Seprevalence and risk factors for *Toxoplasma* infection in pregnant women in Jordan

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الانتشار المصلي وعوامل اختطار عدوى المقوَّسات في السيدات الحوامل بالأردن

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الخلاصـة: تم أخذ عينات مصل من 280 من السيدات الحوامل لتحديد الانتشار المصلي وعوامل الاختطار لداء المقوَّسات بين السيدات الحوامل في الأردن، وجرى اختبار هذه العينات ما بين كانون الثاني/يناير 2000 وأيار/مايو 2001. وقد تم أخذ عينات الدم بعد الزيارة الأولى السابقة للولادة. وتم عزل واختبار المصل لكشف وجود أضداد الغلوبين المناعي G الخاص بالمقوَّسة، وذلك باستخدام الضد المتألِّق غير المباشر. وقد بينت الدراسة تزايُدَ الانتشار المصلي تدريجياً مع تقدم العمر من 31.7٪ عند عمر 15-24 عاماً، إلى 90٪ عند عمر 35-45 عاماً. وبرهن التحليل التحوُّفي على أن الانتشار المصلي لداء المقوَّسات يترابط ترابُطاً إيجابياً مع العمر ومكان الإقامة. وكان استهلاك اللحوم غير المطهية وكذلك التلامس مع التربة عاملين من عوامل الاختطار التي يُعْتَدُّ بها إحصائياً.

ABSTRACT To determine the seroprevalence and risk factors for toxoplasmosis among pregnant women in Jordan, sera from 280 pregnant women were tested during the period January 2000–May 2001. Blood samples were taken after the first antenatal visit. Serum was separated and tested for *Toxoplasma* IgG antibodies using an indirect fluorescent antibody. Seroprevalence gradually increased with age, from 31.7% at 15–24 years to 90.0% at 35–45 years. Regression analysis showed that seroprevalence of toxoplasmosis is positively correlated with age and residence. Consumption of undercooked meat and contact with soil were significant risk factors.

Séroprévalence et facteurs de risque de l'infection à toxoplasme chez les femmes enceintes en Jordanie

RÉSUMÉ Afin de déterminer la séroprévalence et les facteurs de risque de toxoplasmose chez les femmes enceintes en Jordanie, on a testé le sérum de 280 femmes enceintes pendant la période de janvier 2000 à mai 2001. Des échantillons sanguins ont été prélevés après la première consultation prénatale pour une recherche d'anticorps IgG anti-toxoplasmes par immunofluorescence indirecte, après séparation du sérum. La séroprévalence augmentait progressivement avec l'âge, passant de 31,7 % dans la tranche d'âge de 15-24 ans à 90,0 % dans la tranche d'âge de 35-45 ans. L'analyse de régression a montré que la séroprévalence de la toxoplasmose était corrélée positivement avec l'âge et le lieu de résidence. La consommation de viande insuffisamment cuite et le contact avec le sol étaient des facteurs de risque significatifs.

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Introduction

Toxoplasmosis is a disease caused by the protozoan parasite *Toxoplasma gondii.* This disease is clinically insignificant in immunocompetent adults. The immunologic response to primary infection is followed by encystment of the parasite (latent toxoplasmosis), providing life-long immunity. Possible reactivation of latent infection in an increasingly immunosuppressed population, however, makes toxoplasmosis an important opportunistic infection [*1*]. In addition, toxoplasmosis has long been known as a major cause of perinatal morbidity [*2*]. Newly acquired *T. gondii* infection in pregnant women can be transmitted to the fetus and cause mental retardation, blindness, epilepsy and death. Toxoplasmosis is, therefore, a serious clinical and public health problem. The prevalence of antibodies to this disease shows considerable variation from country to country and between different population groups within a country [*3,4*].

High *T. gondii* seroprevalence among pregnant women has been reported as reaching 71% in France, 37% in Slovenia, 42% in Italy and 43.4% in Saudi Arabia [*5–8*]. The risk factors for acquisition of *T. gondii* infection have not been previously reported for pregnant women in Jordan. Recent epidemiological studies have identified the following risk factors: owning cats, eating raw or unwashed fruits and vegetables [*8*], eating raw or undercooked lamb, beef and minced meat products [*9*], animal farming [*10*] and having contact with soil [*9*].

This study was conducted to identify the risk factors for *Toxoplasma* infection during pregnancy with a view to improving primary prevention among non-immune pregnant women since the results may be useful to others working in this field.

Methods

On the basis of previously reported prevalence of toxoplasmosis in the north of Jordan, we studied 280 randomly selected pregnant women of a total of around 25 000 women who attended the obstetric outpatient clinic at Prince Rashid Military Hospital between January 2000 and May 2001. Patients at this hospital are mainly dependents of military personnel. Sample size was calculated on the basis of previously reported prevalence of toxoplasmosis in this area [*11*]. Expected prevalence was 26%, range 21%–31%. Sample size calculated at 95% confidence was 210. All the women in this study were living in Irbid and surrounding villages. Blood samples were taken after the first antenatal clinic visit. Serum was separated by blood centrifugation at 3000 rpm for 5 minutes. Samples were stored at –20 °C until analysis in the Department of Biostatistics for IgG anti-*Toxoplasma* antibodies.

Data were collected from all pregnant women by interview using a specially designed, pretested questionnaire. Interviews were conducted in the clinic by staff nurses or a medical technologist. Women were first asked about age, place of residence (urban or rural) and occupation, then they were asked about contact with cats, consumption of raw or undercooked meat, contact with soil and the probable mode of transmission of *Toxoplasma* to assess their knowledge of the source of infection.

The screening for *Toxoplasma*-specific IgG antibodies was performed by indirect fluorescent antibody test using a commercial kit (Gull Laboratories Inc., Salt Lake City, Utah, USA).

After collection, data were coded and entered on the computer using *SPSS,* version 9.0. Then frequency tables, crosstabulation, chi-squared and the association

between different variables were calculated by logistic regression.

The dependent variable was the stable infection: infected (seropositive)/non-infected (seronegative); all other variables were considered independent.

Results

Prevalence of *Toxoplasma* seropositivity

Basic sociodemographic and epidemiological data of the women who participated in this study are presented in Tables 1 and 2. Overall prevalence of *T. gondii* infection was 47.1% (133/280) on the basis of detection of IgG antibodies, which are indicative of previous infection. Prevalence of seropositivity among pregnant women was calculated on the basis of the first trimester findings: number of seropositive pregnancies related to total number of pregnancies.

Sociodemographic characteristics

Analysis of *Toxoplasma* seropositivity by age (Table 1) showed that the risk of *Toxoplasma* infection among pregnant women was significantly greater among the oldest age group ($P < 0.001$). Correlation coefficient (r) and slope found by logistic regression were positive, indicating that increase in age corresponds with increase in seropositivity. Seropositivity was 31.7% for those aged 15–24 years, 48.3% for those aged 25–34 years, and 90.0% for those aged 35–45 years. The study showed a direct correlation between age and positivity for IgG antibodies ($r = 0.286$, slope = 1.147). The risk of *Toxoplasma* infection in the oldest age group was about 3-fold greater than in the youngest age group [odds ratio (OR) = 3.150]. The risk of toxoplasmosis was significantly greater in pregnant women from rural areas compared with those from urban areas ($P =$

Table 1 **Demographic characteristics for *Toxoplasma gondii* seropositive pregnant women**

Characteristic	*Toxoplasma* seropositive (*n* = 132)		*Toxoplasma* seronegative (*n* = 148)		*P*-value
	No.	%	No.	%	
Age group (years)					< 0.0001
15–24 (*n* = 120)	38	31.7	82	68.3	
25–34 (*n* = 120)	58	48.3	62	51.7	
35–45 (*n* = 40)	36	90.0	4	10.0	
Residence					0.002
Urban (*n* = 177)	71	40.1	106	59.9	
Rural (*n* = 103)	61	59.2	42	40.8	
Working outside the home					0.158
Yes (*n* = 87)	47	54.0	40	46.5	
No (*n* = 193)	85	44.0	108	55.7	

Table 2 **Transmission risk factors for *Toxoplasma gondii* seropositive pregnant women**

Variable	*Toxoplasma* seropositive (*n* = 132)		*Toxoplasma* seronegative (*n* = 148)		*P*-value
	No.	%	No.	%	
Consumption of undercooked meat					< 0.0001
Yes (*n* = 64)	48	75.0	16	25.0	
No (*n* = 216)	84	38.9	132	61.1	
Contact with soil					0.022
Yes (*n* = 26)	18	69.2	8	30.8	
No (*n* = 254)	114	44.9	140	55.1	
Keep cats					0.742
Yes (*n* = 25)	11	44.0	14	56.0	
No (*n* = 255)	121	47.5	134	52.5	
Knowledge of transmission					0.012
Yes	2	12.5	14	87.5	
No	130	49.2	134	50.8	

0.002). The risk was about 2-fold greater (r = 0.318, slope = 0.774, OR = 2.168). There was no significant difference in prevalence of *Toxoplasma* infection between housewives and women who were working outside the home (P = 0.158).

Sanitary risk factor

The prevalence of *Toxoplasma* infection was significantly higher among pregnant women who ate undercooked lamb and goat meat, 75.0%, compared with those who did not, 38.9% (r = 0.235, slope = 1.551, OR = 4.714, P < 0.001) (Table 2).

There was no significant difference in prevalence of *Toxoplasma* infection between pregnant women who kept cats in their home, 44.0% (11/25), and those who did not, 47.5% (121/255) (P = 0.742). There was, however, a significant difference between women who worked on the land and had contact with soil, 69.2% se-

ropositive, and those who did not (r = –0.092, slope = 1.016, OR = 2.762, P = 0.022).

Knowledge about transmission of toxoplasmosis

Pregnant women who had knowledge about the mode of disease transmission had significantly lower prevalence of *Toxoplasma* infection (12.5%) than with those having no knowledge (49.2%) (P = 0.012, r = 0.015, slope =1.914, OR = 6.782).

Discussion

The present study demonstrates that prevalence of anti-*Toxoplasma* IgG antibodies in pregnant women in the north of Jordan is 47.1%. This is in agreement with results reported in studies done in some other countries [*12–16*].

The high prevalence of anti-*Toxoplasma* IgG antibodies in pregnant women appears to be a reflection of chronic infection that might have originated through various risk factors, which will be discussed.

The risk of toxoplasmosis among pregnant women was significantly greater among women in the older age group. This finding is in agreement with that reported by Bobic et al., which indicated that *Toxoplasma* infection increased with age from 57% at 18 years to 93% at 50 years, with an overall mean of 77% (*P* = 0.022) [*14*]. Similar findings were reported by Wong et al., who found that the seropositivity of *Toxoplasma* IgG increased with the age of pregnant women [*15*]. The relatively gradual increase in seroprevalence associated with age suggest that soil exposure, which is greatest during childhood years, may not be the principal mechanism by which people in Jordan are exposed to *T. gondii*.

The prevalence of *Toxoplasma* infection was significantly greater among pregnant women who ate undercooked meat (*P* < 0.0001). The association between eating raw or undercooked meat and *Toxoplasma* infection found in this study has also been a consistent finding in previous studies [*18,19*]. The type of meat, however, has varied. In a Norwegian study, undercooked lamb but not beef was identified as a risk factor [*20*], whereas in northern France beef and lamb were both risk factors [*8*]. Evidence from studies that used bioassay suggested that lamb and goat meat were more commonly infected than beef [*21,22*]. The risk of meat being infected depends on the age of the animal, the proportion of time the animal has spent indoors, farm hygiene [*21,23*] and the specific tissues used: non-skeletal muscle (heart, diaphragm and tongue) had a higher density of cysts than skeletal muscle [*24,25*].

The significance of contact with soil for acquisition of infection has been demonstrated by studies showing a higher prevalence of *Toxoplasma* infection in pregnant women who worked on the land or had contact with soil (*P* = 0.022). Contact with soil was identified as a risk factor for *Toxoplasma* infection in pregnancy in this study and in 2 of 3 previous studies that adjusted for confounders [*8,20,26*].

Although in most previous studies cat ownership has been associated with either increased risk for toxoplasmosis seropositivity or no change in risk [*27,28*], in this study, there was no difference in prevalence of infection between those women who kept cats in their home and those who did not (*P* = 0.742). In another study, it was found that possession of cats decreased the risk for seropositivity [*29*].

The study showed there was a significant difference between prevalence of infection in pregnant women who had knowledge about the mode of transmission of toxoplasmosis and those who did not (*P* = 0.012). Comparing our results with similar results obtained by Cook et al. [*9*], lower rates of exposure were observed among women who identified raw meat as a risk factor for toxoplasmosis. Therefore, health promotion strategies should be based on an understanding of the factors affecting women's behaviour [*30*]. Information given by clinicians to groups or via the media may be more effective than written material [*31–33*].

In summary, this study indicated that the seroprevalence of toxoplasmosis is positively correlated with age. Consumption of undercooked meat and contact with soil are significant risk factors.

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