

## Toxoplasmosis in stray cats and pregnant women in Egypt: Association between Socio-demographic variables and High-risk practices by pregnant women

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**Abstract:** Toxoplasmosis is worldwide zoonosis that poses a major health threat to pregnant women and immunocompetent individuals. This study investigated the prevalence of toxoplasmosis in pregnant women as well as stray cats in Kafrelsheikh province, Egypt during the period between June and August 2016. The results showed that 5 of 113 (4.4%) pregnant women were seropositive (IgM+) for active toxoplasmosis. The *T. gondii* oocysts were detected in 2 of 100 (2%) cat feces samples. A questionnaire was answered by all pregnant participants for possible high-risk practices associated with toxoplasmosis and the answers showed that 82.3% of them routinely practiced at least one of the investigated high-risk practices. Drinking of unhygienic water was the predominant practice (61.9%), while contact with a cat was the lowest (10.6%). Pregnant women with low education level and living in rural dwellings were significantly associated with occupational contact with soil. Consumption of undercooked meat and drinking unhygienic water were significantly associated with residence in urban dwellings and lower education, respectively. There was no significant relationship between seropositivity in pregnant women and age, educational level, residence or any of investigated high-risk practices. This study showed that stray cats may be an important source of *Toxoplasma* infection in Egypt. The high seroprevalence and reported high-risk practices by pregnant women in this study highlighted the urgent need for education campaigns regarding modes of *Toxoplasma* transmission to avoid potential threats to at risk pregnant women in Egypt.

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**Keywords:** Toxoplasmosis, stray cats, pregnant women, high risk practices.

### 1. Introduction

Toxoplasmosis is the infection of human and other warm-blooded animals with zoonotic protozoa called *T. gondii* (Montoya and Liesenfeld, 2004). It has been evaluated that up to one third of human population worldwide are infected with toxoplasmosis (Pappas *et al.*, 2009). The infection may be acquired by drinking water or eating food contaminated with oocysts released in cat feces (Dubey, 2004 and Sroka *et al.*, 2006) or by accidental ingestion of raw or undercooked meat, such as pork and lamb containing *T. gondii* tissue cysts (Garcia *et al.*, 2006). In Egypt and other parts of the world *T. gondii* cause great public health problems. In immunocompetent individuals infection with *T. gondii* is usually asymptomatic and results in latent infection with formation of tissue cyst in different tissues (Weiss and Dubey, 2009). The most frequent manifestation is asymptomatic cervical lymphadenopathy; however, clinical manifestations such as pneumonitis, myocarditis, myositis, hepatitis and encephalitis may

occur in some individuals (Weiss and Dubey, 2009). In immunocompromised patients, toxoplasmosis may lead to encephalitis, myocarditis and pneumonitis manifestations and usually fatal if not treated (Weiss and Dubey, 2009). When maternal infection with *T. gondii* occurs for the first time during pregnancy, it leads to congenital toxoplasmosis which can cause many variable manifestations in the fetus and infant as abortion, still birth or alive infant with typical symptoms of congenital toxoplasmosis as retinochoroiditis, hydrocephalus or microcephalus and cerebral calcifications (Weiss and Dubey, 2009).

Compared with pet cats, stray cats play a major role in the transmission of *T. gondii* as they keep the level of *T. gondii* in the environment. Stray cats live outdoors and may themselves be exposed to environmental *T. gondii* parasites. They can contract feline toxoplasmosis by hunting *Toxoplasma* infected rodents, birds and other wildlife, or by ingesting of garbage containing either undercooked meat with *T. gondii* cyst or scraps contaminated with oocyst (Wang

*et al.*,2012). Infected stray cats shed millions of oocysts in their feces that can contaminate food and/or water of mammals and birds (Davis and Dubey, 1995).

Detection of the prevalence and risk factors of *T. gondii* infection is essential to know the burden of toxoplasmosis and to design effective strategies for prevention of the disease. Several worldwide studies showed that *Toxoplasma* infection in pregnant women was associated with socio-demographic factors as age, education level, socio-economic status and also several high-risk practices as contact with cats, contact with soil, consumption of unhygienic water or undercooked meat (Nissapatorn *et al.*,2011, El Deeb *et al.*, 2012, Kamal *et al.*,2015, Al-Eryani *et al.*,2016 and Ahmadpour *et al.*,2017).

This study aimed to determine the prevalence of *T. gondii* infection in stray cats and the seroprevalence of active *T. gondii* infection in pregnant women in Kafrelsheikh provinces, Egypt. The possible risk factors for *T. gondii* infection in pregnant women and the association between high-risk practices and different socio-demographic variables of the participants were investigated as well.

## 2. Materials and methods

The study was conducted in Kafrelsheikh Province in Nile-Delta of the northern Egypt during the period between June and August 2016. One hundred samples of cat feces were collected from outdoor locations from different localities in Kafrelsheikh province. Stray cats were observed as closely as possible depositing and burying their feces in sandy spots. Samples were transported in ice box to be examined in the lab. The cat feces were examined for the presence of *T. gondii* oocysts using sheather's sugar flotation (1.15 sp. gr) as was previously described by (Dubey 2009). The oocyst size was measured with an ocular micrometer. *Toxoplasma* oocyst size ranges from 9-12Mm. For sporulation, oocysts in fecal floats were taken by automatic pipette, added to a petri dish with water and 2.5% potassium dichromate and aerated on a shaker at room temperature (23-29°C) for 8 hours per day for 1 week. The oocysts were examined microscopically again for confirmation from the shape of the sporulated oocysts.

**Table 1:** Association between toxoplasmosis seropositivity and possible risk factors among pregnant women in this study.

Variables	Groups	No of women	No of Seropositive	Percentage of Seropositive	X <sup>2</sup>	P value
<b>A. Socio-demographic factors</b>						
Age (yr)	17-25	66	4	6	1.004	0.3
	26-35	47	1	2.1		
Educational level	Pre-university	68	3	4.4	0.004	0.95
	University degree	43	2	4.6		
Residence	Urban	18	1	5.5	0.07	0.8
	Rural	95	4	4.2		
<b>B. high risk practices:</b>						
Contact with cats	Yes	12	0	0	0.2	0.7
	No	101	5	2.3		
Occupational soil contact	Yes	25	2	8	0.97	0.3
	No	88	3	3.4		
Unhygienic water consumption	Yes	70	4	5.7	0.7	0.4
	No	43	1	2.3		
Undercooked meat consumption	Yes	43	1	2.3	0.7	0.4
	No	70	4	5.7		

Detection of immunoglobulin M (IgM) Ab in serum of pregnant women indicates active *Toxoplasma* infection (Sroka *et al.*, 2010). After obtaining verbal consents, a total of 113 serum samples were collected by lab specialist from pregnant women attending Gynecology and Obstetrical clinics for routine examinations during pregnancy at Kafrelsheikh province during the period between July

and August 2016. The serum samples were analyzed for diagnosis of toxoplasmosis in these pregnant women. Toxoplasmosis was evidenced by the detection of anti-*T. gondii* IgM antibodies using the indirect enzyme-linked immunosorbent assay (ELISA) technique (SERION, Germany) according to manufacturer's instruction.

A questionnaire was designed for investigating possible high-risk practices associated with toxoplasmosis among the at risk pregnant women. The high-risk practices investigated include contact with cat, occupational contact with soil (i.e. farming), consumption of unhygienic water (i.e. without filtration) and consumption of undercooked meat (i.e. hamburgers or grilled minced meat). The questionnaire was piloted then completed by all the 113 pregnant women participants in this study. Association between investigated risk practices and variables as age, education level and residence was also conducted using Pearson Chi-square test by SPSS V21.0 software (IBM, USA).

### 3. Results

*T. gondii* oocysts were detected in two (2%) out of 100 cat fecal samples. The seropositivity of toxoplasmosis in pregnant women in Kafrelsheikh province was 4.4%. Responses to the questionnaire

showed that there was no significant association between seropositivity for toxoplasmosis and age, education level, residence or any of the investigated risk factors (Table 1), however 4/5 (80%) of seropositive pregnant women recorded routine practicing of at least one of the high-risk practices.

Results in Table 2 showed that 93 of the 113 participants (82.3%) routinely practiced at least one of the investigated high-risk practices. Drinking of unhygienic water was the predominant practice (61.9%), while contact with a cat was the lowest (10.6%). Having a pre-university education and residence in rural dwellings were significantly associated with occupational contact with soil. Drinking unhygienic water and consumption of undercooked meat were significantly associated with participants with lower education and residents in urban dwellings, respectively. There was no significant relationship between seropositivity and age, education, residence or contact with cats.

**Table 2.** Association between socio-demographic variables and high-risk practices among pregnant women in this study.

Variables	Groups	Cat contact				Occupational Soil contact				Unhygienic water consumption				Undercooked meat consumption			
		-ve	+ve	$\chi^2$	<i>P</i>	-ve	+ve	$\chi^2$	<i>P</i>	-ve	+ve	$\chi^2$	<i>P</i>	-ve	+ve	$\chi^2$	<i>P</i>
Age	17-25 years	58	8	0.37	0.5	52	14	0.1	0.8	21	45	2.6	0.1	41	25	0.002	0.9
	26-35 years	43	4			36	11			22	25			29	18		
Educational level	Pre-university	58	10	2.8	0.1	47	21	7.03	0.01*	20	48	4.3	0.04*	44	24	0.9	0.3
	University degree	41	2			39	4			21	22			24	19		
Residence	Urban	16	2	0.01	0.9	18	0	3.9	0.04*	9	9	1.3	0.3	5	13	10.6	0.001*
	Rural	85	10			70	25			34	61			65	30		
<b>Total</b>		<b>113</b>	<b>12 (10.6%)</b>			<b>113</b>	<b>25 (22.1%)</b>			<b>113</b>	<b>70 (61.9%)</b>			<b>113</b>	<b>43 (38.1%)</b>		

### 4. Discussion

The prevalence of *T. gondii* oocyst in cat feces was 2%, which was in line with another report from Egypt (2%) by Amany *et al.*, 2012). Higher prevalence (9%) was also reported in Egypt (Khalafalla, 2011). Lower prevalences were reported in several other countries as Romania 1.2% (Mircean *et al.*, 2010), Canada 1.3% (Stojanovic and Foley, 2011) and Iran 1.4% (Khademvatan *et al.*, 2014). Differences in the prevalences among several studies may be attributed to rate of oocyst shedding, life style of the cat (indoor versus outdoor), age of the cat and the prevalence of *T. gondii* in intermediate hosts (i.e. rodents, birds) near cats (Dubey and Beattie, 1988).

The seroprevalence of toxoplasmosis disease in pregnant women in Kafrelsheikh province, Egypt (4.4%) was higher than previous reports in Egypt (2.8%) and Taiwan (1%) by El-Deeb *et al.* (2012) and Hung *et al.* (2015) respectively. However, higher prevalences were reported in Yemen (7.7%) and Thailand (6.7%) by Al-Eryani *et al.* (2016) and Nissapatorn *et al.* (2011), respectively. The wide variation in the seroprevalence of toxoplasmosis in

humans between countries and often within the same country may be due to several factors as dietary habits, cultural habits, socioeconomic status or food and water sanitation (Pappas *et al.*, 2009).

Several practices were reported to increase the possibility of infection with toxoplasmosis. Among these high-risk practices, contact with cat, contact with soil, drinking unhygienic water and consumption of undercooked meat were associated with toxoplasmosis in Egypt and worldwide (Nissapatorn *et al.*, 2011, El Deeb *et al.*, 2012, Al-Eryani *et al.*, 2016 and Ahmadpour *et al.*, 2017).

Also, age, education level and residence place were reported as influential risk factors on toxoplasmosis prevalence among pregnant women (Nissapatorn *et al.*, 2011, Al-Eryani *et al.*, 2016, Hung *et al.*, 2015, Ahmadpour *et al.*, 2017). In this study, there was no significant association between cases of toxoplasmosis and age, education level or residence place. In agreement with our findings, no significant association was found between toxoplasmosis and age in Taiwan (Hung *et al.*, 2015) or education level in Iran (Ahmadpour *et al.*, 2017). Despite that 80% of the

seropositive pregnant women conducted at least one of the high-risk practices, there was no recorded significant association with any of the high-risk practices as contact with cat, occupational contact with soil, consumption of unhygienic water and consumption of undercooked meat. Same findings were reported by Hung *et al.*, 2015 in Taiwan and this could be attributed to the small samples size of the participants in this study (no. = 113), differences in socio-demographic factors between participants in this report and other studies, or association of the infection with other non-investigated variables.

Majority (82.3%) of the participants in this study routinely practiced at least one of the investigated high-risk practices, which highlighted lack of awareness regarding modes of transmission and risks of toxoplasmosis among pregnant women in the study region. Analyzing the association between socio-demographic factors and high-risk practices in this study revealed that participants with lower education (i.e. pre-university) and living in villages were significantly associated with occupational contact with soil. Most of the village residents with low education in Egypt are enrolled in occupations as crop farming, animal rearing or crop harvesting, all of which are associated with soil contact. Contact with soil was significantly associated with toxoplasmosis in another study in Egypt (El-Deeb *et al.*, 2012). Participants with lower education were also more likely to drink unhygienic water ( $p = 0.04$ ). Hung *et al.* (2015) reported that pregnant women with senior high school education were significantly associated with toxoplasmosis than those with bachelor degree. Higher education level may provide a better knowledge regarding toxoplasmosis and hence minimizing the high-risk practices that may lead to infection. On the other hand, consumption of undercooked meat was significantly more common among city residents ( $p = 0.001$ ), which may be attributed to the higher fast-food eating habit associated with the predominance of fast-food restaurants in cities than villages in Egypt. Consumption of undercooked meat was significantly associated with toxoplasmosis in Iran (Ahmadpour *et al.*, 2017).

### Conclusion

The prevalence of toxoplasmosis among pregnant women in the study region was relatively high. The risk of acquiring the infection is high especially when majority of pregnant participants routinely practiced at least one of the investigated high-risk practices. Health promotion and education of pregnant women about the high-risk practices is necessary to create awareness of the disease in this group. *T. gondii* oocyst shedding in infected stray cats feces may cause substantial environmental

contamination. Prevention strategy for *toxoplasma* infection in stray cats should be implemented and pregnant women should be aware of the potential threats posed by stray cats.

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