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Original Research Article

Seroprevalence and some demographic factors associated with *Toxoplasma gondii* infection among female population in Duhok province, Iraq

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ABSTRACT

Background: The causative agent of toxoplasmosis is *Toxoplasma gondii* which is an intracellular protozoan. It has an important role in abortion and congenital diseases in pregnant women, which lead to infant's defectiveness birth when pregnant, are exposed during pregnancy. Toxoplasmosis is one of the most prevalent and most successful parasitic infectious disease worldwide, due to its efficient transmission through the ingestion of tissue cysts in undercooked and infected meat, or the ingestion of oocysts in contaminated vegetables and water. The present study aimed to investigate the seroprevalence rate of anti-*Toxoplasma gondii* Abs and their relation to some demographic factors among females, in Duhok province/ Kurdistan Region/ Iraq.

Methods: During the period from October 2016 to November 2017, a total of 792 random blood samples were collected from the female population of different ages (16-55) years and various socioeconomic classes, who attended Obstetrics and Gynecology Hospital, Azadi teaching hospital and Central Public Health Laboratory/ Duhok.

Results: Out of 792 samples examined, 288 (36.3%) were seropositive from which 282 (35.61%) were found seropositive for IgG, while only six samples (0.76%) were seropositive for IgM. Regarding to occupation, the highest rate for chronic toxoplasmosis was reported in housewives followed by employed and students at rates of 40.19%, 22.3%, and 14.0%, respectively. These outcomes were statistically significant ($p<0.05$). The age group 36-45 years showed the highest seropositive rate for both IgG and IgM Abs which were 41.02% and 1.28%, respectively, which was statistically non-significant. The higher rate of seropositivity was observed among married females 39.93%, and pregnant 41.9% versus non-pregnant 33.3%. This difference was statistically significant ($p<0.05$) among married while non-significant in pregnant. Concerning to blood groups, the highest rate of seropositivity was reported among females with blood group AB+ which was 60% followed by group O- which was 46.7 %. This difference was statistically non-significant ($p>0.05$).

Conclusions: This study showed the importance of demographic factors to the epidemiology of *T. gondii* in females, which support the role of public health in the control of infectious diseases.

Keywords: IgG, IgM-ELISA, *Toxoplasma gondii*, Toxoplasmosis, Women

INTRODUCTION

Toxoplasmosis is a significant zoonotic disease that is caused by an obligate intracellular protozoan parasite *Toxoplasma gondii* with worldwide distribution.[1] It has

been estimated that *T. gondii* infects about one-third of the human population.[2] A wide variety of warm-blooded animals, including humans, can serve as intermediate hosts harboring the tissue cysts, while cats and other felines are considered as definitive hosts producing oocysts; the ingestion of sporulated oocyst can cause the infection. There is a worldwide variation in the prevalence of toxoplasmosis, being higher in underdeveloped countries than developed once.[3] This variation in prevalence can be explained by several factors including the number and presence of the cats, climate, age, nutritional and associated factors, cultural and ethnic practices.[4,5] Direct contact with cats is not required for transmission due to the longevity of oocysts in the environment.[4]

The low epidemiology rate of toxoplasmosis of about 10-30% have been recorded in many countries included North America, South East Asia, and northern Europe and Sahelian countries of Africa. The low epidemiology rate of toxoplasmosis of about 30-50% have been recorded in countries of Central and Southern Europe, while high epidemiology rate have been recorded in Latin America and tropical African countries.[6] In Turkey, seroprevalence rate of IgG and IgM Abs among a series of Turkish women noticed that 37.6% % and 1.1% respectively, were positive.[7] In Iran, the approved ratio of seropositive for anti *T. gondii* antibodies among childbearing age women was 10.3 %.[8] Another study in Iran reported a prevalence rate of anti-*Toxoplasma* IgG, as 34/98 (34.69 %) while for IgM all pregnant women were negative.[9]

The prevalence rate of toxoplasmosis in Arab countries and neighbors reported with variable rates, by using ELISA technique, the seroprevalence for both IgG and IgM Abs was about 32.5% and 6.4% respectively, in Saudi Arabia among pregnant women from multi-center healthcare in Riyadh.[10] Similarly in Egypt the seropositive rates for IgG and IgM among pregnant women were at high risk of about 38.3% and 18.3%, respectively.[11] Furthermore, in Pakistan the seropositive rates were 24.8% for IgG and 8% for IgM among pregnant women.[12] While in Jordan the seropositive rate for IgG and IgM Abs were 39.5 % and 2.5 %, respectively among cancer patients and for female group, the total positive rate were 38%, 11.6% for both IgG and IgM respectively.[13]

The seroprevalence of toxoplasmosis in Iraq also recorded in different ranges; in Al-Najaf province recorded a rate of 31.5% for IgG Abs among aborted women.[14] In Basra a study involving pregnant women reported a seroprevalence rate of 47.1% , in another study also in Basra reported the seropositivity rate for IgG and IgM at 11.3% and 1.13%, respectively among female university students who were close to childbearing age.[15,16] In Al-Qadisiya, the seropositive rate for IgG Ab was 47.1% while for IgM Ab was 0% among recurrent aborted women.[17]

The seroprevalence of toxoplasma IgG in Garmian area, at Kalar General Hospital and private clinics among aborted and normal birthed women were 26% and 20% for toxoplasma IgM.[18] In Erbil some studies have been done to demonstrate the seroprevalence rates of IgG and IgM Abs ELISA technique of about 20.8% in human sera.[19] Moreover, the seropositive rate for anti-toxoplasma antibodies for IgG and IgM were 34.8% and 12.93% respectively.[20] Also in Erbil the seroprevalence rate for anti-toxoplasma IgM was 33.5% among women with miscarriage.[21]

In Duhok limited studies have been performed on the seroprevalence of toxoplasmosis, such as a study among females at childbearing age, the seropositive rate for anti-toxoplasma antibodies for both IgG and IgM at rates of 27.7% and 0.4%, respectively, another study reported the seropositive rate for *Toxoplasma* antibodies IgG and IgM of about 35.9% and 3.3% among bad obstetric history (BOH) women.[22,23] Furthermore, the seropositive rate was 2.82% for IgM in women with abortion in Duhok city.[24] Most of these studies concentrated on the prevalence of toxoplasmosis among females without estimating the general epidemiological status and the risk factors associated with the prevalence of this disease among females. Moreover, most of examination methods depended on latex agglutination test for detection of *Toxoplasma* antibodies. However, this study is an attempt to correlate between the epidemiology of toxoplasmosis and various demographic factors among females using ELISA technique (Exclusively).

METHODS

The present study was conducted in Duhok Province/Kurdistan Region/Iraq. During the period from October 2016 to November 2017, a total of 792 blood samples were collected from females aged 16-55 years belonging to different socioeconomic classes. From each woman, 5ml of blood was withdrawn using a sterile syringe and transferred to a clean fully labeled tube, then centrifuged at 3000 rpm for 10 minutes to separate the serum. The separated, serum was dispensed into two Eppendorf tubes fully labeled with the required information according to the questionnaire sheet designed for the study and stored at -20^{o}C until used. The seroprevalence of *Toxoplasma* antibodies was determined using ELISA technique. The ELISA kits were supplied by Bioactive Company (Germany). The procedure was done according to the instructions supplied with the kit. The work was performed at the Central Blood Bank Laboratory/ Duhok Province.

Statistical analysis

The data was analyzed on the basis of age group, occupation, marital status, blood groups, using online Open Epi program: Open Source Epidemiologic Statistics for Public Health (Dean and Sullivan, 2013) Version 3.01 www.OpenEpi.com.[25]

RESULTS

The overall seroprevalence rate of *T. gondii* among 792 blood samples was 288 (36.3%) of which 282 (35.61%) were seropositive for IgG Ab, while only six samples (0.76%) were seropositive for IgM Ab. (Table 1). With regards to occupation, the highest percentage for IgG Ab was reported among housewives group followed by employee and student, which were 40.19%, 22.3%, and 14.0% respectively, while the highest percentage (2.0%) for IgM was reported in student's group. These outcomes were statistically significant (p<0.05%) as indicated in (Table 2).

Table 1: The seropositivity rate of anti-Toxoplasma IgG, IgM antibodies in females using ELISA technique.

No. of samples tested	Total positive		IgG +		IgM +	
	No.	%	No.	%	No.	%
792	288	36.3	282	35.61	6	0.76

Table 2: The percentage of seropositivity of anti *T. gondii* IgG and IgM according to the occupation.

Occupation	Samples number	Total positive		IgG		IgM	
		No.	%	No.	%	No.	%
Housewife	612	251	41.01	246	40.19	5	0.82
Student	50	8	16.00	7	14.0	1	2.0
Employee	130	29	22.30	29	22.3	0	0
Total	792	288	36.36	282	35.6	6	0.76
p-value <0.05	Significant						

Table 3: The seropositivity rates of anti *T. gondii* IgG and IgM Antibodies among different age groups.

Age Groups	Samples number	Total positive		IgG		IgM	
		No.	%	No.	%	No.	%
16-25	252	80	31.74	77	30.55	3	1.19
26-35	352	136	38.63	135	38.4	1	0.28
36-45	156	64	41.02	62	39.74	2	1.28
46-55	32	8	25	8	25	0	0
Total	792	288	36.36	282	35.6	6	0.76
p-value >0.05	Non-significant						

Table 4: The percentage of seropositivity of anti *T. gondii* IgG and IgM antibodies due to marital status.

Marital status	Samples number	Positive samples		IgG		IgM	
		No.	%	No.	%	No.	%
Single	126	22	17.46	20	15.9	2	1.58
Married	666	266	39.93	262	39.3	4	0.60
Total	792	288	36.36	282	35.6	6	0.75
p-value <0.05	Significant						

Table 5: The percentage of seropositivity of anti *T. gondii* IgG and IgM antibodies due to gestation status (n=666).

Gestation state	Samples number	Positive samples		IgG		IgM	
		No.	%	No.	%	No.	%
Pregnant	465	197	42.36	195	41.9	2	0.43
Non Pregnant	201	69	34.32	67	33.3	2	0.99
Total	666	266	39.93	262	39.3	4	0.60
p-value >0.05	Non-significant						

In term of age, the highest seropositive percentage has been observed among ages from 36-45 years for both IgG and IgM Abs which were 41.02%, and 1.28% respectively, while the lowest seropositive rates have been observed among ages from 46-55 for both IgG and IgM which were 25% and 0.00% respectively. These outcomes were statistically non-significant (p>0.05%) (Table 3).

Married female showed higher seropositivity rate as compared to unmarried (39.93 % versus 17.46%), and this difference was statistically significant (p<0.05). The seropositivity rate of IgG in married female was also higher than that of unmarried. On the other hand, unmarried female showed a higher IgM seropositivity rate as compared to married female (Table 4).

According to gestation state, pregnant women showed the higher seropositive rate for IgG (41.9%) than non-pregnant but this difference was statistically non-significant (p>0.05) as clarified in Table 5.

In term of blood groups, the highest seropositivity of anti-*Toxoplasma* IgG antibody was reported among females with blood group AB+ followed by group O- which were 60% and 46.7 %, respectively.

Whereas, both groups were negative for IgM antibody. Regarding IgM only 6 cases were reported 5 among blood group B + and one among A-. But statistically these differences were non-significant (p>0.05). (Table 6).

Table 6: The seropositivity rates of anti *T. gondii* IgG and IgM according to blood groups.

Blood Group	Samples No.	Positive samples	IgG	IgM
		No. (%)	No. (%)	No. (%)
A^+	256	83 (32.42)	83(32.42)	0 (0)
A^-	25	10 (40.0)	9 (36.0)	1 (4.0)
B^+	192	68 (35.41)	63 (32.8)	5 (2.6)
B^-	22	9 (40.9)	9 (40.9)	0 (0)
O^+	244	91 (37.3)	91 (37.3)	0 (0)
O^-	30	14 (46.7)	14 (46.7)	0 (0)
AB^+	20	12 (60.0)	12 (60)	0 (0)
AB^-	3	1 (33.3)	1 (33.3)	0 (0)
Total	792	288 (36.36)	282 (35.61)	6 (0.75)
p-value >0.05		Non-significant		

DISCUSSION

During pregnancy trimesters the fetus may have serious consequences if infected with toxoplasmosis, such as abortion, central nervous system infections, chorioretinitis or ocular infection at birth.[26] In general acute infection is determined by IgM Ab levels detection, which rises from one to two weeks of infection.[27] On the other hand chronic infections determined by IgG Ab detection, whereas, it does not differentiate between recent and past infection.[28] Therefore, IgG avidity test is used in order to diagnose recent and past infection with *T. gondii*.[29] In the present study the pattern of seropositive rates in females for acute and chronic toxoplasmosis detected using ELISA technique were agreed with a previous study in Duhok Province that reported lower rate of IgM Ab of about 0.4% and high rate IgG Ab rate of about 27.7% in pregnant women.[22]

Similarly, in Iran, reported positive IgG and IgM titers of 39.5% and 2.5%, in the sera of the pregnant women, respectively.[30] The seroprevalence rate of toxoplasmosis can be affected by many factors for instance the nature of environment surroundings, food and drinks sources, and the hygienic conditions. These outcomes agreed slightly with results recorded the higher rates of seropositive toxoplasmosis among housewives followed by employee then the student of about 50%, 40.9% and 6.8% respectively.[31]

In the current study the outcomes of seropositive rate for age group which started from 16-25 was 30.55, then increased with the increases of the age group till the age 46-55 years at which then decreased to the lower rate of 25%, 0% for both IgG, IgM Abs, respectively. While the higher rate showed among the age group 36-45 years which was 39.74% and 1.28% for both IgG, IgM respectively. This may be due to the higher activities of these ages and they are at more exposure rate to risk factors as compared to older ages. In Ramadi city, the higher seropositive rate between couples at the age group 36 - ≥40 years was 60%.[32] In Iran the higher seropositive rate at age group >30 was 14.2% for IgG antibody.[8]

Related to marital status, in Duhok city the highest seropositivity rate was (33.3%) in married female using ELISA-IgG, while IgM Ab was also higher (0.5 %) in married female.[22]

Concerning the blood groups, the present outcomes are similar to some extent to the study of Obaid (2014) in Kirkuk, which reported the highest seropositive rate among A+, AB+, B- blood groups with rate of 66.6%, 60%, and 33.3% respectively for each blood group.[33]

Within the same country various outcomes can be obtained; this may be due to the contribution of different factors such as, the person age, the nature of work, the environment and the source of serological tests kits, which vary with manufactured companies, and the study conditions or laboratories possibilities. Furthermore, nutritional behaviors which vary within the same country, as well as hygienic habits, climate conditions, also having pets or contact with it incidentally, by working or cleaning house gardens etc.

CONCLUSION

The present study can be considered as a first step in Duhok Province to investigate the prevalence of toxoplasmosis among females from different socioeconomic classes and their relation to demographic factors using ELISA technique (Exclusively).

Toxoplasmosis shows a great threat to females especially pregnant women which lead to miscarriage or dead baby. The current outcomes indicate that toxoplasmosis has high prevalent among females especially housewives who may practice poor hygienic habits and low level of health education, in addition to the abundance of stray cats in the community which can contaminate the environment with the oocysts. Therefore, efforts must be given to achieve good control for food safety, rising level of health education, to control the stray cats in order to reduce the risks of infection with toxoplasmosis.

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