

Seroprevalence of *Toxoplasma gondii* infection among immigrant and native pregnant women in Eastern Spain

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Abstract In European countries, toxoplasma antenatal screening is recommended to prevent toxoplasmosis. The seroprevalence of these infections in immigrants can be different than in native population. From February 2006 to June 2010, a cross-sectional study was carried out in all pregnant women attended at a reference unit in Elche, Spain. An enzyme immunoassay was used for detection of IgG antibodies against *Toxoplasma gondii*. For each immigrant woman, one Spanish pregnant woman of the same age cared for in the same day was recruited (Spanish control group). A total of 1,627 migrant pregnant women participated in this study. The adherence to screening among migrants was 91.9% (95% CI, 90.5–93.1%), similar than that found in Spaniards (92.2%; 95% CI, 90.8–93.4%). Among migrant women, 619 were positive for IgG anti-*T. gondii* antibodies (41.4%; 95% CI, 38.9–43.9%), compared with 12.0% (95% CI, 10.5–13.8%) among Spaniards (odds

ratio (OR), 5.2 (95% CI, 4.3–6.3). Seroprevalence in pregnant women from Latin America, northern Africa, Eastern Europe, Africa Sub-Saharan and Western Europe was higher than in the Spanish control group (OR, 5.4, 5.8, 6.5, 5.4, and 2.4, respectively; $p < 0.001$). No Asian pregnant woman was immune. Seroprevalence increased with increasing age in migrant pregnant women: 15–25 years, 38.2%; 26–35 years, 40.7%; and 36–45 years, 52.8%. The seroprevalence of *T. gondii* infection in migrant pregnant women living in Spain was higher than in the native population. However, no cases were found in Asian immigrants, highlighting the importance of primary prevention of this infection in pregnant women coming from that geographic region.

Introduction

Toxoplasmosis is a worldwide endemic disease caused by an obligate intracellular parasite, *Toxoplasma gondii*. Toxoplasmosis during pregnancy can cause congenital infection and manifest as mental retardation and blindness in the infant. The severity of fetal diseases varies inversely with the gestational age at which maternal infection occurs (Tenter et al. 2000).

Seroprevalence estimated for human population varies greatly among different countries, among different geographical areas within one country and among different ethnic groups living in the same area (Tenter et al. 2000). Seroprevalence of *T. gondii* infection in women at childbearing age ranges between 4–100% (Ertug et al. 2005; Montoya and Liesenfeld 2004). The highest rates have been found in countries from Central and South America, Africa and Asia (>60%) (Lin et al. 2008; Montoya and Liesenfeld 2004; Rosso et al. 2008). Over

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the past few decades, seroprevalence of *T. gondii* infection has been decreasing both in developed countries and to a lesser extent in developing countries (Montoya and Liesenfeld 2004).

The large wave of immigration in Spain has occurred within the last 10 years. Between 1998 and 2009, the number of foreigners registered in Spain has grown more than six times, from 637,058 to 6,466,278, which in 2009 accounted for 13.8% of the total Spanish population. Of the immigrant population, 1.35 million were born in the European Union (including 762,000 in Romania), 2.45 million are from Latin America and 1.04 million are from Africa (including 245,000 from Sub-Saharan) and Asia 323,000 (Instituto Nacional de Estadística 2010). The mobile population to Spain has changed the prevalence of different infectious diseases, including viral hepatitis, Chagas disease and syphilis (Manzardo et al. 2008; Monge-Maillo et al. 2009).

In Spain, serological screening is recommended to prevent congenital toxoplasmosis as part of the antenatal protocol. There are a few studies of seroprevalence of *T. gondii* infection in immigrant pregnant women in Spain (Bartolomé Alvarez et al. 2008) and other Western countries (Tomasoni et al. 2010). The objective of this study was to investigate (1) the prevalence of *T. gondii* infection and (2) adherence to the screening national programme in immigrant pregnant women in Eastern Spain according to countries of origin.

Patients and methods

From January 2006 to May 2010, a cross-sectional study was conducted in all pregnant women attended at Hospital General Universitario de Elche, Alicante, a general medical centre located in the Mediterranean Coast of Spain. During the study period, the hospital provided medical care to 290,481 inhabitants, from three municipalities: Crevillente (28,609 inhabitants), Elche (230,112 inhabitants) and Santa Pola (31,760 inhabitants), distributed in 11 primary care centres. A total of 44,341 of them were foreign people: 12,955 from Latin America and The Caribbean (29.9%), 11,271 were from Western Europe (25.4%), 9,330 were from Eastern Europe (2.0%), 7,508 were from Northern Africa (16.9%), 1,666 from Africa Sub-Saharan (3.7%) and 1,611 from Asia (3.6%). All immigrant women attending the antenatal clinic during the weeks previous to delivery were invited to participate and recruited in a consecutive manner (migrant group). For each immigrant enrolled, one Spanish pregnant woman with the same age attending in the same day was recruited (Spanish control group). Informed consent was obtained from all subjects. Blood samples for anti-*T. gondii* antibody testing were also taken in the first

term of gestation for antenatal routine examination in primary care centres. The age and country of origin were collected in a case sheet specially designed for this study. The migrant population were divided in six groups according the geographical area of birth (Central and South America and The Caribbean, Northern Africa and Middle East, Sub-Saharan Africa, Eastern Europe, Western Europe and Asia).

The detection of IgG antibodies against *T. gondii* was performed by an enzyme immunoassay (Enzygnost toxoplasmosis/IgG, Siemens, Marburg, Germany), according to the manufacturer's instructions.

A descriptive analysis was performed by setting the rates. The adherence to screening programme among migrant and Spanish women were calculated by the number of pregnant women in which an anti-*T. gondii* antibody test was performed in the primary care centre divided by total of pregnant women included in the study. We obtained estimates of the prevalence with confidence intervals (CI) of 95% by the method of Fleiss. We calculated the odds ratio (OR) with 95% of CI of each group of migrants with respect to the Spanish group (reference category).

Results

A total of 1,627 migrant pregnant women participated in this study. The distribution according to geographical area of birth was as follows: Latin America and The Caribbean (564; 34.6%), Northern Africa and Middle East (550; 33.8%), Eastern Europe (288; 15.7%), Sub-Saharan Africa (99; 6.1%), Asia (77; 4.7%) and Western Europe (49; 3.0%). The main country of origin was Morocco (492; 33.8%), followed by Romania (209; 12.8%) and Colombia (163; 10%) as shown in Table 1. Epidemiological data of participants by geographical distribution and country of birth are shown in Table 2. The mean age was 28.4 years (range, 15–45 years). Women from Eastern Europe were significantly younger than those coming from other geographical areas (29.9 years; $p < 0.001$). The mean time elapsed from arrival to Spain to consultation at the antenatal clinic was 48 months (range, 1 week to 170 months); this period was longer for pregnant women from Latin America and Western Europe (60 months in both regions) and lower for those from Northern Africa and Asia (36 months in both regions).

The adherence to the screening programme among migrants was 91.9% (95% CI, 90.5–93.1%), similar to Spaniards (92.2%; 95% CI, 90.8–93.4%). The adherence was lower in women from Western Europe (83.7%; 95% CI, 70.9–91.4%; $p = 0.05$) (Table 3).

IgG anti-*T. gondii* antibodies were positive in 619 of 1,495 (41.4%; 95% CI, 38.9–43.9%) migrant women and

Table 1 Countries of birth of 1,627 immigrant pregnant women included in the study

Countries	Number
Latin America and the Caribbean	
Total	564 (34.6)
Colombia	163 (10.0)
Ecuador	127 (7.8)
Argentina	82 (5.0)
Paraguay	44 (2.7)
Bolivia	39 (2.4)
Brazil	29 (1.8)
Cuba	17 (1.0)
Uruguay	15 (0.9)
Venezuela	14 (0.9)
Peru	8 (0.5)
Mexico	7 (0.4)
Chile	6 (0.4)
Dominican Republic	4 (0.2)
Others	9 (0.5)
Northern Africa and Middle East	
Total	550 (33.8)
Morocco	492 (30.2)
Algeria	51 (3.1)
Others	7 (0.4)
Eastern Europe	
Total	288 (17.7)
Romania	209 (12.8)
Russia	21 (1.3)
Bulgaria	17 (1.0)
Lithuania	10 (0.6)
Ukraine	9 (0.6)
Georgia	7 (0.4)
Poland	7 (0.4)
Moldavia	4 (0.2)
Others	4 (0.2)
Africa Sub-Saharan	
Total	99 (6.1)
Nigeria	44 (2.7)
Senegal	21 (81.3)
Mali	11 (0.7)
Mauritania	8 (0.5)
Cameroon	6 (0.4)
Others	17 (1.0)
Asia	
Total	77 (4.7)
China	75 (4.6)
Others	2 (0.1)
Western Europe	
Total	49 (3.0)
UK	14 (0.9)
France	10 (0.6)

Table 1 (continued)

Countries	Number
Belgium	4 (0.2)
Others	21 (1.3)

Date are no. (%) of patients unless otherwise indicated

179 of 1,488 (12.0%; 95% CI, 10.5–13.8%) Spaniards (OR, 5.2; 95% CI, 4.3–6.3). The seroprevalence for pregnant women from Latin America, Northern Africa, Eastern Europe, Africa Sub-Saharan and Western Europe are shown in Table 3. In pregnant women from all these areas, the prevalence was higher than that found in Spaniards (OR, 5.4%, 5.8%, 6.5%, 5.4%, and 2.4%, respectively; $p < 0.001$). No Asian pregnant woman was immune (OR, 0.0; 95% CI, 0.0–38.5%). Seroprevalence increased with increasing age in both migrants and Spaniards: 15–25 years: 38.2% and 7.4%, respectively; 26–35 years: 40.7% and 12.2%, respectively; and 36–45 year 52.8% and 23.7%, respectively. The increase in seroprevalence with age was seen in migrant women from all geographic areas (Fig. 1).

Discussion

In the current study, the seroprevalence of *Toxoplasma*-specific IgG was 12.0% in native pregnant women. In native women at childbearing age in Spain, a seroprevalence between 16% to 29% has been found during the last decade (Bartolomé Alvarez et al. 2008; Gutiérrez-Zufiaurre et al. 2004; Muñoz Batet et al. 2004). Our study confirms that *T. gondii* prevalence has continued to decline, approaching the seroprevalence of Northern European countries as The Netherlands (Hofhuis et al. 2010), Norway (Chen et al. 2005), Sweden (Evensgård et al. 2001) or UK (Nash et al. 2005).

The seroprevalence of *Toxoplasma* specific IgG was 41.1% in migrant pregnant women, significantly higher than in the native pregnant women. Other studies performed in Spain and in other European countries have also recorded a higher rate of infection among migrant pregnant women than those found in native populations (Bartolomé Alvarez et al. 2008; Tomasoni et al. 2010)

The seroprevalence in women from Latin America, Northern Africa and Sub-Saharan Africa was around 43%, a figure slightly lower than that found in women from Eastern Europe countries (47%). The seroprevalence in women coming from Western Europe countries was 24.4%, lower than in developing countries and slightly higher than in Spaniards. Noteworthy, in women coming from Asia, mainly from China, not a single case of *T. gondii* infection was detected.

Table 2 Epidemiological data of immigrant pregnant women included in the study

	All migrant (n=1,627)	Latin America and the Caribbean	Northern Africa and Middle East	Eastern Europe	Africa Sub-Saharan	Asia	Western Europe	Spaniards (n=1,616)
Median age (years (IQR))	28.4 (24.0–32.7)	28.9 (24.5–33.0)	28.6 (23.6–33.5)	25.9 (22.6–29.7)*	29.0 (26.7–33.3)**	28.2 (26.0–31.8)	31.9 (29.5–33.9)*	28.6 (24.3–32.6)
Age								
16–25	587 (36.1)	185 (32.8)	207 (37.6)	148 (51.4)	23 (23.2)	18 (23.4)	6 (12.2)	549 (34.0)
26–35	827 (50.8)	29 (52.8)	257 (46.7)	121 (42.0)	61 (61.6)	54 (70.1)	36 (73.5)	878 (54.3)
36–45	213 (13.1)	81 (14.4)	86 (15.6)	19 (6.6)	15 (15.2)	5 (6.5)	7 (14.3)	189 (11.7)
Median pre-consultation period ((IQR) months) ^a	48 (24–80)	60 (36–84)*	36 (12–76)**	41 (24–72)	48 (24–72)	36 (21–60)***	60 (24–120)***	–

Date are no. (%) of patients unless otherwise indicated IQR: interquartile range (25th–75th percentile)

^a Defined as months elapsed from arrival to Spain to consultation at antenatal clinic in months

* $p < 0.001$; ** $p = 0.008$; *** $p = 0.03$ (significant difference of the corresponding characteristic with respect to the test)

The seroprevalence of *T. gondii* among migrant women in Spain reflects the prevalence of *T. gondii* specific IgG antibodies in their countries of birth, because the immigration in Spain is a recent fact. In this study, the majority of the women had been in Spain by less than 5 years, and the infection probably had been acquired in their country of origin. In survey studies carried out in Latin America, the seroprevalence varied from 30% in Chile (Contreras et al. 1995) to 46% in Colombia (Rosso et al. 2008) and 65% in Brazil (Fernandes et al. 2009). Human toxoplasmosis is endemic in Morocco where the seroprevalence is above 50% (El Mansouri et al. 2007) and the age plays a role in the epidemiology of the infection (Laboudi et al. 2009). A recent study performed in Qatar has found different prevalence rates of *T. gondii* according to origin of the patients: from 25% in patients from the Arabian Peninsula to 45% in people from African countries (Abu-Madi et al. 2008). Epidemiologic data published in the medical literature from Romania (Eastern Europe) are scanty. The seroprevalence of *T. gondii* antibodies among pregnant women is about 44% (Crucerescu 1998). Seroepidemiological studies from different Western Sub-Saharan African countries show prevalence rates ranging from 27 to 45% (Akinbami et al. 2010; Faye et al. 1998; Kamani et al. 2009).

The reported prevalence of *T. gondii* infection in the Chinese population is around 7–12%, but the sample size of most serological surveys have been limited (Liu et al. 2009; Xiao et al. 2010). Nevertheless, the prevalence has been generally lower than that found in other developed countries (Montoya and Liesenfeld 2004). This low prevalence of *T. gondii* among Chinese people is in line with the fact that we did not find a single case of the infection among the 73 women tested in our survey. Therefore, in our area is very important to inform Chinese pregnant women about the risk factors for acquiring toxoplasmosis in order to prevent the infection (mainly avoidance of consuming raw meat).

Interestingly, the age related trend in prevalence of IgG antibodies has been seen in each of the six groups representing countries of origin of the patients, as well as in the native pregnant women. The overall trend in each regional group was similar, indicating that there is ongoing and repeated exposure to *T. gondii* in all groups in the countries of origin, including Spain. The increasing seroprevalence with age highlights the continuing need to educate women of childbearing age about the risk factors for acquiring toxoplasmosis.

The adherence to the screening programme of *T. gondii* infection to prevent congenital toxoplasmosis among migrant pregnant women was similar than in Spaniards. This is probably related to the fact that in Spain the National Health Service is accessible free of charge for all population with independence of the irregular or regular

Table 3 Adherence to screening programme and seroprevalence of IgG anti-*Toxoplasma cruzi* antibodies in immigrant and native pregnant women

	No. of screened people/no. of women included in the study	Prevalence (95% CI)	OR ^a (95% CI)
Adherence to screening programme			
All migrants	1,496/1,627	91.9 (90.5–93.1)	0.9 (0.6–1.2)
Latin America and the Caribbean	512/564	90.8 (88.1–92.9)	1.2 (0.8–1.8)
Northern Africa and Middle East	512/550	93.1 (90.7–94.9)	1.4 (0.9–2.0)
Eastern Europe	264/288	91.7 (87.9–94.3)	1.0 (0.6–1.6)
Africa	94/99	94.9 (88.7–97.8)	1.7 (0.7–4.1)
Asia	73/77	94.8 (87.4–97.9)	1.6 (0.6–4.4)
Western Europe	41/49	83.7 (70.9–91.4)	0.5 (0.2–0.9)
Spaniards	1,490/1,616	92.2 (90.8–93.4)	
Seroprevalence of IgG anti- <i>Toxoplasma gondii</i>			
All migrant	619/1,495	41.4 (38.9–43.9)	5.2 (4.3–6.3)
Latin America and the Caribbean	218/512	42.6 (38.4–46.9)	5.4 (4.3–6.9)
Northern Africa and Middle East	227/512	44.3 (40.1–48.7)	5.8 (4.6–7.4)
Eastern Europe	124/263	47.1 (41.2–53.2)	6.5 (4.9–8.7)
Africa	40/94	42.6 (33.0–52.7)	5.4 (3.5–8.4)
Asia	0/73	0.0 (0.03–4.9)	0.0 (0.0–38.5)
Western Europe	10/41	24.4 (13.9–39.5)	2.4 (1.2–4.8)
Spaniards	179/1,488	12.0 (10.5–13.8)	

OR odds ratio, CI confidence interval

^a The reference of OR was the Spaniards group

legal situation of the people living in the country. In Italy, the adherence to screening programme was lower in immigrant than in native pregnant women (Tomasoni et al. 2010).

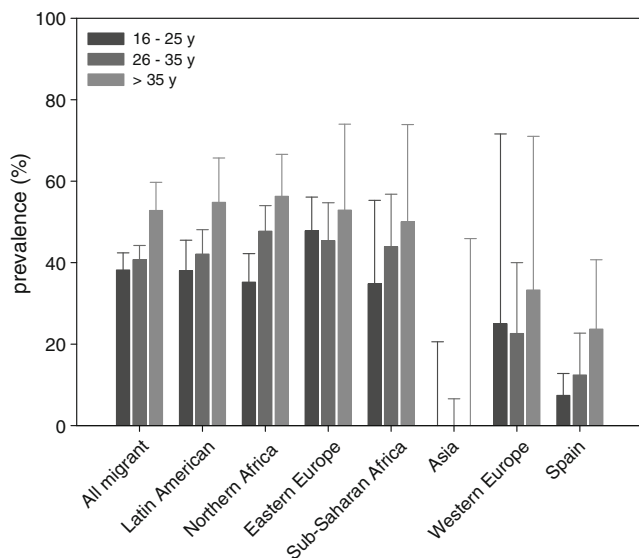


Fig. 1 Seroprevalence of IgG anti-*Toxoplasma cruzi* antibodies in immigrant and native pregnant women stratified by age group 16 to 25, 26 to 35 and more than 35 years

Although our data cannot be considered to reflect prevalence rates throughout the entire population, they provide a quantitative data on toxoplasmosis in the human community in Spain according of country of origin. The study has some limitations. The sample size was restricted by the characteristics of Spanish immigrant populations. As a result, Asian women were less represented and the estimates are therefore less accurate. We did not collect risk factors associated with acquisition of *T. gondii* infection as contact with cats, eating undercooked meat, working with soil or drinking beverages prepared with unboiled water.

In summary, the study confirms that the prevalence of *T. gondii* infection continues to decline in native Spanish population, thus contrasting with the high prevalence found in migrants from most geographic regions, except those coming from Asia. Targeted programmes aimed to primary prevention of toxoplasmosis in Asian pregnant women are warranted.

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