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Research Article
Seroprevalence of *Toxoplasma gondii* Infection in Blood Donors in Makkah Al Mukarramah

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Abstract

Background and Objective: Toxoplasmosis is a severe and life-threatening parasitic infection caused by the *Toxoplasma gondii*. The main aim of the current research was to determine the prevalence of toxoplasmosis among blood donors and determined the risk factors increased the infection and found the source of infection. **Materials and Methods:** A total of 220 blood samples were collected and serum samples were obtained. ELISA IgM and IgG were used to detect and differentiate between acute and chronic infection. **Results:** Approximately 43 out of 220 samples showed positive to IgG with a prevalence rate of chronic toxoplasmosis 19.5%. IgM was not detected in the target group. Significant different between getting chronic toxoplasmosis and age group 30-39 years was recorded ($p = 0.005$). The results showed a relationship between chronic toxoplasmosis and the race of participants. Asian race was more suspected to be infected by chronic toxoplasmosis ($p = 0.001$). High significant was detected between working in the home garden and infection acquired with chronic toxoplasmosis ($p<0.0001$). **Conclusion:** The results obtained from the current study showed that chronic toxoplasmosis was found in blood donors. Latent toxoplasmosis can reactivate in some circumstances and be acute in the blood.

Key words: Seroprevalence, *Toxoplasma gondii*, blood donors, chronic toxoplasmosis, life-threatening parasitic

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Apicomplexa parasite *Toxoplasma gondii* (*T. gondii*) is the cause of toxoplasmosis, so it acts as an emerging global public health problem. It is also one of the global reasons behind the significant morbidity and mortality[1,2]. Although, blood transfusion is one of the saving life therapy and it could be the mode of transmission to many microbes like bacterial, parasite, fungi and viruses, the parasite microbes including *T. gondii*[3]. The intermediate host of *T. gondii* animal and human is a zoonotic protozoan parasite and it may cause stillbirth and abortion in the hosts[4,5]. Moreover, the *T. gondii* infection is transmitted by congenital transmission or ingestion of tissue cysts in undercooked meat or mature oocysts in soil and it is also transmitted by parasite to susceptible recipient by blood or leukocytes transfusion[6-9]. The disease appears more in the developing countries where the climate is warmer and also in the countries where the health infrastructure is not very well achieved and when the environment is contaminated by high resistant oocysts[1,10]. The definitive host of the parasite that causes the disease is present and found everywhere. Over two weeks after the primary infection the cats capable of shedding hundreds of millions of oocysts, which may contaminate the waters and soils, in addition, according to some reports drinking water contaminated with land runoff has linked with human outbreaks of toxoplasmosis[11]. Raw or undercooked beef and vegetables contaminated with parasites may lead to *T. gondii* infection[1,12]. The common cause of toxoplasmosis is the ingestion of fruits, vegetables and water contaminated with sporulated oocysts. A cat can be an intermediate host for the parasite with the occurrence of clinical signs, however *T. gondii* infection of cat usually asymptomatic[13]. As well as, there are some risk factors of *T. gondii* infection have been identified, which include soil contact and frequent gardening[14-16]. In epithelial cells of the small intestine of domestic cats and other Felidae the sexual reproduction of parasite occurs, there are the only definitive hosts of *T. gondii* and it's a major role in the epidemiology of toxoplasmosis, shedding infective oocysts in faces[17]. Consequently, *T. gondii* can cause several severe diseases such as pneumonia, hydrocephalus, stillbirth, encephalitis, microcephalus and cerebral in developing fetus and retinochoroiditis and disseminated systematic disease in immune-compromised patients[18-20]. Individuals that immuno compromised are susceptible to central nervous system disease as encephalitis or brain abscess due to *T. gondii* infection[21,22]. The prevalence of *T. gondii* infection in blood donor varies between countries. Some studies carried out in Saudi Arabia reported the prevalence in blood donor of *T. gondii* which ranged between[23-25] 37.5 and 52.1%.

The diagnosis of *T. gondii* infection ultimately based on laboratory data, conversely diagnose the *T. gondii* based only in clinical data not enough and unreliable. On top of that the laboratory results can indicate the time onset of infection[26,27]. Almost all of blood banks screen the blood product of blood borne pathogen such as viruses[28] in addition most of the studies reported that the prevalence of HCV, HBV and HIV receded remarkably in last two decades due to the conduction of the tests and screening of blood and blood product, which are sensitive and can indicate of the infection earlier and more accurate[29,30].

Therefore, the main aim of the current research was to determine the prevalence of toxoplasmosis among blood donors and determined the risk factors increased the infection and found the source of infection.

MATERIALS AND METHODS

Study population: This was the cross-sectional study in which the target population consisted of all blood donors at Al-Noor hospital, located in Makkah, Saudi Arabia, during the period from June-August, 2017. The total population of current study was 220 donors (100%) male. The age ranged between18-68 years and the average age was 30.9±8.3 years.

Ethical approval: Ethical approval of the study was obtained from the ethical committee of the Faculty of Public Health and Health Informatics, Umm Al-Qura University, Kingdom of Saudi Arabia. Also, the study is approved by the ethical committee of Al-Noor hospital in Makkah. The approval number of this research is 43837.

Data collection: Answers of this study were enrolled from healthy blood donors who knowingly agreed for participation in the study. All participating individuals were given a well-designed questionnaire before collection of blood sample, which provided information about their age, sex, residence area, level of education, social status, occupation, ethnicity, blood type and risk factors including the consumption of raw/undercooked meat, eating a lot in restaurants, consumption of unboiling milk, camel milk drinking, raw seafood lovers, contact with cat, contact with animals, contact with soil in gardening or agricultural activities, travel and stay outside Saudi Arabia for more than 3 months and history of blood transfusion.

Samples collection: Samples were collected using 5 mL plain vacutainer, serum was separated after allowing overnight and centrifuged for 5 min. Sera were kept in cryo tubes and stored in -80°C till used.

Serological test: All of the collected sera were tested for detection of anti-*T. gondii* IgG and IgM antibodies using a commercial ELISA kit (ACON Biotech, Hangzhou, China) based on the manufacturer's instructions. Index value was obtained for both IgG and IgM.

Statistical analysis: Data was treated by using SPSS version 20 software. Descriptive and frequencies analysis for data were analyzed. The chi-square test was used to find the relationship between risk factor and chronic infection with *T. gondii*. A p-value of less than 0.05 was approved as the level of significance.

RESULTS

Prevalence of acute and chronic toxoplasmosis: The prevalence of the acute toxoplasmosis was done by using ELISA IgM. The results obtained showed no positive in 220 samples. While 43 out of 220 samples showed positive to IgG with prevalence rate of 19.5% (Table 1).

Socio-demographic risk factors: The results obtained demonstrated significant difference between getting chronic toxoplasmosis and age group between 30-39 years old ($p<0.05$). The results also showed a relationship between chronic toxoplasmosis and the race of participants. Asian race was more suspected to be infected by chronic toxoplasmosis ($p<0.05$) as mentioned in Table 2.

Attitude and behavioral risk factors: The attitude of participants toward contact with an indoor cat, contact with outdoor and breeding animals had no significant different

Table 1: Seroprevalence of IgM and IgG in blood donors in Makkah Al Mukarramah

	IgM		IgG	
Parameters	Frequency	Percentage	Frequency	Percentage
Negative	220	100.0	177	80.5
Positive	0	0.0	43	19.5
Total	220	100.0	220	100.0

Table 2: Demographic categories affecting the prevalence of chronic toxoplasmosis

Variables	With chronic toxoplasmosis	Without chronic toxoplasmosis	Total	X^2	p-value
Age (years)					
18-29	14 (13.2%)	92 (86.8%)	106	12.896	0.005*
30-39	21 (25.0%)	63 (75.0%)	84		
40-49	4 (16.7%)	20 (83.3%)	24		
>50	4 (66.7%)	2 (33.3%)	06		
Married status					
Married	101 (44.4%)	26 (55.6%)	127	0.611	0.737
Single	16 (8.0%)	74 (92.0%)	90		
Separate	1 (33.3%)	2 (66.7%)	03		
Race					
Arab	32 (17.4%)	152 (82.6%)	184	13.583	0.001*
Asia	9 (52.9%)	8 (47.1%)	17		
Africa	2 (10.5%)	17 (89.5%)	19		
Location					
Makkah	39 (19.5%)	161 (80.5%)	200	0.003	0.957
Outside Makkah	4 (20.0%)	16 (80.0%)	20		
Education					
Non-educated	13 (18.1%)	59 (81.9%)	72	0.681	0.711
Mid-educated	30 (20.5%)	116 (79.5%)	146		
High-educated	0 (0.0%)	2 (100.0%)	02		
Blood group type					
A	14 (28.0%)	36 (72.0%)	50	6.761	0.08
B	11 (29.7%)	26 (70.3%)	37		
AB	0 (0.0%)	6 (100.0%)	06		
O	14 (15.1%)	79 (84.0%)	93		
Rh factor					
Positive	39 (21.5%)	142 (78.5%)	181	1.363	0.243
Negative	0 (0.0%)	5 (100.0%)	05		
Working					
Yes	32 (21.3%)	118 (78.7%)	150	0.958	0.328
No	11 (15.7%)	59 (84.3%)	70		

*p-value less than 0.05 showed significant different

Table 3: Attitude and behavioral risk factors affecting the prevalence of chronic toxoplasmosis

Variables	With chronic toxoplasmosis	Without chronic toxoplasmosis	Total	X^2	p-value
Indoor cat					
Yes	4 (26.7%)	11 (73.3%)	15	0.519	0.471
No	39 (19.0%)	166 (81.0%)	205		
Stray cat					
Yes	36 (19.4%)	150 (80.6%)	186	0.028	0.868
No	7 (20.6%)	27 (79.4%)	34		
Raw meat					
Yes	4 (19.0%)	17 (81.0%)	21	0.004	0.952
No	39 (19.6%)	160 (80.4%)	199		
Restaurant					
Yes	13 (15.9%)	69 (84.1%)	82	1.133	0.287
No	30 (21.7%)	108 (78.3%)	138		
Unboiled milk					
Yes	21 (19.1%)	89 (80.9%)	110	0.029	0.865
No	22 (20.0%)	88 (80.0%)	110		
Camel milk					
Yes	25 (20.2%)	99 (79.8%)	124	0.069	0.793
No	18 (18.8%)	78 (81.2%)	96		
Raw fish					
Yes	4 (15.4%)	22 (84.6%)	26	0.325	0.569
No	39 (20.1%)	155 (79.9%)	194		
Breeding animals					
Yes	9 (21.4%)	33 (78.6%)	42	0.117	0.732
No	34 (19.1%)	144 (80.9%)	178		
Gardening					
Yes	22 (36.7%)	38 (63.3%)	60	15.379	0.0001*
No	21 (13.1%)	139 (86.9%)	160		
Raw vegetables					
Yes	8 (30.8%)	18 (69.2%)	26	2.362	0.124
No	35 (18.0%)	159 (82.0%)	194		
Previous blood transfusion					
Yes	2 (22.2%)	7 (77.8%)	09	0.043	0.836
No	41 (19.4%)	170 (80.6%)	211		
Traveling outside					
Yes	11 (27.5%)	29 (72.5%)	40	1.967	0.161
No	32 (17.8%)	148 (82.2%)	180		

*p-value less than 0.05 showed significant different

(p>0.05). The food habitual of participants showed no significant with acquired the infection (p>0.05). High significant was detected between working in the home garden and infection acquired with chronic toxoplasmosis (p<0.0001). The results also showed no association between previous blood transfusion or travel outside Saudi Arabia and acquired the chronic toxoplasmosis (p>0.05) as shown on in (Table 3).

DISCUSSION

In the current study, the prevalence of chronic toxoplasmosis was 19.5% in blood donors. The majority of suspected people aged between 30 and 39 years and belonged to Asian race. The main source of infection was found to be working in the garden.

Toxoplasma gondii transmission representing a major threat especially for multiple blood transfusion recipients, immunosuppressed patients, fetus and pregnant women, so the blood transfusion is one of the potential routes of that transmission[31].

This study revealed that the overall prevalence of *T. gondii* was 19.5%. Somehow the prevalence considered to be a low percentage that could be because the variation of the characteristics and the behavioral habits of the blood donors, also differences in the environments could be a reason that explains the lower prevalence of *T. gondii* infection in the donors of the present study. In comparing the prevalence of the current study to other reports in different countries, the prevalence is much lower than Brazil 79%, Cuba 73.43%, Egypt 59.6%, New Zealand 42.9% and Mali 41.2%. Also, a slightly lower than found in the Czech Republic 32.1% and Malaysia

28.1%. The prevalence was almost similar to study done in Chile 20.3% and India[32-40] 20%. However, the prevalence in the current study is higher than other reports done in Taiwan 9.3 and 9.6% in Thailand[41-42]. In the United Arab Emirates the prevalence is lower[43] as compare to the current findings. Also, there a study done in Turkish blood donor showed a completely similar prevalence which is 19.5%, but the samples examined by indirect fluorescent antibody test (IFAT)[44].

There was a statistical association between age group (30-39) years and *T. gondii* infection. A similar study done in Iran reported an association between age group (41-50) years and *T. gondii* infection[45]. There were very rare reports connected Asian race and infected with *T. gondii*. In the current study association between Asian donors and seropositive infection of chronic toxoplasmosis was found, which was not consistent with the result of a study done by Nissapatorn *et al*.[38]. The finding in the current study showed no association between *T. gondii* infection and educational level, however there a study was done in Egypt[34] showing a statistical association between *T. gondii* infection and no-educational level.

The present study showed no correlation between locations of participants of blood donation and acquired *T. gondii* infection which is somehow consistent with a study done in Chile around[39] 1998. In a study done in Taiwan by Chiang *et al*.[41] said there was a relationship between *T. gondii* infection and indoor cat and consumption of undercooked meat which is not consistent with current findings. The current study has a statistical association between gardening and the infection of *T. gondii* which is not consistent with a study done in Taiwan[41].

In the current study of total 220 samples only male donors were selected, which is totally not consistent with other studies[46-48]. According to the findings the present study recommended to avoid acquire toxoplasmosis in a male who is working in their gardens, disposable gloves should be used. Moreover, blood in the blood bank should be check for toxoplasmosis before giving to the patient.

CONCLUSION

According to current results obtained, acute toxoplasmosis was not detected. The parasite could cause transmission during the process of blood transfusion when the parasite located in peripheral blood. Chronic toxoplasmosis still important in blood transmission as latent toxoplasmosis can reactivate in some circumstances and be acute in the blood.

SIGNIFICANCE STATEMENT

This study discovered the prevalence of chronic toxoplasmosis in blood donors and the associated risk factors that can be beneficial for blood bank workers and health policymakers. This study will help the researchers to uncover the critical areas of the prevalence of chronic toxoplasmosis in blood donors in Makkah.

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