Seroprevalence of Toxoplasmosis Infection in Diabetic Pregnant Women from Sanandaj, Kurdistan, West of Iran

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Abstract

Background: *Toxoplasma gondii* is an opportunistic parasitic protozoan, which is a causative agent of serious complications such as abortion in pregnant women or fetal still birth. The aim of this study was evaluating the seroprevalence of toxoplasmosis infection in diabetic pregnant women from Sanandaj, Kurdistan, west of Iran. **Methods:** In this study 136 serum samples from diabetic pregnant women were collected from referred to the Toohid hospital diabetes center during June 2018 to October 2019 in Sanandaj, Kurdistan, west of Iran. IgM and IgG titers were evaluated by ELISA(enzyme-linked immunosorbent assay) method. The collected data were analyzed by SPSS 19 software and using Chi-Square and Fisher tests. **Results:** The ELISA method showed 35(25.7%) and 7(5.1%) of diabetic pregnant women were positive for IgG and IgM *T.gondii* antibodies respectively. There was statistically significant relationship between toxoplasma infection and education, gestational age and number of parity. **Conclusion:** The results of this study showed that public awareness and education about toxoplasmosis and its transmission routes before pregnancy may be effective in preventing congenital toxoplasmosis.

Background

Toxoplasmosis is a common parasitic disease caused by an obligate intracellular protozoan called *Toxoplasma gondii*, which has distributed in worldwide. Many mammals and birds act as intermediate hosts while cats are the definitive host of the parasite [1]. *T. gondii* has the number of different forms such as; trophozoite, oocyst and tissue cyst. The form of oocyst is created in the intestine of the definitive host and is excreted in the feces. Transmission of *T. gondii* is usually by undercooked and raw meat, ingestion of cysts infected and by accidental ingestion of oocysts that may contaminate soil, water, food [2] or through the placenta during pregnancy [3]. Organ transplantation and blood transfusion have also been mentioned as possible infection risk factors. This parasite can lead to chronic infection in adults, death in immunocompromised people, intrauterine fetal death, amniotic fluid disorders, spontaneous abortion during pregnancy, and hydrocephalus in congenitally infected newborns. About 20–90% of the world's adult population in different regions is reported to have had contact with the parasite but only about 10% of infected individuals develop clinical signs and symptoms [4]. The seroprevalence of *T.gondii* antibodies in pregnant women can vary from 6.1 to 75.2% in different societies and depending on the geographical region [5]. The prevalence rate of *T. gondii* in pregnant women in Portugal is 59.8% [6] in Turkey 52.1% [7] and in Southeast Asia vary, with higher seroprevalence described for Indonesia more than 60% [8] and Malaysia 49% [9]. Seropositivity of *T. gondii* among Iranian women was 48% -74.6% in the northern area [10], 33% - 44% in the northwest [11–12], 22% -37% in the southwest [13] and 27%-54% in central parts of Iran [14]. According to WHO, diabetes is a chronic disease that occurs when body fails to produce enough insulin, or when the body cannot effectively use insulin. Gestational diabetes mellitus (GDM) is a subtype of DM and is defined as glucose intolerance with onset or first recognition during pregnancy [15–16]. There are serologic techniques are used to measure the level of infection to toxoplasmosis in humans and animals. Among these methods, the most common techniques are ELISA

which is a standard method for examining anti-*T. gondii* antibodies. This method is widely available, easy to perform and has high sensitivity and specificity [17].

The aim of this study was to determine the IgG and IgM antibodies created against *T. gondii* infections using the ELISA method in diabetic pregnant women in Sanandaj, Kurdistan, west of Iran.

Methods

In this study totally 136 blood samples were collected from diabetic pregnant women referred to the Toohid hospital diabetes center during the period of June 2018 to October 2019 in Sanandaj, Kurdistan, west of Iran. Five mL of blood was taken from each person. Then, samples were centrifuged at 3000 rpm for 10 minutes. The sera were separated and kept at -20 °C until the assay. All subjects completed a questionnaire including demographic information and risk factors.

Questionnaire

The applied questionnaire anchored in demographic data including age, education, occupation, and residence was prepared before the collection of blood samples. Moreover, possible risk factors, such as contact to animals, cats, and soil, consumption of half-cooked, cooked and frosty meat, blood transfusion, gestational age, history of abortion, use of well and pipe water, Residence area and the number of parity were evaluated in diabetic pregnant women.

ELISA Test

In this study the anti-*T. gondii* antibodies were evaluated. All the serum samples were tested using the commercially available ELISA kit (Pishtaz Teb Co, Iran). Analyses were performed following the manufacturer's instructions. Based on the ELISA kit, If IgG and IgM antibodies concentration was > 1.1 were defined as positive results, and < 0.9 were defined as negative results.

Statistical analysis

Data were analyzed using SPSS software (version 19). The Chi-square and Fisher tests were used to compare the seroprevalence values, related to the characteristics of the subjects. $P \leq 0.05$ was considered as the level of significance.

Results

A total of 136 diabetic pregnant women of age ranging from 17 to 40 years had participated in this study and the mean age was 32.89. A total of 136 samples, 35 (25.7%) and 7(5.1%) were positive for IgG and IgM antibodies respectively. The results of this study revealed significant statistical differences among risk factors such as; level of education ($P = 0.02$), gestational age ($P = 0.008$) and number of parity ($P =$

0.007) with *Toxoplasma* IgG seroprevalence rate in diabetic pregnant women. No significant correlation was found between age and IgG seropositivity anti-*T. gondii*, but more half (74.3%) of the study participants were in the age range > 30 years. All of them were housewives in occupation. The prevalence rate showed no significant differences between women resident with *Toxoplasma* infection in rural and those in urban and margin areas, but the rate of infection was higher in rural patients than others areas. We did not find significant relationship between diabetic pregnant women and occupation, meat consumption, blood transfusion, History of abortion, contact to cats, animals and soil, and use of water with anti-*Toxoplasma* antibodies. The data of the above variables are summarized in Table 1. We found no statistically significant relationship between all characteristics and risk factors with the IgM *T. gondii* antibody (Data not shown).

Table 1
The Frequency Distribution of Specific anti-*Toxoplasma* IgG in diabetic pregnant women in Sanandaj, West of Iran

		SeropositivityN %	Seronegativity %N	P value
Age groups (yr)	<=20	0	2(2)	0.495
	21–30 years	9(25.7)	33(33.7)	
	> 30 years	26(74.3)	66(65.3)	
Education	Illitrate	5(14.3)	8(7.9)	0.02*
	elementary	14(40.0)	17(16.8)	
	school	2(5.7)	20(19.8)	
	Diploma	8(22.9)	34(33.7)	
	University	6 (17.1)	22(21.8)	
Occupation	Housewife	35(100)	101(100)	
	Employ	0(0)	0(0)	
Meat	forsty	4(11.4)	13(12.9)	0.75
	Half cooked	0	3(3)	
	cooked	30(85.7)	83(83.2)	
	raw	1(2.9)	2(2)	
Gestational age	1st trimester4119	3 (8.6)	28(27.7)	0.008*
	2nd trimester	17(48.5)	24(23.8)	
	Third trimester	15(42.9)	49(48.5)	
Residence area	Urban	6(17.1)	10(10)	0.168
	Rural	23(65.8)	82(82.1)	
	Margin	6(17.1)	9(8.9)	
History of abortion	Yes	11(31.4)	28(27.7)	0. 676
	No	24(68.6)	73(72.2)	
Contact Cat	Yes	1(2.9)	1(1.0)	0.429
	No	34(97.1)	100(99)	
Contact soil	Yes	13(37.1)	23(23)	0.103
* Statistically significant at P < 0.05				

		SeropositivityN %	Seronegativity %N	P value
	No	22(62.9)	77(77)	
Contact animal	Yes	8(22.9)	11(10.9)	0.07
	No	27(77.1)	90(89.1)	
Infusion Blood	Yes	2(5.7)	4(4)	0.663
	No	33(94.3)	97(96)	
Use of water	Tap	33(94.3)	95(94.1)	.0.961
	well	2(5.7)	6(5.9)	
N. Parity	0–2	28(80.0)	96(95)	0.007*
	≥ 3	7(20.0)	5(5)	
* Statistically significant at P < 0.05				

Discussion

This study is the first study to survey the status of *T. gondii* antibodies in diabetic pregnant women in this region. In our study, the seroprevalence of IgG *T.gondii* antibody in diabetic pregnant women was 25.7% which was lower than the studies by Khattab et al (45%) in Egypt in 2019 [18], Yentur et al (53%) in turkey in 2015[19] and Mohammadi et al (28%) in Iran in 2008 [20], but higher than (16.5%) as reported by Li et al in China in 2018 [21], and much higher than (5.4%) by Krause et al in 2009 [22]. In addition, our study showed that the prevalence rate of IgM *T.gondii* antibody in diabetic pregnant women was 5.1% which was agreement by Silva et al (5.3%) in 2015 [23], and higher than a study by Saki et al (2.7%) in 2016 [15] but it was lower than in comparison with the studies by Alghamdi et al (6.4%) in Saudi Arabia in 2015 [24] and Tammam et al (18.4%) in Egypt in 2103 [25]. The results of present study indicated that the prevalence of the IgG *toxoplasma* antibody in pregnant women in Sanandaj was lower than in other parts of Iran [15, 20]. This may be due to the cold climate of this area and this temperature is not suitable for the sporulation of *toxoplasma* oocysts. *Toxoplasma* infection's geographical distribution is related to several environmental factors such as food habits, variations in climate, and contact with infected cat feces [26]. In the north of Iran (around the Caspian Sea), there is a high prevalence of *T. gondii* infection, whereas, in hot provinces and cold mountainous, lower seropositivity rates are found [27]. In this research negative seroprevalence of *T. gondii* IgG and IgM were 74.3% and 94.9% in diabetic pregnant women respectively. Many studies have shown that about 75% of the world's women are serologically negative for this parasite and therefore the risk of acute toxoplasmosis and its transmission to women during pregnancy are likely [28].The present study showed no apparent relationship between *Toxoplasma* infection and age (P = 0.495) but the percentage of IgG seroprevalence was higher in ≥ 30 years old (74.3%) which is agreement with other previous similar studies [29–30].It can be explained that these women have been exposed to the risk factors than other women for a longer period of time [31]. In our

study we did not find significant relationship between the seroprevalence of *T. gondii* infection and the residence areas ($P = 0.168$) which is in accordance with other reports [11, 32], although it was demonstrated in other studies that living in rural areas had a higher risk of toxoplasmosis than those in urban areas [33–34]. In this study, we found a significant relationship between *T. gondii* infection and the level of education ($P = 0.02$). There are similar reports in Iran [35, 11]. In some of the studies, the low level of education was associated with a higher rate of toxoplasmosis. Lack of effective information about this disease such as the route of transmission during pregnancy and poor socioeconomic status can increase the risk of infection [36–37]. The history of contact with cats is often mentioned as a risk factor in pregnant women for *T. gondii* infection [39]. Our findings did not show significant association between *T. gondii* infections and contact to cats ($P = 0.429$) which is accordance with other studies [28, 38]. Moreover, the prevalence of the parasite among domestic cats may depend on the type of cats in different countries. The findings did not reveal a meaningful relationship between the consumption of half-cooked meats or frosty and infection, too, which is line with the study from Turkey [40] but is contrast by previous studies has been conducted in Cameroon and Japan [41–42]. This variation could be due to differences in the prevalence of the parasite in the animals in those countries as well as the type of animals consumed. The current study showed there was association between gestational age and IgG *T.gondi*, antibody ($P = 0.008$). The rate of IgG in the second trimester of pregnancy was more prevalent (48.5%) than its similar subgroups which are similar to other studies [15, 42]. If the mother is infected with *T. gondii* during the second and third trimester of pregnancy, the probability of prenatal transmission will be increased to 80%.

There was a significant relationship between toxoplasmosis and the number of parity in this study which according to similar previous studies ($P = 0.007$) (43).

Contaminated drinking water is also a potential source of *T. gondii* infection. In the present study, there was no association between the source of water for drinking and *Toxoplasma* infection which is consistent with other studies [35, 40]. In the current research similar to the results of previous studies [36, 44], no significant relationship was found between the seroprevalence of *T. gondii* infection and the history of abortion in diabetic pregnant women, in contrast, there were reports in Iraq and China [45–46]. In addition in our study although the rate of IgG and IgM *T.gondii* antibodies in contact to animals and soil in diabetic pregnant women were relatively high, we did not observed significant relation between toxoplasmosis and these risk factors which is agreement with studies conducted in China and Italy [47–48]. No significant association between blood transfusion and occupation with toxoplasma infection was observed.

Conclusion

In present study, level of education, number of parity and gestational age in diabetic pregnant women were risk factors for *T. gondii* positivity. Therefore, require awareness on the disease and its transmission, designing the preventive measures and care to avoid parasite exposure during their pregnancies. Also screening tests for toxoplasmosis periodically should be done.

Abbreviations

T. gondii: *Toxoplasma gondii*, ELISA: enzyme-linked immunosorbent assay, GDM: Gestational diabetes mellitus, DM: diabetes mellitus, WHO: World Health Organization

Declarations

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