

Facts and Fictions about *Toxoplasma gondii* in Women of Misan Province

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Abstract

Background: *Toxoplasma gondii* (*T. gondii*) is one of the most common protozoa worldwide that infects human and animals. Because of lack of data about the facts and myths of *T. gondii* infection in human Iraq, this study was aimed to define and answer all the related questions in a scientific knowledge manner. **Materials and Methods:** A survey study was conducted among women to assess their knowledge about facts and myths of toxoplasmosis in the Department of Microbiology, Faculty of Medicine, University of Misan, Misan, Iraq, from November 1, 2018 to July 30, 2022. All women answered all the questions. A total of 6055 women, aged from 18 to 68 years, were enrolled, only comprising women who lived in Misan. A questionnaire was constructed upon the objectives and involved questions correlated to personal, demographic, social, economic, and educational information. The questionnaire investigated facts and myths concerning *T. gondii*. **Results:** All women completed the survey lists with a response rate of 100%. The mean age was 41.53 ± 20.74 years. Most individuals (3133, 51.74%) were grouped to 18–40 years of age. In terms of the knowledge of toxoplasmosis, women who knew a person with toxoplasmosis (23.15%), though it affects men (47.46%), thought that it is an infectious disease (86.16%), thought that it can be prevented (68.22%), thought that it can be treated or cured (82.84%), thought that it is a hereditary condition (59.64%), thought that cats are a causative agent of toxoplasmosis (74.15%) and thought that it transmits by intersexual course (34.32%). Concerning risk knowledge, women who thought the risk of toxoplasmosis transport by eating unhealthy food are 70.45%, women who thought the risk is raised when wearing tight underwear are 42.25%, women who thought the risk was raised with old age are 49.58%, women who thought the risk could be raised when they use contraceptives are 31.11%, women who thought the risk increased with pregnancy are 84.23%, and women who thought the risk could be raised with smoking and alcohol intake are 45.70%. Of 6055 women, a total of 5578 (92.12%) women said that toxoplasmosis is a zoonotic disease. About 96.10% of the sample said that it transmits by cats. Almost always, 99.45% of women thought that it is a cause of abortion, stillbirth, and congenital anomalies. In addition, only 16.99% of women in this survey know that there are over two million new cases of toxoplasmosis in the world annually. About 11.33% of women thought that toxoplasmosis cases are asymptomatic whereas others thought that they have a fever, gastro intestinal tract symptoms, genito urinary tract symptoms, and ophthalmologic symptoms. **Conclusions:** Many facts and myths can affect the knowledge of women about toxoplasmosis. In kinds of literature, there are no real modes for studying myths about infectious diseases in particular toxoplasmosis which may be of benefit in preventing and managing processes.

Keywords: Cats, myths, protozoa, *Toxoplasma gondii*, toxoplasmosis

INTRODUCTION

The trilogy of abortion or congenital malformations in pregnancy contributed to one, two, or all of three pathogens *Toxoplasma gondii*, *Rubella virus*, and *Cytomegalovirus*.^[1] *T. gondii* is one of the most common protozoa worldwide that infect human and warm-blooded animals, due to ingestion of well-uncooked meat or food contaminated with infected animal feces.^[2,3] Toxoplasmosis presented as a zoonotic disease caused by coccidian protozoa, *T. gondii*.^[4]

Human beings become infected through ingested tissue containing cysts in uncooked meat or contaminated water, soil, and food with oocyst, or directly from cats and other

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feline species' feces.^[5] It is an important tropical disease and globally spreading, which found that is infectious to 30% of the human population worldwide.^[6] Furthermore, the vertical transmission or congenital infection of *T. gondii* was reported. The life cycle is complete when the parasite passes from warm-blooded intermediate hosts to human, *Felidae* is the only known host in which the parasite can reproduce sexually and produce oocysts then shed oocysts in the feces of domestic cats.^[7] The infection can be diagnosed using many laboratory tests, including serological tests, polymerase chain reaction methods, and histological seen of parasites in infected tissue or body fluids or by animal inoculation.^[8] Clinically, the symptoms of toxoplasmosis are fever, anorexia, or dyspnea, and the signs are neural, respiratory, cutaneous, and ocular can be involvement. The diagnosis can be complicated due to the wide range of clinical signs.^[9,10] The disease is enhanced by some factors such as environmental conditions, social, nutritional, economic, cultural habits, and hygiene, and its prevalence in hot and humid climates is higher than that in warm and dry regions.^[11] The screening of IgG and IgM antibodies by enzyme-linked immunosorbent assay study is routinely done. The IgM antibodies are seen in the first week and reached the maximum level after 3 weeks of infection. Whereas IgG antibodies were seen two weeks after infection and reached a peak within 8–10 weeks of infection.^[12,13]

Regarding the lack of data about the facts and myths of *T. gondii* infection in human in Misan province, Iraq, this study was aimed to define and answered all these questions in a scientific knowledge manner.

MATERIALS AND METHODS

A survey study was conducted among women to assess their knowledge about facts and myths of toxoplasmosis in the Department of Microbiology, Faculty of Medicine,

University of Misan, Misan, Iraq, from November 1, 2018 to July 30, 2022. The recruitment period began on the first day until the last day of study ended. All women answered all the questions. A total of 6055 women, aged from 18 to 68 years, were enrolled, only comprising women who lived in Misan. A survey using a questionnaire was constructed upon the objectives and involved questions correlated to personal, demographic, social, economic, and educational information. The survey questionnaire investigated facts and myths concerning *T. gondii*.

Ethical considerations

This study was approved by the University of Misan, Faculty of Medicine Committee Board (ID No. 1002/Feb 2021).

Data collection

The knowledge about toxoplasmosis was assessed by eight questions (1–8). Toxoplasmosis risk factors were reported by six questions (9–14). Facts of toxoplasmosis consist of four questions (15–18). Knowledge of symptoms assessed by one question (Box 1).

Statistical analysis

The data were analyzed using SPSS software (Version 20.0, IBM®, New York, NY). The categorical and quantitative variables were presented as percentages and mean. The likelihood ratio for the multinomial logistic regression model of facts and myths was used. The *P* value of ≤ 0.05 was set as the level of significance using a two-sided test.

RESULTS

The participants in this work comprised 6055 women who were residents of Misan, Iraq. All women were eligible by

Box 1: Study questions about toxoplasmosis asked women.	
Knowledge 1. Do you know someone with toxoplasmosis? 2. Do you think toxoplasmosis affects men? 3. Do you think toxoplasmosis is an infectious disease? 4. Do you think toxoplasmosis can be prevented? 5. Do you think toxoplasmosis can be treated or cured? 6. Do you think toxoplasmosis is a hereditary disease? 7. Is toxoplasmosis caused by cats? 8. Is toxoplasmosis transmitted by intersexual course?	Risks 9. Do you think the risk of toxoplasmosis is transported by eating unhealthy and eating food? 10. Do you think the risk of toxoplasmosis raises when wearing tight underwear? 11. Do you think the risk of toxoplasmosis raises with old age? 12. Do you think the risk of toxoplasmosis raises when using contraceptives? 13. Do you think the risk of toxoplasmosis increases with pregnancy? 14. Do you think the risk raises in smokers and alcoholics?
Facts 15. Is toxoplasmosis a zoonotic disease? 16. Is toxoplasmosis transmitted by cats? 17. Is toxoplasmosis caused abortion, stillbirth, and congenital anomalies? 18. Are you know that there are over two million cases of toxoplasmosis in the world?	Symptoms 19. What are the symptoms of toxoplasmosis? • Asymptomatic • Fever • GIT upset • Others • Eye

GIT, gastro intestinal tract

meeting the research criteria, all of them completed the survey with a response rate of 100%, and all questionnaire data were subjected to a statistical analysis. The mean age

Table 1: Demographic of the study (n = 6055)

Variables		No.	(%)
Age (years)	18–40	3133	51.74
	41–60	2172	35.87
	>61	750	12.39
Education	Undergraduate	1406	23.22
	Postgraduate	655	10.82
	Secondary	1262	20.84
	Primary	1189	19.64
	Illiteracy	1543	25.48
Economic status	Good	897	14.82
	Medium	2005	33.11
	Low	3153	52.07
Marital status	Single	1139	18.81
	Married	2821	46.59
	Divorced	820	13.54
	Widow	1275	21.06

of participants was 41.53 ± 20.74 years. Most individuals (3133, 51.74%) were grouped between 18 and 40 years of age. A large group of women (1543, 25.48%) were illiterate. The low economic status (3153, 52.07%) was frequently recorded. The majority of women were married (2821, 46.59%), whereas 1139 (18.81%) were single [Table 1].

In terms of the knowledge of toxoplasmosis, women who answered “Yes” Q1 in (23.15%), Q2 at (47.46%), Q3 at (86.16%), Q4 at (68.22%), Q5 at (82.84%), Q6 at (59.64%), Q7 in (74.15%), and Q8 in (34.32%) [Table 2].

Table 3 showed the percentage of women in relation to risk knowledge. Women who said “Yes” were (70.45%) for Q9, (42.25%) for Q10, (49.58%) for Q11, (31.11%) for Q12, (84.23%) for Q13, and (45.70%) for Q14.

Data concerning facts about toxoplasmosis are listed in Table 4. A total of 5578 (92.12%) women said “Yes” for Q15. About 96.10% of the sample said “Yes” for Q16, 99.45% for Q17, and 16.99% for Q18.

About 11.33% of women thought that toxoplasmosis cases are asymptomatic, whereas 98.76% thought that they have

Table 2: Toxoplasmosis knowledge

Q	Knowledge		No.	%
1	Do you know someone with toxoplasmosis?	Yes	1402	23.15
		No	4653	76.85
2	Do you think toxoplasmosis affects men?	Yes	2885	47.46
		No	3170	52.54
3	Do you think toxoplasmosis is an infectious disease?	Yes	5217	86.16
		No	838	13.84
4	Do you think toxoplasmosis can be prevented?	Yes	4131	68.22
		No	1924	31.78
5	Do you think toxoplasmosis can be treated or cured?	Yes	5016	82.84
		No	1039	17.16
6	Do you think toxoplasmosis is a hereditary disease?	Yes	3611	59.64
		No	2444	40.36
7	Is toxoplasmosis caused by cats?	Yes	4490	74.15
		No	1565	25.85
8	Is toxoplasmosis transmitted by intersexual course?	Yes	2078	34.32
		No	3977	65.68

Table 3: Toxoplasmosis risk knowledge

Q	Risks	No.	%	
9	Do you think the risk of toxoplasmosis is transported by eating unhealthy food?	Yes	4266	70.45
		No	1789	29.55
10	Do you think the risk of toxoplasmosis is raised when wearing tight underwear?	Yes	2558	42.25
		No	3497	57.75
11	Do you think the risk of toxoplasmosis is raised with old age?	Yes	3002	49.58
		No	3053	50.42
12	Do you think the risk of toxoplasmosis is raised when using contraceptives?	Yes	1884	31.11
		No	4171	68.89
13	Do you think the risk of toxoplasmosis increased with pregnancy?	Yes	5100	84.23
		No	955	15.77
14	Do you think the risk is raised with smoking and alcohol intake?	Yes	2767	45.70
		No	3288	54.30

Table 4: Toxoplasmosis facts

Q	Facts	No.	%
15	Is toxoplasmosis a zoonotic disease?	Yes	5578
		No	477
16	Is toxoplasmosis transmitted by cats?	Yes	5819
		No	236
17	Is toxoplasmosis caused abortion, stillbirth, and congenital anomalies?	Yes	6022
		No	33
18	Are you know that there are over two million new cases of toxoplasmosis in the world annually?	Yes	1029
		No	5026

Table 5: The symptoms of toxoplasmosis knowledge

Symptoms	No.	%
Asymptomatic	686	11.33
Fever	5980	98.76
GIT	3769	62.25
GUT	6050	99.92
Eye	528	8.72

GIT, gastro intestinal tract; GUT, genito urinary tract

a fever, 62.25% said that they suffer from gastro intestinal tract symptoms, 99.92% said that they suffer from genito urinary tract symptoms and 8.72% thought that they complain of ophthalmologic symptoms [Table 5].

The multinomial logistic regression model of the participants' knowledge included 23 covariates. In total, 13 covariates showed a statistical association after modeling the likelihood ratio: Q3 ($P = 0.05$), Q4 ($P = 0.05$), Q5 ($P = 0.001$), Q7 ($P = 0.0001$), Q9 ($P = 0.05$), Q13 ($P = 0.001$), Q15 ($P = 0.0001$), Q16 ($P = 0.0001$), and Q17 ($P = 0.0001$). Furthermore, knowledge about symptoms revealed that thoughts about fever, gastro intestinal tract, and genito urinary tract symptoms have significant differences ($P = 0.0001$, 0.001, 0.0001), respectively [Table 6].

DISCUSSION

The participants comprised 6055 women who lived in Misan. All women completed the survey lists with a response rate of 100%. The mean age was 41.53 ± 20.74 years. Most individuals (3133, 51.74%) were grouped in the range of 18–40 years of age. This agrees with *T. gondii*, and other viral infections are commonly infected in all age groups and are generally asymptomatic illnesses; however, the infection in pregnant women may cause abortion or fetal congenital malformations.^[14] Also, our findings agree with Puccio *et al.*,^[15] in Italy and Simpore *et al.*,^[16] in Burkina Faso. Toxoplasmosis is an important infection in pregnant women up to the time of infection and the virulence of the organism type, and many transmitted parasites from mother to fetus are related to a variety of symptoms and complications.^[17]

In terms of the knowledge of toxoplasmosis, women who knew a person with toxoplasmosis (23.15%), though it affects men (47.46%), thought that it is an infectious disease

(86.16%), thought that it can be prevented (68.22%), thought that it can be treated or cured (82.84%), thought that it is a hereditary condition (59.64%), thought that cats are a causative agent of toxoplasmosis (74.15%) and thought that it transmits by intersexual course (34.32%). Meylan *et al.*,^[18] Moghimi *et al.*,^[19] and Acharya,^[20] revealed similar data. However, in India, Yasodhara *et al.*,^[21] in Turkey, Parlak *et al.*,^[22] and in Switzerland, Boubaker *et al.*,^[23] disagree with these thoughts.

Pribakovic *et al.*, concluded that these knowledge points are influenced by age, educated women, society, economy, and environmental factors.^[24] The youngest females have the highest risk of acquiring this disease during pregnancy.^[25,26]

In relation to risk knowledge, women who thought the risk of toxoplasmosis is transported by eating unhealthy food are 70.45%, women who thought the risk is raised when wearing tight underwear are 42.25%, women who thought the risk raised with old age are 49.58%, women who thought the risk raised when using contraceptives are 31.11%, women who thought the risk increased with pregnancy are 84.23%, and women who thought the risk raised with smoking and alcohol intake are 45.70%. In the former studies, authors reported similar findings for these thoughts, indicating the greatest myths in the regions with a higher prevalence of toxoplasmosis.^[27] The data from other surveys showed a different percentage of these thoughts in China,^[28] and in London.^[10]

In Hormozgan province in Iran, the toxoplasmosis prevalence was high; besides, there were several unpleasant myths about the disease,^[29] when compared with other two similar studies on pregnant women by Makiani *et al.*,^[30] and Setoodeh Jahromi *et al.*,^[31] which are different from our data. The reason for these differences resulting from comparison seems to have been influenced by many environmental and population factors such as selected samples, pregnant women, and hospital policies.

A significant relationship was found between the distribution of many thoughts about *T. gondii* infection and the age of patients and their education level confirmed which was by Doni *et al.*,^[32] in Turkey and Ghadamgahi *et al.*,^[33] and Ajami *et al.*,^[34] in Iran.

Table 6: The likelihood ratio for multinomial logistic regression model of facts and myths of toxoplasmosis knowledge

Thoughts	Likelihood ratio (LR)	P-value
Do you know someone with toxoplasmosis?	15.41	1
Do you think toxoplasmosis affects men?	28.66	0.08
Do you think toxoplasmosis is an infectious disease?	59.73	0.05
Do you think toxoplasmosis can be prevented?	52.99	0.05
Do you think toxoplasmosis can be treated or cured?	254.43	0.001
Do you think toxoplasmosis is a hereditary disease?	44.64	0.06
Is toxoplasmosis caused by cats?	402.73	0.0001
Is toxoplasmosis transmitted by intersexual course?	22.39	0.09
Do you think the risk of toxoplasmosis is transported by eating unhealthy and eating food?	50.88	0.05
Do you think the risk of toxoplasmosis raises when wearing tight underwear?	39.45	0.07
Do you think the risk of toxoplasmosis raises with old age?	20.52	0.1
Do you think the risk of toxoplasmosis raises when using contraceptives?	18.72	1
Do you think the risk of toxoplasmosis increases with pregnancy?	254.21	0.001
Do you think the risk raises in smokers and alcoholics?	11.33	1
Is toxoplasmosis a zoonotic disease?	446.84	0.0001
Is toxoplasmosis transmitted by cats?	507.89	0.0001
Is toxoplasmosis caused abortion, stillbirth, and congenital anomalies?	512.47	0.0001
Are you know that there are over two million new cases of toxoplasmosis in the world annually?	22.58	0.9
Asymptomatic	19.55	0.9
Fever	400.36	0.0001
GIT	188.32	0.001
GUT	589.56	0.0001
Eye	10.98	1

GIT, gastro intestinal tract; GUT, genito urinary tract

Of 6055 women, a total of 5578 (92.12%) women said that toxoplasmosis is a zoonotic disease. About 96.10% of the sample said that it is being transmitted by cats. Almost always, 99.45% of women thought that it is a cause of abortion, stillbirth, and congenital anomalies. In addition, only 16.99% of women in this survey know that there are over two million new cases of toxoplasmosis in the world annually. About 11.33% of women thought that toxoplasmosis cases are asymptomatic whereas others thought that they have a fever, gastro intestinal tract symptoms, genito urinary tract symptoms, and ophthalmologic symptoms. The findings showed a meaningful correlation between these facts and *Toxoplasma*, too. Thus, probably this is a way for people to describe this infection in high-prevalence regions.^[29] However, so far, no study has been conducted on this subject to show similar data to our study.

Setoodeh Jahromi *et al.*,^[31] documented a significant correlation found between the history of contact with cats and the presence of anti-*Toxoplasma* antibodies in pregnant women which indicates a mode of transmission.

Some authors advise combining thoughts and scientific facts to help the population to distinguish between reality and delusion about this zoonotic infection.^[35]

Biological contaminants refer to environmental contamination and food source with living microorganisms such as bacteria, molds, viruses, protozoa, and fungi, in addition to mites, house dust, and pollen that affect

infection.^[36] The contamination of soil with *T. gondii* oocyst could act as the source of acquiring toxoplasmosis.^[37]

CONCLUSIONS

Many facts and myths can affect the knowledge of women about toxoplasmosis. In kinds of literature, there are no real modes for studying myths about infectious diseases in particular toxoplasmosis which may be of benefit in preventing and managing processes.

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Conflicts of interest

There are no conflicts of interest.

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