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Anti-*Toxoplasma* IgM and IgG Seropositivity Among Individuals Referred to a Clinical Laboratory of Isfahan, Central Iran

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Abstract

Background: *Toxoplasma gondii*, a zoonotic parasite, is one of the wide spread parasitic causes of asymptomatic infection in human, yet can cause severe disease and disorders in infants, when infected during pregnancy, and also in immunocompromised individuals. Thus, updated information about the prevalence of the infection in each region and time period is necessary.
Objectives: The aim of the present study was to determine the prevalence of the infection in patients referred to Dr. Sharifi clinical laboratory of Isfahan, Iran, during January 2014 to January 2015.
Methods: In a retrospective study, 1287 patients that had anti-*Toxoplasma* IgM and/or IgG test from January 2013 to January 2015 were selected and included in the study. Quantitative determination of anti-*Toxoplasma* IgM and IgG was performed using antibody capture chemiluminescence immunoassay (CLIA) kits (LIAISON® Toxo IgM and IgG, DiaSorin S.P.A, Italy) applied using the LIAISON (DiaSorin, Germany) device. All the available variables such as anti-*Toxoplasma* IgG and IgM concentrations, gender and age were recorded and analyzed.
Results: Overall, 1287 cases including 1215 (94.4%) females and 72 (5.6%) males with mean age of 28.64 years (min: 1, max: 78) were studied. The results showed that 36 (2.8%) out of 888 and 325 (25.3%) out of 1243 studied individuals were anti-*Toxoplasma* IgM and IgG seropositive, respectively. The mean age observed significantly higher in IgG positive humans ($P < 0.001$), but not in IgM positive ones ($P = 0.065$). No statistically significant relationship was observed for the IgM and IgG seropositivity and concentrations among the genders.
Conclusions: According to the results of the present study, prevalence of infection with *T. gondii* is high in Isfahan, yet it is still lower than most of the other studied regions in the country. Also, the risk of the infection rises with increasing age.

Keywords: IgG, IgM, Iran, *Toxoplasma*

1. Background

Toxoplasma gondii is a coccidian parasite, which causes infection in a variety of hosts, including humans, but can only sexually reproduce in cats. Human can be infected with the parasite by ingestion of undercooked meat containing *Toxoplasma* tissue cysts or food contaminated by its' oocysts (1, 2). Infection is mostly self-limiting with no or subtle symptoms, yet can cause severe disease and disorders in infants, when infected during pregnancy, and also in immunocompromised individuals (3, 4). The parasite stays dormant for a long time in form of tissue cysts and causes no symptoms (5), yet some authors believe that it causes some personality changes at this stage (6, 7).

The disease is present all around the world. The prevalence of the infection is fairly high around the world, yet is higher in temperate regions. In Iran, like other countries, many studies have been carried out in different regions and the highest rates of the infection were reported from North of Iran (5, 8).

The prevalence of the infection varies in different reports from the same places; for example, in Khuzestan province the prevalence of the infection was reported as 12% in 1997, 31.9% in 1997, and 60.95% in 1993 (5, 9). These data showed that the estimation of the frequency of infec-

tion could be different when different methods and equipment in different populations are used. Thus, updated information about the prevalence of the infection in each region and time period with accurate methods seems to be necessary.

2. Objectives

The aim of the present study was to determine the prevalence of the infection with *T. gondii* in humans referred to Dr. Sharifi clinical laboratory of Isfahan, Iran, during January 2014 to January 2015.

3. Methods

In a retrospective study, 1287 individuals that had anti-*Toxoplasma* IgM and/or IgG test from January 2013 to January 2015 were selected and included in the study. All the study population were residents of Isfahan city, central Iran. All the available variables such as anti-*Toxoplasma* IgG and IgM concentrations, gender and age were recorded and analyzed. Quantitative determination of anti-*Toxoplasma* IgM and IgG was performed using antibody capture chemiluminescence immunoassay (CLIA) kits (LIAISON® Toxo IgM and IgG, DiaSorin S.P.A, Italy) applied using the LIAISON (DiaSorin, Germany) device.

All steps of the tests were done by the device according to the manufacturer's instructions. Samples with IgM concentrations below 6 IU/mL were regarded as negative, between 6 and 8 IU/mL graded as equivocal and equal and higher than 8 IU/mL were considered as positive results. Although, samples with IgG concentrations below 7.2 IU/mL were regarded as negative, between 7.2 and 8.8 IU/mL graded as equivocal and equal, and higher than 8.8 IU/mL were considered as positive results.

Data was gathered and analyzed with the SPSS v.16 software (SPSS Inc., Chicago, ILL, USA) using t- and chi-square tests.

4. Results

Overall, 1287 individuals including 1215 (94.4%) females and 72 (5.6%) males with mean age of 28.64 years (minimum: one day, maximum: 78 years old) were studied. The results showed that 36 (2.8%) out of 888 and 325 (25.3%) out of 1243 individuals were anti-*Toxoplasma* IgM and IgG seropositive, respectively. There was no significant relationship among genders and IgG (P = 0.205) and IgM (P = 0.094) seropositivity (Table 1). Additionally, the mean serum concentration of anti-*Toxoplasma* IgM and IgG were not significantly different among the genders (Table 2). Also mean age was significantly higher in IgG positive individuals (P < 0.001), yet not in IgM positive cases (P = 0.065) (Table 3).

5. Discussion

In the present study, 1287 patients that had anti-*Toxoplasma* IgM or IgG test from January 2013 to January 2015 were selected and included in the study. Overall, 1287 individuals including 1215 (94.4%) females and 72 (5.6%) males with mean age of 28.64 years (minimum: one day, maximum: 78 years) were studied. The results showed that 36 (2.8%) out of 888 and 325 (25.3%) out of 1243 were anti-*Toxoplasma* IgM and IgG seropositive, respectively.

The results of the present study indicate high prevalence of toxoplasmosis among residents of Isfahan city, central Iran, yet it is still lower than most of the other studied regions in the country (10-15). Anti-*Toxoplasma* IgM seropositivity was observed in 2.8% of the studied subjects, which seems very low, but based on the fact that IgM mostly rises against the parasite in the acute phase of the infection (5), even 2.8% is considerable.

Daryani et al. (2014) reported the prevalence of toxoplasmosis as 39.3% in the general population of Iran in a meta-analysis. In Isfahan, the prevalence of the infection is lower than the mean prevalence in the country. Similar to our findings, they found no significant difference between the infection rate amongst males and females and also increased rate of infection by age was observed in both studies. The highest rate of infection was reported from North of Iran (86.3%), where the climate is humid and temperate (5).

In Pakistan and Qatar, the neighboring countries, the overall seroprevalence rate of *T. gondii* infection was reported to be 29.45% and 29.8%, respectively (16, 17). The prevalence of the infection in India and China was reported as 30.9% and 12.5%, respectively (18, 19). In the general Mexican population, *T. gondii* infection rate was reported as 20.26% (20). Except China and Mexico, in the other mentioned countries, the infection rate with *T. gondii* is higher than that found in Isfahan.

A study in Isfahan on the prevalence of the infection in 2011 reported *Toxoplasma* IgG and IgM seropositivity in HIV positive patients as 49.75% and 1%, respectively. Furthermore, another study conducted on the general population of the province, reported 41.4% for anti-*Toxoplasma* IgG seropositivity in 2005 (21, 22). The fact that they reported a considerably higher IgG seropositivity than our study is remarkable. They used a different method, enzyme linked immunosorbent assay (ELISA), for determining the infection rate, while in the present study automated antibody capture chemiluminescence immunoassay (CLIA)

Table 1. Odds Ratio Estimated for Anti-*Toxoplasma* IgG And IgM Among Different Genders

	Negative	Positive	Total	OR	95%CI	P Value
IgG						
Gender					0.766, 2.165	0.205
Female	869	303	1172	1.288		
Male	49	22	71	1		
Total	918	325	1243			
IgM						
Gender					0.858, 6.125	0.094
Female	796	31	827	2.293		
Male	56	5	61	1		
Total	852	36	888			

Table 2. Mean Anti-Toxoplasma IgG and IgM Serum Concentrations Amongst Different Genders

	N	Mean	St. Deviation	St. Error Mean	t	Mean Deference	95%CI	P Value
IgM								
Gender					-0.885	0.749	-2.411, 0.912	0.376
Female	827	1.686	6.411	0.222				
Male	61	2.436	5.957	0.762				
IgG								
Gender					-1.428	10.227	-24.492, 4.037	0.157
Female	1172	16.820	44.836	1.309				
Male	71	27.047	59.319	7.039				

Table 3. Mean Age Amongst Anti-Toxoplasma IgG and IgM Seropositive Individuals

Age Mean	N	Mean	St. Deviation	St. Error Mean	t	Mean Deference	95%CI	P Value
IgG								
Negative	864	27.924	7.525	0.256	-4.944	2.573	-3.594, -1.552	0.001 >
Positive	303	30.498	8.517	0.489				
IgM								
Negative	799	28.748	8.325	0.294	1.846	2.662	-0.167, 5.492	0.065
Positive	35	26.085	8.889	1.502				

was used and it has been suggested that this method is more accurate. The reported prevalence of *T. gondii* infection is illustrated in Table 4.

The prevalence of the infection varies in different reports from the same locations; for example, in Khuzestan province the prevalence of the infection was reported 12% in 1997, 31.9% in 1997, and 60.95% in 1993 (5, 9). These data show that the estimate of the frequency of infection would be different when different methods and equipment on various populations are used. In the present study, antibody capture chemiluminescence immunoassay was used for determination of anti-*Toxoplasma* antibodies. The method was automated and believed to be very accurate (25). Higher rates of infection, 50.8%, 29.16%, 41.4% and 51.25%, were reported in the same area, Isfahan province, which were higher than that found in the present study (5). These differences may have resulted from different methods used by previous studies and dif-

Table 4. Prevalence of Toxoplasma Infection Reported From Iran Compared to the Present Study

	Region	Toxoplasma IgG, %	Toxoplasma IgM, %	Year	Method	Reference
Present study	Isfahan	25.3	2.8	2016	CLIA	
Rasouli et al.	West Azerbaijan Province	47	3.5	2014	ECLIA	(14)
Mahmoudvand et al.	Kerman province	28.8	3.2	2015	ELISA	(10)
Sharbatkhori et al.	Gorgan	39.8	3.4	2014	ELISA	(11)
Mostafavi et al.	Isfahan	47.5	-	2012	ELISA	(23)
Mohammadi et al.	Arak	24.3	4.8	2015	ELISA	(24)
Fallah et al.	Hamadan	33.5	-	2008	IFA	(15)

Abbreviations: CLIA, chemiluminescence; ECLIA, electrochemiluminescence; ELISA, enzyme linked immunosorbent assay; IFA, indirect fluorescent antibody.

ferent populations that were studied.

5.1. Conclusions

According to the results of the present study, prevalence of infection with *Toxoplasma* is high in Isfahan area, yet it is still lower than most of the other studied regions in the country. Also, the risk of the infection rises with older age.

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References

1. Torrey EF, Yolken RH. Toxoplasma oocysts as a public health problem. *Trends Parasitol.* 2013;**29**(8):380–4. doi: 10.1016/j.pt.2013.06.001. [PubMed: 23849140].
2. Dubey JP, Tiao N, Gebreyes WA, Jones JL. A review of toxoplasmosis in humans and animals in Ethiopia. *Epidemiol Infect.* 2012;**140**(11):1935–8. doi: 10.1017/S0950268812001392. [PubMed: 22874099].
3. Nissapatorn V. Toxoplasmosis in HIV/AIDS: a living legacy. *Southeast Asian J Trop Med Public Health.* 2009;**40**(6):1158–78. [PubMed: 20578449].
4. Oz HS. Maternal and congenital toxoplasmosis, currently available and novel therapies in horizon. *Front Microbiol.* 2014;**5**:385. doi: 10.3389/fmicb.2014.00385. [PubMed: 25104952].
5. 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. doi: 10.1016/j.actatropica.2014.05.015. [PubMed: 24887263].
6. Cook TB, Brenner LA, Cloninger CR, Langenberg P, Igbide A, Giegling I, et al. "Latent" infection with Toxoplasma gondii: association with trait aggression and impulsivity in healthy adults. *J Psychiatr Res.* 2015;**60**:87–94. doi: 10.1016/j.jpsychires.2014.09.019. [PubMed: 25306262].
7. Flegr J. Influence of latent Toxoplasma infection on human personality, physiology and morphology: pros and cons of the Toxoplasma-human model in studying the manipulation hypothesis. *J Exp Biol.* 2013;**216**(Pt 1):127–33. doi: 10.1242/jeb.073635. [PubMed: 23225875].
8. Hill DE, Chirukandoth S, Dubey JP. Biology and epidemiology of Toxoplasma gondii in man and animals. *Anim Health Res Rev.* 2005;**6**(1):41–61. [PubMed: 16164008].
9. Hoghooghi-Rad N, Afraa M. Prevalence of toxoplasmosis in humans and domestic animals in Ahwaz, capital of Khoozestan Province, south-west Iran. *J Trop Med Hyg.* 1993;**96**(3):163–8. [PubMed: 8505770].
10. Mahmoudvand H, Saedi Dezaki E, Soleimani S, Baneshi MR, Kheirandish F, Ezatpour B, et al. Seroprevalence and risk factors of Toxoplasma gondii infection among healthy blood donors in southeast of Iran. *Parasite Immunol.* 2015;**37**(7):362–7. doi: 10.1111/pim.12198. [PubMed: 25891186].
11. Sharbatkhori M, Dadi Moghaddam Y, Pagheh AS, Mohammadi R, Hedayat Mofidi H, Shojaee S. Seroprevalence of Toxoplasma gondii Infections in Pregnant Women in Gorgan City, Golestan Province, Northern Iran-2012. *Iran J Parasitol.* 2014;**9**(2):181–7. [PubMed: 25848383].
12. 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. doi: 10.1007/s12639-013-0358-6. [PubMed: 25698852].
13. 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;**2**(1):16–8.
14. Rasouli S, Sadaghian M, Jafari R. Prevalence of human toxoplasmosis and related risk factors using Electrochemiluminescence (ECLIA) method in West Azarbaijan Province, Iran, 2010. *Int J Biosci.* 2014;**4**(8):124–30.
15. Fallah M, Rabiee S, Matini M, Taherkhani H. Seroepidemiology of toxoplasmosis in primigravida women in Hamadan, Islamic Republic of Iran, 2004. *East Mediterr Health J.* 2008;**14**(1):163–71. [PubMed: 18557464].
16. Tasawar Z, Aziz F, Lashari MH, Shafi S, Ahmad M, Lal V, et al. Seroprevalence of Human toxoplasmosis in southern Punjab, Pakistan. *Pak J Life Soc Sci.* 2012;**10**:48–52.
17. Abu-Madi MA, Al-Molawi N, Behnke JM. Seroprevalence and epidemiological correlates of Toxoplasma gondii infections among patients referred for hospital-based serological testing in Doha, Qatar. *Parasit Vectors.* 2008;**1**(1):39. doi: 10.1186/1756-3305-1-39. [PubMed: 18937857].
18. 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**:4. doi: 10.1186/1471-2334-10-4. [PubMed: 20055991].
19. Meisheri YV, Mehta S, Patel U. A prospective study of seroprevalence of Toxoplasmosis in general population, and in HIV/AIDS patients in Bombay, India. *J Postgrad Med.* 1997;**43**(4):93–7. [PubMed: 10740734].
20. Galvan-Ramirez Mde L, Troyo R, Roman S, Calvillo-Sanchez C, Bernal-Redondo R. A systematic review and meta-analysis of Toxoplasma gondii infection among the Mexican population. *Parasit Vectors.* 2012;**5**:271. doi: 10.1186/1756-3305-5-271. [PubMed: 23181616].

21. Mohraz M, Mehrkhani F, Jam S, SeyedAlinaghi S, Sabzvari D, Fattahi F, et al. Seroprevalence of toxoplasmosis in HIV(+)/AIDS patients in Iran. *Acta Med Iran.* 2011;**49**(4):213–8. [PubMed: 21713730].
22. Mostafavi SN, Ataei B, Nokhodian Z, Yaran M, Babak A. Seroepidemiology of Toxoplasma gondii infection in Isfahan province, central Iran: A population based study. *J Res Med Sci.* 2011;**16**(4):496–501. [PubMed: 22091265].
23. Mostafavi N, Ataei B, Nokhodian Z, Monfared LJ, Yaran M, Ataie M, et al. Toxoplasma gondii infection in women of childbearing age of Isfahan, Iran: A population-based study. *Adv Biomed Res.* 2012;**1**:60. doi: 10.4103/2277-9175.100181. [PubMed: 23326791].
24. Mohammadi A, Shojaee S, Salimi M, Zareei M, Mohebali M, Keshavarz H. Seroepidemiological Study of Toxoplasmosis in Women Referred to Arak Marriage Consulting Center during 2012-2013. *Iran J Public Health.* 2015;**44**(5):654–8. [PubMed: 26284206].
25. Haywood B, Patel M, Hurday S, Copping R, Webster D, Irish D, et al. Comparison of automated chemiluminescence immunoassays with capture enzyme immunoassays for the detection of measles and mumps IgM antibodies in serum. *J Virol Methods.* 2014;**196**:15–7. doi: 10.1016/j.jviromet.2013.10.027. [PubMed: 24183918].