

ORIGINAL ARTICLE

SEROPREVALENCE OF *TOXOPLASMA GONDII* INFECTION AMONG PATIENTS ADMITTED TO AL-ZAHRA HOSPITAL, ISFAHAN, IRAN

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Background: *Toxoplasma gondii* (*T. gondii*) infection is one of the most common parasitic infections among humans and other warm-blooded animals worldwide. The aim of this study was to evaluate toxoplasmosis status in patients admitted to Al-Zahra hospital, Isfahan, Iran. **Methods:** This cross-sectional study was conducted from October 2012 to January 2015. During this period, 716 patients referred to Al-Zahra hospital in Isfahan city, Iran, were studied to investigate the IgG and IgM antibodies against *T. gondii* using ELISA kit. The data were analysed by Chi-square and Fisher's exact tests. In addition, the relation of data with age and sex were also examined. **Results:** Among 716 patients, 21 patients (2.9%) had positive IgM and 288 patients (40.2%) had positive IgG titer against *T. gondii*. Data analysis by Chi-square and Fisher's exact tests revealed that there was no significant relationship between IgG titer and age ($p>0.05$). Additionally, there was no relationship between IgM titer and age ($p>0.05$). The data showed that there was no relationship between IgG and IgM antibody titer and sex ($p>0.05$). **Conclusion:** The prevalence of toxoplasmosis in Isfahan inhabitants seems fairly high but it can be concluded that the rate of seropositive patient is moderate comparing to other regions of country. Accordingly, the authors propose that all sensitive patients have to be tested for *T. gondii* antibody in order to prevent the consequences of disease.

Keywords: Sero-prevalence, *Toxoplasma gondii*, Infection, Isfahan, Iran

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INTRODUCTION

Toxoplasma infection is one of the most common parasitic infections among humans and other warm-blooded animals worldwide. *Toxoplasma* (*T.*) *gondii* is an obligate intracellular parasite which has an active form, so-called tachyzoite, and two resistant forms, namely tissue cyst and oocyst.¹ In the life cycle of *T. gondii*, cats and felidae are definitive hosts and humans, birds and other mammals act as intermediate hosts. *T. gondii* infection in humans and other hosts can be found all over the world, but its prevalence, depending on age, geographical location and dietary habits is different in various regions so that the rate of infection has been reported between 40 to 70% in different areas in Iran.² The infection primarily occurs through eating food or water contaminated with oocysts excreted by cats as well as raw or undercooked meat that may be contaminated with tissue cysts.³

Toxoplasmosis can be seen in two forms, congenital or acquired. Congenital is more important than acquired toxoplasmosis.⁴ On the other hand, in people with normal immune systems, symptoms limit to mild fever and swollen glands, however, due to activation of latent form in people with suppressed immune systems, the disease occurs with symptoms such as swollen lymph glands, convulsions, cerebral

calcification, pneumonia, myocarditis, encephalitis and etc.⁵ This parasite utilizes a wide variety of mechanisms to evoke host immune responses. One of the much important mechanisms by which *T. gondii* confuses host immune responses is antigen shedding in which the parasite releases so much antigens in the host's body leading to the induction of immune responses and production of a great deal of antibodies.^{6,7} These antibodies are detectable using ELISA method. This method indicates the presence of specific antibodies against this parasite in human serum and has been considered as the most common test for the detection of *T. gondii* and the patients screening in a society.⁸

Approximately 85% of women at childbearing age in the United States are at risk of acute infection with *Toxoplasma* and 400 to 4000 cases of congenital toxoplasmosis occur annually in this country.⁹ Toxoplasmosis is also highly prevalent in Iran and average number of children suffering from this disease is 3200 people per year.¹⁰ According to the various incidence of disease in a society and limitations of the diagnosis and treatment, screening strategies to identify the percentage of prone individuals in the community seems necessary. On the other hand, the global prevalence of toxoplasmosis according to the

regional demographic factors and personal habits of the population is changing. Accordingly, awareness of this tendency, especially in sensitive populations can greatly help to correct policies for the target population. The aim of this study was to evaluate toxoplasmosis status in patients admitted to Al-Zahra hospital, Isfahan, Iran.

MATERIAL AND METHODS

This cross-sectional study was conducted from October 2012 to January 2015. During this period, 716 patients referred to Al-Zahra hospital in Isfahan city, Iran, were studied to investigate the IgG and IgM antibodies against *T. gondii* using ELISA kit (Euroimmion, Germany). About 5 ml of blood sample were collected from each patient and then centrifuged at 3000 × g for 5 min to separate the sera. The isolated sera were stored at -20 °C until use. ELISA procedures were according to the test instructions suggested by the manufacturer. The absorbance was measured at 450 nm using ELISA reader (Biotec, USA). The obtained results were interpreted for IgG and IgM antibodies as recommended by the manufacturer. In addition, demographic data, i.e., age and sex were recorded.

Finally, Chi-square and Fisher’s exact tests were employed to examine the antibodies status in different age and sex groups in the studied population. A P-value of less than 0.05 was considered as significant statistically.

RESULTS

Among 716 patients, 21 patients (2.9%) had positive IgM and 288 patients (40.2%) had positive IgG titer against *T. gondii*. Data analysis by chi-square test revealed that there was no significant relationship between IgG titer and age ($\chi^2=16$, $df=9$, $p=0.67$). Additionally, there was no relationship between IgM titer and age ($p>0.05$) (Table-1).

Fisher’s exact test was used to confirm the Chi-square results, because the assumptions of Chi-square test was violated ($p=0.69$). The relationship between IgG and IgM antibody titers and sex has been presented in the table-2.

The data demonstrated that there is no relationship between IgG antibody titer and sex ($\chi^2=1.61$, $df=1$, $p=0.2$), and also, Fisher’s exact test revealed that there was no significant relationship between IgM antibody titer and sex ($p=0.19$).

Table-1: The relationship between age and IgG and IgM titer in the patients admitted to Al-Zahra hospital, Isfahan, Iran

| Age | IgG | | Total | IgM | | Total |
|--------------|----------------|----------------|------------|----------------|----------------|------------|
| | Negative n (%) | Positive n (%) | | Negative n (%) | Positive n (%) | |
| <10 | 63 (67.7%) | 30 (32.3%) | 93 (100%) | 89 (95.7%) | 4 (4.3%) | 93 (100%) |
| 10–15 | 6 (60%) | 4 (40%) | 10 (100%) | 10 (100%) | 0 | 10 (100%) |
| 15–20 | 18 (78.3%) | 5 (21.7%) | 23 (100%) | 23 (100%) | 0 | 23 (100%) |
| 20–25 | 71 (60.7%) | 46 (39.3%) | 117 (100%) | 110 (94%) | 7 (6%) | 117 (100%) |
| 25–30 | 110 (64.7%) | 60 (35.3%) | 170 (100%) | 167 (98.2%) | 3 (1.8%) | 170 (100%) |
| 30–35 | 98 (55.1%) | 80 (44.9%) | 178 (100%) | 174 (97.8%) | 4 (2.2%) | 178 (100%) |
| 35–40 | 28 (52.8%) | 25 (47.2%) | 53 (100%) | 51 (96.2%) | 2 (3.8%) | 53 (100%) |
| 40–45 | 7 (38.9%) | 11 (61.1%) | 18 (100%) | 18 (100%) | 0 | 18 (100%) |
| 45–50 | 9 (42.9%) | 8 (57.1%) | 14 (100%) | 14 (100%) | 0 | 14 (100%) |
| >50 | 21 (52.5%) | 19 (47.5%) | 40 (100%) | 39 (97.5%) | 1 (2.5%) | 40 (100%) |
| Total | 428 (59.8%) | 288 (40.2%) | 716 (100%) | 695 (97.1%) | 21 (2.9%) | 716 (100%) |

Table-2: The relationship between sex with IgG and IgM titer in the patients admitted to Al-Zahra hospital, Isfahan, Iran.

| Sex | IgM | | Total | IgG | | Total |
|--------------|----------------|----------------|------------|----------------|----------------|------------|
| | Negative n (%) | Positive n (%) | | Negative n (%) | Positive n (%) | |
| Woman | 600 (97.4%) | 16 (2.6%) | 616 (100%) | 374 (60.7%) | 242 (39.3%) | 616 (100%) |
| Man | 95 (95%) | 5 (5%) | 100 (100%) | 54 (54%) | 46 (46%) | 100 (100%) |
| Total | 695 (97.1%) | 21 (2.9%) | 716 (100%) | 428 (59.8%) | 288 (40.2%) | 716 (100%) |

DISCUSSION

Toxoplasmosis is one of the most common infections all over the world and many sero-epidemiological studies confirm the truth. The prevalence of this disease in different countries and even various regions of a country, depending on various factors such as age, sex, occupation, geographical conditions, habits and traditions, nutritional status may be varied significantly.^{11,12} Toxoplasmosis is

considered to be as an opportunistic infection, especially in immune-compromised patients.⁵ In these patients, the lack of clinical signs and problem in diagnosis can be led to secondary toxoplasmosis and eventually death in more than 65% of these patients.¹³ The results of this study showed that approximately half of all patients referred to Al-Zahra hospital had positive antibody titer against *T. gondii*. The infection rate was higher than that was conducted by Xiao *et al.*¹⁴ in china with 12.3%

prevalence. In another study conducted by Daryani *et al.*¹⁵ in HIV/AIDS patients in the north of Iran, the rate of infection was 77.4%. Daryani *et al.*¹⁶ also reported 72.5% *Toxoplasma* antibody in schizophrenia patients and 61.6% in control group in a similar study in Sari. In Tehran, the rate of infection was 68.3% by IFA test¹⁷ and in Tabriz it was 35.1%.¹⁸ Recently, the results of a study showed that antibody against this parasite is present in the serum of 4.8% students in the United States.¹⁹ Another study on mentally retarded patients revealed that about 30.4% of them were seropositive for *T. gondii*.²⁰ Authors elsewhere showed that anti-*T. gondii* IgG antibody had a prevalence of about 35.56% in cancer patients, especially those who were suffering from lung cancer.²¹ Contrary to the present study, researchers in a study mentioned that the risk of *T. gondii* infection increases with age.²² In similar to the current study, a study showed that there was no significant difference between the toxoplasmosis prevalence as compared to age and sex.²³ A large number of studies demonstrated that the consumption of raw or undercooked meat and keeping pets are the main causes of toxoplasmosis distribution.¹⁴ It should be noted that consumption of raw meat because of customs and traditions is non-common in Iranian nutrition but unfortunately, the habit of keeping pets in cities such as Isfahan is becoming a culture which could be considered as a main cause of disease in this area. Some scientist believes that jobs related with soil can be considered as a main cause of toxoplasmosis.¹⁸ In recent years, there is an increase in the number of cats in many public areas in cities in Iran^{24,25} while infected cats could shed a plenty of oocyst into the environment daily and provide the basis for the entry of the parasite to the host.

CONCLUSION

Finally, the prevalence of toxoplasmosis in Isfahan inhabitants seems fairly high but it can be concluded that the rate of seropositive patient is moderate comparing to other regions of country. Accordingly, the authors propose all sensitive patients have to be tested for *T. gondii* antibody in order to prevent the consequences of disease.

Conflict of interest: The authors have no financial or personal relationship with other people or organizations that could inappropriately influence or bias this paper.

AUTHOR'S CONTRIBUTION

MAM, MA and FM were responsible for the experimental design of the study; MAM, HY, MH, MG and FN were responsible for the execution techniques and parasitological examination. MA, HK, SHH and SMTS were responsible for the

statistical analysis and HY and MH for the collection of the samples. All authors reviewed and contributed to the writing of this manuscript. MA, MAM and FN are responsible for the manuscript.

REFERENCES

1. Labesse G, Gelin M, Bessin Y, Lebrun M, Papoin J, Cerdan R, *et al.* ROP2 from *Toxoplasma gondii*: a virulence factor with a protein-kinase fold and no enzymatic activity. *Structure* 2009;17(1):139–46.
2. Gharavi MJ, Rahnama N, Jahani MR. Seroepidemiological survey of *Toxoplasma* infections of mentally retarded children. *Iran J Public Health* 2005;34(1):19–22.
3. Carruthers VB, Suzuki Y. Effects of *Toxoplasma gondii* infection on the brain. *Schizophr Bull* 2007;33(3):745–51.
4. Wallon M, Peyron F, Cornu C, Vinault S, Abrahamowicz M, Kopp CB, *et al.* Congenital *Toxoplasma* infection: monthly prenatal screening decreases transmission rate and improves clinical outcome at age 3 years. *Clin Infect Dis* 2013;56(9):1223–31.
5. Bossi P, Bricaire F. Severe acute disseminated toxoplasmosis. *Lancet* 2004;364(9434):579.
6. Daryani A, Sharif M, Kalani H, Rafiei A, Kalani F, Ahmadpour E. Electrophoretic patterns of *Toxoplasma gondii* excreted/secreted antigens and their role in induction of the humoral immune response. *Jundishapur J Microbiol* 2014;7(4):e9225.
7. Daryani A, Sharif M, Dadimoghaddam Y, Souteh MBH, Ahmadpour E, Khalilian A, *et al.* Determination of parasitic load in different tissues of murine toxoplasmosis after immunization by excretory–secretory antigens using Real time QPCR. *Exp Parasitol* 2014;143:55–9.
8. Alvarado-Esquivel C, Torres-Castorena A, Liesenfeld O, García-López CR, Estrada-Martínez S, Sifuentes-Alvarez A, *et al.* Seroepidemiology of *Toxoplasma gondii* infection in pregnant women in rural Durango, Mexico. *J Parasitol* 2009;95(2):271–4.
9. Jones J, Lopez A, Wilson M. Congenital toxoplasmosis. *Am Fam Physician* 2003;67(10):2131–46.
10. Fallah E, Navazesh R, Majidi J, Kushavar H, Mahdipourzareh N. An epidemiological study of *Toxoplasma* infection among high-school girls in Jolfa. *J Reprod Infertil* 2005;1:261–9.
11. Ghasemloo H, Ghomashlooyan M, Hooshyar H. Seroprevalence of *Toxoplasma gondii* infection among pregnant women admitted at Shahid Akbar Abadi hospital, Tehran, Iran, 2010-2013. *J Med Microbiol Infect Dis* 2014;1(2):16–9.
12. Benenson MW, Takafuji ET, Lemon SM, Greenup RL, Sulzer AJ. Oocyst-transmitted toxoplasmosis associated with ingestion of contaminated water. *N Engl J Med* 1982;307(11):666–9.
13. Benenson MW, Takafuji ET, Lemon SM, Greenup RL, Sulzer AJ. Oocyst-transmitted toxoplasmosis associated with ingestion of contaminated wa
14. .ter. *N Engl J Med* 1982;307(11):666–9
15. 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.
16. Daryani A, Sharif M, Meigouni M. Seroprevalence of IgG and IgM anti-*Toxoplasma* antibodies in HIV/AIDS patients, northern Iran. *Asian Pac J Trop Med* 2011;4(4):271–4.
17. Ahmad D, Mehdi S, Sayed HH, Sayed AK, Shirzad G. Serological survey of *Toxoplasma gondii* in schizophrenia patients referred to psychiatric hospital, Sari city, Iran. *Trop Biomed* 2010;27(3):476–82.

18. Salahi-Moghaddam A, Hafizi A. A serological study on *Toxoplasma gondii* infection among people in south of Tehran, Iran. *Korean J Parasitol* 2009;47(1):61–3.
19. Jafari R, Sadaghian M, Safari M. Seroprevalence of *Toxoplasma gondii* infection and related risk factors in Tabriz city, Iran, 2008. *J Res Health Sci* 2012;12(2):119–21.
20. Rosypal AC, Houk AE, Zajac AM, Lindsay DS. Prevalence of IgG antibodies to *Toxoplasma gondii* in veterinary and undergraduate students at Virginia Tech, Blacksburg, Virginia. *Zoonoses Public Health* 2015;62(7):553–6.
21. Ezatpour B, Zibaie M, Rahmati H, Pournia Y, Azami M, Ebrahimzadeh F, *et al.* Seroprevalence of toxoplasmosis in mentally retarded patients in Iranian rehabilitation centers. *J Parasit Dis* 2015;39(1):13–7.
22. Cong W, Liu GH, Meng QF, Dong W, Qin SY, Zhang FK, *et al.* *Toxoplasma gondii* infection in cancer patients: prevalence, risk factors, genotypes and association with clinical diagnosis. *Cancer Lett* 2015;359(2):307–13.
23. Minbaeva G, Schweiger A, Bodosheva A, Kuttubaev O, Hehl AB, Tanner I, *et al.* *Toxoplasma gondii* infection in Kyrgyzstan: seroprevalence, risk factor analysis, and estimate of congenital and AIDS-related toxoplasmosis. *PLoS Negl Trop Dis* 2013;7(2):e2043.
24. Wang L, He LY, Meng DD, Chen ZW, Wen H, Fang GS, *et al.* Seroprevalence and genetic characterization of *Toxoplasma gondii* in cancer patients in Anhui Province, Eastern China. *Parasit Vectors* 2015;8(1):162.
25. Sharif M, Nasrolahei M, Ziapour S, Gholami S, Ziaei H, Daryani A, *et al.* *Toxocara cati* infections in stray cats in northern Iran. *J Helminthol* 2007;81(1):63–6.
26. Sadjjadi SM, Oryan A, Jalai AR, Mehrabani D. Prevalence and intensity of infestation with *Toxocara cati* in stray cats in Shiraz, Iran. *Vet Arh* 2001;71(3):149–57.

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