



Seroprevalence and potential risk factors associated with *Toxoplasma gondii* infection in women from Tripoli, Libya

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ABSTRACT

Aims: To determine the seroprevalence of *Toxoplasma gondii* (*T. gondii*) in women from Aljalla Maternity and Gynaecology Hospital (AMGH) and to evaluate the association between the infection and potential risk factors.

Methods: A cross-sectional study was conducted at AMGH in Tripoli during the year 2012. Data on potential risk factors were collected by a structured questionnaire and results of the test. The output data of questionnaire were used to assess potential risk factors for positive outcome. All sera ($n = 500$) was screened against ToxoG, by using the Vidas machine automated enzyme-linked fluorescent immunoassay. The association between the outcome variables and its potential risk factors were screened in a multivariate analysis. A p -value < 0.05 was considered to be significant.

Results: The overall seroprevalence was estimated to be 50.8% with 95% confidence interval (CI) (46.42%–55.18%). The results revealed that *T. gondii* infection is highly prevalent, and eating habits (consuming raw meat and/or raw vegetables or fruits) were highly significant associated in multivariable analysis. Expectedly, a significantly [odds ratio (OR):1.712; $p = <0.0001$] higher *T. gondii* seroprevalence of 78.63% (95 CI: 71.21%–86.06%) with ownership cat, as compared to 42.30% (95 CI: 37.35%–47.25%) of not keeping cats. The seroprevalence of 67.3% (95 CI: 61.35%–72.75%) and 33.2% (95 CI: 27.09%–39.02%) among individual living in the villages and cities, respectively, was a significant risk factor in multivariable analysis (OR: 1.482; $p = <0.0001$).

Conclusion: Our results show a high seroprevalence of toxoplasmosis in women seen in the health centre studied. Any future studies should consider a large number of population of different age groups per nation and both sexes to provide more reliable estimates of national level variations and to assess national level risk factors, and it is necessary to develop preventive actions among the population.

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Introduction

Toxoplasmosis is a zoonotic disease caused by *Toxoplasma gondii*. *Toxoplasma gondii* is an obligate intracellular protozoan that infects a wide range of mammals and birds [1]. Wild and domestic felids are the definitive hosts [2], in which the parasites concurrently undergo a sexual cycle of replication [3], while a wide range of herbivores and carni-

vores serve as intermediate hosts contributing to the maintenance of infection in nature through harbouring viable stages of the parasite in tissues [4]. Toxoplasmosis commonly is asymptomatic or latent infection but in certain circumstances, including congenital infection and immunocompromised patients, may cause severe disease and produces symptomatic infections which includes

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lymphadenopathy, pneumonia, hepatitis, blindness, or severe neurological disorders [5,6]. The most important source of Human *T. gondii* infections is the consumption of tissue cysts (bradyzoites or sporadically tachyzoites) in raw and undercooked meat from infected animals [7]. *Toxoplasma gondii* can also be transmitted transplacentally resulting in a spontaneous abortion, a still birth, or a child that is severely handicapped mentally and/or physically (Congenital toxoplasmosis) [8]. Although the presence of infections with *T. gondii* is recognized in domestic animals, but to best of our knowledge, a little is known about prevalence in the human population [9,10]. So, the aim of this study was to determine the seroprevalence of *T. gondii* in women from Tripoli and assess the risk factors associated with the parasite infection.

Material and Method

Study area and study design

The present study was conducted during 2012 in hospital of capital Tripoli city, Aljalla Maternity and Gynaecology Hospital (AMGH). A cross-sectional study was conducted to determine the seroprevalence of toxoplasmosis. A pre-structured questionnaire used to collect the relevant data and results of the test. The output data of questionnaires were used to assess potential risk factors for seropositive patients.

Questionnaire survey

The questionnaire was designated to determine the risk factors associated with *T. gondii* seroprevalence. The questionnaire was filled on the spots, while testing the samples by taking the relevant information from the patient at AMGH. The data was collected for various risk factors that may associate with the prevalence of *T. gondii* infection. The information was collected concerning the various parameters, such as cooking state of food, (well cooked, undercooked), ownership animals (cats), eating habits (raw vegetables/fruits or washed vegetable/fruits), and residence (village or city).

Statistical analyses

The collected data were entered into a computer on a Microsoft Excel spread sheet and coded to be analysed and interpreted as per the standard method of statistics. Statistical analysis was applied by using Statistical Package for the Social Sciences version 22. For each proportion the seroprevalence and 95% confidence intervals (CI) were calculated

using the Bayesian approach of Beta distribution. The association between the outcome variables and its potential risk factors were screened in a multivariate analysis. A p -value <0.05 was considered to be significant.

Serological assay

The Vidas Machine as an automated enzyme-linked fluorescent immunoassay (ELFA VIDAS TOXO IgG II; Biomérieux SA, France) was applied to detect anti-*T. gondii* IgG antibodies (ToxoIgG), the Calibration of this system according to manufactures, and the procedure of the test was carried out following the operative standard. In our study, we performed IgG, the technique is characterized by highly performance IgG avidity. In an evaluation and comparative studies, sensitivity of the assay was shown to be above 99% and specificity above 98% [11,12].

Results

In this study, an overall *T. gondii* seroprevalence was estimated to be 50.80% (95% CI: 46.42%–55.18%). The results of the multivariate analysis were demonstrated in Table 1. The seroprevalence of 67.3% (95% CI: 61.35%–72.75%) and 33.2% (95% CI: 27.09%–39.02%) among individual living in the villages and cities, respectively, was a significant risk factor in multivariable analysis [odds ratio (OR): 1.482; $p = <0.0001$]. Higher seroprevalence of 78.63% (95% CI: 71.21%–86.06%) with keeping cats, as compared to 42.30% (95% CI: 37.35%–47.25%) of not keeping cats, which provide to be a risk factors associated with seropositive of *T. gondii* in multivariate analysis (OR: 1.712; $p = <0.0001$). Statistical difference ($p = <0.0001$) of the *T. gondii* seroprevalence values of 40.79% (95% CI: 35.85%–45.73%) and 82.50% (95% CI: 75.70%–89.30%) were also demonstrated among women consumed well cooked and under cooked meat respectively, and was positively correlated with *T. gondii* infection in multivariate analysis (OR: 1.754; $p = <0.0001$). The seroprevalence was found to be higher in women consumed raw (unwashed) vegetables 83.87% (95% CI: 77.40%–90.34%) while in women consumed washed vegetables 39.89% (95% CI: 34.94%–44.84%), and was significantly in the multivariate analysis (OR: 1.758; $p = 0.00001$). 0 out of 254 seropositive *T. gondii* had history of abortion or congenital toxoplasmosis.

Discussion

This paper reports high seroprevalence of *T. gondii* among women in Tripoli, the overall seroprevalence

Table 1. Results of multivariate analysis for the association between potential risk factors and *T. gondii* seroprevalence.

Variable	Total number (n)	Seropositive		multivariate analysis	
		n	%	Odds ratio (95% CI)	p
Residence					
City	239	79	33.2%	1.482 (1.424–1.540)	<0.0001
Village	261	175	67.3%		
Ownership animal					
Keeping	117	92	78.6%	1.712 (1.712–1.824)	<0.0001
Not keeping	383	162	42.3%		
Meat					
Cooked	380	155	40.8%	1.754 (1.699–1.810)	<0.0001
Under cooked	120	99	82.5%		
Vegetables					
Raw	124	103	83.9%	1.758 (1.703–1.812)	<0.0001
Washed	376	105	39.9%		
Total	500		50.8%		

CI = confidence interval.

(50.80%; 95% CI: 46.42%–55.18%) reported in the present study was higher than that reported by other authors in Libya [9,13], in which reflect the high pathogenic index and endemic picture of toxoplasmosis at least in the surveyed area. The seroprevalence of *T. gondii* reported in our study is higher than those reported (47.7%) in Tunisia [14], (45.8%) in Egypt [15], in Algeria the seroprevalence of *T. gondii* from 2014 to 2017 ranged between 39.9% and 47.8% [16,17], and was consistent with that reported (50.6%) in Morocco [18]. Indeed, the variation of *T. gondii* seroprevalence among individuals could be attributed to many factors, such as climates, eating, and hygiene habits, and this variability reflect the difference of *T. gondii* seroprevalence between countries and/or regions. The Tripoli city is characterized by a Mediterranean climate, with warm, moist, and mild winters in which favourable for the survival of oocysts. The excretion of resistant oocysts by domestic cats and other members of the Felidae into the environment is prevalent, however, the oocysts are not immediately infective when they are eliminated by felines [5]. The maturation to infectious sporulated oocysts occurs in the environment, and sporulated oocysts survive for long periods under most ordinary environmental conditions [2]. Unexpectedly, all *T. gondii* seropositive women in the present study had no history of abortion or congenital toxoplasmosis. It is well known that *T. gondii* is considered frequently the main cause of abortion and/or congenital toxoplasmosis

among the pregnant women [8]. The primary *T. gondii* infection during gestation lead to infection of the placenta and vertical transmission, and could be serious for unborn child, whereas the secondary infection poses less risk to the fetus [19,20], thus these women might be had acquired the infection long time before gestation. In other word, the maternal infection acquired before gestation poses little or no risk to the fetus in contrast to the women who become infected a few months before conception. In the present study, over 50% women had a history of close contact with cats, and expectedly, there was significance association found between the seroprevalence of toxoplasmosis and ownership cats ($p < 0.0001$). However, in line with other similarly studies reported significance association with *T. gondii* seroprevalence and own cats [21–23]. Similarly, the residence significantly ($p < 0.0001$) influence seroprevalence of *T. gondii* among individuals living in the rural and urban communities. Our findings could be explain by free roaming of the cats in the villages than in the cities [24], and it might be as an evident that, people in the villages exposed to more toxoplasma infection [25–27]. Yet, there is no data available about how much cat's population in the villages and cities in Libya, and due to higher number of stray cats free roaming and living in closely contact (indoors and/or outdoors), and moreover, the custom life in the villages is consider as a predisposing factors would be increase to more risk of exposure of *T. gondii* infection. Since,

the higher seroprevalence among women from villages, which might be linked to farming activities, thus they are frequently in direct contact with vegetables and/or fruits during their work in the farms. These vegetables are customarily collected and eaten without washing. Though, our findings reported that, women are living in the villages could be have more potential risk of exposure to *T. gondii* infection, thus, our results in agreement with other authors had reported same results [7,27]. The seroprevalence of *T. gondii* (82.5%) among women consumed under cooked meat was higher than that (40.3%) reported in women consumed well-cooked meat, and consequently, the present study showed statistical difference (p -value < 0.0001) among well cooked and under cooked. It's well known that most of *T. gondii* infection among people occur by eating raw or undercooked meat containing *T. gondii* tissue cysts or eating food that has been cross contaminated with raw/undercooked meat [7], and likewise regarding the raw vegetables by ingesting oocysts from soil (for example, through gardening, handling/eating vegetables, or changing a cat litter box). Nonetheless, the meat eating habit in this country, where well-cooked meat frequently is practiced, but study results revealed that an association of *T. gondii* infection with women had undercooked meat. The results in line with the previous studies that reported high *T. gondii* seroprevalence in countries where undercooked meat is commonly eaten [1, 28,29]. It is known that, there is a paucity of information on the endemicity and potential risk factors of women toxoplasmosis in Libya, but our findings still gives a small spotlight to awareness and stress the importance of control and preventive measures against neglected *T. gondii* infection in the country.

Conclusion

Our results show a high seroprevalence of toxoplasmosis in women seen in the health center studied. Our results also show that eating habits (consuming undercooked meat and/or raw vegetables or fruits), ownership animals (cats), and residence (village or city) appear to be of high epidemiological relevance among seropositive patient. Any future studies should consider a large number of populations of different age groups per nation and both sexes to provide more reliable estimates of national-level variations and to assess national-level risk factors, and it is necessary to develop preventive actions among the population.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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