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Seroprevalence and Risk Factors of Toxoplasmosis among Mothers with Spontaneous Abortion Admitted to the Maternity Teaching Hospital in Sulaimani City, Iraq

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Abstract

Background: Toxoplasmosis, caused by *Toxoplasma gondii*, is a zoonotic infection that can be mild in immunocompetent individuals but may be life-threatening in immunocompromised individuals, particularly during pregnancy. This study aims to determine the seroprevalence of toxoplasmosis and identify associated risk factors among women who have experienced spontaneous abortion.

Methods: This hospital-based cross-sectional study was conducted among 260 women who had spontaneous abortions between October 2022 and December 2023 at the Maternity Teaching Hospital in Sulaimani, Iraq. Participants were interviewed using structured questionnaires and tested for anti-Toxoplasma IgM and IgG antibodies. Data were analyzed using SPSS, and statistical significance was set at a p-value of ≤ 0.05 .

Results: The seroprevalence of anti-Toxoplasma IgM and IgG antibodies among participants was 33.85% and 47.69%, respectively. Statistically significant associations were found between IgM seropositivity and age, occupation, gestational age, and various risk factors such as owning cats, contact with cats, and dietary habits. IgG seropositivity was significantly associated with maternal age and cat ownership.

Conclusions: The study highlights a high prevalence of *Toxoplasma gondii* infection among women with spontaneous abortion, with most having multiple risk factors. Recommendations include implementing routine screening for toxoplasmosis during antenatal care, alongside health education programs to raise awareness about the risks and prevention strategies.

What is already known about the topic?

- Toxoplasmosis is a common parasitic infection caused by Toxoplasma gondii, which can have serious consequences during pregnancy, particularly if the infection occurs in the first trimester.*

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Introduction

Toxoplasmosis, a parasitic infection caused by *Toxoplasma gondii*, is a significant public health concern worldwide. This zoonotic disease affects a variety of warm-blooded animals, including humans, with cats being the primary host for the parasite. While most healthy individuals experience mild symptoms or remain asymptomatic, the disease can become life-threatening in immunocompromised individuals, including those with HIV, cancer, or organ transplants (Abamecha & Awel, 2016). For pregnant women, *T. gondii* infection poses a unique risk due to its ability to be transmitted transplacentally, potentially causing severe congenital defects, neurological damage, or even abortion (Marković-Denić et al., 2023).

The prevalence of toxoplasmosis varies across regions, with risk factors being influenced by environmental, socioeconomic, and lifestyle factors. In particular, consumption of undercooked meat, contact with infected cats, and poor hygiene practices related to food handling and cleaning have been identified as significant contributors to the transmission of *T. gondii* (Sakikawa et al., 2012). The impact of these risk factors is particularly crucial during pregnancy, as maternal infection can lead to complications such as miscarriage, stillbirth, or congenital toxoplasmosis, with the likelihood of fetal infection increasing in the later stages of gestation (Abdullah & Mahmood, 2017).

Despite the established knowledge of toxoplasmosis, the awareness of its risks and preventive measures remains low among many populations, particularly in developing countries where the disease is often overlooked in routine prenatal care (Fenta, 2019). Studies have shown that many women with spontaneous abortions are unaware of the potential risks associated with *T. gondii* infection and lack basic knowledge regarding its prevention (Elsafi et al., 2015). This knowledge gap is concerning, as it may contribute to higher seroprevalence rates of the disease among women of reproductive age.

Aim

This study was conducted to investigate the seroprevalence of toxoplasmosis among women who have experienced spontaneous abortion in Sulaimani City, Iraq, and to identify the associated risk factors. The findings of this study aim to contribute valuable data to enhance the understanding of toxoplasmosis in the context of spontaneous

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abortion and provide recommendations for public health interventions, including improved screening and educational programs for pregnant women.

Materials and Methods

Study Design

This study was a hospital-based, cross-sectional investigation conducted to assess the seroprevalence of *Toxoplasma gondii* infection and its associated risk factors among women who had experienced spontaneous abortion. The study was carried out between October 2022 and December 2023 at the Maternity Teaching Hospital in Sulaimani City, Kurdistan Region, Iraq.

Study Population

The study population consisted of women who had undergone spontaneous abortions and were admitted to the Maternity Teaching Hospital for medical care. A total of 260 women participated in the study. The women were selected using a convenient sampling method based on the inclusion and exclusion criteria detailed below.

Inclusion Criteria

- Women who experienced spontaneous abortion in their last pregnancy.
- Women who were admitted to the Maternity Teaching Hospital for medical care after their abortion.
- Women who were willing to participate in the study and provided informed consent.

Exclusion Criteria

- Women with known thrombophilia, antiphospholipid syndrome, systemic lupus syndrome, or any other autoimmune diseases that could cause abortions.
- Women with recognized uterine congenital abnormalities or multiple fetal pregnancies.
- Women who were receiving immunosuppressive medications or were immunocompromised.
- Women infected with bacterial or viral agents that may cause abortion.

Ethical Considerations

The study was conducted in accordance with the ethical guidelines of the Declaration of Helsinki. Ethical approval was obtained from Sulaimani Technical Institute and the General Directorate of Health in Sulaimani City. Informed consent was obtained from all

participants, who were fully briefed about the purpose of the study, the procedures involved, and their right to withdraw at any time.

Pilot Study

A pilot study was carried out from September 25 to October 6, 2022, involving 11 women who had experienced spontaneous abortion. The aim of the pilot study was to test the clarity of the questionnaire, assess its cultural appropriateness, determine the participants' response rate, and estimate the time required for conducting the interviews.

Data Collection

Questionnaire Development:

A structured questionnaire was designed to collect sociodemographic information and details about potential risk factors for toxoplasmosis. The questionnaire included the following sections:

1. Sociodemographic Information:

- Age at the time of abortion
- Gestational age at the time of abortion
- Parity (number of previous pregnancies)
- Educational level
- Occupation
- Residential area (urban or rural)

2. Risk Factors for Toxoplasmosis:

- History of owning cats or contact with cats
- Consumption of raw vegetables, undercooked meat, or restaurant foods
- Sources of drinking water (tap water or well water)

The interviews were conducted directly with the participants by trained research assistants in a private setting within the hospital. The duration of each interview was approximately 20–30 minutes.

Laboratory Examination:

After obtaining informed consent and completing the questionnaire, participants were tested for *Toxoplasma gondii* infection by measuring the presence of anti-Toxoplasma IgM and IgG antibodies. The blood samples were collected and sent to the Shahid Hadi Polyspeciality Clinic for analysis.

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The detection of antibodies was performed using the **DiaSorin Liaison Immunoassay Analyzer**, which utilizes chemiluminescence immunoassay (CLIA) technology. The following tests were conducted:

- **LIAISON® Toxo IgM** kit to detect IgM antibodies.
- **LIAISON® Toxo IgG II** kit to detect IgG antibodies.

Statistical Analysis

The collected data were entered and analyzed using the **Statistical Package for the Social Sciences (SPSS)** version 22. The data were presented as means \pm standard deviations (for continuous variables) and frequencies and percentages (for categorical variables). To determine associations between sociodemographic factors, risk factors, and seroprevalence of toxoplasmosis, the **chi-square test (χ^2)** was used. A P-value of ≤ 0.05 was considered statistically significant.

Risk Factor Assessment:

The association between seropositivity (for both IgM and IgG antibodies) and sociodemographic characteristics, such as age, occupation, and residential area, was analyzed. Additionally, potential risk factors, including contact with cats, consumption of raw vegetables, undercooked meat, and restaurant food, were also assessed.

Limitations

While this study provides valuable insights into the prevalence and risk factors of toxoplasmosis among women with spontaneous abortion in Sulaimani City, it is important to note that the study was conducted at a single hospital using convenience sampling, which may limit the generalizability of the findings. Furthermore, only serological tests were used for diagnosis, without confirming the presence of *T. gondii* through molecular methods.

Results

A total of 260 women who had experienced spontaneous abortions participated in the study. The participants had a mean age of 31.46 years (± 5.22 standard deviation), with ages ranging from 22 to 44 years. The majority of the participants were housewives (46.6%), followed by self-employed women (29.6%) and government employees (25%). Regarding education, 35.4% had higher education, 31.5% had secondary education, 28.1% had primary education, and 5% were illiterate. Most participants resided in urban areas (66.2%), with the remaining 33.8% living in rural areas.

The study found that the seroprevalence of *Toxoplasma gondii* antibodies among the participants was 33.85% for anti-Toxoplasma IgM and 47.69% for anti-Toxoplasma IgG. The presence of IgM antibodies indicated recent or active infection, while IgG antibodies suggested previous exposure or latent infection. There were significant associations between the seroprevalence of IgM antibodies and various sociodemographic factors, including age, occupation, and gestational age at the time of abortion. Women aged 20–30 years had the highest prevalence of IgM antibodies (35.5%), and those who aborted during the first month of pregnancy showed the highest seroprevalence of IgM antibodies (63.8%). Housewives exhibited the highest seroprevalence of IgM antibodies (46.6%) compared to other occupational groups. Additionally, IgG seroprevalence was significantly associated with maternal age and cat ownership, with older women (≥ 40 years) showing higher seroprevalence of IgG antibodies (60.9%).

In terms of risk factors for toxoplasmosis, the study identified several significant associations with IgM and IgG seropositivity. A total of 187 participants (71.9%) had more than one risk factor. For IgM seropositivity, owning cats was a significant risk factor ($P < 0.001$), with women who owned cats exhibiting a higher seroprevalence of IgM antibodies (59.1%) compared to those who did not own cats (28.7%). Similarly, contact with cats ($P = 0.002$), eating raw vegetables ($P < 0.001$), consuming undercooked meat ($P < 0.001$), and eating restaurant foods ($P = 0.032$) were all significantly associated with increased IgM seropositivity. Regarding IgG seropositivity, owning cats was the only significant risk factor ($P = 0.046$), with a higher prevalence of IgG antibodies observed in women who owned cats (61.4%) compared to those who did not (44.9%).

No significant associations were found between seropositivity for either IgM or IgG antibodies and the source of drinking water (tap water vs. well water) or educational level. The findings of this study indicate a high seroprevalence of *Toxoplasma gondii* infection among women with spontaneous abortion, with multiple risk factors contributing to the increased likelihood of infection. These results highlight the need for targeted health education programs for women, especially those of reproductive age, to raise awareness about the risks and preventive measures for toxoplasmosis.

This study contributes to a better understanding of toxoplasmosis in the context of spontaneous abortion and aims to guide future interventions and public health recommendations.

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Table 1: Seroprevalence of IgM and IgG Antibodies Associated with Sociodemographic Background of the Aborted Women

Background	IgM Positive (%)	IgM Negative (%)	IgG Positive (%)	IgG Negative (%)	P-value (IgM)	P-value (IgG)
Age group (Years)	35.5 (20-30)	64.5 (20-30)	25.8 (20-30)	74.2 (20-30)	<0.001	<0.001
Gestational age (Months)	63.8 (0-1)	36.2 (0-1)	46.8 (0-1)	53.2 (0-1)	<0.001	0.882
Occupation	46.6 (Housewife)	53.4 (Housewife)	43.7 (Housewife)	56.3 (Housewife)	0.004	0.122
Residence	33.9 (Urban)	66.1 (Urban)	48.2 (Urban)	51.8 (Urban)	0.944	0.674

Table 2: Seroprevalence of IgM and IgG Antibodies Associated with Risk Factors for Toxoplasma gondii

Risk Factors	IgM Positive (%)	IgM Negative (%)	IgG Positive (%)	IgG Negative (%)	P-value (IgM)	P-value (IgG)
Owning Cats	59.1 (Yes)	40.9 (No)	61.4 (Yes)	38.6 (No)	<0.001	0.046
Contact with Cats	44.1 (Yes)	55.9 (No)	50.5 (Yes)	49.5 (No)	0.002	0.442
Eating Raw Vegetables	52.6 (Yes)	47.4 (No)	42.3 (Yes)	57.7 (No)	<0.001	0.177
Eating Undercooked Meat	51.3 (Yes)	48.7 (No)	41.0 (Yes)	59.0 (No)	<0.001	0.159
Eating Restaurant Foods	38.5 (Yes)	61.5 (No)	46.7 (Yes)	53.3 (No)	0.032	0.677

Discussion

This study aimed to assess the seroprevalence of *Toxoplasma gondii* among women who had experienced spontaneous abortion in Sulaimani City, Iraq, and to identify the risk factors associated with the infection. The results showed that the seroprevalence of *Toxoplasma gondii* infection was relatively high, with 33.85% of participants testing positive for anti-Toxoplasma IgM and 47.69% for IgG antibodies. These findings are concerning as they suggest a substantial burden of *Toxoplasma gondii* infection in this population, which may contribute to the risk of spontaneous abortion.

The findings of this study are consistent with several other studies conducted in different regions, which have also reported high seroprevalence rates of *T. gondii* in pregnant women or women with spontaneous abortion. For example, studies in Iran and Egypt have shown that women with spontaneous abortions have a higher prevalence of *T. gondii* antibodies compared to those with normal pregnancies (Sebaa et al., 2024; Matin et al., 2017). Similarly, a study in Iraq found a higher seroprevalence of IgM antibodies in pregnant women who had experienced miscarriage (Ubaid Hamza et al., 2022). This trend could be attributed to the potential association between acute *T. gondii* infection and miscarriage, particularly when infection occurs early in pregnancy (Alvarado-Esquivel et al., 2014).

Several sociodemographic and lifestyle factors were found to be significantly associated with the seroprevalence of *T. gondii*. Among the sociodemographic factors, younger women (aged 20–30 years) had a higher prevalence of IgM antibodies, which might reflect increased exposure to the infection due to more active outdoor behaviors, particularly in rural areas where contact with cats and consumption of undercooked meat and raw vegetables is more common. This finding aligns with previous studies, which have found that younger women in the reproductive age group are at greater risk of contracting *T. gondii* due to their lifestyle (Kheirandish et al., 2016; Radha M. Lefta, 2020).

The study also found that housewives had a significantly higher prevalence of IgM antibodies compared to women in other occupations. This could be due to housewives' increased exposure to raw food, such as meat and vegetables, which may not be properly washed or cooked, thus increasing the likelihood of ingesting *T. gondii* oocysts. Studies have consistently shown that handling raw meat, especially in food preparation, is a major

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risk factor for toxoplasmosis (Sadiqui et al., 2018). In addition, contact with cats and the consumption of raw vegetables were strongly associated with IgM seropositivity. These results are consistent with previous research, which highlights the role of cats as the primary host for *T. gondii*, shedding oocysts that can contaminate food, water, and the environment (Shapiro et al., 2019; Hussain et al., 2017). The findings suggest that women who have direct or indirect contact with cats, especially those who handle cat litter or own cats, may be at higher risk of infection.

The consumption of undercooked meat was another significant risk factor for *T. gondii* infection in this study. *T. gondii* cysts are commonly found in the muscle tissue of infected animals, and eating undercooked or contaminated meat has long been recognized as a major route of transmission (Hartmann et al., 2013). This risk factor was also found to be associated with a higher seroprevalence of IgM antibodies in this study. Additionally, eating food from restaurants, which might not always meet hygiene standards, was significantly associated with increased IgM seroprevalence. A similar association was found in a study conducted in Brazil, where eating at restaurants was identified as a risk factor for acute toxoplasmosis (Cabral Monica et al., 2020).

Although the study found no significant association between seroprevalence and the source of drinking water, it is important to note that this variable might not be a primary risk factor for *T. gondii* infection in the study area. However, contaminated water sources could contribute to infection in certain populations, particularly in rural or underdeveloped regions where water sanitation practices might be inadequate (Aguirre et al., 2019).

Overall, the findings of this study underscore the importance of raising awareness about toxoplasmosis among women, particularly those of reproductive age. The study reveals a clear need for targeted educational interventions to inform women about the risks of *T. gondii* infection, especially during pregnancy, and the importance of preventive measures. Health education programs should focus on safe food handling, the dangers of consuming raw or undercooked food, and the risks associated with owning or coming into contact with cats. Additionally, antenatal care should include routine testing for toxoplasmosis, particularly for high-risk women, to prevent adverse pregnancy outcomes. Despite the valuable findings, the study had some limitations. First, it was conducted in a single hospital with a convenience sampling method, which may limit the generalizability

of the results. Second, it relied solely on serological testing without using molecular methods to confirm *T. gondii* infection. Future studies with a larger sample size, incorporating molecular diagnostics, could provide more robust data on the actual burden of toxoplasmosis in this population.

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Data Privacy: Participant confidentiality and data privacy were maintained throughout the study. Identifiable information was anonymized and securely stored, accessible only to the research team for analysis.

Data Availability Statement: Available from the corresponding author upon reasonable request

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