

Seroprevalence and associated risk factors of toxoplasmosis in pregnant women in Hebron district, Palestine

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معدّل الانتشار المصلي وعوامل الخطر المرافقة لداء المقوسات لدى الحوامل في منطقة الخليل، فلسطين
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الخلاصة: لقياس معدّل انتشار داء المقوسات، أجرى الباحثون اختبارات شملت 204 حاملاً للتعرف على الأضداد من الغلوبين المناعي G ومن الغلوبين المناعي M للمقوسات الغوندية باستخدام المقيسة المناعية المرتبطة بالإنزيم، وذلك في منطقة الخليل خلال عام 2005. وقد وجدوا أن معدّل الانتشار المصلي للأضداد من الغلوبين المناعي G للمقوسات الغوندية 27.9٪، وأن معدّل الانتشار المصلي للأضداد من الغلوبين المناعي M للمقوسات الغوندية 17.6٪، مع ازدياد في معدّل الانتشار المصلي للمقوسات الغوندية مع تقدم العمر. وكانت نسبة النسوة الريفيات اللاتي لديهن معدّل الانتشار المصلي للأضداد من الغلوبين المناعي G للمقوسات الغوندية (36.8٪) أكبر مما هي لدى الحضريات (21.4٪). وطرق سراية العدوى المحتملة هي التراب الملوث، وشرب مياه الأمطار، وتناول الخضراوات النيئة أكثر من أكل اللحم غير المطبوخ أو مخالطة القطط. وقد بلغ معدّل انتشار إسقاط سابق 37.3٪ مع ترافق خفيف (ولكن لا يعتد به إحصائياً) مع داء المقوسات.

ABSTRACT To measure the prevalence of toxoplasmosis, we tested 204 pregnant women for IgG and IgM antibodies to *Toxoplasma gondii* using an enzyme-linked immunoassay. The study was conducted in Hebron district during the year 2005. The seroprevalence of IgG antibodies to *T. gondii* was 27.9% while IgM seroprevalence was 17.6%; the seroprevalence of *T. gondii* increased with age. More women from rural areas (36.8%) had IgG antibodies to *T. gondii* than urban women (21.4%). Possible routes of infection were contaminated soil, drinking rainwater and eating raw vegetables rather than eating uncooked meat or contact with cats. The prevalence of previous abortion was 37.3%, with a slight (but not statistically significant) association with toxoplasmosis.

Séroprévalence de la toxoplasmose chez les femmes enceintes du district d'Hébron (Palestine) et facteurs de risque associés

RÉSUMÉ Afin de mesurer la prévalence de la toxoplasmose, nous avons effectué une recherche d'anticorps IgG et IgM anti-*Toxoplasma gondii* chez 204 femmes enceintes au moyen d'un test immunoenzymatique. Cette étude a été menée dans le district d'Hébron au cours de l'année 2005. La séroprévalence des anticorps IgG anti-*T. gondii* était de 27,9 %, alors que celle des anticorps IgM était de 17,6 % ; la séroprévalence de *T. gondii* augmentait avec l'âge. Les femmes vivant en zone rurale qui présentaient des anticorps IgG anti-*T. gondii* étaient plus nombreuses (36,8 %) que celles vivant en zone urbaine (21,4 %). Les voies d'infection possibles étaient les sols contaminés, la consommation d'eau de pluie et de légumes crus, davantage que la consommation de viande non cuite ou le contact avec des chats. La prévalence d'avortements antérieurs était de 37,3 %, avec une association légère (sans être statistiquement significative) avec la toxoplasmose.

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Introduction

Toxoplasmosis is a very common infection caused by the obligate intracellular protozoan parasite *Toxoplasma gondii*. Most *Toxoplasma* infections are asymptomatic, but the implications in pregnant women are manifold. The women may have spontaneous abortions, stillbirths or premature delivery in addition to various fetal anomalies [1,2]. The parasite is transmitted to humans by ingestion of the tissue cysts in raw or undercooked meat, as well as ingestion of food and water contaminated with oocysts from cat faeces [3,4]. Human infection with *T. gondii* is very frequent throughout the world: the seroprevalence ranges from 15% in the United Kingdom to 80% in South America and certain European countries such as France [5]. In developing countries toxoplasmosis is also very frequent: in Turkey, IgG seroprevalence of *T. gondii* among pregnant women was 60% [6] while in India it was 45% [7]. Studies among Arab populations have reported the seroprevalence of toxoplasmosis ranging from 22.9% in the United Arab Emirates [8] to 47% in Jordan [9].

The frequency of severe congenital infections can be limited by early screening for specific antibodies to *T. gondii* in the serum of pregnant women [10]. Many developed countries have implemented a toxoplasmosis screening programme [11,12], however, such programmes have not been implemented in most developing countries, including Palestine. If seroconversion is documented, therapy by sulfadiazine is offered to pregnant women during the first trimester and to the infant until 1 year of age [13].

Only a few studies have been done in Palestine, but not enough to provide the necessary information about toxoplasmosis. The aim of the present study was, therefore, to determine seroprevalence IgG and IgM

antibodies to *T. gondii* among first trimester pregnant women in Hebron district, Palestine.

Methods

Study population

The study was conducted in Hebron district, 40 km from Jerusalem. The district has 400 000 inhabitants and includes the city of Hebron and many villages engaged in agriculture. According to the 1997 population census, 66% of the population live in rural areas [14].

Sampling procedure

The study was carried out on pregnant women aged 16–43 years in their first trimester of pregnancy. They were recruited on their first prenatal visit to an obstetrics/gynaecology clinic in Hebron city during January–August 2005. We gave out invitations and information letters to pregnant women during their first visit to the clinic and all those meeting the inclusion criteria were invited to participate. All agreed to participate and were asked to provide a blood sample and answer a self-reported questionnaire containing sociodemographic questions, including age, number of children, smoking, occupation and date of marriage as well as questions related to route of exposure to the parasite, abortion and number of dead children.

Immunological tests

IgG and IgM antibodies to *T. gondii* were measured using a commercial kit (Platelia Toxo IgG, IgM TMB, Bio-Rad Laboratories) according to the manufacturer's instructions. An aliquot of blood was withdrawn from each woman by a professional clinical laboratory technician. Sera were then separated by centrifugation and stored at -20°C until analysis. Each blood sample

was analysed for the presence of *T. gondii* by identifying serum IgG and IgM antibodies to *T. gondii* using an enzyme-linked immunoassay test.

Data and statistical analysis

The seroprevalence IgG and IgM antibodies to *T. gondii* was calculated among pregnant women in both urban and rural areas. Seroprevalence was also calculated according to different sociodemographic characteristics, including age, occupation and years of marriage, using SPSS, version 12. The association between IgG seropositivity to *T. gondii* and previous abortion was calculated by logistic regression. Odds ratio (OR) was adjusted for age category (16–22, 23–29, 30–43 years), cigarette smoking (yes, no) and main occupation (housewife, other). Calculated 95% confidence intervals (95% CI) that did not include the null value were considered statistically significant. Frequencies, and means and standard deviations (SD) of sociodemographic and lifestyle factors were also calculated.

Results

Altogether, all 204 eligible women agreed to participate in the study. The mean age of the sample was 26.4 (SD = 6.1) years; 57.4 % of the sample were from Hebron city ($n = 117$) with a mean age of 25.5 (SD = 6.0) years. The rest were from the rural area of Hebron district (Table 1). The pregnant women from the villages [mean age 27.7 (SD = 6.0) years] were slightly older than those from the city. The mean age at marriage was 19.3 (range = 12–38; SD 3.7) years. The majority of the participants (80.4%) were housewives (did not work outside the home). Keeping cats and eating raw meat were not common among the women we studied. Sociodemographic and lifestyle characteristics are shown in Table 1.

The overall seroprevalence of IgG antibodies to *T. gondii* was 27.9%. A higher prevalence of *T. gondii* IgG antibodies was seen among women from the rural areas (36.8%) compared with those from the city (21.4%). The highest prevalence of *T. gondii* IgG antibodies (38.2%) was seen in the age stratum 30–43 years, while the age group 16–22 showed the lowest IgG seroprevalence (17.9%). Housewives had a higher IgG seropositivity, 29.3%, compared with others (22.5%) (Table 2).

Few of the women kept cats: only 1 woman kept a cat inside the house, while 14 kept a cat outside (Table 1). Among these, *T. gondii* IgG seroprevalence was 100.0% ($n = 1$) and 21.4% ($n = 3$) respectively.

Previous abortion was reported by 37.3% of the participants, with a slightly higher prevalence in urban women (Table 1). *T. gondii* IgG seroprevalence was significantly higher among women from rural areas who had previously had an abortion (50.0%) than those from the city (20.5%) ($P = 0.007$).

Overall, the seroprevalence of IgM antibodies to *T. gondii* was 17.6%; it was higher among those from rural areas (19.5%), women married at age < 20 years (18.7%), and housewives (18.3%) (Table 2). *T. gondii* IgM seroprevalence among women who had had an abortion was 18.4% ($n = 147$) (Table 3). Both IgG and IgM antibodies to *T. gondii* were found in 6.4% of the sample.

The association between previous abortion and toxoplasmosis was estimated using logistic regression. A slight, but not statistically significant, association was found between previous abortion and *T. gondii* IgG seropositivity (OR = 1.47; 95% CI: 0.79–2.7). When the OR for abortion was adjusted for age, smoking and occupation, a slightly higher, but still not statistically significant, association was found (adjusted OR = 1.67; 95% CI: 0.88–3.2).

Table 1 Sociodemographic characteristics of pregnant women (n = 204) from urban and rural areas of Hebron district, 2005

Characteristic	Urban (n = 117; 57.4%)		Rural (n = 87; 42.6%)		Total (n = 204)	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	25.5	6.0	27.7	6.0	26.4	6.1
Age at marriage (years)	19.4	4.0	19.2	3.3	19.3	3.7
	No.	%	No.	%	No.	%
Age group (years)	47	40.2	20	23.0	67	32.8
16–22	37	31.6	32	36.8	69	33.8
23–29	33	28.2	35	40.2	68	33.3
30–43	47	40.2	20	23.0	67	32.8
Age at marriage (years) ^a						
< 20	73	63.5	50	57.5	123	60.3
≥ 20	42	36.5	37	42.5	79	39.1
Smoking	8	6.8	0	0.0	8	3.9
Occupation						
Housewife	96	82.1	68	78.2	164	80.4
Secretary	1	0.9	0	0.0	1	0.5
Schoolteacher	6	5.1	9	10.3	15	7.4
Nurse	1	0.9	1	1.1	2	1.0
Other	13	11.1	9	10.3	22	10.8
Keeps a cat						
In the home	1	0.9	0	0.0	1	0.5
Outside the home	10	8.5	4	4.6	14	6.9
Eats raw meat	3	2.5	5	5.7	8	3.9
Previous abortion	44	37.6	32	36.8	76	37.3

^a2 urban cases missing (n = 115).

SD = standard deviation.

Discussion

In this study overall seropositivity to *T. gondii* among pregnant women (IgG seroprevalence) was 27.9%, which means that about 72% of pregnant women are at risk of acquiring the infection if they are exposed during pregnancy, and consequently could transmit the infection to the fetus. The IgG seroprevalence of *Toxoplasma* increased with age: older women are more susceptible to the parasite than younger women as a result of longer exposure time. Our findings are consistent with those of other researchers in Jordan and Turkey [9,15].

Although cats are the main host for *Toxoplasma*, this is not the main route of

infection worldwide [16]. Eating uncooked food was found to be a major factor in transmitting the parasite in a number of countries [16], including the Arab population of Israel [13] and Jordan [17]. However, in Hebron district, keeping cats inside houses as well as eating raw or undercooked meat were not common (Table 1). This might be related to cultural behaviour: meat is usually cooked thoroughly before serving. The possible route of infection in the Hebron population might involve other factors such as contact with contaminated soil, water and vegetables [9]. The IgG seropositivity of *Toxoplasma* was higher among women from rural areas, which could be related to

Table 2 Seroprevalence of IgG and IgM antibodies to *Toxoplasma gondii* in urban and rural pregnant women according to sociodemographic characteristics

Characteristic	Seroprevalence											
	Urban (n = 117)				Rural (n = 87)				Total (n = 204)			
	IgG		IgM		IgG		IgM		IgG		IgM	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
<i>Age group (years)</i>												
16–22	8	17.0	9	20.5	4	20.0	7	36.8	12	17.9	16	25.4
23–29	8	21.6	6	16.2	11	34.4	3	10.0	19	27.5	9	13.4
30–43	9	27.3	5	16.1	17	48.6	6	17.6	26	38.2	11	16.9
<i>Age at marriage (years)</i>												
< 20	11	15.1	13	17.8	19	38.0	10	20.0	30	24.4	23	18.7
≥ 20	14	33.3	7	16.6	13	35.1	6	16.2	27	34.2	13	16.5
<i>Occupation</i>												
Housewife ^a	21	21.9	17	17.7	27	39.7	13	19.1	48	29.3	30	18.3
Other	4	19.0	3	7.5	5	26.3	3	7.5	9	22.5	6	15.4
Total	25	21.4	21	17.9	32	36.8	17	19.5	57	27.9	36	17.6

^aNot working outside the home.

agricultural activities. Agricultural activities in Hebron district are mainly family-run businesses, where husbands, wives and children (both sexes) help in planting, harvesting and collecting vegetables [18]. During their work they would be susceptible to parasitic infection through direct contact with soil and plants contaminated with *Toxoplasma* oocysts shed in cat faeces. At the same time, most houses in the city have small gardens where vegetables are grown. These gardens are irrigated by rainwater collected in special containers put beside the houses to collect water during the winter to support families during the water shortages in

summer. Collected water is often used for drinking without boiling or addition of chloride for sterilization. Such water is expected to be highly contaminated with different organisms, including *Toxoplasma* oocysts.

The fact that most of the women in our sample were housewives might increase the seroprevalence of toxoplasmosis since they are usually in direct contact with vegetables during food preparation. These vegetables are usually collected from house gardens (where cats are often seen) and eaten without washing. In the absence of poor hand hygiene, these vegetables could be a main route for infection [19,20]

Table 3 Seroprevalence of IgG and IgM antibodies to *Toxoplasma gondii* among women who had previously aborted (n = 76)

Antibody	Seroprevalence					
	Urban (n = 44)		Rural (n = 32)		Total (n = 76)	
	No.	%	No.	%	No.	%
IgG	9	20.5	16	50.0	25	32.9
IgM	7	15.9	7	21.9	14	18.4

Overall IgM seroprevalence was 17.6%, the proportion of cases negative for IgG and positive for IgM was 11.3%; this reflects the risk among pregnant women with a recent infection who might transfer the parasite to the fetus. However, the interpretation of IgM positivity as an indication of recent infection requires additional laboratory confirmation, either by the demonstration of a significant rise in the IgM antibody titres in sequential serum samples or by using PCR for the *Toxoplasma* genome in the amniotic fluid of the fetus [13]. Determining time of infection in pregnant women is particularly important because infection before conception poses no substantial risk for transmission of infection to the fetus, but infection after conception does pose such a risk [21].

There was a slight (but not statistically significant) association between previous abortion and toxoplasmosis. Both IgG and IgM seroprevalence were much higher among women from rural areas who had had previous abortion compared with women from the city, although the actual prevalence of previous abortion was slightly

higher among women from the city (37.6%) compared to those from rural areas (36.8%). This could indicate the presence of other factors, such as early marriage, that may contribute to abortion; 63.5% of the urban women married at age < 20 years compared to 57.5% in rural areas. Furthermore, 10.9% of the selected women had married at age ≤ 15 years (data not shown), thus early marriage could be a potential risk factor for previous abortion among studied cases [22].

To conclude, our results showed that women in Hebron district are susceptible to the toxoplasmosis parasite. The implementation of regular serological testing during pregnancy is important to reduce the effects of the disease on mothers as well as on newborn babies.

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