

***Toxoplasma gondii* seroprevalence among women of childbearing age referred to clinical laboratories in Ilam, Western Iran**

Original
Article

Marziyeh P Nasirkandy¹, Milad Azami²

Departments of Obstetrics and Gynecology, Women's Reproductive Health Research Center, School of Medicine, Tabriz University of Medical Sciences, Tabriz¹, Ilam University of Medical Sciences, Ilam², Iran

ABSTRACT

Background: Primary infection with toxoplasmosis during pregnancy can be transmitted to the fetus and may cause serious complications.

Objective: The present study was conducted to determine the seroprevalence of *T. gondii* antibodies in women of child-bearing age in Ilam, Iran.

Subjects and Methods: The present cross-sectional research was conducted among 797 women of childbearing age who were referred to laboratories in Ilam, in the west of Iran. Inclusion criteria for participants were being a woman of child-bearing age, referred to one of four laboratories for routine check-up in different areas of Ilam city, and willing to participate. A venous blood sample was collected from each participant. Separated sera were examined using ELISA for measurement of anti-*Toxoplasma* IgG, and IgM.

Results: The study included a total number of 797 women of child-bearing age with mean age of 29.92±7.23 years. The total seroprevalence of *T. gondii*, as measured by IgG level was 23.46% (187 women), of which 0.6% were seropositive for IgM. No significant relationship was recorded between seroprevalence of *Toxoplasma* antibodies and education level, occupation or residence, but age was significantly associated with toxoplasmosis ($P=0.001$).

Conclusion: These results indicate that most women of child-bearing age (76%) in Ilam are susceptible to infection and should be warned against the risk factors for toxoplasmosis to minimize exposure to *T. gondii*. Prenatal screening is recommended to help identify susceptible women to *T. gondii*.

Keywords: *Toxoplasma* antibodies; Iran; risk factors; reproductive; seroprevalence; toxoplasmosis; women.

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Corresponding Author: Milad Azami; **Tel.:** +989120291600; **Email:** Milad98azami@gmail.com

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INTRODUCTION

Toxoplasmosis is a zoonotic illness with global prevalence, caused by *T. gondii*^[1]. This universal parasite is spread through three principal routes of transmission: Foodborne by eating undercooked or contaminated meat, zoonotic by contact with the cat definitive host, and congenital^[2-3]. Studies published recently revealed high *Toxoplasma* seroprevalence in children due to infection of their mothers^[4-6]. A primary infection in pregnant women can be transferred to the foetus and could lead to complications^[2,6]. Infants infected in utero in the first and second trimester often experience a combination of symptoms at birth such as chorioretinitis sclopetaria, cross-eyed, blindness, seizure, cognitive or psychological retardation, anaemia, icterus, rash, petechia, thrombocytopenia, inflammation of the brain tissue, pneumonia, microcephaly, and cerebral calcification^[2]. Conversely, most cases of in utero infection in the third trimester are asymptomatic or insignificant^[2-3].

The prevalence of *Toxoplasma* infection among humans varies in different areas according to age, presence of house cats, nutritional habits, lifestyle, and geographical temperature and humidity^[7].

Among women of childbearing age in Iran, *T. gondii* seroprevalence has been estimated as 8.3-44%^[1,8-12]. Only one study was conducted in Ilam province and one of its limiting factors was including fewer women^[13]. Considering the shortage of comprehensive epidemiological studies conducted in Ilam province among women of reproductive age, the current research was conducted to assess toxoplasmosis seroprevalence among women of childbearing age referred to medical labs in Ilam, Iran.

SUBJECTS AND METHODS

The present cross-sectional research was carried out at Ilam University of Medical Sciences (IUMS) from April 2019 until March 2022.

Study design: The study was designed in two stages; demographic data collection by questionnaire and interviews, and blood sampling for measurement of antibodies against *T. gondii*.

Sample size and target population: The sample size was determined to be 369 women based on the study

of Mansouri *et al.*^[14] using IgG seroprevalence of 38%, a desired accuracy of 0.01 and a 99% confidence interval (CI). Inclusion criteria for participants included being a woman of child-bearing age (15 to 49 years), being referred to one of four laboratories (Erem, Asia, Ibn Sina, and Dr. Azizian) for routine check-up in different areas of Ilam city, and being willing to participate. A demographic data questionnaire was prepared to record age groups (15–20, 21–30, 31–40 and 41–50), educational stage (illiterate, can only read or write, elementary school, high school, academic degree), occupation (housewife, merchant, student, government employee), area of residence (urban and rural).

Blood sampling: Blood samples were collected by laboratory staff. For each patient, five ml of blood was drawn and transferred to a dry tube labelled with the name and code of the patient. After serum separation, samples of serum were kept at -20°C until use.

Serological methods: Serum samples were tested for IgG and IgM using ELISA kits (Pishtazteb, Tehran, Iran). based on the instructions of manufacturer^[15].

Statistical analysis: Statistical analysis was performed by SPSS Ver. 17 (SPSS Inc., Chicago, Illinois, United States) using analytical as well as descriptive statistics. Frequency was obtained in descriptive statistics and the central indices (mean) and the index of dispersion (range of variation and standard deviation) were used. The Chi-square and Fishers exact tests were used to investigate the relationship between seroprevalence of *T. gondii* and variables. The confidence interval used in this study was 95% and associations were considered significant when *P* was below 0.05.

Ethical considerations: Ethical approval was obtained from the Ethics Committee in Ilam University of Medical Sciences (IUMS) with the code IR.MEDILAM.REC.1397.063. To protect participants' information, each participant was given a code and names were hidden at all stages. Participants gave their consent to be part of the research and they were assured that their response would remain confidential.

RESULTS

A total of 982 women were invited to participate in the study; 172 women declined to participate and 810 agreed. After applying study criteria, 13 women were excluded for being outside the study age range, leaving 797 for the analyses (Table 1). The mean child-bearing age was 29.92 ± 7.23 years (median = 29.00). Most of the women in the study were married (502; 63%), were in the 31–40 age group (347; 43.53%), were housewives (438; 54.96%) and had low education level (included women who were unable to read or write and those only able to read and write; 446; 55.96%).

Overall, 23.4% (187/797) had IgG anti-*Toxoplasma* antibody and 0.6% (5 cases) had IgM anti-*Toxoplasma* antibody. There was no significant association between IgG antibody seroprevalence and educational level, occupation, or residence. Seroprevalence of IgG antibody was significantly associated with the 31–40 age-group (*P*=0.001) (Table 2).

Table 1. Demographic information in women of child-bearing age referred to clinical laboratories in Ilam, Western Iran, 2017–2019.

Variable	Characteristics	Frequency (%)
Marital status	Married	502 (63)
	Single	295 (37)
Age (years)	15 – 20	72 (9.03)
	21 - 30	248 (31.12)
	31 – 40	347 (43.54)
	41 – 50	130 (16.31)
Educational level	Illiterate	166 (20.83)
	Only read or write	280 (35.13)
	Elementary school	243 (30.49)
	High school	60 (7.52)
Occupation	Academic degree	48 (6.03)
	Housewife	438 (54.96)
	Merchant	30 (3.76)
	Student	264 (33.13)
Residence	Government employee	65 (8.15)
	Urban	697 (87.45)
	Rural	100 (12.55)
Total examined		797

Table 2. Seroprevalence distribution of IgG antibody against *Toxoplasma gondii* among women of childbearing age referred to clinical laboratories in Ilam, Western Iran, 2017–2019.

Variable	Positive No. (%)	Borderline No. (%)	Negative No. (%)	<i>P</i> value
Age groups	15 – 20	7 (0.88)	0 (0)	0.001
	21 - 30	35 (4.39)	1 (0.12)	
	31 – 40	63 (7.90)	1 (0.12)	
	41 – 50	82 (10.29)	0 (0)	
Educational status	Lower than high school	167 (20.95)	1 (0.12)	0.196
	High school and above	20 (2.51)	1 (0.12)	
Occupation	Housewife	100 (12.55)	1 (0.12)	0.711
	Merchant	6 (0.75)	0 (0)	
	Student	67 (8.41)	1 (0.12)	
	Government employee	14 (1.77)	0 (0)	
Residence	Urban	157 (19.69)	2 (0.25)	0.101
	Rural	30 (3.77)	0 (0)	

DISCUSSION

This research showed that of 797 studied women of reproductive age, only 23.46% had IgG antibodies against *T. gondii*. The seroprevalence rate of 23.46% in the current study is similar to the 33% prevalence found by a meta-analysis conducted among Iranian women of childbearing age^[16]. In another review study by Daryani *et al.* in Iran, *T. gondii* seroprevalence among the general population was reported as 39.30% (95% CI: 33.0%-45.70%)^[8].

Climate is an important factor for *T. gondii* infection since it is more prevalent in areas of the world that have hot, humid climates and lower altitudes. This is because the oocysts survive better in these types of environments^[17]. The climate in different regions of Iran varies and this form of climatic situations can create bias in the incidence of *T. gondii* infection. In studies of other cities in Iran, the seroprevalence of IgG antibodies against *T. gondii* varied across different regions, including Birjand (8.3%), Meshkinshahr (17.2%), Alborz (20.2%), Islamshahr (42.6%), Kermanshah (39.3%), Saveh (35.6%), Sanandaj (32.9%), Yazd (44%), and Isfahan (36.3%)^[1,8-12]. Ilam is situated in the cold mountainous region of Iran, which may explain the lower seroprevalence observed in the present study.

A global meta-analysis study estimated the seroprevalence of *T. gondii* in women of childbearing age was reported as 32%^[18]. Another meta-analysis from Eastern Mediterranean countries^[19] reported a seroprevalence of 36.5% in pregnant women. These findings agreed with our study. Comparing results in the present study with results obtained in previous studies from other parts of the world, *T. gondii* prevalence remains lower than the prevalence recorded in Brazil (58%)^[20], Algeria (48%)^[21], Nigeria (40.25%)^[22], Ethiopia (38.3%)^[23], Indonesia (32.6%)^[24], France (31.3%)^[24], Saudi Arabia (27.8%)^[26], and higher compared to the prevalence recorded in Serbia (12.7%)^[27] and China (12.3%)^[28].

Compared to our study, the higher prevalence reported in other studies may be due to the high temperature and abundance of cat or contact with cat and/or its faeces^[9-10,12]. However, the tests and sampling methods may influence the differences between the serological prevalence in all countries. In another study, seroprevalence of *T. gondii* among pregnant Ilamian women was 44.80% concluding that pregnant women are at risk for *T. gondii*. They attributed the high prevalence of *T. gondii* to contaminated water or vegetables in Ilam^[13]. From the results of the present study, we recommend that *T. gondii* antibody testing of women of child bearing age should be integrated in educational and health programs, especially in this region. If the IgG antibody result is negative, the pregnant women should be

followed up, and it is necessary to educate them and increase their awareness regarding the ways of transmission and the importance of this disease. Women should also avoid eating raw meat, consume safe and completely sterilized vegetables, and avoid having contact with cats when they are pregnant. On the other hand, a positive IgG and negative IgM antibodies response indicates immunity against *T. gondii*^[7-8,11-12].

In the present study, a significant correlation was found between IgG antibody against *T. gondii* and age. According to two studies^[10,29], this relationship was significant, but in the study from Daryani^[20], this relationship was not significant. Also, in the present study, other variables such as educational stage, occupation, and residence were not significant. In a meta-analysis of Iranian women, a significant association was found between *T. gondii* and contact with cats, but other factors like age, being in contact with animals, educational status, meat use, raw vegetable/fruit consumption, occupation, milk consumption, wearing gloves during cutting meat, type of washing vegetable/fruit, residence were not significant^[7,8,11-12].

The limitations of this study include sample collection sites. Because samples were collected from women referred to the laboratory for disease testing, they may not be representative of the general population. Additionally, the present study did not ask participants whether they had regular contact with or kept animals like cats in the home, or whether they consumed raw meat.

In conclusion, the findings in this study showed that the seroprevalence of IgG antibody against *T. gondii* is 23.46%, which is relatively low, because the positive IgG antibody and negative IgM antibody is a person who is immune against *T. gondii*. Currently, screening for toxoplasmosis during prenatal consultation is not systematic in public and private health centres in Iran. Therefore, prenatal screening can help to identify women seropositive for *T. gondii*. In addition, recognition campaigns regarding the transmission pathways of toxoplasmosis infection for women should be planned by public health authorities to better prevent and control congenital transmission during pregnancy.

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REFERENCES

- Sadeghi DZ, Partoandazanpour A, Adolmaleki N. Seroprevalence and risk factors of *Toxoplasma gondii* infection among pregnant women in Sanandaj, west of Iran: A Cross-Sectional Study. *JZD* 2022; 6(2):78-83.
- Fanigliulo D, Marchi S, Montomoli E, Trombetta CM. *Toxoplasma gondii* in women of childbearing age and during pregnancy: Seroprevalence study in Central and Southern Italy from 2013 to 2017. *Parasite* 2020; 27:2.
- Olarinde O, Sowemimo OA, Chuang TW, Chou CM, Olasanmi SO, Ikotun K, et al. *Toxoplasma gondii* infection: Seroprevalence and associated risk factors for women of childbearing age in Osun State, Nigeria. *Pathog Glob Health* 2022; 116(1):59-65.
- Hamed A, El-Gebaly N, Abdel Megeid A, Elsebaei E. Seroprevalence of *Toxoplasma gondii* infection in mentally retarded children in Egypt. *PUJ* 2018; 11(3):155-161.
- Taman A, Alhusseiny S. Exposure to toxoplasmosis among the Egyptian population: A systematic review. *PUJ* 2020; 13(1):1-10.
- Elblihy A, Taman A, Wahba Y, Hamouda, M. Toxoplasmosis among children with Down syndrome: A case control study. *PUJ* 2023; 16(2):114-120.
- Nadia NAC, Nino LG, Cédric Y, Raoul SNS, Christian NO, Esther DD, et al. Seroprevalence of *Toxoplasma gondii* IgG and IgM antibodies and associated risk factors among pregnant women consulted in three health centers in Dschang, Cameroon. *Parasite Epidemiol Control* 2023; 22:e00306.
- Daryani A, Sarvi S, Aarabi M, Mizani A, Ahmadpour E, Shokri A, et al. Seroprevalence of *Toxoplasma gondii* in the Iranian general population: A systematic review and meta-analysis. *Acta Trop* 2014; 137:185-94.
- Khlaghi L, Ghasemi A, Hadighi R, Tabatabaie F. Study of seroprevalence and risk factors for *Toxoplasma gondii* among pregnant women in Karaj township of Alborz Province. *J Entomol Zool Stud* 2014; 2:217-219.
- Khademi SZ, Ghaffarifar F, Dalimi A, Davoodian P, Abdoli A. Prevalence and risk factors of *Toxoplasma gondii* infection among pregnant women in Hormozgan Province, South of Iran. *Iran J Parasitol* 2019; 14(1):167-173.
- Shahighi M, Heidari A, Keshavarz H, Bairami A, Shojaee S, Sezavar M, et al. Seroepidemiological study of toxoplasmosis in women referred to a pre-marriage counselling center in Alborz Province, Iran. *BMC Res Notes* 2021; 14(1):163.
- Kanani B, Namaei MH, Kareshk AT, Solgi R. Seroprevalence of *Toxoplasma gondii* infection among women of reproductive age in Birjand, Iran. *Mod Care J* 2022; 19(4).
- Abdi J, Shojaee S, Mirzaee H, H Keshavarz H. Seroprevalence of toxoplasmosis in pregnant women in Ilam Province, Iran. *Iran J Parasitol* 2008; 3(2):34-37.
- Mansouri A, Adhami Mojarad MR, Badfar G, Abasian L, Rahmati S, Kooti W, et al. Epidemiology of *Toxoplasma gondii* among blood donors in Iran: A systematic review and meta-analysis. *Transfus Apher Sci* 2017; 56(3):404-409.
- Teimouri A, Modarressi MH, Shojaee S, Mohebbali M, Zouei N, Rezaian M, et al. Detection of *Toxoplasma* specific immunoglobulin G in human sera: Performance comparison of inhouse Dot-ELISA with ECLIA and ELISA. *Eur J Clin Microbiol Infect Dis* 2018; 37(8):1421-1429.
- Mizani A, Alipour A, Sharif M, Sarvi S, Amouei A, Shokri A, et al. Toxoplasmosis seroprevalence in Iranian women and risk factors of the disease: A systematic review and meta-analysis. *Trop Med Health* 2017; 45:7.
- Yan C, Liang LJ, Zheng KY, Zhu XQ. Impact of environmental factors on the emergence, transmission and distribution of *Toxoplasma gondii*. *Parasit Vectors* 2016; 9:137.
- Rahmanian V, Rahmanian K, Jahromi AS, Bokaie S. Seroprevalence of *Toxoplasma gondii* infection: An umbrella review of updated systematic reviews and meta-analyses. *J Family Med Prim Care* 2020; 9(8):3848.
- Rabaan AA, Uzairue LI, Alfaraj AH, Halwani MA, Muzahed, Alawfi A, et al. Seroprevalence, risk factors and maternal-fetal outcomes of *Toxoplasma gondii* in pregnant women from WHO Eastern Mediterranean Region: Systematic review and meta-analysis. *Pathogens* 2023; 12(9):1157.
- Moura FL, Amendoeira MR, Bastos OM, Mattos D, Fonseca AB Nicolauet JL, et al. Prevalence and risk factors for *Toxoplasma gondii* infection among pregnant and postpartum women attended at public healthcare facilities in the City of Niterói, State of Rio de Janeiro, Brazil. *Rev Soc Bras Med Trop* 2013; 46(2):37.
- Messerer L, Bouzbid S, Gourbdji E, Mansouri, Bachi F. Seroprevalence of toxoplasmosis in pregnant women in Annaba, Algeria. *Rev Epidemiol Sante Publique* 2014; 62(2):160-165. (Article in French)
- Karshima SN, Karshima MN. Human *Toxoplasma gondii* infection in Nigeria: A systematic review and meta-analysis of data published between 1960 and 2019. *BMC Public Health* 2020; 20(1):1-5.
- Kassie E, Kebede N, Kassa T, Garoma A, Girma M, Asnake Y, et al. Seroprevalence and risk factors for *Toxoplasma gondii* infection among pregnant women at Debre Markos Referral Hospital, northwest Ethiopia. *Trans R Soc Trop Med Hyg* 2023; trad053.
- Polanunu NF, Wahyuni S, Hamid F. Seroprevalence and associated risk factors of *Toxoplasma gondii* infection among pregnant mothers in Makassar, Indonesia. *Plos One* 2021; 16(6):e0245572.
- Robinson E, de Valk H, Villena I, Le Strat Y, Tourdjman M. National perinatal survey demonstrates a decreasing

- seroprevalence of *Toxoplasma gondii* infection among pregnant women in France, 1995 to 2016: Impact for screening policy. *Eurosurveillance* 2021; 26(5):1900710.
26. Alzaheb RA. Seroprevalence of *Toxoplasma gondii* and its associated risk factors among women of reproductive age in Saudi Arabia: A systematic review and meta-analysis. *Int J Women's Health*. 2018; 10:537–544.
27. Marković-Denić L, Stopić M, Bobić B, Nikolić V, Djilas I, Srzentić SJ, *et al*. Factors Associated with *Toxoplasma gondii* seroprevalence in pregnant women: A cross-sectional study in Belgrade, Serbia. *Pathogens* 2023; 12(10):1240.
28. Xiao Y, Yin J, Jiang N, Xiang M, Hao L, Lu H, *et al*. Seroepidemiology of human *Toxoplasma gondii* infection in China. *BMC Infect Dis* 2010; 10(1):4.
29. Ghadamgahi F, Bahadoran M, Shariat-Bahadori E, Ahmadi-Ahvaz N, Ghadrdoost B, Hejazi SH. Study of serological toxoplasmosis and risk factors associated with infection in women referred to labs of Northern Tehran, Iran. *J Isfahan Med School* 2013; 31(248):1258–1266.