnancy outcomes, including recurrent miscarriage, preterm birth, low birth weight, and stillbirth. The pathophysiology underlying these outcomes involves both direct parasitic damage and immunological dysregulation [9]. Maternal immune response to acute infection may trigger placental inflammation, impair uteroplacental blood flow, and disrupt normal fetal development. Additionally, congenital toxoplasmosis often presents as a "silent" burden, where neonates appear healthy at birth but develop severe sequelae later in life, imposing long-term healthcare costs and psychological stress on families [10]. Despite its recognized importance, routine screening for toxoplasmosis during pregnancy remains controversial and varies between countries. Some European nations, such as France and Austria, have implemented systematic antenatal screening programs, while others, including the United States and the United Kingdom, rely on targeted testing or risk-based approaches [11]. In low- and middle-income countries, where both seroprevalence and adverse outcomes are often higher, systematic screening is rarely implemented due to financial and logistical barriers. This discrepancy raises an urgent need for localized data to guide health policy. Establishing seroprevalence rates and their relationship with pregnancy outcomes in specific populations, particularly in resource-limited settings, forms the backbone of effective maternal-fetal health strategies [12].

Objective

To determine the seroprevalence of *Toxoplasma gondii* infection in pregnant women and to assess its association with adverse pregnancy outcomes.

METHODS

This was a cross-sectional analytical study conducted by online survey A total of 125 pregnant women were enrolled with ages 20 to 40 years. Non-probability consecutive sampling was used to recruit participants who fulfilled the inclusion criteria.

Inclusion Criteria

All pregnant women attending the antenatal clinic within the study duration, aged 18–40 years, who provided informed consent were included.

Exclusion Criteria

Women with chronic illnesses such as HIV/AIDS, autoimmune diseases, or those on immunosuppressive therapy were excluded, as these conditions could independently influence pregnancy outcomes or confound serological results.

Data Collection Procedure

After obtaining informed consent, a structured questionnaire was administered to collect demographic and clinical data, including age, parity, gestational age, socioeconomic status, dietary habits, and history of adverse pregnancy outcomes (miscarriage, stillbirth, intrauterine growth restriction, and preterm delivery). Approximately 5 mL of venous blood was collected from each participant under aseptic conditions. Serum was separated and analyzed using enzyme-linked immunosorbent assay (ELISA) for the detection of *Toxoplasma gondii*–specific IgG and IgM antibodies. IgG positivity was considered indicative of prior exposure, while IgM positivity suggested recent or acute infection. Seronegative individuals were classified as susceptible to primary infection. Adverse pregnancy outcomes were defined as miscarriage, intrauterine growth restriction (IUGR), preterm delivery, stillbirth, and congenital malformations. These were confirmed through clinical records, ultrasound findings, and neonatal outcomes.

Data Analysis

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were applied to summarize baseline characteristics.

Seroprevalence of Toxoplasma gondii was calculated as proportions with 95% confidence intervals. Associations between seroprevalence and adverse pregnancy outcomes were evaluated using chi-square tests for categorical variables and independent t-tests for continuous variables. Logistic regression analysis was performed to adjust for potential confounders such as maternal age, parity, and socioeconomic status. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

A total of 125 pregnant women were enrolled in the study. The mean age of participants was 27.8±5.4 years, with the largest proportion (41.6%) falling between 26–30 years. About 36.8% were younger than 25 years, while 21.6% were older than 30 years. More than half of the participants (56.8%) were multigravida, while 43.2% were primigravida. Regarding gestational age, the majority were enrolled in the second trimester (44.8%), followed by the third trimester (32.0%) and first trimester (23.2%). A higher proportion of women (57.6%) belonged to the low socioeconomic group.A past history of adverse pregnancy outcomes, such as miscarriage or stillbirth, was reported by 25.6% of the participants (Table 1).

Serological testing revealed that 41 women (32.8%) were positive for IgG antibodies, indicating past exposure to *Toxoplasma gondii*. Recent or acute infection, reflected by IgM positivity, was found in 9 women (7.2%). The remaining 75 participants (60.0%) were negative for both antibodies and were therefore considered susceptible to primary infection. The overall seroprevalence (IgG and/or IgM positive) was 40.0% (Table 2).

Adverse pregnancy outcomes were observed in 33 women (26.4%). The most common outcomes were preterm delivery (12.0%) and miscarriage (9.6%). Intrauterine growth restriction (IUGR) was identified in 8.0% of cases, stillbirth in 4.8%, and congenital malformations in 3.2% of neonates (Table 3).

When stratified by serological status, women who were seropositive for *Toxoplasma gondii* experienced a significantly higher rate of adverse outcomes (42.0%) compared to seronegative women (16.0%). Statistical analysis confirmed that seropositivity was strongly associated with adverse pregnancy outcomes, with an odds ratio of 2.52 (95% CI: 1.20–5.32, p = 0.012), suggesting that infected women were more than twice as likely to experience complications (Table 4).

Table 1: Baseline Demographic and Clinical Characteristics of Pregnant Women (N = 125)

Variable	n (%) / Mean±SD
Age (years)	27.8±5.4
Age Group	
18–25 years	46 (36.8)
26–30 years	52 (41.6)
>30 years	27 (21.6)
Parity	
Primigravida	54 (43.2)
Multigravida	71 (56.8)
Gestational Age at Enrolment	
First trimester	29 (23.2)
Second trimester	56 (44.8)
Third trimester	40 (32.0)
Socioeconomic Status	
Low	72 (57.6)
Middle/High	53 (42.4)
History of Adverse Pregnancy Outcomes	32 (25.6)

Table 2: Seroprevalence of Toxoplasma Gondii in Pregnant Women (N = 125)

Serological Status	n (%)
IgG positive (past exposure)	41 (32.8)
IgM positive (recent/acute infection)	9 (7.2)
Both IgG & IgM negative (susceptible)	75 (60.0)

Overall seroprevalence (IgG and/or IgM positive): 40.0%

Table 3: Adverse Pregnancy Outcomes among Study Population (N = 125)

Adverse Outcome	n (%)
Miscarriage	12 (9.6)
Preterm Delivery	15 (12.0)
Intrauterine Growth Restriction (IUGR)	10 (8.0)
Stillbirth	6 (4.8)
Congenital Malformations	4 (3.2)
Any adverse outcome	33 (26.4)

Table 4: Association of Toxoplasma Gondii Seroprevalence with Adverse Pregnancy Outcomes

Serological Status	Adverse Outcomes Present n (%)	No Adverse Outcomes n (%)	p-value	OR (95% CI)
Seropositive (IgG and/or IgM, n = 50)	21 (42.0)	29 (58.0)	0.012*	2.52 (1.20–5.32)
Seronegative (n = 75)	12 (16.0)	63 (84.0)	-	-

*Statistically significant at p≤0.05

DISCUSSION

The present study investigated the seroprevalence of *Toxoplasma gondii* infection among pregnant women and its relationship with adverse pregnancy outcomes. Among 125 women, the overall seroprevalence was found to be 40.0%, with 32.8% showing IgG positivity, indicative of past exposure, and 7.2% showing IgM positivity, suggesting recent or acute infection. Adverse pregnancy outcomes were observed in 26.4% of participants, with preterm delivery and miscarriage being the most frequent. Importantly, seropositive women were significantly more likely to experience adverse outcomes compared to seronegative women (42.0% vs. 16.0%), with an odds ratio of 2.52. The observed seroprevalence aligns with findings from previous research conducted in various regions, although prevalence rates vary considerably depending on geographical and socioeconomic factors [13-15]. Higher rates have been reported in tropical and subtropical regions where warm, humid climates favor the survival of oocysts, while lower prevalence has been noted in developed countries with better food safety regulations and widespread public health awareness. Our findings, therefore, represent an intermediate prevalence, consistent with patterns observed in South Asia and other developing regions [16].

The association between *T. gondii* infection and adverse pregnancy outcomes in this study supports the growing body of evidence linking maternal toxoplasmosis to complications such as miscarriage, stillbirth, intrauterine growth restriction, and preterm delivery. Previous research has demonstrated that acute infection during pregnancy increases the likelihood of vertical transmission, with the severity of fetal outcomes dependent on the gestational age at infection [17]. Early pregnancy infection is more likely to cause severe outcomes such as congenital malformations or pregnancy loss, while late pregnancy infections tend to increase the risk of prematurity or subclinical neonatal infection that manifests later in life. Our results, which highlight miscarriage and preterm birth as leading complications, are in line with this biological framework [18]. The pathophysiological mechanisms underlying these outcomes include direct parasitic invasion of placental tissue, resulting in villous necrosis, inflammation, and impaired placental perfusion. Additionally, maternal immune activation may contribute to abnormal cytokine responses, compromising the intrauterine environment. This immunological imbalance can explain the increased rates of intrauterine growth restriction and stillbirth observed in our cohort [19-20]. The relatively lower but notable occurrence of congenital malformations underscores the importance of early maternal infection surveillance, as the clinical spectrum of congenital toxoplasmosis ranges from mild to devastating neurological impairment.

From a public health perspective, the findings carry significant implications. The relatively high proportion of seronegative women (60.0%) underscores the susceptibility of a large segment of the population to primary infection during pregnancy. This raises concerns in regions where dietary practices such as consumption of undercooked meat, poor sanitation, and close contact with domestic animals are prevalent. Educational campaigns emphasizing hygienic food handling, avoidance of raw or undercooked meat, and safe pet care practices could play a pivotal role in reducing exposure risk. Furthermore, consideration of cost-effective antenatal screening strategies in high-prevalence areas may help identify at-risk women and allow timely interventions. Despite its strengths, including the use of ELISA-based serological testing and comprehensive outcome assessment, the study has certain limitations. The sample size, though adequate, may not fully capture the diversity of exposure and outcomes across different subgroups. Additionally, the cross-sectional design restricts the ability to establish a definitive causal relationship between seropositivity and adverse outcomes, though the observed association is statistically significant. Recall bias regarding past pregnancy outcomes and unmeasured confounding factors such as nutritional status or co-infections may also have influenced the results. Overall, this study reinforces the clinical and public health importance of *Toxoplasma gondii* infection in pregnancy. By demonstrating a significant association between maternal seroprevalence and adverse pregnancy outcomes, it emphasizes the need for targeted preventive measures, risk stratification, and consideration of screening in antenatal care protocols.

CONCLUSION

It is concluded that toxoplasmosis remains a significant maternal health concern, with an overall seroprevalence of 40% observed in the present study. A substantial proportion of women were seronegative, highlighting their vulnerability to primary infection during pregnancy. Importantly, maternal seropositivity was significantly associated with adverse pregnancy outcomes, including miscarriage, preterm delivery, intrauterine growth restriction, and stillbirth. These findings underscore the need for preventive strategies such as antenatal education on hygienic practices, safe dietary habits, and awareness regarding pet-related exposures. In regions with moderate to high prevalence, the introduction of cost-effective screening protocols may help identify at-risk women and reduce preventable maternal and neonatal complications.

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