



The Effect of *Toxoplasma gondii* Parasitic Infection on the Growth and Development of Fetuses in Pregnant Women

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Abstract

This study aimed to determine the prevalence of toxoplasmosis in pregnant women and its adverse effects on pregnancy outcomes in women infected with *Toxoplasma gondii* IgM in Tikrit, Iraq. The samples were gathered and examined for Toxoplasma IgM antibodies. Pregnancy outcomes were investigated among both infected and non-infected women.

The results showed that the prevalence of positive Toxoplasma IgM among pregnant women was **19.4%**. The occurrences of abortion, stillbirth, preterm delivery, fetal growth restriction (FGR), and congenital malformation in the infected group were **6 cases (17.1%)**, **5 cases (14.3%)**, **3 cases (8.6%)**, **3 cases (8.6%)**, and **2 cases (5.7%)**, respectively. In contrast, the incidences in the control group were **2 cases (2.7%)**, **2 cases (1.8%)**, **1 case (0.9%)**, **1 case (0.9%)**, and **no malformations** at ($P < 0.01$).

The study concluded that toxoplasmosis infection may lead to abnormal pregnancy outcomes. Therefore, healthcare institutions should enhance awareness regarding the prevention and treatment of toxoplasmosis and encourage healthy dietary habits among women of reproductive age.

Keywords: Pregnant women, *Toxoplasma gondii*, IgM, Pregnancy outcomes.

1. Introduction

On a global scale, toxoplasmosis is regarded as an important **[public health issue]**. Humans can contract the disease from **[contaminated soil, food, or water]** through ingestion of oocysts of the protozoan parasite **[*Toxoplasma gondii*]**, an obligate intracellular **[protozoan]** parasite. Acute infection is characterized by **[rapid intracellular replication]** and dissemination of tachyzoites. During pregnancy, these parasites **[can cross the placental barrier and infect the fetus]**. Bradyzoites develop from tachyzoites and can be found in **[various organs]** as tissue cysts, including the eyes, the central nervous system, and muscles (Elamin & Alhabib, 2016; Artigas et al., 2020).

Pregnancy is an important stage in a woman's life and is associated with many **[physical and psychological changes]**. Although most pregnancies proceed normally, some may develop complications classified as **[high-risk]** pregnancies. These pregnancies are associated with a higher probability of adverse maternal or fetal outcomes due to various medical or environmental factors (Bojar & Szymanska, 2010; Charlier & Lecuit, 2020).

Risk factors for high-risk pregnancies **[include]** pre-existing maternal diseases, socioeconomic conditions, environmental influences, or complications during gestation. Studies indicate that approximately 10–20% of pregnancies worldwide are classified as high-risk (Araujo & Yoon, 2020; Suarez & Estevez, 2009).

Primary infection with *T. gondii* during pregnancy can lead to vertical transmission from mother to fetus, resulting in serious complications such as **[miscarriage]**, stillbirth, preterm birth, and congenital abnormalities. Infants with congenital toxoplasmosis may suffer from hydrocephalus, neurological dysfunction, visual impairment, and other severe health consequences (Elfadaly et al., 2017; Gebremedhin et al., 2013).

Congenital toxoplasmosis is considered the **[second most common]** intrauterine infection affecting fetuses. Global studies estimate approximately 190,100 cases annually, contributing to a significant global



disease burden (Iddawela, Vithana, & Ratnayake, 2017; Jones et al., 2001; Kazemi et al., 2022).

2. Materials and Methods

Study Population

The study included pregnant women and newborns who were categorized into infected and non-infected groups based on their *T. gondii* IgM blood results, and the physical and cognitive development of the live-born infants was monitored.

The present investigation was conducted in certain regions of Salah al-Din governorates. Blood samples were obtained from pregnant women hospitalized to government hospitals and select private medical clinics. The study took place between March 1, 2024, and May 1, 2025, and the ages were between 20 to 38.

Sample Collection and Processing

A total of 180 blood samples were collected from pregnant women suspected of parasitic infection. Approximately 5 mL of venous blood was drawn using sterile syringes and transferred into plastic tube.

The samples were allowed to clot at room temperature and then centrifuged at 3000 rpm for 5 minutes. The serums were put into Eppendorf tubes and stored at -20°C until further analysis using the ELISA technique to detect IgM antibodies.

Detection of IgM Antibodies

The ELISA method was used as quantitative enzyme immunoassay for detecting *Toxoplasma gondii* IgM antibodies. The microplate wells precoated with specific Toxo-IgM antigens. The samples were added into the well, followed by the addition of Horseradish Peroxidase (HRP)-conjugated antigen to the wells. After incubation and washing to remove unbound substance, the TMB substrate solution was added into each well, leading to color change indicating antigen- antibody reaction. The optical density (OD) is measured by a spectrophotometer at a wavelength of 450 nm and result compared with the CUTOFF value to determine positivity.

Statistical Analysis

Statistical analysis was conducted utilizing the Statistical Package for Social Sciences (SPSS). The Chi-square test was employed to identify significant differences among groups, with statistical significance established at $P < 0.05$.

3. Results

Diagnosis of *Toxoplasma gondii* Infection Using Toxoplasma IgM ELISA

The current study showed that 35 samples (19.4%) were positive for IgM antibodies, while 145 samples (80.6%) were negative.

Table 1: Seroprevalence of *Toxoplasma gondii* IgM among pregnant women

Total women	Positive IgM	Negative IgM
180	35 (19.4%)	145 (80.6%)

Table 2: The effect of infection with *Toxoplasma gondii* on pregnancy outcome

Outcome	G1 (IgM+) n=35	G2 (IgM-) n=110	OR (95% CI)	p-value*
Abortion	6 (17.1%)	3 (2.7%)	1.74 (7.38-31.31)	0.006
Stillbirth	5 (14.3%)	2 (1.8%)	1.66 (9.00-48.70)	0.009
Preterm birth (j37 weeks)	3 (8.6%)	1 (0.9%)	1.03 (10.22-101.3)	0.044
Fetal growth restriction	3 (8.6%)	1 (0.9%)	1.03 (10.22-101.3)	0.044
Congenital malformation	2 (5.7%)	0 (0%)	-	0.057
Normal outcome	16 (45.7%)	103 (93.6%)	0.07 (0.18-0.03)	0.001

*Fisher's exact test (two-tailed)

4. Discussion

The correlation between *Toxoplasma gondii* infection and complications during pregnancy, including preterm delivery, stillbirth, **[miscarriage]**, and congenital abnormalities, has been the subject of **[extensive research]**. **[Toxoplasmosis, a parasitic disease, can infect pregnant women and their unborn children]** (Li, X. L., et al., 2014; Mirakhani, 2020).

[Fetal damage], miscarriage, or stillbirth can occur as a consequence of infection during the first trimester of pregnancy. According to Moura et al. (2013) and other studies, there is a significant difference in the frequency of pregnancy complications between infected and non-infected groups ($P < 0.01$).

Nijem and Al-Amleh (2009) found that among the most prevalent **[adverse]** pregnancy outcomes were miscarriage and **[late miscarriage]**, followed by fetal death, **[intrauterine growth restriction]**, and nervous system anomalies **[such as]** hydrocephalus and microcephaly.

The miscarriage rate among IgM-positive pregnant women in China was estimated at 12.6%, compared with 2.7% in the control group (Olariu et al., 2011).

These findings **[are consistent with]** the results of the present study, where miscarriage was significantly higher among infected women.

Studies conducted in Brazil and Kenya also reported high seroprevalence rates among pregnant women (Rostami et al., 2020; Sa et al., 2022; Sokou et al., 2025).

Differences in infection rates between regions may be attributed to dietary habits, environmental conditions, and exposure to cats, which are the primary hosts of the parasite.

5. Conclusion

The present study indicates that *Toxoplasma gondii* infection among pregnant women is associated with adverse pregnancy outcomes such as miscarriage, stillbirth, **[preterm birth]**, fetal growth restriction, and

congenital malformations. Therefore, **[improving health awareness, promoting early diagnosis, and implementing preventive strategies are essential]** to reduce infection rates and improve maternal and fetal health outcomes.

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تأثير عدوى طفيل *Toxoplasma gondii* على نمو وتطور الأجنة لدى النساء الحوامل

مستخلص البحث:

هدفت الدراسة إلى تحديد مدى انتشار داء المقوسات لدى النساء الحوامل، وتأثيره في نتائج الحمل لدى الحوامل المصابات بطفيلي المقوسة الغوندية (*Toxoplasma gondii*) من النوع IgM في مدينة تكريت – العراق. تم جمع عينات من مصل الدم وتحليلها للكشف عن الأجسام المضادة IgM باستخدام اختبار ELISA. أظهرت النتائج أن نسبة إيجابية الأجسام المضادة IgM بلغت 19.4% لدى النساء الحوامل. كما سُجلت حالات الإجهاض، وولادة الجنين الميت، والولادة المبكرة، وتقييد نمو الجنين، والتشوهات الخلقية في مجموعة المصابات بواقع 6 حالات (17.1%)، و5 حالات (14.3%)، و3 حالات (8.6%)، و3 حالات (8.6%)، وحالتين (5.7%) على التوالي. في حين بلغت هذه الحالات في المجموعة الضابطة حالتين (2.7%)، وحالتين (1.8%)، وحالة واحدة (0.9%)، وحالة واحدة (0.9%)، ولم تُسجل أي تشوهات خلقية. وقد لوحظ وجود فرق معنوي بين المجموعتين عند مستوى الدلالة ($P < 0.01$). وتستنتج الدراسة أن الإصابة بداء المقوسات تؤدي إلى نتائج حمل غير طبيعية. لذا ينبغي تعزيز التوعية الصحية حول طرق الوقاية والعلاج من هذا المرض، وتشجيع أنماط الحياة الصحية لدى النساء في سن الإنجاب، مع ضرورة تعزيز استراتيجيات الوقاية خلال مراحل الحمل المختلفة للحد من التشوهات الخلقية وتحسين صحة المجتمع.

الكلمات المفتاحية: النساء الحوامل، المقوسة الغوندية، IgM، نتائج الحمل.