

Original Research Article

Evaluation of the knowledge and practices of pregnant Yemeni Women regarding teratogens

Saeed O Alfadly^{1,2}, Syed Wajid^{3*}, Mahfoudh Al-Musali M Abdulghani¹, Mohammed Saif Anaam¹, Mahmoud Salem Bajubair², Suad M Ba-Samad², Mohammed N Alarifi³, Salmeen D Babelghaith³, Ibrahim Sales³ and Wael H Mancy³

¹Department of Pharmacy Practice, Unaizah College of Pharmacy, Qassim University, ²Department of Pharmacy Practice, College of Medicine and Health Science, Hadramout University, Yemen, ³Department of Clinical Pharmacy, College of Pharmacy, King Saud University Riyadh, Saudi Arabia

*For correspondence: **Email:** wali@ksu.edu.sa; **Tel:** +966503754169, 0096614677354, **Fax:** 096614674229

Sent for review: 20 April 2017

Revised accepted: 12 August 2017

Abstract

Purpose: To investigate the knowledge and practice of pregnant women with regards to teratogens.

Methods: A month-long cross-sectional study was carried out among 150 pregnant women selected from four Motherhood and Child Healthcare Centers (MCHCs) in Mukalla District of Yemen. Data collection was conducted during face-to-face interviews using a questionnaire. Descriptive and simple regression analyses were used.

Results: Of the 150 pregnant women who participated in the study, 95.3 % of the pregnant women were < 36 years old, 7.4 % had children with congenital malformations, 62 % indicated that they had heard about folic acid; however, only 16.6 % knew the significance of folic acid. Regarding toxoplasmosis, 94.7 % indicated that they had heard about toxoplasmosis, and 76 % knew about the serious consequences of the disease (congenital malformation and abortion) during pregnancy. Based on simple regression analysis, the results indicate that education and parity, irrespective of age or income level, were the major factors determining better knowledge and practices in pregnancy with regards to toxoplasmosis.

Conclusion: Knowledge of folic acid deficiency among pregnant women in Mukalla District of Yemen is relatively low. Furthermore, preventive practices to avoid folic acid deficiency are minimal.

Keywords: Knowledge, Practices, Teratogens, Pregnant Yemeni women, Folic acid deficiency

Tropical Journal of Pharmaceutical Research is indexed by Science Citation Index (SciSearch), Scopus, International Pharmaceutical Abstract, Chemical Abstracts, Embase, Index Copernicus, EBSCO, African Index Medicus, JournalSeek, Journal Citation Reports/Science Edition, Directory of Open Access Journals (DOAJ), African Journal Online, Bioline International, Open-J-Gate and Pharmacy Abstracts

INTRODUCTION

Congenital abnormalities are the root cause of neonatal death in 11 % of Yemeni infants [1]. The annual mortality rate of neural tube defects (NTD) is approximately 2.5 per 100,000 infants in Yemen [2]. Further, the seroprevalence of *T.gondii*, the causative agent in toxoplasmosis infections, was found in approximately 45 % of women in Sana'a, Yemen [3]. Although Yemen

does not have any official recommendations regarding folic acid supplementation, the World Health Organization recommends daily folic acid supplementation with 400 µg (0.4 mg) folic acid. Supplementation should be commenced as early as possible to prevent neural tube defects [4]. In addition, toxoplasmosis screening is not routinely tested in Yemeni women despite its high seroprevalence [3,5-7].

A teratogen is an agent to which exposure during pregnancy can cause a harmful effect on the fetus. This teratogen can induce or increase the incidence of congenital malformation [8]. Folate deficiency is one of the most common vitamin deficiencies in women. Women who consume a low level of folate during pregnancy are at risk for poor pregnancy outcomes, including NTDs [9,10]. Several studies have shown that periconceptional use of folic acid has an effective role in the prevention of NTDs [10-13]. Czeizel and colleagues in a cohort-controlled trial in Hungary reported that periconceptional multivitamin supplementation causes a reduction in certain congenital abnormalities, including NTDs [11]. Wilson and colleagues showed the efficacy of supplementary folic acid in the prevention of NTDs [12]. Bower and colleagues showed that periconceptional folic acid supplementation in Western Australia since 1996 has reduced anencephaly by 32 %, spina bifida by 23 % and encephalocoele by 34 % [13]. Berry and colleagues reported that periconceptional folic acid supplementation reduced the rate of NTDs in China [14]. Studies have also shown that 50-80 % NTDs can be prevented if a woman consumes sufficient amounts of folic acid daily before conception and throughout the first trimester of her pregnancy [11-14].

Based on the authors' knowledge, there is no study has been conducted on this Toxoplasmosis issue in the Mukalla District of Yemen, and hence, this study has been addressed in this research. The aim of this study was to determine the level of knowledge and identify the practices of Yemeni women regarding folic acid supplementation.

METHODS

Pretest

A pilot survey was conducted among 15 pregnant women in the Mukalla District of Yemen. The sample of pregnant women used in this analysis was not included in the study. The questionnaire was pretested to determine the length of the interview, question sequence, and the identification of difficult questions.

Ethical consideration

Ethical approval was obtained from Hadramout University College of Medicine (HUCOM), Department of Community Medicine (11 /2012).

Study design

A cross-sectional study was conducted and the data was collected by a group of 3rd year medical students to assess the knowledge and practices among pregnant women regarding folic acid deficiency and toxoplasmosis.

Study setting

The study was conducted among pregnant women who attended the one of four local Motherhood and Child Healthcare Centers (MCHCs): As-Salam MCHC, 30th of November MCHC, University Center MCHC, or Rokob MCHC in the Mukalla District during the year 2012-2013 (Table 1). There are approximately 2,824 pregnant women who visit the MCHCs each year.

All pregnant women in the selected MCHCs were included in our study. The sample size was distributed proportionally among all the MCHCs according to the total number of pregnant women visits to each MCHC (Table 1). The convenient sample applied to select pregnant women from each MCHC. If one pregnant woman could not participate for any reason, another one would be chosen.

Data collection

The data was collected by face-to-face interviews using the adopted questionnaire. It contained open- and closed-ended questions and was divided into: (a) Personal data and socio-demographic characteristics of the pregnant women such as income and educational level; (b) the personal profile of the pregnant women such as age, address, number of pregnancies, number of abortions, number of living offspring, number of children with anomalies and the kind of anomalies – if found; and (c) questions relating to the knowledge and practice of the pregnant

Table 1: Name of maternity and child health centers and number of pregnant women visiting

Name of center	Total number of pregnant women visitors to center yearly	%	Sample size size
Al-salam MCHC	1044	37	55
30 th of November MCHC	488	17	33
University Center MCHC	248	9	17
Rokob MCHC	1044	37	55
Total	2824	100	150

women towards teratogens (i.e., folic acid deficiency and toxoplasmosis infection).

Statistical analysis

The data was checked for accuracy and completeness, then coded, and finally entered into the computer using statistical package for social science (SPSS) version 19. The obtained data was analyzed using descriptive statistics (frequencies and percentages). Simple regression analysis was also used ($p = 0.05$). Data presented in the tables were arranged using computer applications (Word® and Photoshop®).

RESULTS

A total of 150 pregnant women participated in the study. In terms of age, 35.3% were 26-30 years old and 32.7% were between 21 – 25 years old. Regarding the income level of the families of the pregnant women, 85.3% indicated that their income only meets their family's needs and 5.4% stated that their income exceeds their needs. Twenty-six percent of interviewed women were illiterate, whereas the rest completed the following levels of education: 54% primary, 12% secondary, and 8% university degrees or higher. Approximately 84.7% of women had between 1 - 5 pregnancies and only 0.7% had more than 10 pregnancies. Abortion history was negative for 68 % of pregnant women and positive for 29 % of pregnant women. About 7.4 % of pregnant women declared that they had children with congenital anomalies, and brain defects were the most common anomalies (Table 2).

When women were asked whether they heard about folic acid or not, 62 % said yes, and although 79.6 % of those who said yes stated that they knew the importance of folic acid, only 33.8 % gave the correct answer about its significance. Around 55 % knew the proper time for folic acid supplementation, 38.7 % gave incorrect answers, and 6.4 % didn't know the proper time for folic acid supplementation. When asked whether they heard about neural tube defects, most of them, 76.7 %, responded no, and out of those who had heard about neural tube defects, 65.7 % said that there is relationship between neural tube defects and folic acid deficiency (Table 3).

When those who heard about folic acid were asked whether they had taken folic acid supplementation before, 80.6 % responded that they took folic acid supplementation and 19.4 %

responded that they didn't take folic acid supplementation (Table 3). When pregnant women were asked whether they ate green leafy vegetables during their pregnancy, 74 % responded with yes, 25.3 % said not too much, and only 0.7 % said no.

Table 2: Demographic characteristics of the pregnant Yemeni women (n = 150)

Variable	N	Percentage (%)
Age (years)		
16-20	23	15.3
21-25	49	32.7
26-30	53	35.3
31-35	18	12
36-40	7	4.7
Income		
Meets family needs	128	85.3
Less than family needs	14	9.3
Exceeds family needs	8	5.4
Education		
Illiterate	39	26
Primary	81	54
Secondary	18	12
University	12	8
Parity		
1-5	127	84.7
6-10	22	14.6
11-15	1	0.7
Abortion		
0	102	68
1-3	44	29.3
4-7	4	2.7
Anomaly		
None	139	92.7
One episode	10	6.7
Two episode	1	0.7
Anomaly type		
On head	6	54.5
On heart	1	9.1
Down syndrome	1	9.1
Cleft lip	2	18.2
Neural tube defect	1	9.1

Pregnant women were asked if they heard about toxoplasmosis, and 94.7 % answered in the affirmative. Those who had heard of toxoplasmosis were asked, if they knew what toxoplasmosis can do to pregnant women, and 80.3% gave correct answers (Table 4).

Table 3: Knowledge and practice of pregnant women about folic acid

Variable	N	(%)
Knowledge of folic acid among pregnant women		
Heard about folic acid	93	62
Know importance of folic acid	74	79.6
Significance of folic acid		
Correct	25	33.8
Vague	49	66.2
Proper time of folic acid supplementation		
Before pregnancy	14	15.1
During first trimester	37	39.8
During second trimester	9	9.7
Last trimester	15	16.1
Through all stages	12	12.9
Does not know	6	6.4
Heard about neural tube defect	35	23.3
Thinks there is relation between folic acid deficiency and neural tube defect (n=35)	23	65.7
Practice of pregnant women towards folic acid		
Took folic acid	75	80.6
Eat fruit and vegetable including green leaves during pregnancy		
Yes	111	74
Not too much	38	25.3
No	1	0.7

The positive responders were also asked if toxoplasmosis can be transmitted through external touch to cat hair. Nearly 39 % responded yes, 28.9 % responded no, and 32.4 % declared they did not know. Furthermore, they were asked whether toxoplasmosis could be transmitted when you work in the garden without gloves, and 40.1% said yes, 16.9% said no, and 43% said they did not know. When asked if they did an investigation for toxoplasmosis, 45.1 % said no and 54.9 % said yes, and out of those who have been tested, 41% claimed that they tested positive (Table 4). All 150 pregnant women were asked if they wash their fruits and vegetables before eating, and 93.3 % responded with always, 6% responded with sometimes, and 0.7% responded with never. The detailed information about the knowledge and practices of pregnant women towards toxoplasmosis were given in Table 4.

Using simple regression analysis, there was no significant association between knowledge and the practice of pregnant women about the significance of folic acid and age, income, and educational level (Table 5). Eighty percent of those with university degrees or higher knew the correct answer as opposed to 45.4 % of those with secondary education, 30 % of women with primary education, and 22.2 % of illiterate women (Table 6).

In addition, participants were asked if there were cats in their houses. Thirty-six percent said yes, 59.3 % said no, and 4.7 % said occasionally. Those who had cats in their houses were asked if they had physical contact and/or interacted with the cats. An equal proportion of patients, 49.2 % said yes and no, and 1.6 % said sometimes. Almost 65 % of women who interacted with cats washed their hands after dealing with the cats, and 35.5% didn't wash their hands.

Raw meat was eaten by 29.3 % of pregnant women, 67.3 % didn't eat raw meat, and 3.3 % occasionally ate raw meat. The most common source of knowledge for pregnant women about toxoplasmosis were friends and relatives, 39.4 %, then media, 35.9 %, doctors or nurses, 20.4 %, books or magazines, 3.5 %, and finally, other resources, 0.7 % (Table 4). Knowledge of pregnant women about the serious consequences of toxoplasmosis exposure to pregnant women was analyzed with age, education, income level, and parity using simple regression analysis, and there was a significant difference with education level ($p \leq 0.025$) (Table 7).

Practice of pregnant women was analyzed with age, education, income level, and parity using simple regression analysis, and there was a significant difference with parity level ($p \leq 0.011$) (Table 7). The women who knew the correct answers were 100 % with university degrees or higher, 82.3 % of those with secondary education, 82 % of women with primary education, and 68.5 % of illiterate women (Table 8). All (100 %) of women with parity between 11-15 pregnancies were tested for toxoplasmosis, 76 % of women with parity between 6 and 10 pregnancies, and 50 % of women with parity between 1 - 5 pregnancies (Table 9).

DISCUSSION

Surprisingly, this study showed that 7.4 % of pregnant women had children with major congenital anomalies. Overall, 62 % of interviewed pregnant women in our study heard about folic acid due to the folic acid package insert information. This result is relatively in an agreement with the results of a study conducted in Poland in which 67.5 % of women had heard of folic acid. In contrast, studies in Iran and the United Arab Emirates (UAE) have published rates of awareness reaching 96.2 % [15] and 79.1 % [16], respectively.

Out of those 62 % who heard about folic acid, 79.6 % said that they knew the importance of folic acid. However, only 33.8 % of them gave

Table 4: Knowledge, Practice and source of knowledge of pregnant women towards toxoplasmosis

Variable	N	(%)
Knowledge of toxoplasmosis		
Heard about toxoplasmosis	142	94.7%
Know what toxoplasmosis cause	114	80.3%
Toxoplasmosis can spread by superficial touch of cat	55	
Yes		38.7%
No	41	28.9%
I don't know	46	32.4%
Toxoplasmosis can spread by gardening without gloves	14	15.1%
Yes	57	40.1%
No	24	16.9%
I don't know	61	43%
Practice of pregnant women towards toxoplasmosis		
Have you been tested for toxoplasmosis	78	54.9
The results of test		
Positive	32	41
Negative	46	59
Source of toxoplasmosis		
Wash vegetables and fruits before eating		
Always	140	93.3
Sometimes	9	6
Never	1	0.7
Cats in home		
Yes	54	36
No	89	59.3
Sometimes	7	4.7
Deal with cats		
Yes	30	49.2
No	30	49.2
Sometimes	1	1.6
Wash hands after dealing with cats		
Yes	20	64.5
No	11	35.5
Eat raw meat		
Yes	44	29.3
No	101	67.4
Sometimes	5	3.3
Source of knowledge		
Doctor or nurse	29	20.4
Friends or relatives	56	39.5
Media (television) or broadcast	51	35.9
Book or magazine	5	3.5
Another resource	1	0.7

the correct answer of folic acid in preventing congenital anomalies, and the remaining 66.2 % gave vague answers. These results are comparable to the results of the study conducted by Abdulrazzaq and colleagues in the UAE in which 46.6 % gave correct answers related to folic acid and congenital prevention [16]. Although 62 % of the pregnant women had heard of folic acid in our study, only 15.1 % of the women reported that the proper time for folate

supplementation should be pregnancy. This is lower than the 29.5% that was reported by Abdulrazzaq and colleagues in the UAE [16].

Only 23.3 % of the interviewed women heard or identified NTDs, and 65.7 % of those who heard or identified NTDs said that there was a connection between NTDs and folic acid deficiency. Although this result is similar to what was found in the UAE (66.7 %) [16], other

Table 5: Regression factors associated with knowledge and practice of folic acid

Variable	B	P-value
Knowledge		
Age	0.003	0.957
Income level	0.054	0.555
Education level	0.183	0.014
No pregnancies	0.167	0.248
Practice		
Age	0.009	0.834
Income level	0.033	0.668
Education level	0.011	0.849
No pregnancies	0.107	0.358

Table 6: Knowledge of importance of folic acid according to education level

Education level	Correct	Vague	Total
Illiterate	4	14	18
Primary	12	28	40
Secondary	5	6	11
University	4	1	5
Total	25	49	74

Table 7: Simple regression analysis of factor associated with knowledge and practice towards toxoplasmosis

Variable	B	Significance
Knowledge		
Age	0.013	0.711
Income level	0.063	0.330
Education level	0.096	0.025
No of pregnancies	0.084	0.376
Practice		
Age	0.052	0.241
Income level	0.018	0.829
Education level	0.019	0.718
No of pregnancies	0.306	0.011

Table 8: Knowledge of toxoplasmosis according to education level

Education level	Yes	No	Total
Illiterate	24	11	35
Primary	64	14	78
Secondary	14	3	17
University	12	0	12
Total	114	28	142

Table 9: Practice of pregnancy according to parity

No. of pregnancies	Yes	No	Total
1-5 pregnancies	61	59	120
6-10 pregnancies	16	5	21
11-15 Pregnancies	1	0	1
Total	78	64	142

studies, such as Kondo and colleagues reported that less than 15 % of Japanese women were aware of a link between folic acid and NTDs [17]. In addition, a study in the United States revealed that 13 % of all women surveyed knew that folic

acid helps prevent birth defects [18]; however, an UAE study reported lower rates, 69.7 % [16]. Using simple regression analysis, our study showed that education was the most important significant factor influencing pregnant women's knowledge regarding the importance of folic acid in pregnancy. This was similar to the study conducted in United Arab Emirates [16].

Regarding toxoplasmosis, 94.7 % of our population study had heard about toxoplasmosis and 80.3 % of them knew the affects of toxoplasmosis upon a pregnant women and her fetus. However, a study in the United States indicated that only 48 % of interviewed women heard about toxoplasmosis [19]. In addition, 38.7 % of those women who had heard about toxoplasmosis were aware that external or superficial physical contact with cats could transmit toxoplasmosis. Furthermore, 40.1 % of women who had heard about toxoplasmosis thought that gardening without gloves could spread toxoplasmosis infection, 16.9 % thought it was not possible, and 43 % didn't know exactly whether it transmits infection or not. These results are different form the results of the study conducted in the United States that showed that 29 % of the study population thought that gardening without gloves could transmit infection, 20 % thought that it couldn't, and 59 % were not sure [19].

Regarding their practices towards toxoplasmosis, 54.9 % of women who heard about toxoplasmosis stated that they tested for the disease, and about 41 % of those who tested said that their result was positive. These results are inconsistent with the study published by Jones and colleagues [24] where only 7% were aware of being tested for disease. Most of the participants, 93.3 %, always wash their fruits and vegetables before eating, and this is a good indication of good health practices. Also, 40.7 % of our study population said that there were cats permanently in their houses, and about 50.8 % of those who had cats in their houses interacted with the cats.

Out of those who interacted with cats, 64.5 % washed their hands after dealing with the cats. Jones and colleagues [19] reported that 80 % of pregnant women washed their hands after dealing with cats. Regarding raw meat, 32.6 % of our study population ate raw meat whereas in the study by Jones and colleagues [19], only 6 % of pregnant women ate raw meat. The reason behind this difference could be due to the high emphasis on good hygiene in the American population.

CONCLUSION

The results of this study suggest that more professional education is needed by healthcare providers to increase the awareness of pregnant women about the importance of folate supplementation in pregnancy. Yemen does not have any official guidelines on folic acid periconceptional use; therefore, a specific policy should be established to promote folic acid intake in the periconceptional period in order to reduce the risk of congenital abnormalities. More health education programs addressing the methods of transmission of toxoplasmosis and its prevention should be conducted. Further studies are required to determine the prevalence of congenital anomalies and to assess the knowledge of pregnant women regarding other teratogens.

DECLARATIONS

Acknowledgement

None.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them.

Open Access

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided the original work is properly credited.

REFERENCES

1. Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE, Cousens S, Mathers C, Black RE. Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: an updated systematic analysis. *Lancet* 2015; 385(9966): 430-440.
2. Global Health Data Exchange and the World Bank. <http://global-disease-burden.healthgrove.com/l/79226/Neural-Tube-Defects-in-Yemen>. Accessed January 9, 2017.
3. Al-Eryani SM, Al-Mekhlafi AM, Al-Shibani LA, Mahdy MM, Azazy AA. *Toxoplasma gondii* infection among pregnant women in Yemen: Factors associated with high seroprevalence. *J Infect Dev Ctries*. 2016 30; 10(6): 667-672.
4. World Health Organization. *WHO recommendations on antenatal care for a positive pregnancy experience*. Geneva, World Health Organization; 2016.
5. Al-Nahari AM, Al-Tamimi AS. Seroprevalence of anti-*Toxoplasma gondii* IgG and IgM among pregnant women in Sana'a capital and capital Trusteeship. *Sci J King Faisal Univ (Basic Appl Sci)* 2010; 11: 1431.
6. Saif N, Al-Ameeri G, Alhweesh M, Alkadasi M, Zaid AA. Sero prevalence of toxoplasmosis in pregnant women in Taiz-Yemen. *Int J Curr Microbiol Appl Sci* 2014; 3: 680-690.
7. Muqbil NA, Alqubatii MA. Seroprevalence of toxoplasmosis among women in Aden city, Yemen. *Arch Biomed Sci* 2014; 2: 42-50.
8. Holmes BL. *Human teratogens: updated 2010: birth defects research part A: Clin Molecul Teratol* 2011; 91(1): 1-7.
9. Gotalipour MJ, Mobasheri E, Vakili MA, Keshtkar AA. Epidemiology of neural tube defects in northern Iran, 1998-2003. *East Mediterr Health J* 2007; 13: 560-566
10. Berg MJ. The importance of folic acid. *J Gender Specific Med*. 1999; 2(3): 24-28.
11. Czeizel AE, Dobó M, Vargha P. Hungarian cohort? Controlled trial of periconceptional multivitamin supplementation shows a reduction in certain congenital abnormalities. *Birth Defects Res A Clin Mol Teratol* 2004; 70: 853-861.
12. Wilson RD, Davies G, Désilets V, Reid GJ, Summers A, Wyatt P, Young D. Genetics Committee and Executive and Council of the Society of Obstetricians and Gynaecologists of Canada. The use of folic acid for the prevention of neural tube defects and other congenital anomalies. *J Obstet Gynaecol Can*. 2003; 25(11): 959-973.
13. Bower C, D'Antoine H, Stanley FJ. Neural tube defects in Australia: trends in encephalcoele and other neural tube defects before and after promotion of folic acid supplementation and voluntary food fortification. *Birth Defects Res a Clin Mol Teratol* 2009; 85: 269-273.
14. Berry RJ, Li Z, Erickson JD, Li S, Moore CA, Wang H, Mulinare J, Zhao P, Wong LY, Gindler J, Hong SX, Correa A. Prevention of neural-tube defects with folic acid in China. China-U.S. Collaborative Project for Neural Tube Defect Prevention. *N Engl J Med*. 1999 11; 341(20): 1485-1490. Erratum in: *N Engl J Med* 1999 9; 341(24): 1864.
15. Sohelliian M, Heidari K, Yazdani S, Shahsavari M, Ahmadiéh H, Dehghan M. Patterns of uveitis in a tertiary

- eye care center in Iran. *Ocul Immunol Inflamm* 2004; 12: 297–310.
16. Abdulrazzaq YM, Al-Gazali LI, Bener A, Hossein M, Verghese M, Dawodu A, et al. Folic acid awareness and intake survey in the United Arab Emirates. *Reprod Toxicol* 2003; 17: 171-176.
17. Kondo A, Kamihira O, Shimosuka Y, Okai I, Gotoh M, Ozawa H. Awareness of the role of folic acid, dietary folate intake and plasma folate concentration in Japan. *J Obstet Gynaecol Res* 2005; 31: 172-177.
18. Mead PS, Slutsker L, Dietz V, McCaig LF, Bresee JS, Shapiro C, Griffin PM, Tauxe RV. Food-related illness and death in the United States. *Emerg Infect Dis.* 1999; 5(5): 607-625.
19. Jones JL, Ogunmodede F, Scheftel J, Kirkland E, Lopez A, Schulkin J, Lynfield R. Toxoplasmosis-related knowledge and practices among pregnant women in the United States. *Infect Dis Obstet Gynecol.* 2003; 11(3): 139-145.