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Short communication

Seroprevalence of IgG and IgM antibodies against *Toxoplasma gondii* in pre-pregnancy women in Yazd, Iran

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Abstract
Toxoplasmosis, caused by *Toxoplasma gondii*, is an important zoonotic disease produced by ingesting food contaminated with oocysts and tachyzoites of this parasite and as well as congenital infection occurs unintentionally in humans by the placenta. The study of this parasite in pre-pregnancy women is of paramount importance because of abortion, hydrocephalus, microcephalus, intracranial calcifications, retinochoroiditis, strabism, blindness, epilepsy, psychomotor and mental retardation. Therefore, the present study aims to investigate the seroepidemiology of *T. gondii* infection in pre-pregnancy women referring to private laboratories in Yazd city. In this study, blood was sampled from 185 pre-pregnancy women. Anti-*T. gondii* IgG and IgM antibodies were determined in separated serum samples using the ELISA test. Data were entered in Excel 2016 to calculate the percentages. The results indicated that 50 (27.03%) out of 185 pregnant women were positive for anti-*Toxoplasma* antibodies. Among these women, IgG and IgM antibodies were observed in 35 (18.91%) and 14 (7.56%) subjects, respectively. Both antibodies were found in the serum of one participant (0.5%). Since the anti-*T. gondii* antibody level is low in the blood serum of pregnant women in this region; pregnant women are recommended to avoid contact with cats, restrain from eating raw meat and food during pregnancy, and be tested for *T. gondii* at least once, particularly in the first trimester of pregnancy.
***Keywords**: Toxoplasma gondii*, IgG, IgM, pregnant women, Yazd

Introduction

As the causative agent of toxoplasmosis, *Toxoplasma gondii* is an obligate intracellular parasite of warm-blooded animals as intermediate hosts and cats and felids as final hosts. This parasite is transmitted horizontally through water and fodder infected with the oocyst stage of the parasite in herbivorous intermediate hosts and through eating undercooked meat, raw egg, and milk infected with tachyzoite, and oocyst stages of the parasite in cats and humans (Asiyabi Aghdam et al., 2022; Deljavan et al., 2022; Nahavandi et al., 2021). This disease is generally asymptomatic in healthy immunocompetent people, but infection of pregnant women with *T. gondii* causes fetal death, premature birth, and congenital toxoplasmosis in some cases, according to trimesters of pregnancy. Congenital toxoplasmosis may lead to mental retardation, multiple organ failure, hydrocephalus, or the death of a fetus (Tonkin, 2020). Ocular

toxoplasmosis most often presents as a focus of retinitis involving the inner layers of the retina and presents as a whitish, fluffy lesion with surrounding retinal edema (Khan and Khan, 2018). Toxoplasmic encephalitis is the most prevalent cause of facial nerve disorder observed in patients with immunodeficiency, such as AIDS. The symptoms include headache, drowsiness, unilateral partial paralysis, seizures, coma, and subsequent death (Ahmadpour et al., 2014; Dhaliwal and Dutt Juyal, 2015). The prevalence of infection differs in different regions of Iran based on the climate. Environmental conditions, such as changes in humidity and temperature, directly affect the preservation and sporulation of oocysts excreted by cats. The highest prevalence of toxoplasmosis is reported in northern regions, followed by temperate and dry regions of Iran (Foroutan-Rad et al., 2016; Hosseini et al., 2019; Mizani et al., 2017; Nahavandi et al., 2021). The seroprevalence of *T. gondii* in humans has been studied in Iran and other countries (Alvarado-Esquivel et al., 2011; Arefkhah et al., 2019; Deshmukh et al., 2021; Foroutan-Rad et al., 2016; Mizani et al., 2017; Siponen et al., 2019). A toxoplasmosis prevalence rate of 18-85% is reported in different regions of Iran (Mizani et al., 2017). To identify *Toxoplasma* infection in pregnant women, antibody screening programs are conducted in some countries. When *Toxoplasma*-specific antibodies are detected in the serum, it is necessary to determine whether the infection occurred during or before pregnancy, hence it is crucial to determine the exact time of infection. To this aim, specific anti-*Toxoplasma* IgM and IgG antibodies and their titer should be identified to determine the onset of infection. Few studies have been conducted on anti-*T. gondii* antibodies in the serum of pregnant women in Yazd city. Therefore, this study aimed to determine IgG and IgM antibodies against *T. gondii* in urban and rural pregnant women referring to private laboratories in Yazd city using the ELIZA method.

Materials and methods

This descriptive cross-sectional study was conducted on 185 pre-pregnancy women in Yazd city in 2018-2020. The clients referring to ten private laboratories in the city were sampled randomly by the clustering method. Two ml of blood was collected from individual pre-pregnancy under aseptic conditions. After serum separation from the blood samples, the IgG and IgM antibodies were titrated by ELISA using anti-*T. gondii* ELISA commercial kits (Euroimmune, UK) according to the kit instructions. IgG antibody titer values are based on U/ml units, in which values < 8, 8-11, and 11 U/ml were considered negative, suspicious, and positive values, respectively. For antibody titer values, IgM values < 0.8, > 0.8 - < 1.1, and > 1.1 U/ml were taken as negative, suspicious, and positive values, respectively. The data were entered using Microsoft® Office Excel to calculate the percentage of infection.

Results

The results showed that 50 out of 185 (27.3%; 95% CI: 27.03±0.33) pregnant women were positive for anti-*Toxoplasma* antibodies. Among these women, IgG and IgM antibodies were observed in 35 (18.91%; 95% CI: 18.91±0.24) and 14 (7.56%; 95% CI: 7.56±0.81) subjects, respectively. Both antibodies were found in the serum of one participant (0.5%; 95% CI: 0.5± 0.01).

Discussion

Toxoplasmosis is a foodborne zoonotic disease caused by *T. gondii*, an obligate intracellular parasite with global spread (Wam et al., 2016). In the present study, the prevalence rate of *T. gondii* in the serum of pregnant women was 27.03%, which was lower than those obtained in previous studies. The seroprevalence of toxoplasmosis was reported to be 42.8% in a study on pregnant women in Qom (Mardani and Keshavarz, 2004). Panah et al. (2013) determined a seroprevalence rate of 75.02% for *T. gondii* infection among pregnant women in Mazandaran, with 5.10% and 69.91% having IgM and IgG antibodies, respectively (Panah et al., 2013). The seroprevalence rates of *T. gondii* in pregnant women were reported to be 32% in Yazd by Anvari and Ghafoorzadeh (Anvari Tafti and Ghafourzadeh, 2014), 29.23% in Kermanshah

by Kalani et al. (2021). A study in Cameroon showed that the seroprevalence of *T. gondii* IgG and IgM antibodies was 54.5% in women of reproductive age infected with this parasite (Wam et al., 2016). In this research, IgG (88.7%), IgM (30.9%), and both antibodies (19.6%) were found in the subjects. However, the seroprevalence obtained in our research is higher than those reported in some other studies. For example, Kanani et al. (2022) found the seroprevalence of *T. gondii* among women of reproductive age to be 8.3% in Birjand (Kanani et al., 2022).

The seroprevalence rate of 27.03% obtained in this study that of Manouchehri-Naeini et al. who determined toxoplasmosis seroprevalence rates of 27.4% (Manouchehri-Naeini et al., 2004) and 27.6% (Manouchehri-Naeini et al., 2006) using the IFA method in rural pregnant women of Charmahal and Bakhtiari province. Similarly, Dalimi-Asl and Arshad (2012) reported a prevalence rate of 26.6% in pregnant women admitted to Al-Zahra Hospital in Tabriz (Dalimi Asl and Arshad, 2012).

In the current study, the values of IgG and IgM antibodies were 18.91% and 7.56%, respectively, in the serum samples of pre-pregnancy women. Likewise, higher levels of IgG antibody than IgM were reported in other studies (Akhlaghi et al., 2013; Dalimi Asl and Arshad, 2012; Kalani et al., 2021; Panah et al., 2013). Usually, specific IgM appears nearly one week after the exposure, and IgG appears one to three weeks after IgM appearance. The absence of IgM usually shows evidence of past infections of *T. gondii*, while the presence of the antibodies demonstrates acute infections (Teimouri et al., 2020).

The difference between the results of this study and other studies probably results from geographical and social differences, the type of consumed meat, eating habits among different communities, and consumption of vegetables. Due to warm and relatively dry climate in Yazd city, it expectedly affects the survival of the parasite's oocysts in the open environment, leading to lower prevalence than in other regions of the country (Foroutan-Rad et al., 2016).

Conclusion

The results of the present study showed that specific anti-*T. gondii* antibodies were absent in 72.97% of the studied pregnant women. Therefore, a significant percentage of people are likely to encounter and prone to infection with this parasite during pregnancy, thereby transmitting the disease to their fetuses. Accordingly, the high risk of congenital toxoplasmosis in the studied area should be a matter of concern for the health system.

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Ethical approval

The study protocol was approved by the Ethical Committee of the Medical Sciences Faculty of Yazd (IR.YAZd.REC.1208.116)**.**

Conflict of interest statement

The authors declare that there is no conflict of interest.

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