

Original Research Article

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Toxoplasma Sero-Prevalence and Related Knowledge Survey in Pregnant Women and University Staff

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ABSTRACT

Toxoplasmosis is a disease of all regions and communities. The present study was conducted in 2017 to evaluate *Toxoplasma* prevalence and related knowledge in pregnant women and university staff of Kirkuk city. 1000 individuals had submitted a questionnaire form to assess their knowledge on *Toxoplasma*. Sero-prevalence screen of the disease was done by ELISA technique in 276 individuals of the pregnant women. The total infection rate of the disease among the pregnant women was 9.8%. Entirely the educated persons had more knowledge background on toxoplasmosis comparing to uneducated, in both university staff and pregnant women. The proportion of university staff who knew what is the disease was 41.4 %. While a proportion of 58.6% did not know the disease. Among pregnant women a proportion of 35.3% had knew some information on the disease and a rate of 64.7% of them were only heard on the disease. Very high percentages of questioned cohorts have no information on the diseases host types, modes of transmission, infected body organs, populations more at risk for getting the infection and other diseases related knowledge's because the disease is more related to women than men. These results highlight the significance of a regular seminars and conferences on toxoplasmosis among females especially pregnant, as well as the importance of periodically serological screening process during prenatal care.

Keywords

Toxoplasma,
Knowledge, Survey,
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Introduction

Toxoplasma gondii is a zoonotic disease that infects a wide range of animals and human (Dubey and Jones, 2008). All these animals serve as intermediate hosts for the parasite. Cats and other feline are final hosts (Dubey *et al.*, 2012). It considers one of the most common human parasites. *T. gondii* cause a self-limiting flu like disease in intact immune

system persons. In infant and immunocompromised persons, the disease is more severe and serious. Occasionally life threatening illness can be resulted (Robert and Dardec, 2012; Demar *et al.*, 2007). Congenital toxoplasmosis cause abortion, still birth or a birth of defected child. Placental *Toxoplasma* infected child may suffer from mental retardation, retinocoroiditis, microcephaly, hydrocephaly and other central

nerve system related symptoms (Elsheikla, 2008; Remington *et al.*, 2010). Likewise the parasite is transmitted to animal fetus, and it's responsible of abortion of high number of newborn animals and losses of thousands of dollars (Dubey *et al.*, 2012). Several modes of transmitting occur in human, the cat freed oocysts can contaminate any food or drink material (Bojar and Szymanska, 2010). The tissue cyst can transmit through ingestion of under cooked meat of infected animal (Dumetre and Darde, 2003). Toxoplasmosis is prevalent in our province (Kirkuk), the disease seroprevalence was 18.7% in healthy persons (Obaid *et al.*, 2017). And 21.5% among university students (Obaid, 2017), 36.53 % in married and unmarried women (Obaid, 2014), 15.5% in pregnant women (Obaid and Juma, 2016). In Muthana a prevalence of 44.5 % was recorded among pregnant women (ALseadawy, 2010). The anti-*Toxoplasma gondii* IgM and IgG rates were 22.2, 32.4% in Wassit pregnant women. Ignorant of prophylaxis factors such as consumption of undercooked meat, exposures to soil and contact with cats were significantly associated with the prevalence rates (Tawfeeq *et al.*, 2012). Despite the high frequency of the parasite among population, most of educated or uneducated people have little or no information about the disease. The aim of the present study was to determine the infection rate among pregnant women, and estimate the knowledge background of *Toxoplasma* in pregnant women and university staff.

Materials and Methods

Population study

The statistical study on *Toxoplasma gondii*, began in October 2016 to February 2017. The study was conducted to evaluate the extent of information among Kirkuk University staff and pregnant women. This two community

samples were chosen because, the university staff is consider as educated community part, and pregnant woman are the most affected part by the disease. The study included 1207 persons. 907 individual (456 male, 451 female) was from university and 300 were pregnant women. Of university staff, 207 persons was excluded from the questionnaire form because they have been never heard about the disease therefore the questionnaire form was submitted to only 700 of them. Educational status of questioned persons was recorded as uneducated, primary and high school certificate, college students, Diploma, Bachelor, Master and Philosophy awarded degrees.

The questionnaire form was included the following questions:-

What is Toxoplasmosis or what is its causative agent? What animal has a close relation with the disease? Does meat is a possible source of infection? Are vegetables and fruits a possible source of infection? Dose contact with soil may cause the disease? What is the most community part more affected with disease? Do animals can be infected with disease?

Samples collection

In order to collect serum samples, 5 ml of blood was taken from 276 of the pregnant women. The sera were separated from the blood by centrifugation. The obtained sera were saved at (-20°C) till used for *Toxoplasma* antibody screening (Obaid *et al.*, 2017).

Toxoplasma antibody screening

For *Toxoplasma* antibody screening, kits of *Toxoplasma* IgG and IgM Enzyme Immunoassay from Bio Check, Inc. USA were used kit instructions for *Toxoplasma* detection

were performed. Tomicro titer coated wells diluted serum was added By ELISA washer, samples were washed and HRP-conjugate was added. The wells were washed once more to remove excess conjugate. To each well TMB reagent was added. Then the reaction was stopped. The produced color amount is proportional to IgG or IgM quantity. At450 nm the optical density was read. In compression way with calibrator and controls (an index of 1.00 or greater is positive and shows the possibility of new or latest toxoplasmosis) (Obaid and Juma, 2016).

Results and Discussion

The overall infection rate among pregnant women as shown in table 1 was 9.8%. High percentage (6.9%) of *Toxoplasma* positive samples were for IgG antibody, and a rate of 1.8% was for IgM, lower rate (1.08 %) was for both the antibodies.

The rate of informational status about what is toxoplasmosis or what is its causative agent is indicated in table 2. Significantly high percentage of university staff who knew what is toxoplasmosis were bachelor certificate holders with rate of 56.7%. The lowest was for uneducated with rate of 14.3%. In pregnant women the highest rate was for PhD certificate holders 42.9% and the lowest percentage was for uneducated persons.

Table 3 had included the question about what animal has a close relation with the disease. High percentage of university staff had known the correct answer with rate of 64.4% while in pregnant a rate of 49.7% was correctly answered.

Equal low percentage (29.3 %) of questioned university staff and pregnant women, had information about the role of meat in the disease transmission table 4. Half (49.1%) of questioned university staff about the

possibility of the disease transmission by vegetables and fruits had answered correctly versus 32% in pregnant women (Table 5).

A rate of 46, 32.2 % had knew that contact with soil may cause the disease, in each of university staff and pregnant women respectively (Table 6).

Table 7 showed that 37.7, 42.3% of answers about (what is the community part most affected with disease?) were correct in both of university staff and pregnant women respectively.

About what concern to the animal types that may be infected or harbor the disease low rates (26.1, 23 %) of questioned university staff and pregnant women were knew that all warm blooded animals may harbor the disease or may be infected with it (Table 8).

Toxoplasmosis is a disease of all regions and communities, the infection rate of the disease among pregnant women in this study was 9.8%, this was agreed with what found (8.9, 9.5%) by others (Obaid and Juma, 2016) but not agreed with higher rats (54%, 28.5) found by Tawfeeq *et al.*, (2012) and Amin *et al.*, (2013). The infection is endemic more in populations that unaware of prophylaxes and preventative strategies. The present study proved that the educational status is significantly related with the disease informational background and protection practice. This was agreed with previous studies (Millar *et al.*, 2014; Andiappan *et al.*, 2014; Ebrahimi *et al.*, 2015).For all interviewed persons the number and rates of negative answers were significantly higher than positive answers. In university staff its was expected that the knowledge background will be high, because they are the well-educated part in the community, but the number of positive answers were few for all submitted questions. Even though the rates of

negative answers were higher in pregnant women, this result confirms the request of more informational providences in most parts of population. The current study demonstrated that the rates of correct answers were fluctuated in both cohorts of the study. About what concerning the causative agent of the disease or what is the disease, high rate of questioned individuals not knew the correct answer. Identical results have been observed. In Rio De Janeiro, Brazil, 72.2% of interviewed women had not heard on toxoplasmosis (Millar *et al.*, 2014). Based on a survey, 89% of pregnant women had never heard or seen facts about toxoplasmosis (Andiappan *et al.*, 2014). Only 15.7% of questioned students had heard about toxoplasmosis (Ebrahimi *et al.*, 2015). 65% of university students didn't respond to any submitted questions, in Payame-noor University of Ilam, Iran (Abdi *et al.*, 2016). 40% of women knew that toxoplasmosis is an infection, and 21% believed that a poison causes it (Jones *et al.*, 2003) and 75.5% of Dhahran, Saudi Arabia pregnant contributors had never heard about toxoplasmosis (Elsafi *et al.*, 2015). This situation sets individuals especially pregnant on high risk for getting *Toxoplasma* infection. Knowledge deficiency could expose the people to acute or chronic infection. Among our questioned group a proportion of 64.4, 49.7% had knew that the cat feces contain the disease infective stage. Similar studies showed that, 61% of the pregnant women had known that the parasite is shed in cat feces (Abdi *et al.*, 2016). And another 95.5% of pregnant women knew that contact with feline feces may cause the infection (Millar *et al.*, 2014). Many women had not recognized the role of cats feces in the illness transmission (Andiappan *et al.*, 2014; Ebrahimi *et al.*, 2015; Amin *et al.*, 2013). Ignorance of cats role in the disease transmission will highly increase its prevalence among population especially cat owners. High number of included university

staff and pregnant women in this study didn't know about the risk factor of raw or undercooked meat dialing or consumption. Also they didn't know the vegetables, or contact with soil is possible route for getting the infection. Prior studies have confirmed this results, among the questioned women 63.1% erroneously answered about the consumption of raw meat, 74.8 % erroneously answered about the role of vegetables (Millar *et al.*, 2014). Merely 30% of the women were responsive to disease spread by raw or undercooked meat (Jones *et al.*, 2003). High number of interviewed persons failed to recognize hazard aspects such as ingestion of undercooked meats, thoroughly unwashed fruits and vegetables and contacting with soil (Andiappan *et al.*, 2014; Amin *et al.*, 2013). 75.5% of the contributors had never gotten information about toxoplasmosis and the related risk aspects (Elsafi *et al.*, 2015). About what related with the most population group which can be affected by the disease, or the animal types that may be infected with *T. gondii*, only a few percentage of questioned individuals were correctly answered. Likewise high percentages of interviewed people had erroneously answered (Andiappan *et al.*, 2014; Jones *et al.*, 2003; Amin *et al.*, 2013; Dabritz and Conrad, 2010). Unawareness of these information and hazardous or risk factors will amplify the chance of getting the infection. It's a national request to provide knowledge about this disease and other risky disease to grantee a healthy offspring. It was worthy providing information about the illness, all *Toxoplasma* related knowledge have been raised among participants after informational handout providences (Dabritz and Conrad, 2010). After congenital *Toxoplasma* control program application, it was detected a 63% decrease in the number of infected pregnant women and a 42% decrease in the number of children forwarded to reference services (Lopes-Mori *et al.*, 2011).

Table.1 The infection rates among pregnant women

| Type of antibody | Total No. examined | No. +ve samples | Percentages |
|------------------|--------------------|-----------------|-------------|
| IgG | 276 | 19 | 6.9 |
| IgM | 276 | 5 | 1.8 |
| IgG+IgM | 276 | 3 | 1.08 |
| Total | 276 | 27 | 9.8 |

Table.2 Number and rates of answers on (What is Toxoplasmosis or what is its causative agent?)

| Education status | University staff | | | | Pregnant women | | | |
|-----------------------------|--|-----|-------------|------|---|------|-------------|------|
| | Total No. | % | +ve answers | % | Total No. | % | +ve answers | % |
| Uneducated | 56 | 8 | 8 | 14.3 | 45 | 15 | 10 | 22.2 |
| Primary, high school | 58 | 8.2 | 11 | 18.9 | 70 | 23.3 | 23 | 32.9 |
| College student | 340 | 49 | 148 | 43.5 | 85 | 28.3 | 41 | 47 |
| Diploma | 57 | 8 | 24 | 42 | 35 | 11.7 | 12 | 34.3 |
| Bachelor degree | 120 | 17 | 68 | 56.7 | 33 | 11 | 9 | 27.3 |
| Master degree | 49 | 7 | 24 | 49 | 18 | 6 | 5 | 27.8 |
| Philosophy degree | 20 | 2.9 | 7 | 35 | 14 | 4.7 | 6 | 42.9 |
| Total No. | 700 | | 290 | 41.4 | 300 | | 106 | 35.3 |
| X² value | Evaluated X ² value = 61.55, X ² value of P < 0.01 = 26.2(significant) | | | | Evaluated X ² value = 21.62, X ² value of P < 0.01 = 16.8 (significant) | | | |

Table.3 Number and rates of answers on (What animal has a close relation with the disease?)

| Education status | University staff | | | | Pregnant women | | | |
|-----------------------------|---|-----|-------------|------|---|------|-------------|------|
| | Total No. | % | +ve answers | % | Total No. | % | +ve answers | % |
| Uneducated | 56 | 8 | 24 | 42.9 | 45 | 15 | 20 | 44.4 |
| Primary, high school | 58 | 8.2 | 28 | 48.3 | 70 | 23.3 | 33 | 47.1 |
| College student | 340 | 49 | 234 | 68.8 | 85 | 28.3 | 56 | 65.9 |
| Diploma | 57 | 8 | 36 | 63.2 | 35 | 11.7 | 12 | 34.3 |
| Bachelor degree | 120 | 17 | 85 | 70.8 | 33 | 11 | 11 | 33.3 |
| Master degree | 49 | 7 | 31 | 63.3 | 18 | 6 | 10 | 55.6 |
| Philosophy degree | 20 | 2.9 | 13 | 65 | 14 | 4.7 | 7 | 50 |
| Total No. | 700 | | 451 | 64.4 | 300 | | 149 | 49.7 |
| X² value | Evaluated X ² value = 47.28, X ² value of P < 0.01 = 34.8 (Significant) | | | | Evaluated X ² value = 23.91, X ² value of P < 0.01 = 16.8 (Significant) | | | |

Table.4 Number and rates of answers about (Does meat is a possible source of infection)?

| Education status | University staff | | | Pregnant women | | |
|-----------------------------|--|-----|---------------|--|------|---------------|
| | Total No. | % | +ve answers % | Total No. | % | +ve answers % |
| Uneducated | 56 | 8 | 6 10.71 | 45 | 15 | 10 22.2 |
| Primary, high school | 58 | 8.2 | 12 20.7 | 70 | 23.3 | 21 30 |
| College student | 340 | 49 | 130 38.2 | 85 | 28.3 | 37 43.5 |
| Diploma | 57 | 8 | 10 17.5 | 35 | 11.7 | 6 17.4 |
| Bachelor degree | 120 | 17 | 34 28.3 | 33 | 11 | 9 27.3 |
| Master degree | 49 | 7 | 8 16.3 | 18 | 6 | 1 5.5 |
| Philosophy degree | 20 | 2.9 | 5 25 | 14 | 4.7 | 4 28.6 |
| Total No. | 700 | | 205 29.3 | 300 | | 88 29.3 |
| X² value | Evaluated X ² value = 36.129, X ² value of P < 0.01 = 26.2 (significant) | | | Evaluated X ² value = 1.78, X ² value of P < 0.01 = 9.21 (significant) | | |

Table.5 Number and rates of answers on (Are vegetables and fruits a possible source of infection?)

| Education status | University staff | | | | Pregnant women | | | |
|-----------------------------|---|-----|---------------|------|--|------|---------------|------|
| | Total No. | % | +ve answers % | | Total No. | % | +ve answers % | |
| Uneducated | 56 | 8 | 10 | 17.9 | 45 | 15 | 17 | 37.8 |
| Primary, high school | 58 | 8.2 | 20 | 34.5 | 70 | 23.3 | 21 | 30 |
| College student | 340 | 49 | 178 | 52.4 | 85 | 28.3 | 34 | 40 |
| Diploma | 57 | 8 | 29 | 50.9 | 35 | 11.7 | 9 | 25.7 |
| Bachelor degree | 120 | 17 | 73 | 60.8 | 33 | 11 | 9 | 27.3 |
| Master degree | 49 | 7 | 25 | 51 | 18 | 6 | 2 | 11.1 |
| Philosophy degree | 20 | 2.9 | 9 | 45 | 14 | 4.7 | 4 | 28.6 |
| Total No. | 700 | | 344 | 49.1 | 300 | | 96 | 32 |
| X² value | Evaluated X ² value = 97.94, X ² value of P < 0.01 = 26.2 (significant) | | | | Evaluated X ² value = 1.66, X ² value of P < 0.01 = 9.21 (significant) | | | |

Table.6 Number and rates of answers on (Dose contact with soil may cause the disease?)

| Education status | University staff | | | | Pregnant women | | | |
|-----------------------------|---|-----|-------------|------|---|------|-------------|------|
| | Total No. | | +ve answers | | Total No. | | +ve answers | % |
| | % | | % | % | | | | |
| Uneducated | 56 | 8 | 16 | 28.6 | 45 | 15 | 14 | 31.1 |
| Primary, high school | 58 | 8.2 | 24 | 41.4 | 70 | 23.3 | 21 | 30 |
| College student | 340 | 49 | 172 | 50.6 | 85 | 28.3 | 37 | 43.5 |
| Diploma | 57 | 8 | 22 | 38.6 | 35 | 11.7 | 8 | 22.9 |
| Bachelor degree | 120 | 17 | 57 | 47.5 | 33 | 11 | 8 | 24.2 |
| Master degree | 49 | 7 | 20 | 40.8 | 18 | 6 | 4 | 22.2 |
| Philosophy degree | 20 | 2.9 | 11 | 55 | 14 | 4.7 | 5 | 35.7 |
| Total No. | 700 | | 322 46 | | 300 | | 97 32.3 | |
| X² value | Evaluated X ² value = 22.27, X ² value of P < 0.01 = 16.8 (significant) | | | | Evaluated X ² value = 1.707, X ² value of P < 0.01 = 9.21 (significant) | | | |

Table.7 Number and rates of answers on (What is the community part most affected with disease?)

| Education status | University staff | | | | Pregnant women | | | |
|-----------------------------|---|-----|-------------|------|---|------|-------------|------|
| | Total No. | | +ve answers | | Total No. | | +ve answers | % |
| | % | | % | % | | | | |
| Uneducated | 56 | 8 | 12 | 21.4 | 45 | 15 | 20 | 44.4 |
| Primary, high school | 58 | 8.2 | 12 | 20.7 | 70 | 23.3 | 29 | 41.4 |
| College student | 340 | 49 | 141 | 41.5 | 85 | 28.3 | 44 | 51.8 |
| Diploma | 57 | 8 | 31 | 54.4 | 35 | 11.7 | 9 | 25.7 |
| Bachelor degree | 120 | 17 | 42 | 35 | 33 | 11 | 10 | 30.3 |
| Master degree | 49 | 7 | 16 | 32.7 | 18 | 6 | 8 | 44.4 |
| Philosophy degree | 20 | 2.9 | 10 | 50 | 14 | 4.7 | 7 | 50 |
| Total No. | 700 | | 264 37.7 | | 300 | | 127 42.3 | |
| X² value | Evaluated X ² value = 41.85, X ² value of P < 0.01 = 43 (significant) | | | | Evaluated X ² value = 5.601, X ² value of P < 0.01 = 13.3 (significant) | | | |

Table.8 Number and rates of answers on (Does animals can be infected with disease?)

| Education status | University staff | | | | Pregnant women | | | |
|-----------------------------|--|-----|-------------|------|--|------|-------------|------|
| | Total No. | | +ve answers | | Total No.% | | +ve answers | |
| | | % | % | | % | % | % | |
| Uneducated | 56 | 8 | 29 | 51.8 | 45 | 15 | 4 | 8.9 |
| Primary, high school | 58 | 8.2 | 29 | 50 | 70 | 23.3 | 22 | 31.4 |
| College student | 340 | 49 | 58 | 17.1 | 85 | 28.3 | 28 | 32.9 |
| Diploma | 57 | 8 | 20 | 35.1 | 35 | 11.7 | 7 | 20 |
| Bachelor degree | 120 | 17 | 30 | 25 | 33 | 11 | 5 | 15.2 |
| Master degree | 49 | 7 | 9 | 18.4 | 18 | 6 | 3 | 16.7 |
| Philosophy degree | 20 | 2.9 | 8 | 40 | 14 | 4.7 | 0 | 0 |
| Total No. | 700 | | 183 26.1 | | 300 | | 69 23 | |
| X² value | Evaluated X ² value = 100.87, X ² value of P < 0.01 = 43 (significant) | | | | Evaluated X ² value = 7.29, X ² value of P < 0.01 = 13.3 (significant) | | | |

It is concluded that there are a great deficiency of knowledge in our community about toxoplasmosis. Therefore it's very important to, offer a handout or texts to women during parental care in health centers or hospitals. Making periodically meeting groups during pregnancy to promote health education prevention and correct the information on the illness. Using of public media for spreading knowledge about these kinds of illness.

References

Abdi, J., Safarpour, O., Biglari, K.H. and Sayehmiri, K., 2016. Female students' knowledge on toxoplasmosis in Payame-noor University of Ilam, west of Iran. Sky Journal of Microbiology Research.4(1): 001-004.

Al Se'adawy, M.A., 2010. prevalence of Toxoplasmosis in pregnant women in Al Muthana province / Iraq Kufa Journal For Veterinary Medical Sciences. 1(1): 166-173.

Amin, T.T., Al Ali, M.N., Alrashid, A.A., Al-Agnam, A.A. and Al Sultan, A.A., 2013.Toxoplasmosis Preventive Behavior and Related Knowledge among Saudi Pregnant Women: An Exploratory Study. Global Journal of Health Science. 5(5):

131-143.

Andiappan, T.H., Nissapatorn, V., Sawangjaroen, N., Khaing, S., *et al.*, 2014. Knowledge and practice on *Toxoplasma* infection in pregnant women from Malaysia, Philippines, and Thailand. Frontiers in Microbiology, Microbial Immunology. 5(291): 1-8.

Bojar, I. and Szymanska, J., 2010. Environmental exposure of pregnant women to infection with *Toxoplasma gondii*-state of the art. Ann Agric Environ Med.17: 209-214

Dabritz, H.A. and Conrad, P.A., 2010.Evaluation of an educational handout on knowledge about toxoplasmosis. Scientia Medica (Porto Alegre). 20(1):51-58.

Demar, M., Azenberg, D., Maubon, D., Djossou, F., Panchoe, D., Punwasi, W., *et al.*, 2007. Fatal outbreak of human toxoplasmosis along the Maroni River: epidemiological, clinical, and parasitological aspects. Clin Infect Dis.45:88-95.

Dubey J.P., Lago, E.G., Gennari, S.M., Su, C. and Jones, J.L., 2012. Toxoplasmosis in humans and animals in Brazil: high prevalence, high burden of disease, and epidemiology. Parasitology.139:1375-

- 424.
- Dubey, J.P. and Jones, J.L., 2008. *Toxoplasma gondii* infection in humans and animals in the United States. *Int J Parasitol.* 38: 1257-1278.
- Dumètre, A. and Dardé, M.L., 2003. How to detect *Toxoplasma gondii* oocysts in environmental samples? *FEMS Microbiol Rev.* 27:651-61.
- Ebrahimi, M., Ahmadi, A., Yaghfoori, S., Rassouli, M., Azizzadeh, M., 2015. Evaluating the prior knowledge of toxoplasmosis among students of Ferdowsi University of Mashhad. *Med J Islam Repub Iran.* 29(163): 1-3.
- Elsafi, S.H., Al-Mutairi, W.F., Al-Jubran, K.M., Abu Hassan, M.M. and Al Zahrani, E.M., 2015. Toxoplasmosis seroprevalence in relation to knowledge and practice among pregnant women in Dhahran, Saudi Arabia. *Pathogens and Global Health.* 109 (8):377-381.
- Elsheikha, H.M., 2008. Congenital toxoplasmosis: priorities for further health promotion action. *Public Health.* 122:335-353.
- Jones, J.L., Ogunmodede, F., Scheftel, J., Kirkland, E., *et al.*, 2003. Toxoplasmosis-related knowledge and practices among pregnant women in the United States. *Infect Dis Obstet Gynecol.* 11:139–145.
- Lopes-Mori, F.M.R., Mitsuka-Breganó, R., Capobiango, J.D., Inoue, I.T., Reiche, E.M.V., Morimoto, H.K., *et al.*, 2011. Programas de controle da toxoplasmose congênita. *Rev Assoc Med Bras.* 57:594-9.
- Millar, P.R., De Moursal, F.L., Bastos, O.M., De Mattos, D.P., *et al.*, 2014. Toxoplasmosis-related knowledge among pregnant and postpartum women attended in public health units in Niterói, Rio De Janeiro, Brazil. *Rev. Inst. Med. Trop. Sao Paulo.* 56(5):433-438.
- Obaid, H.M. and Juma, S.A., 2016. TORCH screening test in pregnant women of Kirkuk city. *Al-Mustansiriyah Jour. Scie.* 27(5): 17-25.
- Obaid, H.M., Noor aldeen, M.Y. and Mohammad, L.M., 2017. Seroprevalence of Anti *Toxoplasma gondii* IgG and IgM in Healthy Blood Donors in Kirkuk City *Journal of Babylon University/Pure and Applied Sciences.* 3(25): 946-954.
- Obaid, H.M., 2014. Serological and microscopical detection of *Toxoplasma gondii* in Kirkuk city- Iraq. *Diyala journal for pure science.* 10 (4): 59-73 ..
- Obaid, H.M., 2017. Survey study on toxoplasmosis among Kirkuk university students. *Journal University of Kerbala.* 15 (1):253-259.
- Remington, J.S., McLeod, R., Wilson, C.B. and Desmonts, G., 2010. Toxoplasmosis. In: Remington JS, Klein JO, editors. *Infectious diseases of the fetus and newborn infant.* 7th ed. Pennsylvania: Elsevier. 918-1041.
- Robert-Gangneux, F. and Dardé, M.L., 2012. Epidemiology of and Diagnostic Strategies for Toxoplasmosis. *American Society for Microbiology. Clinical Microbiology Reviews.* 25(2): 264–296.
- Tawfeeq, W.F., Saeed, A.K. and Muslim, T.M., 2012. Seroprevalence and Associated Factors of *Toxoplasma* Infection among Sample of Pregnant Women in Wassit Governorate- Iraq. *Medical Journal of Babylon.* 9(4): 873-882.

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