Check for updates

RESEARCH ARTICLE

REVISED Distribution of *Toxoplasma gondii* IgM and IgG antibody seropositivity among age groups and gestational periods in pregnant women [version 2; peer review: 1 approved, 1 approved with reservations]

Shahida Sadiqui¹, Syed Rafiq Hussain Shah¹, Babiker Saad Almugadam², Qismat Shakeela³, Shehzad Ahmad¹

¹Department of Microbiology, Hazara University, Mansehra, Pakistan

²Department of Microbiology, Faculty of Medical Laboratory Sciences, University of El Imam El Mahdi, Kosti city, White Nile state, Sudan

³Department of Microbiology, Abbottabad University of Science and Technology, Mansehra, Pakistan

V2 First published: 20 Nov 2018, 7:1823
<https://doi.org/10.12688/f1000research.15344.1>
 Second version: 25 Mar 2019, 7:1823
<https://doi.org/10.12688/f1000research.15344.2>
 Latest published: 18 Jun 2019, 7:1823
<https://doi.org/10.12688/f1000research.15344.3>

Abstract

Background: Toxoplasmosis is a globally distributed parasitic disease. The present study aimed to estimate the prevalence and geographic distribution of toxoplasmosis as well as evaluate the role of animal contact in disease development and determine the percentage of toxoplasmosis-associated IgM and IgG seropositivity among different age groups. In addition, it aimed to estimate the proportion of toxoplasma IgM seropositivity among pregnancy trimesters.

Methods: A total of 500 pregnant women were included in this study. From each participant, a 5-ml venous blood sample was collected and centrifuged to obtain serum that was tested for *Toxoplasma gondii* IgM and IgG antibodies using immunochromatographic testing and ELISA.

Results: The overall seroprevalence of toxoplasmosis was 24.8%, with rates of acute infection of 8%. Among positive cases of every trimester, 54.34% of first trimester positive cases had a serologic marker for acute toxoplasmosis. Among the overall positive cases, out of the 35 pregnant women with previous history of cow/buffalo contact and toxoplasmosis, 45.7% were seropositive for toxoplasma IgM; and out of 15 women with prior history of dog contact, 33.3% had a serological marker of acute toxoplasmosis.

Conclusions: In this study, there is a high prevalence of toxoplasmosis and contact with domestic animals is a risk factor of this illness. Therefore, it is necessary to test every pregnant woman for toxoplasmosis and distinguish the type of infection, as well as the

Open Peer Review

Approval Status

	1	2
version 3
(revision)
18 Jun 2019
version 2
(revision)
25 Mar 2019
version 1
20 Nov 2018

1. **Wafa Babiker**, University of Khartoum, Khartoum, Sudan

2. **Asghar Fazaeli**, Zanjan University of Medical Sciences, Zanjan, Iran

Any reports and responses or comments on the article can be found at the end of the article.

conduction of public health education programs to generate the awareness.

Keywords

Toxoplasma gondii, Toxoplasmosis, Seroprevalence, IgG, IgM, Pregnant women

Corresponding author: Syed Rafiq Hussain Shah (syedrafiq223@gmail.com)

Author roles: **Sadiqui S:** Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Software, Validation; **Shah SRH:** Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Writing – Review & Editing; **Almugadam BS:** Software, Writing – Original Draft Preparation, Writing – Review & Editing; **Shakeela Q:** Data Curation, Methodology, Project Administration; **Ahmad S:** Data Curation, Methodology, Project Administration, Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

Copyright: © 2019 Sadiqui S *et al.* This is an open access article distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. Data associated with the article are available under the terms of the [Creative Commons Zero "No rights reserved" data waiver](#) (CC0 1.0 Public domain dedication).

How to cite this article: Sadiqui S, Shah SRH, Almugadam BS *et al.* **Distribution of *Toxoplasma gondii* IgM and IgG antibody seropositivity among age groups and gestational periods in pregnant women [version 2; peer review: 1 approved, 1 approved with reservations]** F1000Research 2019, 7:1823 <https://doi.org/10.12688/f1000research.15344.2>

First published: 20 Nov 2018, 7:1823 <https://doi.org/10.12688/f1000research.15344.1>

REVISED Amendments from Version 1

We have made minor changes in some words and sentences, improved the English language of paper, regenerated Table 2, and changed the title for the dataset and study questionnaire. In addition, we replaced reference 12 by another one, removed reference 36 to avoid duplication, and subsequently re-ordered references 37, 38, 39, and 40.

See referee reports

Introduction

Toxoplasmosis is a widely distributed zoonotic illness causes by *Toxoplasma gondii*, an obligate intracellular parasite^{1,2}. Globally, the distribution of this disease is extremely variable even inside the countries^{3,4}. In all host species, including humans, Toxoplasmosis is generally acquiring either vertically from mother to fetus (congenital infection), or through ingestion of oocysts in contaminated food or water⁵. Rarely, *T. gondii* can transmit through organ transplantation and the transfusion of infected blood^{6,7}. Following ingestion, the intestinal epithelium is the primary portal of entrance for *T. gondii*; next, it spreads to other tissues, where it can cause more severe pathogenesis^{8,9}. If toxoplasmosis is acquired during pregnancy, severe infection may develop, especially in immunocompromised individuals, such as those with defects in T-cell-mediated immunity¹⁰. In patients with AIDS, toxoplasmosis may lead to life-threatening disease¹¹. For example, cerebral focal lesions are caused by cerebral toxoplasmosis (CT) in HIV-infected patients¹².

The signs and symptoms of this illness are markedly divergent and range from asymptomatic to serious infection¹³. This variation depends on several factors includes inoculum size, virulence of the strain of toxoplasma, the individual's genetic background and the status of the immune system of the infected individual¹⁴. In addition, since the organism has an affinity for muscular and neural tissues as well as the other visceral organs, many hosts harboring latent tissue cysts following toxoplasmosis¹⁵.

Fetuses may acquire toxoplasmosis through the placenta during pregnancy¹⁶. Early infection of the fetus may cause severe damage, or either pre- or post-natal death¹⁷. The clinical manifestations of congenital toxoplasmosis generally depends on the gestational stage, and can include seizures, mental retardation, severe neurological defects, chorioretinitis, epilepsy and blindness^{10,16,18}.

Approximately 90% of pregnant women infected with *T. gondii* are asymptomatic, and recover spontaneously^{19,20}. Only a small percentage of pregnant women show the clinical symptoms of disease^{19,21}. In pregnant women, the clinical signs are no more severe than in non-pregnant women, and typically an influenza-like illness is seen after an incubation period of 5 to 18 days^{19,22,23}. Early diagnosis and treatment of mothers during pregnancy prevents fetal infection and minimizes the probability of complications^{24,25}.

Laboratory diagnosis of toxoplasmosis is usually performed by serological detection of *T. gondii*-specific IgG and IgM antibodies²⁶. Worldwide, the screening of *T. gondii* infection in pregnant

women is preferably performed during the first trimester and subsequently every month or trimester in seronegative women, as applied in many countries²⁷.

Our study was undertaken to determine the prevalence and geographic distribution of toxoplasmosis. In addition, it sought to evaluate the role of animal contact in disease development among pregnant women through the serological detection of toxoplasma IgM and IgG antibodies, as well as to estimate the seropositivity of these antibodies among different age groups. It also attempted to identify the percentage of toxoplasma IgM seropositivity (indicative of acute infection) among different pregnancy trimesters.

Methods

This a descriptive cross-sectional hospital-based study carried out in the District Head quarter Hospital (Mansehra, Hazara, Pakistan) and Ayub Medical Complex Hospital (Abbottabad, Khyber Pakhtunkhwa, Pakistan) over a period of 4 months (April to July 2015).

Study population and sample size

Our study included pregnant women of different trimesters, ages and ethnic groups who visited our study areas hospitals; the only eligibility criteria were pregnancy and visiting the hospitals in our study area. Patients were recruited by the researchers face-to-face. During this study duration, a total of 500 pregnant women (convenience sample) fulfilled the inclusion criteria. Out of the total of participants, 204 were recruited from Abbottabad and 296 from Mansehra district.

Laboratory analysis

A total of 5 ml venous blood was collected from each participant using a sterile syringe and transferred to a blood container without anticoagulant, allowed to clot at room temperature for 15 minutes, then centrifuged at 3000 rpm for 10 minutes to obtain serum, which was transferred into a 1.5ml microcentrifuge tube and stored at -80°C for further analysis. In this study, every sample was screened and confirmed for toxoplasmosis through the serological tests.

Screening

All sera samples were screened for *T. gondii* IgG and IgM antibodies using Rapid Diagnostic immunochromatographic test (Tox IgG/IgM Rapid Test Dip strip, CTK BIOTECH, San Diego, USA) according to manufacturer instructions. In order to avoid false-positive results due to the incomplete specificity of the screening test, every positive sample was further subject to confirmation step by ELISA. Each positive individual also answered a questionnaire concerning their age, trimester and whether they had been in recent contact with animals (Supplementary File 1).

Confirmation

Following the screening, all the positive samples (n=150) were further confirmed to toxoplasmosis using IgM and IgG ELISA kit (Monobind, San Diego, USA) according to the manufacturer protocol. The positive ELISA test for *T. gondii* IgG titers indicates the chronic infection, whereas with high IgM titers

indicate the recent or acute infection. All ELISA tests were performed in triplicate.

Ethical statement

Our study was approved by the Ethics Review Committee of Hazara University. Further approval was provided by the administration of Ayub Medical Complex Hospital. From every participant, written informed consent was obtained for conduction of the study. In addition, all the performed steps in this study were completely in accordance with the Helsinki Declaration and the rules defined by the World Medical Association, including samples collection and processing.

Statistical analysis

The obtained results were analyzed by Graph Pad Prism 5 (Graph Pad Software, La Jolla, CA, USA). A χ^2 test was involved to check the statistical differences in seropositivity and negativity of anti-toxoplasma antibodies among the participants of different study areas and gestational periods or those had/had no prior history of animal contact, at 95% level of significance. Moreover, ANOVA has tested the statistical difference of these antibodies among the participants of every age group. The difference was considered statistically significant when $P < 0.05$.

Results

Seroprevalence of toxoplasmosis

Out of 500 women, using ELISA the overall seroprevalence of toxoplasmosis was 24.8% (124/500). Statistically significant differences were observed between the seroprevalence of disease in Abbottabad and Mansehra district (Figure 1). In addition, the prevalence of toxoplasma antibodies among pregnant women revealed out of the total of 500 participants, only 8% had a serological marker of acute toxoplasmosis (Figure 2).

Toxoplasma antibodies seropositivity among age groups and gestational periods in overall positive cases

Among the positive cases ($n=124$), the seropositivity of toxoplasma antibodies was shown to be statistically significant different among different age groups (Table 1). There was also a statistically significant difference in the seropositivity of toxoplasma IgM (indicating acute infection) between different

Figure 1. Seroprevalence of toxoplasmosis in different districts. Out of the total of participants in every district, 38.7% (79/204) had the serologic marker of toxoplasmosis in Abbottabad district and 15% (45/296) in Mansehra. *** $P = 0.0002$.

Figure 2. The overall prevalence of Toxoplasma IgM (acute infection) and IgG (chronic infection). Out of 500 pregnant women, 8% (40/500) were positive to IgM, 10.8% (54/500) to IgG, and 6% (30/500) to both antibodies. $P = 0.567$.

Table 1. Percentage of Toxoplasma gondii antibodies seropositivity among the total of positive cases in every age group.

Age, years	Positive cases	IgG	IgM	IgG and IgM
17–24	46	43.5% (20/46)	32.6% (15/46)	23.9% (11/46)
25–32	54	40.7% (22/54)	35.2% (19/54)	24.1% (13/54)
33–40	24	50% (12/24)	25% (6/24)	25% (6/24)
P value		0.003		

gestational trimesters, the highest level of IgM seropositivity was observed in first trimester (54.34%) (Figure 3).

Previous animal contact

Our study findings revealed the previous animal contact is associated with toxoplasmosis (Table 2). In addition, the occurrence of Toxoplasmosis is also influenced by the species of the animal. As we displayed in Table 2, out of 35 women with prior history of cow/buffalo contact, 45.7% were seropositive for toxoplasma IgM. As well as, out of 15 women with earlier history of dog contact, 33.3% had serologic marker of acute toxoplasmosis.

Dataset 1. The raw data associated with this study. Excel file includes the results of screening (ICT) and confirmatory tests (ELISA), plus the history of animal contact and pregnancy trimesters of toxoplasmosis positive cases

<http://dx.doi.org/10.5256/f1000research.15344.d224335>

Discussion

Toxoplasmosis in pregnancy can predispose the fetus to serious complications²⁸. The fetus can be severely damaged when the infection is acquired during pregnancy²⁹. Therefore, testing the serum of pregnant women for toxoplasma IgG and IgM is important to avoid intrauterine infection and complications. The current study was conducted on 500 blood samples collected from pregnant women in Mansehra and Abbottabad district of Pakistan,

Figure 3. Percentage of IgM seropositivity among the total of positive cases in each pregnancy trimesters. Among the total of positive cases in every trimester, the seropositivity of IgM revealed statistically significant difference. Out of 46, 51, and 27 toxoplasmosis infected cases in a first, second and third trimesters, respectively, 54.34% (25/46) were seropositive to IgM (acute infection) in first trimester, 21.56% (11/51) seropositive to IgM in second trimester, and 14.81% (4/27) seropositive to IgM in third trimester. ****P = 0.0001.

Table 2. Frequency of Toxoplasma IgM seropositivity (acute Toxoplasmosis) among positive cases (ELISA+ve) with a prior history of contact with domesticated animals.

Type of animal	Prior history of animal contact, n	Toxoplasma IgM	
		Seropositive	Seronegative
Cats	19	15.8% (3/19)	84.2% (16/19)
Goats	18	38.9% (7/18)	61.1% (11/18)
Dogs	15	33.3% (5/15)	66.7% (10/15)
Cows/buffalos	35	45.7% (16/35)	54.3% (19/35)
P value (seropositive vs seronegative)		0.177	

and examined for *T. gondii* IgM (acute infection) and IgG (chronic infection) antibodies. Out of the total of 500 pregnant women, 24.8% (124 women) had a serologic marker of toxoplasmosis. Among the 124 positive cases, 54 were seropositive for toxoplasma IgG antibody, 40 cases for Toxo-IgM and 30 cases for both IgM and IgG antibody. In addition, out of 500 participants, 8% had a serologic marker of acute toxoplasmosis. In 2007, Obeed reported the prevalence of IgG (chronic infection) and IgM (acute infection) antibodies were 36% and 26.6%, respectively, which are greater than those seen in our study results³⁰. In addition, the seroprevalence of toxoplasmosis in Saudi Arabia was reported as 21.8%³¹. In pregnant women from South Korea, a low prevalence was observed (0.79%)³², with rates of 20% reported in Finland³³ and 24% in Prague³⁴. These findings indicate the prevalence of toxoplasmosis is markedly different in different countries.

Moreover, our study revealed that the geographic distribution of toxoplasmosis is significantly different among the study

areas. Out of the 296 participants analyzed from Mansehra and 204 from Abbottabad, the overall prevalence of toxoplasmosis was 15% and 38.7%, respectively. The higher prevalence in Abbottabad when compared with Mansehra may be because Abbottabad is an area where agricultural practices are common, and domestic animals like cats and goats were generally kept in or near the homes. Thus, contact with these animals may be the main risk factor of the disease. In addition, low educational and socioeconomic level may have contributed.

In our study, a high percentage of IgM seropositivity was reported in the 1st trimester, which indicated a high prevalence of acute toxoplasmosis or recent infection in this trimester compared with the others. Furthermore, as reported in this study, there is a mild difference in the seropositivity of toxoplasma antibodies among age groups, which requires further study to assess whether, is there any significant association exists between toxoplasmosis and age.

Usually *T. gondii* does not cause clinical illness in the majority of animal species³⁵. Human often acquires this infection from animals by ingestion of improperly cooked or raw animal meat, or via consumption of contaminated food and water with animal's waste¹⁴. However, there is a need for detailed knowledge about the risk factors of toxoplasmosis. Previously, it was reported that some risk factors are associated with toxoplasmosis, such as owning cats³⁶. Our study found that a considerable percentage of acute toxoplasmosis-infected women had a previous history of close contact with animals; for example, 15.8% had a history of contact with cats, 33.3% with dogs, 38.9% with goats and 45.7% with cows/buffalos. These results show that contact with domestic animals may associate with this disease. Similar results are also reported by many studies^{37,38}.

In this study, a high prevalence of toxoplasmosis was revealed. Lacks of awareness together with domesticated animals contact are potential risk factors in Mansehra and Abbottabad district of Pakistan. Moreover, in the first and second trimester of pregnancy, the prevalence of acute toxoplasmosis seems to be higher compare with a third. Thus it is necessary to test every pregnant woman for toxoplasmosis and distinguish the type of infection. In addition, urgent treatment and medicine are essential to decrease the risk of intra-uterine infection and congenital toxoplasmosis. Additionally, there is a need to conduct public health education to create greater awareness about the disease, its transmission, symptoms, and prevention. In addition, screening of *T. gondii* infection and maternal care should be considered as the main stratagem to reduce the risks of congenital toxoplasmosis.

Data availability

Dataset 1. The raw data associated with this study. Excel file includes the results of screening (ICT) and confirmatory tests (ELISA), plus the history of animal contact and pregnancy trimesters of toxoplasmosis positive cases.

DOI: <https://doi.org/10.5256/f1000research.15344.d224335>³⁹.

Grant information

The author(s) declared that no grants were involved in supporting of this work.

Acknowledgements

The authors acknowledge the study participants and staff of District Head Quarter Hospital and Ayub Medical Complex Hospital.

Supplementary material

Supplementary File 1. Study questionnaire

[Click here to access the data](#)

References

1. Tenter AM, Heckeroth AR, Weiss LM: **Toxoplasma gondii: from animals to humans.** *Int J Parasitol.* 2000; **30**(12–13): 1217–1258.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
2. Dubey JP: **Toxoplasmosis of animals and humans.** 2nd edition. CRC Press; Boca Raton, Florida, U.S.A. 2010; 1–313.
[Publisher Full Text](#)
3. Ertug S, Okyay P, Turkmen M, *et al.*: **Seroprevalence and risk factors for toxoplasma infection among pregnant women in Aydin province, Turkey.** *BMC Public Health.* 2005; **5**: 66.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
4. Darabus G, Hotea I, Oprescu I, *et al.*: **Toxoplasmosis seroprevalence in cats and sheep in Western Romania.** *Revue Med Vet.* 2011; **162**(6): 316–320.
[Reference Source](#)
5. Dubey JP: **Toxoplasma gondii.** In S. Baron, ed. *Medical Microbiology.* Texas: University of Texas Medical Branch. 1996; 486–512.
[PubMed Abstract](#)
6. Singh S, Nautiyal BL: **Seroprevalence of toxoplasmosis in Kumaon region of India.** *Indian J Med Res.* 1991; **93**: 247–49.
[PubMed Abstract](#)
7. Sabin AB: **Toxoplasmosis: recently recognized disease.** *Adv Pediatr.* 1942; **1**: 1–54.
8. Barragan A, Sibley LD: **Migration of Toxoplasma gondii across biological barriers.** *Trends Microbiol.* 2003; **11**(9): 426–30.
[PubMed Abstract](#) | [Publisher Full Text](#)
9. Silveira C, Belfort R Jr, Muccioli C, *et al.*: **A follow-up study of Toxoplasma gondii infection in southern Brazil.** *Am J Ophth.* 2001; **131**(3): 351–4.
[PubMed Abstract](#) | [Publisher Full Text](#)
10. Hokelek M: **Toxoplasmosis.** Medicine cited November, Retrieved march 6, 2011.
[Reference Source](#)
11. Nissapattorn V, Lee C, Quek K, *et al.*: **Toxoplasmosis in HIV/AIDS patients: a current situation.** *Jpn J Infect Dis.* 2004; **57**(4): 160–165.
[PubMed Abstract](#)
12. Luft BJ, Remington JS: **Toxoplasmic encephalitis in AIDS.** *Clin Infect Dis.* 1992; **15**(2): 211–222.
[PubMed Abstract](#) | [Publisher Full Text](#)
13. Dubey JP, Lago EG, Gennari SM, *et al.*: **Toxoplasmosis in humans and animals in Brazil: high prevalence, high burden of disease, and epidemiology.** *Parasitology.* 2012; **139**(11): 1375–1424.
[PubMed Abstract](#) | [Publisher Full Text](#)
14. Montoya JG, Liesenfeld O: **Toxoplasmosis.** *Lancet.* 2004; **363**(9425): 1965–1976.
[PubMed Abstract](#) | [Publisher Full Text](#)
15. Dubey JP: **Detection of Toxoplasma gondii oocysts in drinking water.** *App Env Micro.* 1998; **64**(6): 2278–2280.
[PubMed Abstract](#) | [Free Full Text](#)
16. Wu L: **Toxoplasmosis Medicine.** Cited April 2007. Retrieved April 3. 2011.
[Reference Source](#)
17. Muhie Y, Keskes S: **Toxoplasmosis: Emerging and Re-Emerging zoonosis.** *Afr J of App Micro.* 2014; **3**: 1–11.
[Reference Source](#)
18. Rothova A: **Ocular manifestation of toxoplasmosis.** *Curr open Ophthalmol.* 2003; **14**(6): 384–8.
[Reference Source](#)
19. Boyer K, Holfels E, Roizen N, *et al.*: **Risk factors for Toxoplasma gondii infection in mothers of infants with congenital toxoplasmosis: implications for prenatal management and screening.** *Am J Obstet Gynecol.* 2005; **19**(2): 564–71.
[PubMed Abstract](#) | [Publisher Full Text](#)
20. Kravetz JD, Federman DG: **Prevention of toxoplasmosis in pregnancy: knowledge of risk factors.** *Infect Dis Obstet Gynecol.* 2005; **13**(3): 161–5.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
21. Carlo DP, Romano A, Schimmenti MG, *et al.*: **Materno-fetal Toxoplasma gondii infection: critical review of available diagnostic methods.** *Inf Med.* 2008; **16**(1): 28–32.
[PubMed Abstract](#)
22. Jones J, Lopez A, Wilson M: **Congenital toxoplasmosis.** *Am Fam Physician.* 2003; **67**(10): 2131–8.
[PubMed Abstract](#)
23. Stray-Pedersen B: **Toxoplasmosis in pregnancy.** *Baillieres Clin Obstet Gynaecol.* 1993; **7**(1): 107–37.
[PubMed Abstract](#)
24. Wallon M, Liou C, Garner P, *et al.*: **Congenital toxoplasmosis: systematic review of evidence of efficacy of treatment in pregnancy.** *BMJ.* 1999; **318**(7197): 1511–4.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
25. Peyron F, Wallon M, Liou C, *et al.*: **Treatments for toxoplasmosis in pregnancy.** *Cochrane Database Syst Rev.* 2000; **13**(2): CD001684.
[PubMed Abstract](#) | [Publisher Full Text](#)
26. Weigel RM, Dubey JP, Dyer D, *et al.*: **Risk factors for infection with Toxoplasma gondii for residents and workers on swine farms in Illinois.** *Am J Trop Med Hyg.* 1999; **60**(5): 793–8.
[PubMed Abstract](#)
27. Avelino MM, Amaral WN, Rodrigues IM, *et al.*: **Congenital toxoplasmosis and prenatal care state programs.** *BMC Infect Dis.* 2014; **14**: 33.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
28. Hohlfield P, Daffos F, Thulliez P: **Fetal toxoplasmosis: outcome of pregnancy and infant follow-up after in utero treatment.** *J Pediatr.* 1989; **115**(5 Pt 1): 765–9.
[PubMed Abstract](#) | [Publisher Full Text](#)
29. Dubey JP: **Toxoplasmosis - a waterborne zoonosis.** *Vet Parasitol.* 2004; **126**(1–2): 57–72.
[PubMed Abstract](#) | [Publisher Full Text](#)
30. Obeed R: **Seroepidemiological study of toxoplasmosis among different groups of population in Najaf of city (Thesis).** Kufa University. 2007.
31. Al-Qurashi AR, Ghandour AM, Obied OE, *et al.*: **Seroepidemiological study of Toxoplasma gondii infection in the human population in the Eastern Region.** *Saudi Med J.* 2001; **22**(1): 13–18.
[PubMed Abstract](#)
32. Song KJ, Shin JC, Shin HJ, *et al.*: **Seroprevalence of toxoplasmosis in Korean pregnant women.** *Korean J Parasitol.* 2005; **43**(2): 69–71.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
33. Lappalainen M, Koskela P, Hedman K, *et al.*: **Incidence of primary toxoplasma infections during pregnancy in southern Finland: a prospective cohort study.** *Scand J Infect Dis.* 1992; **24**(1): 97–104.
[PubMed Abstract](#) | [Publisher Full Text](#)
34. Flegr J, Hrdá S, Kodým P: **Influence of latent 'asymptomatic' toxoplasmosis on body weight of pregnant women.** *Folia Parasitol (Praha).* 2005; **52**(3): 199–204.
[PubMed Abstract](#) | [Publisher Full Text](#)

35. Cunningham AA, Buxton D, Thomson KM: **An epidemic of toxoplasmosis in a captive colony of squirrel monkeys (*Saimiri sciureus*).** *J Comp Pathol.* 1992; **107**(2): 207–219.
[PubMed Abstract](#) | [Publisher Full Text](#)
36. Baril L, Ancelle T, Goulet V, *et al.*: **Risk factors for Toxoplasma infection in pregnancy: a case-control study in France.** *Scand J Infect Dis.* 1999; **31**(3): 305–9.
[PubMed Abstract](#) | [Publisher Full Text](#)
37. Elnahas A, Gerais AS, Elbashir MI, *et al.*: **Toxoplasmosis in pregnant Sudanese women.** *Saudi Med J.* 2003; **24**(8): 868–70.
[PubMed Abstract](#)
38. Morris A, Croxson M: **Serological evidence of *Toxoplasma gondii* infection among pregnant women in Auckland.** *N Z Med J.* 2004; **117**(1189): U770.
[PubMed Abstract](#)
39. Sadiqui S, Shah SRH, Almugadam BS, *et al.*: **Dataset 1 in: Distribution of *Toxoplasma gondii* IgM and IgG antibody seropositivity among age groups and gestational periods in pregnant women.** *F1000Research.* 2018.
<http://www.doi.org/10.5256/f1000research.15344.d224335>

Open Peer Review

Current Peer Review Status:

Version 2

Reviewer Report 08 April 2019

<https://doi.org/10.5256/f1000research.20454.r46160>

© 2019 Fazaeli A. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Asghar Fazaeli

Department of Medical Parasitology & Mycology, School of Medicine, Zanjan University of Medical Sciences, Zanjan, Iran

The authors' response about association of animal contact and toxoplasmosis is not convincing. The following descriptions may help to this discussion: 1) Cat is the only animal as the definitive host for *Toxoplasma gondii* which can shed *Toxoplasma* oocysts becoming infective after a few days in environment; so this is the only animal species with possible association of its contact with toxoplasmosis. 2) Other animals like cow, buffalo, goats, and dogs may harbor the latent parasite (tissue cysts) inside their body tissues and cannot transmit to human or other animal by outer contact. 3) Even if this idea, possible association between these animal spp and *Toxoplasma* infection, could be proposed, the method of the present study is not suitable for this evaluation, as the study population contained only seropositive women, whereas no seronegative control groups with animal contacts were included in the study. So, the authors' aim to measure the association of these animal contact with toxoplasmosis is not basically scientific and the relevant data and discussion are not acceptable.

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 03 April 2019

<https://doi.org/10.5256/f1000research.20454.r46159>

© 2019 Babiker W. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Wafa Babiker

Department of Microbiology, Faculty of Medical Laboratory Sciences, University of Khartoum, Khartoum, Sudan

I think, it is an acceptable improvement.

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 12 February 2019

<https://doi.org/10.5256/f1000research.16719.r43385>

© 2019 Fazaeli A. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Asgar Fazaeli

Department of Medical Parasitology & Mycology, School of Medicine, Zanjan University of Medical Sciences, Zanjan, Iran

The manuscript is written in a good structure and presents useful data including the rate of anti-*Toxoplasma* antibodies (IgG and IgM) in sera of pregnant women referred to hospitals of two districts in Pakistan. The manuscript however requires some corrections and modifications as follows:

1. The authors should consider that "toxoplasmosis" is not necessarily "illness or disease" as such they have mentioned in many parts of the manuscript. Toxoplasmosis is an infection which is mostly latent and does not lead to disease or illness in most of immunocompetent individuals. Also, some other issues in the Introduction are scientifically susceptible, e.g. toxoplasma acquisition in fetuses during delivery (mentioned in the 3rd paragraph of the Introduction); to my knowledge, this issue is not documented in the literature.
2. The basis of data arrangement, analysis and discussion about percentage of *Toxoplasma gondii* antibodies in different age groups (Table 1) is not valid. For this issue, all 500 study cases must be primarily divided into different age groups, then the percentage of seropositivity (IgG, IgM, IgG+IgM) in all initial samples of each group should be calculated and consequently compared and analyzed.
3. There is no scientific reason to indicate possible relation between *Toxoplasma* infection and contact with animals like cow, buffalo, goats, and dogs, except for cats which are a definitive host of *Toxoplasma* and shed oocysts. The only way of passing *Toxoplasma* infection from

these animals to humans, is ingestion of undercooked meats or rarely through contact of open wounds with meats contaminated with bradyzites, but not other types of contact with these animals or their wastes. So, this variable (animal contact) is not wise to be included in the manuscript and is recommended to be removed from all parts of the manuscript.

4. Miss-citation is the case for some *Toxoplasma* facts in the manuscript. For example, cerebral toxoplasmosis is referred to Kristiah (2009), which is not the right citation; while it was originally reported and discussed by other researchers, i.e. Luft and Remington (1988¹) and Luft and Remington (1992²).

5. English writing correction is required in some parts of the manuscript text.

References

1. Luft BJ, Remington JS: AIDS commentary. Toxoplasmic encephalitis. *J Infect Dis.* 1988; **157** (1): 1-6 [PubMed Abstract](#)
2. Luft BJ, Remington JS: Toxoplasmic encephalitis in AIDS. *Clin Infect Dis.* 1992; **15** (2): 211-22 [PubMed Abstract](#)

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 16 Mar 2019

Syed Rafiq Hussain Shah, Hazara University, Mansehra, Pakistan

Dear Dr. Asghar Fazaali,

Most of your suggestions have been addressed in Version 2, while we didn't address points 2 and 3 due to the following reasons:

1. Because we aimed to estimate the percentage of toxoplasma antibodies seropositivity among positive cases. Therefore, we calculate them by dividing the frequency of Ab seropositivity/Number of positive cases.
2. Because toxoplasmosis is a zoonotic disease, thus it can transmit to humans from animals as we mentioned in Version 1. In addition, in past research, scholars have found that there is an association of cat contact with disease development, while the association of other kinds of animals with disease is poorly understood. Therefore, we aimed to evaluate the role of different kinds of animals in disease development.

Thank you.

Competing Interests: No competing interests were disclosed.

Reviewer Report 10 December 2018

<https://doi.org/10.5256/f1000research.16719.r40932>

© 2018 Babiker W. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Wafa Babiker

Department of Microbiology, Faculty of Medical Laboratory Sciences, University of Khartoum, Khartoum, Sudan

This article has studied toxoplasmosis, which is considered as one of the most common causes of abortion, stillbirth, intrauterine death, and congenital abnormalities. In addition, it's a globally distributed disease.

The paper is well designed and clearly written; the results were presented accurately and the conclusion is supported by study findings. In my opinion, it's perfect and scientifically acceptable. However for further improvement of the article, the authors should revise the English grammar.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 19 Mar 2019

Syed Rafiq Hussain Shah, Hazara University, Mansehra, Pakistan

Dear Dr. Wafa Babiker,

We have addressed your suggestion in Version 2. Thank you.

Competing Interests: No competing interests were disclosed.

The benefits of publishing with F1000Research:

- Your article is published within days, with no editorial bias
- You can publish traditional articles, null/negative results, case reports, data notes and more
- The peer review process is transparent and collaborative
- Your article is indexed in PubMed after passing peer review
- Dedicated customer support at every stage

For pre-submission enquiries, contact research@f1000.com

F1000Research