



SCIREA Journal of Biology

<http://www.scirea.org/journal/Biology>

August 12, 2020

Volume 5, Issue 3, June 2020

Review of Seroprevalence of Toxoplasmosis in Iraq

Huda Sahib Al-Rawazq

Anatomy/ Biology section, College of Medicine, University of Baghdad, Baghdad, Iraq.

Email : Hudasahib_2015@Yahoo.com.

Abstract

Toxoplasma gondii (T.gondi) is a protozoan parasite caused zoonotic disease prevalent worldwide called Toxoplasmosis. An intracellular protozoan obligatory parasite with complex life cycle and cases toxoplasmosis between humans and infecting the globe population that is the most prevalent chronic infections. The most common typically asymptomatic parasitic infections in humans. However, the acute and disabling disease in the evolving fetus including abortion show in primary infection in a pregnant woman. Asymptomatic in acute *Toxoplasma* infections in immunocompetent hosts their represent 80 %. And the common manifestations of symptomatic infection occurs in immunocompetent individuals. Review was based on the information provided by the collection and summarizing of 30 articles from Iraqi researchers from North to the south. These were collected from Google Scholar and Iraq Academic scientific Journals. These studies Constricted on the connection between pregnant women and aborted women with Toxoplasmosis.

Keyword: *Toxoplasma gondii*, zoonotic parasite disease, Toxoplasmosis.

Introduction:

Toxoplasma gondii (*T.gondi*) is a protozoan parasite caused zoonotic disease prevalent worldwide called Toxoplasmosis (1). An intracellular protozoan obligatory parasite with complex life cycle and cases toxoplasmosis between humans and infecting the globe population that is the most prevalent chronic infections (2). The broad geographic site of toxoplasmosis is linked with several risk factors such as the nutritional habits and location of one residence, geographical climate, contacted him with Cal's or other pet's feces, (3). The most common typically asymptomatic parasitic infections in humans. However, the acute and disabling disease in the evolving fetus including abortion show in primary infection in a pregnant woman (4). Asymptomatic in acute *Toxoplasma* infections in immunocompetent hosts their represent 80 %. And the common manifestations of symptomatic infection occurs in immunocompetent individuals include: influenza-like illness, lymphadenopathy and Chorioretinitis occur more rarely, the immunocompromised complications can include cerebral or ocular infection, miscarriage in pregnant women according to toxoplasmosis can result stillbirth, congenital toxoplasmosis in baby causing arrange of potential long-term conditions (5). A relationship between toxoplasmosis and the development of psychiatric disorders including schizophrenia show in some epidemiological studies (6). Earlier researcher has revealed the infection was more frequent between those with raw meat, history of close contact with cats, vegetable consumption and low learning level (7).

Epidemiology:

Toxoplasma infected the world's human population Approximately 25-30 %. The prevalence in a particular country or between different communities in the same region varies greatly (from 10 to 80 %). The decrease in seroprevalence (10-30 %) was observed in North Europe and Sahel region of Africa, North America, Southeast Asia, Moderate prevalence (30-50 %) was found in central and south European countries and Latin America and African tropical countries there were high prevalence rates (8,9). The world whatever it is, the land, the navy or the wings, is full of toxoplasmosis (10). *Toxoplasma* spread is evolving constantly and varies greatly. As in geographical areas within the same country and among different countries. It is influenced by

different and complex risk factors whether health, environmental and socioeconomic related practices (11).

Transmission and life cycle:

Two mechanism of transmission in toxoplasmosis can occur: the first vertically from a mother to fetus (12-14). Although in healthy individuals *T. gondii* remains dormant. And the vertical transmission to the embryo occurs due to exposure to parasites during the pregnancy (15). During the pregnancy the maternal infection incidence is 1-8 per 1000 pregnancies (16). In congenitally infected infants the intensity of clinical disease is related inversely the gestational age at the time of primary maternal infection (17,18). And horizontally infection is acquired by the tissue cysts existing in raw meat or by chance ingesting Oocysts in water, food, and soil contaminated with cat feces (19, 20).

There are three stages in life cycle: the Oocyst, bradyzoite and trophozoite (21). *Toxoplasma gondii* can be found in the infected meat of animals such as sheep, cattle and pigs and in environments contaminated by infected cat feces. In epithelial cells gut for cats, the parasite infects reproduces and Oocysts are excreted in feces. In humans the organism's prevalence throughout the body in the tachyzoite form through ingestion of toxoplasma Oocysts. For life in the host these tachyzoites can compose intracellular tissue cysts within they may remain bradyzoite form. Other animals including humans if these tissue cysts are ingested become infectious (22). The obtaining of Toxoplasmosis in humans by; ingesting of sporulated Oocysts from the environment usually from water contaminated with cats feces, vegetables, fruit or soil, take in cyst in food produced from an infected animal; organ transplantation or blood transport; from an infected mother to her fetus; direct contact with lambing and ingesting the parasite (5).

Diagnosis of Toxoplasmosis:

Toxoplasmosis is routinely diagnosed with serological techniques such as ELISA by identifying the parasite specific IgG and IgM antibodies in the serum (23). The diagnosis can be made directly by identifying the parasite in tissue sections or in body fluid or indirectly by serological and biochemical techniques (24). On the other hand, the direct detection of the parasite by means

of PCR, cell culture, histology, and mouse inoculation in immune-compromised individuals (25). The rapid detection of *T. gondii* by additional diagnostic tool in various clinical materials represents detection of the parasite by molecular methods like Real-time polymerase chain reaction (RT-PCR) (26). Most Laboratories have abandoned to color test in favor of simpler technique's that use killed antigens, such as the IFA, ELISA, agglutination and indirect hemagglutination (IHA) tests (27).

Toxoplasmosis in Iraq:

Review was based on the information provided by the collection and summarizing of 30 articles from Iraqi researchers from North to the south. These were collected from Google Scholar and Iraq Academic scientific Journals. These studies Constricted on the connection between pregnant women and aborted women with Toxoplasmosis.

Toxoplasmosis studies about pregnant and aborted women in Different Area:

There are several studies:

The First articles in Baghdad by Mossa (28) in 2009 included 54 Women patient with toxoplasmosis, the range of Age group between (16-45) years old. The study 51 (94 %) were represents pregnant women with positive IgG, 3 (6 %) were represents pregnant women with negative IgG. And 27 (50 %) was performed to women with IgM from this positive was 9 (33 %), negative was 18 (67 %), at end IgG test show pregnant with a history of abortion was positive in 82 %, women with a history of stillbirth was positive in 18 %.

Mohammed et al. (29) in 2010 reported study involving 120 women. The result of abortive women specified that 43.33 % were detected positive for anti-toxoplasma antibodies 25.83 % of them has IgG, 4.16 % has IgM and 56.55 % has no antibodies by ELISA. Thereafter, detecting in blood of abortive women *T. gondii* DNA by used nested PCR analysis. Of abortive women found exposed positive result for B1 gene of *Toxoplasma gondii* is 15.83 %, 31.57 % of those abortive women involved with IgG, 10.52 % with IgM and 26.31 % with both (IgG & IgM), non-anti-toxoplasma antibodies represent 31.57 %.

Hussan (30) in 2013, From a total 210 aborted women 32 (15.23 %) were positive of toxoplasma IgM, ACL IgG antibodies positive were 12 (5.7 %) and APS IgG positive were 7 (3.3 %). And the rate of one miscarriage in abortive women was 71.6 % (86/120) higher than two and three miscarriages 25 % (30/120), 3.4 % (4/120) respectively. When compared with first and second and third trimester's abortion of ACL IgG and APS IgG show higher in first trimester abortion.

Al-Fakar et al. (31) in 2015 reported study included 76 women: 42 women had recent abortion and 34 healthy women with no history of abortion. Ages range between (15-40) years. A result shows anti-phosphatidyl serine-Abs in association with acute phase of toxoplasmosis and important role in recent abortion more than the role of anticardiolipin Abs.

Al-Hindawi & Al-Shanawi (32) in 2014 show in study performed 282 aborted women and 50 normal pregnant women (control group). The primary tests with latex Agglutination test (ALT) show a percentage of positive antibodies of *T. gondii* in aborted women 99 (35.1 %) and normal pregnant women 13 (26 %). And the second test used was ELISA for the positive sera in (ALT) of *T. gondii* antibodies. In this test, the women sera were divided into four groups for both aborted and normal pregnant women the result for this group (IgG+ & IgM-) 73 (73.7 %), (IgG+ & IgM+) 2 (2 %), (IgG- & IgM+) 2 (2 %), (IgG- & IgM-) 22 (22.3 %) compared with control group 13 (100 %) for only the first group.

Mohammed and et al. (33) in 2015, were collected from aborted women that are suspected to have *T. gondii* 96 blood and amniotic fluids samples from 368 samples and compared with those of 79 apparently healthy controls volunteers pregnant. This study revealed that is a highly significant increment in genotyping of toxoplasma Type II [9 (15.25 %)], Type I and III [2 (3.38 %)], while the distribution the genotype of toxoplasma strains according to age groups showed that highest frequency (55.6 %) of Type I was among those at age (15-25) years, while Type II was predominant (39.6 %) among the age group (36-45) years. For Type III, it was observed in very low percentage among aborted (only two cases out of 96). The results showed a highly significant difference in IgM level [48 (93.8 %)] among Type II, [9 (100 %)] Type I and [2 (100 %)], Type III in comparison with healthy controls ($P < 0.01$), moreover, the current results revealed a highly significant difference in Alpha-fetoprotein AFP positively among Type I [8 (88.9

%), Type II [46 (95.8 %)], Type III [2 (100 %)] in comparison with [16 (43.2 %)] of healthy control while level of AFP ($P < 0.01$).

Al-Garawi (34) in 2016. In Three group of women who suffered recurrent spontaneous abortion determined the interfere of Serum Luteinizing Hormone Level (S. LHL) with toxoplasmosis infection. A first group was pregnant women with once abortions and second group multiple abortions this compared with a third group a control group represents normal pregnant women. From the first group 45 women from those 53 % have shown increase positive IgG value, while within the normal group 47 % of those patients stayed negative IgG. the second group has increase 73 % of positive IgG level. And the corresponding S. LHL was significantly elevation in addition notable high of S. LHL was recorded in negative IgG with the second group. The result a significant contribution of higher S.L HL in spontaneous abortion uncovers.

In Al-Diwaniyah the first studies reported by Jassem (35) in 2008 determine 200 blood samples of women the result shows obvious increase in general seropositive rate to reach 45.5 % with marked variation according to different categories in women with habitual abortion 20.5 %, Abortion for one time 13.5 %, Normal pregnancy 2.5 %, and not married women 9 %.

Al-Shaimmery (36) in 2011, From Al- Diwaniyah 125 sample collected from miscarriages and healthy women as control group the result show 65 (22+43) were positive for anti-toxoplasma antibody IgM and IgG antibodies respectively whereas all control group for *T. gondii* 25 have been found to be negative. the study has found that second trimester of pregnancy highest prevalence of toxoplasmosis recorded for women.

Ibadi (37) in 2015. There are 68 respondents in this study, (25 %) of them was the majority of age group (35-39) years, the majority of them have low-level of education, (41.2 %) of theme were respondents at a primary level of education and (76.5 %) of them were housewives, about 52.9 % of theme were living in the urban area from the middle income .

Hadi et al. (38) in 2016. The present study was performed on 125 as case group in aborted women and 30 healthy women as control group (15 pregnant women and 15 non pregnant). The results expound the seroprevalence of IgM (recently acquired infection) and IgG (latent infection) anti-Toxoplasma antibodies (4 %) were positive in 5/125 cases and (44 %) in 55/125 cases respectively, however 48% in aborted women was overall seroprevalence of anti-*T. gondii* antibodies, in this study were didn't have recorded mixed seropositive for IgG and IgM , whereas

all antibodies were 0 % for healthy women for , the total seroprevalence for IgM 3.2 % and for IgG 35.4 % and (38.7 %) for all antibodies in both groups were positive in 60/155 cases .

In wassit province the studies was reported by Al-saidi (39) in 2009 in this study 648 was detection serologically among women. Toxoplasma-specific IgG antibody was detected using latex agglutination test showed that 5 % (357 out of 648) of patients were positive for IgG antibodies wheras 31 % (112 out of 357) were positive for IgM by using ELISA. The risk factors for IgG anti-toxoplasma seropositivity were consumption of raw meat.

In Wassit the second study reported by Rahi and Jasim (40) 2011. In this study 49 sera were tested by using dipstick dye immunoassay method for anti-Toxoplasma IgM antibodies in women with recurrent abortion . Seropositive cases were 24 (4 %) and 25 (51 %) were seronegative for anti-Toxoplasma IgM antibody. The higher infection (70 %) among women in age (26-35) years the lower (14 %) in age > 45 years. Also, the results were showed there was relationship between the prevalence of disease and history of contact with cats 20/24 (83 %).

Tawfeeq et al. (41) in 275 pregnant women in age group (15-45) years old a descriptive cross sectional study was done. The result showed seroprevalence of IgG seropositivity (chronic infection) was 32.4 % whereas anti-Toxoplasma gondii IgM antibody (acute infection) was 22.2 % with significant association with consumption of one meal of meat/day, consumption of under-cooked beef meat , and/or contact with cats were significant associated factors and exposures to soil .

A'aiz (42) A total of 508 clinical specimens (blood 500 and placenta 8) of women were initially serologically examined by ELISA and moreover tested by RT-PCR technique to affirm the infection with *T. gondii* through B1 gene amplification. Technique to affirm the infection with *T. gondii* through B1 gene amplification. Then, genetic characterization depends up on SAG2 gene of the positive DNA samples were assayed by nested PCR-RFLP. From total show only 15 were affirm positive *T. gondii* DNA. Discover genotyping assay that examined isolates of 6.6 % (1/15) represent the genotypes I, examined isolates of 13.3 % (2/15) represent the genotypes II and examined isolates of 80 % (12/15) represent the genotypes III. The dominant picture in human is type II.

In Al-Najaf Kadhim and Ajam (43) in 2017, the total 340 diagnosed for toxoplasmosis in pregnant women within age range (20-45) years old. Represented (32.4 %) highest ratio of cases

was in age group (25-29) years, however (27.6 %) In the age range (35-39) years with control group. Most cases had two cases of abortion (3.8.2 %) according to the number of abortion. On the other hand, the hormones of steroid (cortisol and free testosterone) is the most control respondents had zero abortion (20 %), these hormones are considered a protective factor in the control and are considered a significant risk factor in cases group.

Another author Al-Jorany et al. (44) In 2012, the present study infection with toxoplasma gondii of aborted women among 90 only due to toxoplasmosis infection 70 of them with recurrent abortion and 20 without toxoplasmosis as control group (10 healthy aborted women and 10 feverish aborted women) is an expression of heat shock protein (Hsp 70) by . The total number of studied were 70 (100 %) cases of toxoplasmosis by ALT and 20 (29.5 %) by IgG- ELISA and IgM-ELISA. The present study revealed among those with three number of abortion 4.26 % and 9.47 % among those four number abortions that the concentration of Hsp 70 was elevated.

Abbas and Al-Hamairy (45) in 2016. The results showed that PCR technique was for IgM and IgG and both (IgM and IgG) in pregnant women its (35.1 %, 22.8 % and 19.3 %) and in aborted women its (59.0 %, 20.5 % and 20.5 %). The results connection of residence area (urban and rural area) with infection these positive of cases of IgM and IgG and both as the following (16.9 %, 49.2 % and 20.0 %) for urban area and (32.3 %, 35.5 % and 19.4 %) in rural area. Whereas for age groups the result for IgM and IgG and both (IgM & IgG) for age group (22-26), (27-31) and (32-36) years which were (28.6 %), (16.2 %) and (42.9 %), (45.0 %) and (30.0 %) respectively. The infected person's those keeping the cats or not their houses for IgM and IgG and both (IgM & IgG) shows (45.7 %, 30.4 % and 23.9 %) and (44 %, 14 % and 16 %) respectively. The IgM and IgG and both (IgM & IgG) for the pregnant and aborted women for these eating fresh vegetables and using sterilization or not or completely not eating fresh vegetables were (6.9 %, 86.2 % and 6.9 %), (28.8 %, 27.3 % and 25.8 %), and (0 %, 0 % and 0 %) respectively. According to periods number in pregnant (1-3 month) which were (16.6 %, 33.3 % and 50 %), (3-6 month) which were (22.2 %, 55.6 % and 22.2 %), and (6-9 month) which were (23.8 %, 31 % and 14.3 %). The time numbers of abortion (once, two and more) and relation with cases of IgM positive and IgG and both (IgM & IgG) which were (11.1 %, 55.6 % and 33.3 %), (41.7 %, 63.6 % and 0 %) and (11.1 %, 61.1 % and 27.8 %).

Mohammed and Al-Janabi (46) in 2018, the study included 75 sera sample were collected the seropositivity of aborted women to *T. gondii* was 42.6 % when used Latex agglutination test while 4 % and 22.6 % when detection of *T. gondii* IgM and IgG respectively. The highest percentage of infection was found by ELISA to be 18.6 % in the age group of 21-25 years, in patients inhibited in rural area. Also seropositive in women with double frequent of abortion.

In Al-Muthana, Al-seadawy (47) in 2010, the total infection was 44.5 % in population study and their effect of age proportion which increase directly with age. Lowest infection rate was at age groups (15-19) years and highest at age group (35-39) years, while, the infection in employed women was 25 % and higher ratio in unemployed women was 75 % of the abortion, was high and reached to 69.4 % from total infected women and 54.3 % due to toxoplasma infections of total abortions.

In Erbil, Husain et al. (48), 2011. For detection of anti-toxoplasma IgG in sera of 348 pregnant women ELISA technique is applied. The seropositivity rates are 29.05 % for Toxoplasma IgG. The increasing times of abortion is associated with increasing age. Multiple abortions is related to cases with co-infection and socioeconomic status of pregnant women is statistically not highly associated with the number of abortions.

Author by Al-Daoudy (49) 2012, a total of 322 serum sample by using LAT the overall prevalence was 94 (29.19 %). The Seropositive rate of Latent (IgG) *T. gondii* infection was 19.88 %. And recent (IgM) *T. gondii* infection was 7.76 % No significant relations were observed between genders, contact with cats, and inhabitants of rural and urban area, education level, occupation and anti-*T. gondii* antibodies.

Ali (50) in 2010, Out of 250 the study showed that 112 cases by using LAT were seropositive for toxoplasma *gondii*, by using ELISA 65 cases for IgG and 50 cases for IgM. Out of 150, it showed 87 cases by using LAT were seropositive in the abortion group, 51 case for IgG and 40 cases for IgM (26.6 %), whereas in normal birth group (control), Out of 100 by using LAT it showed 25 cases were seropositive, by using ELISA 14 cases for IgG and 10 cases for IgM. Among housewives the percentage of seropositivity was recorded high (35.2 %) than teacher (29.4 %) and (28.5 %) employers. Furthermore, percentage of toxoplasma seropositivity was recorded higher in rural area than urban area. The higher rate of toxoplasma seropositivity showed in the

abortion women who were in contact with soil (38.7 %) than those were not in contact with soil (25 %).

In Salah-Adden , Al-Dory (51), 2011, the study show in 226 sample was tested the reasons of single or multiple fetal loss in pregnant women, result 66 (29.2 %) samples of pregnant women has toxoplasmosis. All women were examined for presence of toxoplasma indicate 7 (3.1 %) of cases was IgM antibodies resent or acute infection while 59 (26.1 %) of cases was Anti-toxoplasma IgG indicate old or chronic infection by using agglutination and ELISA for specific IgG and IgM antibodies.

Tawfiq (52), in 2018, study among pregnant women 180 and married non-pregnant women as control 100 to discover the time of toxoplasmosis. 64 (35.56 %) among pregnant women were the rates of Toxo-IgG seropositive . in various toxoplasma antigens the reactivity Toxo-IgG was determined , the rates were positive for toxoplasma [ROP1c 40 (62.50 %)], [MIC3 39 (60.93 %)], [GRA7 63 (98.43%)], [GRA8 55 (85.93 %)], [P30 63 (98.43 %)], [MAD1 62 (96.87 %)], [GRA1 41 (64.04 %)] and [rSAG1 42 (65.62 %)] antigens, the elevated rate of avidity was 85.0 % for ROP1c antigen, included the elevated rate predicting toxoplasma infection interval of more than six months which make it less serious for fetal health and maternal.

In Al-Anbar, Al-Mishhadani (53) in 2008, study 340 women samples (for aborted women 230 samples & for normal pregnant women as control 110 samples). Higher rate of (IgG 58.3 % and IgM 8.3 %) specific for toxoplasma among aborted women than control women (IgG 36.4 % and IgM 2.7 %). The overall with increasing age of aborted women's frequency of recurrent abortion the prevalence of toxoplasmosis infection was increased. In conclusion, among aborted women were higher rates of toxoplasmosis infection who living in rural areas than those in urban Ares.

In Diayala, Darweesh (54) in 2017, study included 100 women in two groups aborted women's group (58), pregnant women with previous abortion group (42), showed by ELISA (IgG &IgM) were positive 44 (44 %) which considered confirmed toxoplasmosis cases 38 (38 %) had IgGpositive, 4 (4%) of theme had IgM positive and 2 (2%) had both (IgM & IgG) positive, result were observed the highest in non-pregnant and pregnant women in age group 25-34 and 35-44 years and the study suggest the relationship between T. gondii with the pregnant women and the time and number of abortion. By RT-PCR the aborted women were 15 (15 %) positive for toxoplasmosis connected with low avidity IgG. abortive women were 4 with IgM positive. In

addition, abortive women were 7 with IgG positive, abortive women were 2 with (IgM & IgG) positive, abortive women were 2 with (IgM & IgG) negative.

In Al-Hawija and Al-Baiji, Al-jeburi et al. (55) in 2009. study show a high frequency of toxoplasmosis ratio was seen in women with one abortion group that are happen during their life . According too many risk factor including age, contact with host animals, number of deliveries the high spread of toxoplasmosis among the investigated high risk women at Al-Hawaiga and at Al-B aiji.

References

- [1] Retamanasari A, Widaartono BS, Wijayanti MA, et al. Prevalence and Risk Factors for Toxoplasmosis in Middle Java, Indonesia. *Eco Health*. 2017; 14(1) :162-170. <https://doi.org/10.1007/s10393-016-1198-5>.
- [2] Taha RK, Hamad MN, Taha KM, et al. Seroprevalence of Toxoplasmosis between aborted ladies in Atbara district, Sudan. *MOJ Women's Health*. 2019; 8(1): 86-87. <https://doi.org/10.15406/mojwh.2019.08.00217>
- [3] EL Deeba HK, Salah Eldin H, Khodeere S, et al. Prevalence of Toxoplasma gondii infection in antenatal population in Menoufia, governorate Egypt. *Acta. Trop*. 2012; 124(3): 185-191. <https://doi.org/10.1016/j.actatropica.2012.08.005>
- [4] Gebremedhin EZ, Abebe AH, Tessema TS, et al. Seroepidemiology of Toxoplasma gondii infection in women of child-bearing age in central Ethiopia. *BMC infect. Dis*. 2013; 13(1): 101. <https://doi.org/10.1186/1471-2334-13-101>
- [5] Said B, Halsby KD, Oconnor CM. Risk Factors for Acute Toxoplasmosis in England and Wales *Epidemiol. Infect*. 2017; 145: 23-29. <https://doi.org/10.1017/S0950268816002235>
- [6] Torrey E. and Yolken R. Schizophrenia and Toxoplasmosis. *Schizophrenia Bulletin*. 2007; 33(3): 727-728. <https://doi.org/10.1093/schbul/sbm026>
- [7] Daryani A, Sarvi S, Aarabi M, et al. Seroprevalence of Toxoplasma gondii in the Iranian general population : a systematic review and metaanalysis. *Acta. Trop*. 2014; 137(1): 185-194. <https://doi.org/10.1016/j.actatropica.2014.05.015> PMID: 24887263

- [8] Dubey JP. The history of *Toxoplasma gondii* the first 100 Years. *J Eukaryot. Microbiol.* 2008; 55(6): 467-475. <https://doi.org/10.1111/j.1550-7408.2008.00345.x> PMID: 19120791
- [9] Robert-Gangeneux F and Darde ML. Epidemiology of and Diagnostic Strategies for toxoplasmosis. *Clin. Microbiol Re.* 2012; 25(2): 264-296. <https://doi.org/10.1128/CMR.05013-11>. PMID: 22491772
- [10] Mihai M, Manole A, Tiperciuc R-A, et al. Toxoplasmosis in North- East Romania, Descriptive study counting cases Between 2010 and 2016. *Rev.Med Chir. Soc .Med. Nat. Lasi.* 2017; 121(3): 616-623. Available at: <https://www.revmedchir.ro/index.php/revmedchir/article/view/76>
- [11] Pappas G, Roussos N, Falagas ME. Toxoplasmosis Snapshots: global status of *Toxoplasma gondii* seroprevalence and Implications for pregnancy and congenital toxoplasma. *Int. J. Parasitol.* 2009; 39(12): 1385-1394. <https://doi.org/10.1016/j.ijpara.2009.04.003> PMID: 19433092
- [12] Fusco G, Rinaldi L, Guarino A, et al. *Toxoplasma gondii* in sheep from Campania region (Italy). *Veterinary Parasitology.* 2007; 149(3-4): 271-274. <https://doi.org/10.1016/j.vetpar.2007.07.020> MID: 17764846
- [13] Uttah E, Emmanuel O, Christiana O. Toxoplasmosis: A global infection so widespread, so neglected. *Internat. J. of Scient. And Resea. Publicat.* 2013; 3: 2250-3153. Available at: <http://www.ijsrp.org/research-paper-0613/ijsrp-p18109>
- [14] Wing EJ. Toxoplasmosis: Cats have it, humans get It, but how much disease does it cause ? *Clinil. Infect. Disea.* 2016; 63(4): 476-477. <https://doi.org/10.1093/cid/ciw358> PMID: 27353664
- [15] Daryani A, Sarvi S, Aarabi M. et al. Seroprevalence of *Toxoplasma gondii* in the Iranian general population: a systematic review and Meta-analysis. *Acta. Trop.* 2014; 137: 185-194. <https://doi.org/10.1016/j.actatropica.2014.05.015> PMID: 24887263
- [16] Borna S, Shariat M, fallahi M, et al. Prevalence of Immunity to Toxoplasmosis among Iranian child bearing age women: Systematic review and meta-analysis. *Iran. J. Reprod. Med.* 2013; 11(11): 861-668. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3941396>

- [17] Robbins JR, Zeldovich VB, Poukchanski A, et al. Tissue barriers of the human placenta to infection with *Toxoplasma gondii*. *Infect. Immun.* 2012; 80(1): 418-428. <https://doi.org/10.1128/IAI.05899-11>
- [18] McAuley JB. Congenital Toxoplasmosis. *J. Pediatr. Infect. Dis. Soc.* 2014; 3(1): 30-35. <https://doi.org/10.1093/jpids/piu077>
- [19] Torgerson PR and Mastroiacovo P. The Global burden of Congenital Toxoplasmosis: a systematic review. *Bull. World Health organ.* 2013; 91:501-508. <http://dx.doi.org/10.2471/BLT.12.111732> PMID: 23825877
- [20] Kirby T. Calls for more detailed studies on Toxoplasmosis. *Lancet. Infect. Dis.* 2012; 12(12): 912-913. [https://doi.org/10.1016/s1473-3099\(12\)70303-1](https://doi.org/10.1016/s1473-3099(12)70303-1) PMID: 23316490
- [21] Lee W, Hye-Jin A, Je-Hyun B, et al. Comprehensive proteome analysis of the Excretory / Secretory proteins of *Toxoplasma gondii*. *Bull. Korea. Chemi. Socie.* 2014; 35(10): 3071-3076. <https://doi.org/10.5012/bkcs.2014.35.10.3071>
- [22] Tenter A, Heckerroth A, Weiss L, *Toxoplasma gondii*: from animals to humans. *Internat. J. Parasit.* 2000; 30 (12-13): 1217-1258. [https://doi.org/10.1016/s0020-7519\(00\)00124-7](https://doi.org/10.1016/s0020-7519(00)00124-7) PMID: 11113252
- [23] Molan AL and Rasheed EH. Study the possible link between Toxoplasmosis and Different kinds of Cancer in Iraq. *Amer. J. Life. Sci. Res.* 2016; 4(3): 83-88. Available at: <http://www.diili.org/ojs-2.4.6/index.php/ajlsr/article/view/97>
- [24] Montoya J and Liesenfeld O. Toxoplasmosis. *Lancet.* 2004; 363(9425):1965-1976. [https://doi.org/10.1016/S0140-6736\(04\)16412-X](https://doi.org/10.1016/S0140-6736(04)16412-X) PMID: 15194258
- [25] Alfonso Y, Fraga J, Jim E, et al. Detection of *Toxoplasma gondii* in cerebrospinal fluid from AIDS patients by nested PCR and rapid identification of Type I allele at B1 gene by RFLP analysis *Exp. Parasitol* 2009; 122 (3): 203-207. <https://doi.org/10.1016/j.exppara.2009.03.009> PMID: 19318095
- [26] Su C, Shwab EK, Zhou P. Moving towards an integrated approach to molecular detection and Identification of *Toxoplasma gondii*. *Parasitol.* 2010; 137 (1): 1-11. <https://doi.org/10.1017/S0031182009991065> PMID: 19765337

- [27] White MW, Radke JR, Radke JB. Review: Toxoplasma development Turn the switch on or off? *Cell Microbiol.* 2014; 16(4): 466-472. <https://doi.org/10.1111/cmi.12267> PMID: 24438211
- [28] Mossa HA, Toxoplasmosis in Iraqi Women: a Retrospective study. *karbala J. Med.* 2009; 2(8): 697-701. Available at: <https://www.iasj.net/iasj?func=fulltext&aId=58473>
- [29] Mohammed SH, Hassani HH and Zghair KH. Detection of B1 gene of *Toxoplasma gondii* in blood of pregnant and abortive women infected with this parasite. *Iraqi J. Med. Sci.* 2010; 8(3): 42-48. Available at: <http://www.iraqijms.net/upload/pdf/iraqijms57187cc4ca465.pdf>
- [30] Hussan BM. Study the Prevalence of ACL, APL, CMV, HSV, Rubella and *Toxoplasma gondii* in Aborted women in Baghdad. *Med. J. Babylon.* 2013; 10(2): 455-464. Available at: <https://www.iasj.net/iasj?func=article&aId=75624>
- [31] Al-Fakahar SA, Al-Asady RA, Rasheed HA. The Importance of Auto-antibodies in the aborted Females with Toxoplasmosis. *J. Fac. Med. Baghdad.* 2015; 57(2): 160-163. Available at: <https://www.iasj.net/iasj?func=article&aId=102975>
- [32] Al-Hindawi NG. Al-Shanawi FA. Seroprevalence of *Toxoplasma gondii* and Cytomegalovirus in Aborted women in Baghdad –Iraq. *Irai.J.Scie.* 2015; 56(1): 649-655. Available at: <https://www.iasj.net/iasj?func=article&aId=102909>
- [33] Mohammed NSH, Al-A'ssie AH, Al-Saqur IM. Genotyping of *Toxoplasma gondii* Isolated from Aborted Iraqi women. *Diyala J. Med.* .2015; 9(1): 44-52. Available at: <http://djm.uodiyala.edu.iq/index.php/djm/article/view/295>
- [34] Al-Garawi Z.S. Toxoplasmosis and Luteinzing Hormone in women with and without Recurrent Abortion in Baghdad. *J.Bacteriol. Paesitol.* 2016; 7(5): 1-4. <https://doi.org/10.4172/2155-9597.1000289>
- [35] Jassem GA. Immunoprevalence of Toxoplasmosis in different categories in women in Al-Diwaniyah. *Kufa. Med. J.* 2008; 11(2): 36-38. Available at:
- [36] Al-Shimmery MN, Al-Hilaly HA, Al-Khafaji AA. Seroprevalence of Cytomegalovirus and Toxoplsmosis in cases of Miscarriages women in Al-Diwaniyah province. *Al-Qadisiyah. J.* 2011; 7(11): 160-168. Available at: <https://www.iasj.net/iasj?func=article&aId=14048>

- [37] Ibadi AK and Hamedon TR. The Sociodemo-graphic Characteristics of Pregnant women with Toxoplasmosis in Al-Qadisiyah-Iraq. *Internat. J. Public Health. Clinical. Scie.* 2015; 2(6): 59-67. Available at: <http://publichealthmy.org/ejournal/ojs2/index.php/ijphcs/article/view/247>
- [38] Hadi HS, Kadhim RA, Al-Mammori RT. Seroepidemiological aspects for *Toxoplasma gondii* infection in women of Qadisiyah Province, Iraq. *Internat. J. Phar. Tech. Resea..* 2016; 9(11): 252-259. Available at: [http://www.sphinxesai.com/2016/ph_vol9_no11/1/\(252-259\)V9N11PT.pdf](http://www.sphinxesai.com/2016/ph_vol9_no11/1/(252-259)V9N11PT.pdf)
- [39] Al-Saidi MA. Serological detection of Toxoplasmosis among women in Wassit Province. *Wassit.J. Scie. & Med.* 2009; 2(1): 150-156. Available at: <https://www.iasj.net/iasj?func=fulltext&aId=56594>
- [40] Rahi AA and Jasim SE. Diagnosis of Toxoplasmosis *gondii* in women by Dipstick Dye Immunoassay (DDIA). *Wassit. J. Scie. & Med.* 2011; 4(2): 58-61. Available at: <https://www.iasj.net/iasj?func=article&aId=51466>
- [41] Tawfeeq WF, Saeed AK, Muslim TM. Seroprevalence and Associated Factors of *Toxoplasma* infection among sample of Pregnant Women in Wassit Governorate- Iraq. *Med. J. Bahy* 2012; 9(4): 873-882. Available at: <https://www.iasj.net/iasj?func=article&aId=68510>
- [42] A'aiz NN. Genotyping of *Toxoplasma gondii* isolates from human being in Wassit Province /Iraq. *Al-Qadis. Med. J.* 2016; 12(22): 26-32. Available at: <https://www.iasj.net/iasj?func=fulltext&aId=151481>
- [43] Kadhum IA and Ajam SR. Influence of Toxoplasmosis on Human personality Among pregnant women in Al-Najaf Province. *Internat. J. Med. Res. Heal. Sci.* 2017; 6(12): 59-64. Available at: <https://www.ijmrhs.com/archive/ijmrhs-volume-6-issue-12--2017.html>
- [44] Al-Jorany RA, Sultan BA, Al-turiahi AM. Detection of Heat Shock Protein(Hsp 70) in aborted women infected with *Toxoplasma gondii*. *Kufa.Med. J.* 2012; 15(1): 245-253. Available at: <https://www.iasj.net/iasj?func=fulltext&aId=47934>
- [45] Abbas ShS and Al-Hamairy AK. Molecular study of Toxoplasmosis and Its Relationship with some parameters (TSP, Globulin and Albumin) among pregnant and aborted women in the

Babylon Province Iraq. *Internat. J. Pharma. Tech. Res.* 2016; 9(9): 366-380. Available at: [http://sphinxesai.com/2016/ph_vol9_no9/2/\(366-380\)V9N9PT.pdf](http://sphinxesai.com/2016/ph_vol9_no9/2/(366-380)V9N9PT.pdf)

- [46] Mohammed LJ and Al-Janabi MS. Seroprevalence of Toxoplasmosis in Aborted women in Babylon Province, Iraq. *Med. J. Baby.* 2019; 16(3): 188-191. https://doi.org/10.4103/MJBL.MJBL_26_19
- [47] Seadawy MA. Prevalence of Toxoplasmosis in Pregnant women in Al-Muthana Province /Iraq. *Kuf.J.Veter. Med. Sci.* 2010; 1(1): 166-172. Available at: <https://www.iasj.net/iasj?func=fulltext&aId=35133>
- [48] Husain SK, Al-Barzanjy ZK, Bakir AA, et al. Detection of anti-CMV ant-Toxoplasma gondii IgG in pregnant women with history of abortion zanco. *J. Med. Sci.* 2011; 15(3): 19-23. Available at: <https://www.iasj.net/iasj?func=article&aId=159197>
- [49] Al-Daoudy AA. Detection of Toxoplasma gondii Antibodies in persons Referred to maamon-Dabbagh Health Center for Medical examination before marriage Erbil, North of Iraq. *Tikrit. Med. J.* 2012; 18(1): 11-25. Available at: <https://www.iasj.net/iasj?func=article&aId=71111>
- [50] Ali SI. Epidemiological Survey of Toxoplasmosis among aborted women in Garmin district, Kurdistan Region, Iraq. *Kurdi. J. Appli. Res.* 2018; Special. Issue: 2 nd. Inter. Conf. Heal. .*Med. Sci.*: 140-145. <http://doi.org/10.24017/kjar>
- [51] Al-Dory AZ. Seroprevalence study of Toxoplasmosis among Pregnant women in Salah-Adden government. *Tikrit. Med. J.* 2011; 17(1): 64-73. Available at: <https://www.iasj.net/iasj?func=article&aId=22184>
- [52] Tawfiq SK, Rezaiq ZS, Al-Hebory MM. Determination the Time of Toxoplasmosis among pregnant women by using IgG avidity to Various Toxoplasma gondii Antigens. *Kirk.Unive. J.* 2019; 14(1): 1-12. <http://doi.org/10.32894/kujss.2019.14.1.1>
- [53] Al-Mishhadani JI and Al-Janabi AU. Toxoplasmosis and Cytomegalovirus infection among Aborted women in Al-Anbar Government. *Al-Anbar Univ. J.* 2008; 6(1):1-14. Available at: <https://www.iasj.net/iasj?func=article&aId=15678>

- [54] Darweesh NH, Hussein RA, Salman ST. Immunological and Molecular study of toxoplasma gondii from aborted women in Diyala/Iraq. *Sci. J. Med. Res.* 2018; 2(6): 75-82. Available at: <http://sjomr.org/wp-content/uploads/2018/06/5-182651.pdf>
- [55] Al-Jebouri M, Al-Janabi M, Ismaail H. The Prevalence of Toxoplasmosis among female Patients in Hawija and Al-Baiji Districts In Iraq. *Open.J. Epidemiol.* 2013; 3: 85-88. <http://dx.doi.org/10.4236/ojepi.2013.32013>