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Seroprevalence of *Toxoplasma gondii* infection among childbearing age women in Kerman city, southeastern Iran

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Abstract This cross-sectional study aims to determine the prevalence of IgM and IgG anti-*T. gondii* antibodies and the associated risk factors among childbearing age women referring to counseling centers before marriage in Kerman city, southeast of Iran. Totally, 300 serum samples were collected from women referred to Central Laboratory for Marriage Consultation in Kerman city were screened for IgG and IgM anti-*T. gondii* antibodies by enzyme linked immunosorbent assay (ELISA). Out of the 300 serum samples, 38 (12.6 %) tested seropositive for anti-*T. gondii* antibodies; 31 (10.3 %) samples tested seropositive for only IgG antibody, 1 (0.33 %) tested seropositive for both IgM and IgG and 6 (2.0 %) were positive for IgM antibody alone. Statistical analyses also indicated that seroprevalence of anti-*T. gondii* antibodies increased with age ($p < 0.05$). Moreover, some risk factors such as, living in rural regions, contact with cats, raw/half-cooked meat consumption, and agricultural activities were significantly ($p < 0.05$) related to *T. gondii* seropositivity. The findings revealed that more than three-quarters of the childbearing age women studied in the present investigation are susceptible to infection during pregnancy. Thus, by adopting correct and improved practices we can improve their living conditions, and prevent infection and awareness and control of pathogens associated with disease is recommended.

Introduction

Toxoplasma gondii is a ubiquitous obligatory intracellular coccidian parasite found globally that infects a wide range of warm-blooded animals and nearly one-third of the human population in the world (Hill and Dubey 2002). Humans can be mainly infected by three routes of transmission: (1) Ingestion of tissue cysts in raw or undercooked infected meat, (2) Ingestion of food or water contaminated with sporulated oocysts shed in the feces of an infected cat, and (3) Congenitally (Dubey and Beattie 1998; Mahmoudvand et al. 2015). Depending on social and cultural habits, geographic factors, climate, and transmission routes prevalence of this infection varies widely between different countries (10–80 %) (Robert-Gangneux and Darde 2012). The importance of toxoplasmosis mainly lies among pregnant women (due to the risk of transmission to fetus), transplant recipients and patients with acquired immunodeficiency syndrome (Derouin and Pelloux 2008; Signorini et al. 2007; Sukthana 2006). The incidence of maternal infection during pregnancy is 1–8 per 1000 pregnancies. According to the gestational age at seroconversion, risk of transmission and severity of fetal illness are varied from ophthalmic lesions and central nervous system to even death (Borna et al. 2013). Regarding these manifestations such as severe mental retardation and blindness could be associated with disability, decreased quality of life and increased socioeconomic cost, women in reproductive age are the most important group to call to attention (Kravetz 2013). Mainly, to prevent the effects of disease before pregnancy, giving counseling before marriage about

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awareness of routine laboratory tests can benefit for childbearing age women. Whether they are susceptible to acute or chronic infection therapeutic measures can be linked in the treatment so that non-immune individual can be benefited from special health care facilities before pregnancy (Youssefi et al. 2007). Although, several epidemiological studies have been reported that the rate of seroprevalence varies widely from 4.6 to 74.6 % among childbearing age women in some provinces of Iran (Borna et al. 2013); However, there is no study on the seroprevalence of infection in reproductive age women in the Kerman province, southeastern Iran. Therefore, this cross-sectional study aims to determine the prevalence of IgM and IgG anti-*T. gondii* antibodies and the associated risk factors among childbearing age women referring to counseling centers before marriage in Kerman city, southeast of Iran.

Materials and methods

Ethics

The present investigation was approved by Ethics Committee of Kerman University of Medical Sciences (Permit No. 93/109). However, a written informed consent was obtained from all the participants before blood sampling.

Study design

In this descriptive and cross-sectional study, totally, 300 serum samples were collected from women referred to Central Laboratory for Marriage Consultation in Kerman city, southeast of Iran during January to April 2015. Kerman is the capital city of Kerman Province, Iran. At the 2011 census, its population was 821,374, in 221,389 households, making it the 10th most populous city of Iran.

Questionnaire

The applied questionnaire (before blood sampling) was based on demographic data including age, education, residence. Moreover, possible risk factors, such as animal contacts (cats), raw/half-cooked meat consumption, and gardening or agriculture activity were also evaluated.

Enzyme-linked immunosorbent assay (ELISA) test

To determine the anti-*T.gondii* antibodies, serum samples were transported from the Central Laboratory for Marriage Consultation to Parasitology Laboratory, Department of Parasitology and Mycology, Kerman University of Medical

Sciences (Kerman, Iran) and stored at -20 °C until being tested. All the serum samples were tested using the commercially available ELISA kit (Dia.Pro, Italy). Analyses were performed following the manufacturer's instructions. On the basis of the ELISA kit, positive results for IgG and IgM were defined as values of ≥ 50 international units (IU)/ml and index values of ≥ 0.6, respectively. Also, negative results were defined as <50 IU/ml and index values of <0.6 were considered for IgG and IgM, respectively.

Statistical analyses

Analytical and descriptive statistics was carried out using SPSS 17.0 software (SPSS Inc., Chicago, IL, USA). Descriptive statistics were reported in terms of percent (for categorical) and mean (SD) (for continuous) variables. Chi square test was applied to access the univariate association between independent variables and outcome.

Results

Participants

A total of 300 blood samples from women referred to Central Laboratory for Marriage Consultation in Kerman city were included in the this investigation; the mean age of the participants was 23.3 years old (ranging from 16 to 38 years old). Our results showed that most participants were aged 20–30 years old, living in urban areas, who had college education or above.

Seroprevalence and risk factors

Out of the 300 serum samples, 38 (12.6 %) tested seropositive for anti-*T. gondii* antibodies; 31 (10.3 %) samples tested seropositive for only IgG antibody, 1 (0.33 %) tested seropositive for both IgM and IgG and 6 (2.0 %) were positive for IgM antibody alone. These findings demonstrated that the prevalence rates of IgG and IgM anti-*T.gondii* antibodies were 10.6 and 2.3 %, respectively. Chi square test indicated that seroprevalence of IgG and IgM anti-*T. gondii* antibodies increased with age ($p < 0.05$). Moreover living in rural regions was significantly ($p < 0.05$) related to *T. gondii* seropositivity (Table 1). The results obtained also showed that some risk factors such as, contact with cats, raw/half-cooked meat consumption, and agricultural activities were significantly ($p < 0.05$) related to *T. gondii* seropositivity (Table 2). In contrast other demographic and risk factors including education and eating uncooked vegetables did not show any association with *T. gondii* seropositivity.

Table 1 Demographic characteristics and *T. gondii* sero-prevalence among healthy blood donors in Kerman city southeast of Iran (n = 300)
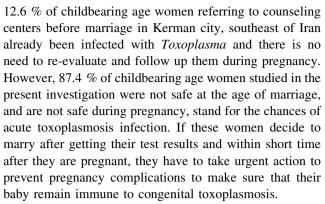
Variables	No. (%)	IgG positive	IgM positive	*P* value
Age groups				
<20 years	58 (19.3)	4 (6.8)	1 (1.7)	0.01
21–30	207 (69.0)	23 (11.1)	5 (2.4)	
>30 years	35 (11.6)	5 (14.2)	1 (2.8)	
Residential place				
Urban	222 (74.0)	21 (9.5)	4 (1.8)	0.035
Rural	78 (26.0)	11 (14.1)	3 (3.8)	
Education				
Less than diploma	51 (17.0)	6 (11.7)	1 (1.9)	–
Diploma and above	249 (83.0)	26 (10.4)	6 (2.4)	

Table 2 Risk factors and *T. gondii* sero-prevalence among healthy blood donors in Kerman city southeast of Iran (n = 300)

Variables	No. (%)	IgG positive	IgM positive	*P* value
Being in contact with cat				
No	198 (66.0)	17 (8.5)	4 (2.0)	0.001
Yes	102 (34.0)	15 (14.7)	3 (2.9)	
Raw/half-cooked meat consumption				
No	268 (89.3)	26 (9.7)	6 (2.3)	0.01
Yes	32 (10.7)	6 (18.7)	1 (3.1)	
Eating uncooked vegetables				
No	71 (13.7)	7 (9.8)	1 (1.4)	–
Yes	229 (76.3)	25 (10.9)	6 (2.6)	
Gardening or agriculture				
No	266 (88.6)	26 (9.7)	6 (2.2)	0.05
Yes	34 (11.4	6 (17.6)	1 (2.9)	

Discussion

Toxoplasma infection is one of the most widespread infections in humans and warm-blooded animals. The prevalence of this infection in different parts of Iran is different, and the exposure to different people, especially women, the possibility of miscarriage, premature delivery and congenital malformations in children who are born is imminent. It is necessary to obtain a level of awareness for safety of women and girls susceptible and non immune to toxoplasmosis at the age of marriage. In this study, we found that 12.6, 10.3, 0.33, and 2.0 % of samples from women referred to Central Laboratory for Marriage Consultation in Kerman city were positive for anti-*T. gondii* antibodies, only IgG antibody, both IgM and IgG, and IgM antibody alone, respectively. These findings indicating that

12.6 % of childbearing age women referring to counseling centers before marriage in Kerman city, southeast of Iran already been infected with *Toxoplasma* and there is no need to re-evaluate and follow up them during pregnancy. However, 87.4 % of childbearing age women studied in the present investigation were not safe at the age of marriage, and are not safe during pregnancy, stand for the chances of acute toxoplasmosis infection. If these women decide to marry after getting their test results and within short time after they are pregnant, they have to take urgent action to prevent pregnancy complications to make sure that their baby remain immune to congenital toxoplasmosis.

Several studies have been carried out on seroprevalence of anti-*T. gondii* antibodies among childbearing age women different areas of Iran (Borna et al. 2013). These studies revealed that the minimum prevalence of anti-*Toxoplasma* antibody was reported in Jolfa (21.8 %) with a sample size of 1000; whereas the highest rate of prevalence was found in Mashhad (54 %) (Falah et al. 2005; Fatta et al. 2001). These variations in the seroprevalence of anti-*T. gondii* antibodies among childbearing age women in different parts of Iran might be related to geographical and environmental factors, and transmission routes in the studied population, sampling method, types of laboratory tests and tools, cut off point for positive test (positive test definition), etc. (Alvarado-Esquivel et al. 2007; Haghdoost et al. 2007). The obtained results exhibited that both contact with cats and consumption of raw/half-cocked meat are significant risk factors for *T. gondii* seropositivity, which indicated that, among childbearing age women in this study, both infection routes, the ingestion of oocysts (animal to human transmission) and that of tissue cysts in meat (food-borne transmission), existed, similar to the infection routes reported in other studies (Khazaei et al. 2012).

Our findings demonstrated that rate of seropositivity increased with age as a consequence of increased opportunity for exposure; such a finding was in agreement with those observed in other studies (Mahmoudvand et al. 2015). Moreover, it was found that risk of *T. gondii* was higher in the women living in rural than those living in urban regions. This significant difference could be attributed to occupational activities related to contact with animals and having lower socioeconomic and lower hygienic lifestyle levels as described elsewhere (Mahmoudvand et al. 2015). Similar to the previous investigations, we found that contact with cats, raw/half-cocked meat consumption, and agricultural activities (as potential risk factors for acquiring toxoplasmosis) were associated with the seropositivity of *T. gondii* (Borna et al. 2013). However, no difference was observed between education and eating uncooked vegetables on the one hand seroprevalence of anti-*T. gondii* antibodies on the other.

Conclusion

The findings revealed that more than three-quarters of the childbearing age women studied in the present investigation are susceptible to infection during pregnancy. Thus, by adopting correct and improved practices we can improve their living conditions, and prevent infection and awareness and control of pathogens associated with disease is recommended.

Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interest in this study.

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