Seroepidemiology of toxoplasmosis in primigravida women in Hamadan, Islamic Republic of Iran, 2004

M. Fallah,¹ S. Rabiee,² M Matini¹ and H Taherkhani¹

الوبائيات السيرولوجية لداء المقوَّسات لدى بِكَريَّات الحمل في مدينة همدان، جمهورية إيران الإسلامية، 2004

محمد فلاح، صغرا ربيعي، محمد متيني، حشمت طاهر تاحرخاني

الخلاصة: قام الباحثون في هذه الدراسة بتحديد مدى انتشار أضداد المقوسات لـدى 576 امرأة من بكريَّات الحمل، تم انتقاؤهن عشوائياً من وحدات الرعاية الصحية الأولية في مدينة همدان. وتم تقييم العلاقة بين الإيجابية للأضداد وبين بعض عوامل الاختطار. وجُمعت المعطيات عن طريق استبيان، وفُحصت عينات من الـدم لتحرِّي أضداد المقوَّسات باستخدام اختبار الضد المتألق غير المباشر. وبيَّنت الدراسة أن هؤلاء النسوة الـ 576 كانت 193 منهن (نسبة 3.5.٪) إيجابيات لأضداد المقوسات (العيار كـ 2011). وتبيَّن أيضاً أن العمر، وتناوُل اللحم الطازج الناقص الطبخ، وتكرار تناوُل الخضراوات النيَّة، كل هذه تـترابط ترابُطاً يُعتَدُّ به إحصائياً مع ارتفاع معدلات والنشاط الزراعي، وطريقة غسل الخضراوات، وتناوُل اللبن غير المعليم، ولمس القطط، والتعامل مع اللحم النيِّئ،

ABSTRACT We determined the prevalence of *Toxoplasma* antibodies in 576 primigravid women randomly selected from health houses in Hamadan. The relationship between positivity and some risk factors was assessed. Data were collected by questionnaire and blood samples examined for *Toxoplasma* antibodies by indirect fluorescent antibody test. Of the 576 women, 193 (33.5%) were positive for *Toxoplasma* antibodies (titre \geq 1:20). Age, consumption of fresh undercooked meat and frequent consumption of raw vegetables were statistically significantly associated with higher infection rates. Educational level, touching cats, handling raw meat, farming, method of washing vegetables and consumption of raw milk and eggs were not associated with infection.

Séroépidémiologie de la toxoplasmose chez la femme primipare à Hamadan (République islamique d'Iran) en 2004

RÉSUMÉ Nous avons déterminé la prévalence des anticorps antitoxoplasmiques au sein d'un échantillon aléatoire de 576 femmes primipares sélectionnées dans les maisons de santé à Hamadan et évalué la relation existant entre la séropositivité et certains facteurs de risque. Les données ont été collectées par le biais d'un questionnaire, et la recherche d'anticorps anti-*Toxoplasma* dans les prélèvements sanguins a été effectuée par immunofluorescence indirecte. Sur les 576 femmes testées, 193 (33,5 %) étaient séropositives pour les anticorps antitoxoplasmiques (titre \ge 1:20). Il est apparu une association statistiquement significative entre un taux d'infection accru et l'âge, la consommation de viande fraîche mal cuite et la consommation fréquente de légumes crus. Par contre, nous avons constaté l'absence d'association entre l'infection et le niveau d'instruction, le contact des chats, la manipulation de viande crue, le jardinage, la méthode de lavage des légumes ou la consommation de lait et d'œufs crus.

¹Department of Parasitology; ²Department of Obstetrics and Gynaecology, School of Medicine, Hamadan University of Medical Sciences, Hamadan, Islamic Republic of Iran (Correspondence to M. Fallah: mohfall@yahoo.com). Received: 21/08/05; accepted: 13/12/05

Introduction

Infection by the protozoan parasite Toxoplasma gondii is widely prevalent in animals and humans throughout the world [1]. The ingestion of food and water contaminated with oocysts from infected cat faeces or the ingestion of tissue cysts from ingested meat are 2 major sources of T. gondii infection in humans [2]. Prevalence data for human infection vary from place to place for reasons that remain largely obscure. The importance of toxoplasmosis is primarily in pregnant women, organ transplantation patients and immunodeficient individuals [3-5]. With yearly seroconversion rates of 3%-5%, fetal risk is high because more mothers in the childbearing range of 20 to 30 years become infected. Congenital toxoplasmosis is a major problem in most communities with a high prevalence of T. gondii infection and study of the seroepidemiology of this infection among women of reproductive age could provide appropriate approaches to preventive measures [6, 7].

The prevalence of *Toxoplasma* infection in different population groups and different parts of the Islamic Republic of Iran as reported in different studies is shown in Table 1. It has been reported to be: 49.6% in the south-west region, 55.7% the northern region, 36.4% in the western region, 26% in the southern region and 27.4% in some central areas. Seropositivity in intermediate hosts such as sheep, goats, cattle and birds was: 24.5% to 61% for sheep, 17% to 19% for goats, 11% for cattle and 29% for domestic fowl [8–24].

Results of previous surveys carried out in the Islamic Republic of Iran indicate that *Toxoplasma* infection is quite high. Despite several reports of *Toxoplasma* antibody determination in the general population [12,16], few seroepidemiological studies have been performed in pregnant women, particularly in primigravidas. There are certain factors in Hamadan province (west of the country) which may increase the risk of *Toxoplasma* infection; for example, the large population of stray cats, especially in the capital of the province, the traditional way of preparing certain foods, and the consumption of underdone mutton and chicken (as kebab). The present study was therefore carried out to determine the prevalence of *Toxoplasma* antibodies in primigravid women admitted to prenatal care units in Hamadan and investigate certain risk factors for infection.

Methods

The investigation was carried out in Hamadan province, in western Islamic Republic of Iran, which has a population of about 1.7 million. Most areas of the province are mountainous (about 1200 m altitude) and the main occupation of the people is agriculture. The average temperature is 9 °C (varying from -28 °C in the winter to 36 °C in the summer) and the annual rainfall varies from 11 to 141 mm.

In the Iranian health system, all pregnant women have a health file in the urban and rural health houses for periodical, prenatal and antenatal check-ups. The study population was all women who had health files in the health houses of the province. The study sample was selected randomly, using a random table, from the health files of the target population. All the files of multiparous and non-pregnant women were excluded and only primigravid women were included for sampling. Sample size was calculated assuming a prevalence of 40% (as reported in similar regions), a degree of precision of 4 and 95% confidence interval. Therefore, the sample size was calculated as 576 primigravid women.

Table 1 Seroprevalence of *Toxoplasma* infection in humans and animals in different areas of the Islamic Republic of Iran

Population	Number examined	Positive d (%)	Test	Date [reference]		
Humans						
Gilan and Mazandaran	1779	55.7	IFA	1978 [<i>8</i>]		
Khuzestan	1806	49.6	IFA	1993 [<i>9</i>]		
Azerbaijan and Khuzestan	3370	12.8	IFA	1981 [<i>10</i>]		
Gilan (Roodsar)	975	86.3	IFA	1994 [<i>11</i>]		
Malayer	917	41.3	IFA	1994 [<i>12</i>]		
Hamadan (women 15–45 yeas)	360	38.9	IFA	2003 [<i>13</i>]		
Kermanshah (pregnant women)	495	32.7	IFA	1994 [<i>14</i>]		
Kermanshah (total)	1837	36.4	ELISA	2004 [<i>15</i>]		
Fars	300	26	IFA	1978 [<i>16</i>]		
Chaharmahal Bakhteyari						
(pregnant women)	394	27.4	IFA	2002 [17]		
Animals						
Domestic fowl (hens, roosters,						
turkeys, pigeons, geese, ducks)	160	29	IHA	1990 [<i>18</i>]		
Sheep (Tehran)	378	61.24	DA	1993 [<i>19</i>]		
Sheep (Khuzestan)	138	13.8	LAT	1993 [<i>9</i>]		
Cattle	142	14.8	LAT	1993 [<i>9</i>]		
Cats (Tehran)	94	89.2	DT	1990 [2 <i>0</i>]		
Cats (Ahwaz)	101	59.4	DA	1992 [2 <i>1</i>]		
Sheep (Islamic Republic of Iran)	3311	24.5	LAT	1996 [22]		
Cattle (Islamic Republic of Iran)	2000	0	LAT	1996 [22]		
Goats (Islamic Republic of Iran)	638	19.25	LAT	1996 [22]		
Buffaloes (Khuzestan)	385	8.8	IFA	1998 [23]		
Sheep (200), Goats (200), Cattle	600	31 (sheep),	ELISA	2005 [24]		
(200) (Ardabil)						
11 (cattle)						

IFA = indirect fluorescent antibody; ELISA = enzyme-linked immunosorbent assay; IHA = indirect haemagglutination test; DA = direct agglutination; LAT = latex agglutination test.

Blood samples were collected from the 576 selected women and sera were separated and stored at -20 °C until analysis in the Department of Parasitology of the School of Medicine. Samples were examined by indirect fluorescent antibody (IFA) test. Antigen was obtained from the Pasteur Institute of the Islamic Republic of Iran, Tehran. Polyvalent anti-human conjugated serum and serum controls were purchased from Baharafshan Company, Tehran. Tests

were performed according to Ghorbani [8]. Sera reacting positively at dilutions \geq 1:20 were considered indicative of previous *Toxoplasma* exposure and infection.

A questionnaire was used to obtain data on age and education level and exposure to the following main risk factors for *Toxoplasma* infection: contact with or touching cats, presence of cats in or around the house, consumption of fresh, undercooked meat (i.e. barbecued kebabs or hamburgers which are traditionally undercooked), consumption of raw vegetables, handling raw and fresh meat, vegetable washing method (using water only, using antiseptic solution, using solution of hypertonic salt), and consumption of raw milk and eggs.

The chi-squared test was used for statistical analysis using *SPSS*, version 10. P < 0.05 was considered significant.

Results

A total of 193 serum samples were positive by IFAT at titre $\geq 1:20$ (cut-off), a seroprevalence of 33.5%. The distribution of titre ratios (1:20, 1:50, 1:100, 1:200, 1:400, 1:800) is shown in Table 2. Only 2.6% of the women had titres $\geq 1:400$. Most of the women (55.4%) had a titre of 1:20. For the purposes of statistical analysis, age was divided into 6 groups: 15-18 years (n =81), 19–22 years (n = 215), 23–26 years (n= 168), 27–30 years (n = 68), 31–34 years (n = 31) and ≥ 35 years (n = 13). Table 3 shows the infection rate according to age distribution, educational status, and certain risk factors for Toxoplasma infection. Seroprevalence was found to differ significantly with age (χ_{5}^{2} = 8.69, *P*< 0.001). The highest prevalence rate was also observed in wom-

Table 2 Frequency of Toxoplasma antibodytitres in primigravid women in Hamadan						
Indirect fluorescent antibody titre	orescent No. (<i>n</i> = 576) tre					
0	383	66.5				
1:20	107	18.6				
1:100	70	12.2				
1:200	11	1.9				
1:400	4	0.7				
1:800	1	0.2				
> 1:1600	0	0				

en who were illiterate (61.5%), but the difference was not significant. The prevalence was significantly higher among women who was consumed barbecued meat (Iranian kebab) (P < 0.05), and those who consumed raw vegetables daily (P < 0.001).

In multivariate analysis, the risk of *T*. gondii infection increased with age. The highest infection rate was found in the age group ≥ 35 years. Striking differences in seropositivity were found between women with illiterate status and those who consumed kebab frequently as well.

Of all the women participating in the survey, none had previously undergone serological testing for the detection of *Toxoplasma* antibodies.

Discussion

This study showed a moderate seroprevalence (33.5%) of *T. gondii* antibodies in comparison with other parts of the Islamic Republic of Iran as shown in Table 1. Most of the studies on toxoplasmosis at the community level in the country have been conducted on the general population or some subgroups, like immunodeficient subjects. Few have been conducted on primigravid women.

Because of some reports on congenital toxoplasmosis [25,26], various epidemiological studies have been performed in some parts of the country [10,16]. High prevalence rates have been reported from humid regions like the northern parts of country; 55.7% and 87% seropositivity rates have been documented in eastern and western parts of the Caspian basin respectively [8,11]. Rates from 6% to 23% have been reported in the north-west mountainous region [10] and 9.3% to 26% in the south-west parts of country [10,16].

Table 3 Seropositivity for *Toxoplasma* antibodies in primigravid women in Hamadan, by women's characteristics and food consumption

Variable	No. positive	%	No. negative	%	Statistical tests
Age groups (years)					$\chi_5^2 = 8.69, P < 0.001$
15–18	21	25.9	60	74.1	
19–22	53	24.7	162	75.3	
23–26	65	38.7	103	61.3	
27–30	27	39.7	41	60.3	
31–34	18	58.1	13	41.9	
>34	9	69.2	4	30.8	
Education					$\chi^2_4 = 8.71, P > 0.05$
Illiterate	8	61.5	5	38.5	
Primary school	61	38.4	98	61.6	
Junior high school	52	33.5	103	66.5	
High school	54	28.4	136	71.6	
University/further education	18	31.3	41	69.5	
Meat consumption					$\chi^2_{2} = 8.55, P < 0.02$
Well cooked	104	30.5	230	68.9	<i>1</i> 03
Undercooked					
Kebab	13	61.9	8	38.1	
Hamburger	4	40	6	60	
Both undercooked and well					
cooked	72	34.1	139	65.9	
Raw vegetables consumption					$\gamma^2 = 6.55, P < 0.001$
Daily	86	38.2	139	61.8	λ ₂ στος, τ τοτοστ
Weekly	90	32.7	185	67.3	
Rarely	17	22.4	59	77.6	
Handling fresh meat					$v^2 = 0.619 P > 0.05$
Yes	168	34 1	324	65.9	$\chi_2 = 0.010, T \ge 0.00$
No	25	29.8	59	70.2	
Ownership of and touching cats		_0.0			$w^2 = 0.751 P > 0.05$
	33.0	30	77 0	70	$\chi_2^- = 0.751, F > 0.05$
No	160	34 3	306	65.7	
Crowing (vagatables) in the gorden	100	04.0	000	00.7	2 2 C14 D 0 0 F
Growing (vegetables) in the garden	2	44.0	40	05 7	$\chi_2^2 = 5.014, P > 0.05$
ies No	3	14.3	10	85.7 65.9	
	190	34.Z	300	05.0	
Raw milk consumption			_		$\chi_2^2 = 0.491, P > 0.05$
Yes	4	44.4	5	55.6	
NO	189	33.3	378	66.7	
Total	193	33.5	383	66.5	

Regarding the source of infection, pigs and lambs are the important sources in Western countries such as the United States and Europe [27,28], rather than sheep and cattle. In contrast, sheep and cattle appear to be the main sources of *T. gondii* infection

in Islamic countries, such as the Islamic Republic of Iran [9,19,29]. However, other surveys suggest that small animals, especially sheep, play a more important role as a source of toxoplasmosis than cattle [22–24]. Furthermore, since the consumption of mutton is much greater than that of beef or goat, this increases the importance of sheep as source of local infection in the Islamic Republic of Iran. Although meat consumption behaviour did not appear to have a significant association with seropositivity in our study, data collected by questionnaire should be interpreted with caution in countries with low cultural and health-related knowledge.

Seropositivity increased significantly with age while it decreased with higher educational level but the difference was not statistically significant. Increased knowledge through higher education and its impact on behaviour may lead to a decrease in *T. gondii* infection, and may have an indirect effect on environmental and cultural factors involved in *Toxoplasma* infection. Our findings are similar to a report from Malayer in the east of this region [12] and slightly higher than the neighbouring province of Kermanshah [14,30].

According to some reports of *Toxoplasma* infection of intermediate hosts, such as sheep, goats, cattle and birds, especially chicken, it seems that the main route of human infection is ingestion of the undercooked meat of these animals, particularly mutton and lamb, which is the commonest meat consumed in all parts of the country. However, in our study there was no significant correlation between infection rate and the consumption of fresh, undercooked meat.

The role of definitive and intermediate hosts were studied in different parts of the Islamic Republic of Iran [18,31]. The infection rates in cats (definitive host) ranged

from 59.4% in Ahwaz to 94% in Tehran. Birds (intermediate host) may also be a potential source of *Toxoplasma* infection in the country because of the high seropositivity. Similar findings have been reported from other countries [11].

Different investigations performed throughout the world show a wide spectrum of seropositivity for *Toxoplasma* antibodies among pregnant women (different gravidas), ranging from 14% (Sweden, Stockholm) to 77% (Belgrade, Yugoslavia) [32,33]. The seroprevalence of a group of women of child-bearing age (between 16 and 36 years) in Nepal was 55.4% [34]. A study carried out on primigravidas found a 41.7% seropositivity in Indian women [35]. Lower prevalences are found in North America, South-east Asia and Oceania [36,37]. Regional variation has been attributed to climate, cultural differences and the amount and type of meat consumed. A previous study on prevalence of this infection in this region showed 38.9% seropositivity in women of child-bearing age [13].

Our results indicate that a large number of the study subjects (over 65%) were vulnerable to Toxoplasma infection. If these infections had occurred during the pregnancy the fetuses would have been at risk of infection. There is a need to provide health education to pregnant women in order to prevent primary Toxoplasma infection during pregnancy. Women should be counselled and evaluated before conception. The focus should include questions on contact with pets, especially cats, and whether the cats are confined indoors or allowed outdoors. Other questions should include a woman's preference about cooked meat and her hygiene habits in the kitchen (washing of fruits, vegetables and utensils) and her work in the garden or farm. If she has any of the above risk factors, then a

screening test for toxoplasmosis could be considered.

We recommend further studies to determine the incidence of acute *Toxoplasma* infection and congenital toxoplasmosis in humans and the prevalence of infection in stray and household cats and intermediate hosts in this region.

Acknowledgements

This work was supported in part by a grant from the Postgraduate Council, Education Deputy, Hamadan University of Medical Sciences.

We thank the staff of the health centres for their kind collaboration.

References

- Dubey JP. Toxoplasmosis. In: Cox FEG, Kreier JP, Wakelin D, eds. *Topley & Wil*son's microbiology and microbial infections, 9th ed., Vol. 5. London, Arnold, 1998:303–18.
- 2. Gilles HM. *Protozoal diseases*. London, Arnold, 1999:530–47.
- Antoniou M et al. Incidence of toxoplasmosis in 5532 pregnant women in Crete, Greece: Management of 185 cases at risk. European journal of gynecology and reproductive biology, 2004, 117:138–43.
- Nissapatorn V et al. Toxoplasmosis in HIV/AIDS patients: a current situation. Japanese journal of infectious diseases, 2004, 57:160–5.
- Holliman RE et al. Toxoplasmosis and heart transplantation. *Journal of heart and lung transplantation*, 1991, 10(4):608–10.
- Neto EC et al. Newborn screening for congenital infectious diseases. *Emerging infectious diseases*, 2004, 10(6):1068–73.
- Breugelmans M, Naessens A, Foulon W. Prevention of toxoplasmosis during pregnancy: an epidemiologic survey over 22 consecutive years. *Journal of perinatal medicine*, 2004, 32(3):211–4.
- Ghorbani M, Edrissian GH, Assad N. Serologic survey of toxoplasmosis in northern part of Iran using IFAT. *Transactions* of the Royal Society of Tropical Medicine and Hygiene, 1978, 72(4):369–71.
- 9. Hoghooghi-Rad N. Prevalence of toxoplasmosis in human and animals in

Ahwaz, capital of Khuzestan province, South-west Iran. *Journal of tropical medicine and hygiene*, 1993, 96 (3):163–8.

- Ghorbani M, Edrissian GH, Afshar A. Serologic survey of toxoplasmosis in mountainous regions of the north – west and south – west part of Iran. *Transactions* of the Royal Society of Tropical Medicine and Hygiene, 1981, 75(1):38–9.
- Daryaei A. [Seroepidemiology of toxoplasmosis in the northern part of Iran, Guilan, 1994.] [Thesis]. Tehran, Faculty of Medical Sciences, Tarbiat Modares University, 1994 [in Farsi].
- Shahmoradi A, Sardarian K, Fallah M. [Seroepidemiological survey of toxoplasmosis among the health centres referred women in the Malayer city.] Shahed University scientific journal, 1994, 2:(5,6):70– 3 [In Farsi].
- 13. Rabiee S et al. Seroepidemiology of *Tox-oplasma* infection in women aged 15–45 years in Hamadan west of Iran. *Journal of research in health sciences*, 2003, 3(1):9–12.
- 14. Athari A et al. Seroprevalence of *Toxoplasma* antibodies among pregnant woman in Kermanshah. *Medical journal of the Islamic Republic of Iran*, 1994, 8(2):93–5.
- Mansoori F et al. [Seroepidemiology of toxoplasmosis in Kermanshah province, west of Iran, 2002.] Behboud, The Scientific Journal of Kermanshah University of Medical Sciences, 2004, 7(2):12–19 [in Farsi].

- 16. Sedaghat A et al. The prevalence of *Toxoplasma* infection in Southern Iran. *Journal of tropical medicine and hygiene*, 1978, 81:204–7.
- Manouchehri Naeini K, Deris F, Zebardast N. [The immunity status of the rural pregnant women in Chaharmahal and Bakhtyari province against *Toxoplasma* infection, 2001–2002.] *Journal* of Shahrekord University of Medical Sciences, 2004, 6(3):63–72 [in Farsi].
- Ghorbani M, Gharavi MJ, Kahnamoui A. Serological and parasitological investigations on *Toxoplasma* infection in domestic fowls in Iran. *Iranian journal of public health*, 1990, 19(1–4):9–17.
- Shahmoradi A, Rezaeian M, Dalimi asl A. Sheep: an important reservoir of human toxoplasmosis in Iran. *Medical journal* of the Islamic Republic of Iran, 1993, 7(3):173–4.
- Seyed Tabaei SJ. [*Toxoplasmosis in stray* cats in Tehran, 1990.] [Thesis]. Tehran, Tehran University of Medical Sciences, School of Public Health, 1990 [In Farsi].
- Hoghooghi-Rad N et al. A survey on toxoplasmosis in the sheep, cattle, birds, and stray cats in the Ahwaz region, Khuzestan province, Iran, 1992. Ahvaz, Chamran University of Ahwaz, 1992, (Monograph): 15 [in Farsi].
- 22. Hashemi-Fesharaki R. Seroprevalence of *Toxoplasma gondii* in cattle, sheep and goats in Iran. *Veterinary parasitology*, 1996, 61(1–2):1–3.
- Navidpour S, Hoghoogh-Rad N. Seroprevalence of anti-*Toxoplasma gondii* antibodies in buffaloes in Khuzestan province, Iran. *Veterinary parasitology*, 1998, 77(2–3):191–4.
- Ghazaei C. Serological survey of antibodies to Toxoplasma. Internet journal of veterinary medicine, 2005, 2(1):1–5 (http://www.ispub.com/ostia/index. php?xmlFilePath=journals/ijvm/vol2n1/

toxoplasma.xml, accessed 23 April 2007).

- 25. Ghorbani M et al. Congenital toxoplasmosis in Iran. *Iranian journal of public health*, 1977, 6:1–5.
- Ghorbani M et al. Isolation of *Toxoplasma* gondii from human tissues. *Iranian journal* of public health, 1979, 8:23–9.
- 27. Dubey JP et al. High prevalence of viable *Toxoplasma gondii* infection in market weight pigs from a farm in *Massachusetts journal of parasitology*, 2002, 88(6):1234–8.
- Cook AJ et al. Sources of toxoplasma infection in pregnant women: European multicentre case–control study. European Research Network on Congenital Toxoplasmosis. *British medical journal*, 2000, 321:142–7.
- 29. Ghorbani M et al. Animal toxoplasmosis in Iran. *Journal of tropical medicine and hygiene*, 1983, 86:73–6.
- Mansouri F et al. [Seroepidemiology of toxoplasmosis in Kermanshah Province, 1999–2000.] Behbood (Medical journal of Kermanshah University of Medical Sciences), 2001, 8(2):12–9 [In Farsi].
- Asmar M et al. Toxoplasmosis in Iran: results of a seroepidemiological study. Bulletin de la Société de pathologie exotique, 1997, 90(1):19–21.
- 32. Petersen K et al. Seroprevalence of *Toxoplasma gondii* among pregnant women in Sweden. *Acta obstetricia et gynecologica Scandinavica*, 2000, 79(10):824–9.
- Bobic B et al. Risk factors of *Toxoplasma* infection in a reproductive age female population in the area of Belgrade, Yugoslavia. *European journal of epidemiology*, 1998, 14(6):605–10.
- 34. Rai SK et al. *Toxoplasma* antibody prevalence in Nepalese pregnant women and women with bad obstetrics history. *South*-

east Asian journal of tropical medicine and public health, 1998, 29(4):739–43.

- 35. Akoijam BS et al. Seroprevalence of *Toxoplasma* infection among primigravidas women attending clinic at a secondary level hospital in North India. *Journal of the Indian Medical Association*, 2002, 100(10):591–6.
- Markell EK, John DT, Krotoski WA. Markell and Voge's medical parasitology, 8th ed. Philadelphia, WB Saunders, 1999:161–71.
- Jones JL et al. *Toxoplasma gondii* infection in the United States: Seroprevalence and risk factors. *American journal of epidemiology*, 2001, 154(4):357–65.

Notice of inadvertent duplicate publication

The Eastern Mediterranean health journal would like to draw attention to the paper entitled Mental health publications from the Arab world cited in PubMed, 1987–2002, by M. Afifi, which was published in the Eastern Mediterranean health journal, 2005, May, Vol. 11, No. 3:319-28 (Received 30 September 2003; accepted 17 May 2004). This paper is substantially similar to a paper by the same author entitled Analysis of mental health publications from Arab countries in PubMed, 1987-2002 published in Neurosciences, 2004, April Vol. 9, No.2:108-112 (Received 27 July 2003; accepted in final form 10 September 2003). While there is a small amount of additional information on adolescents in the EMHJ paper, the degree of overlap is so large as to constitute duplicate publication. At no time did the author inform us of the existence of the earlier paper, which is in contravention of EMHJ's guidelines for authors and internationally agreed guidelines, nor did he cite the earlier paper in the EMHJ article. Dr Afifi has apologized saying that at the time he was unaware that duplicate publication was unacceptable.