Seroprevalence of toxoplasmosis in reproductive-aged women in Jeddah Province, Saudi Arabia: A retrospective study

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Toxoplasmosis; an opportunistic protozoan parasitic disease caused by Toxoplasma gondii, still imposes a major health concern and a significant economic burden worldwide particularly in developing countries. Nevertheless, the epidemiological status of toxoplasmosis among Saudi female population remains largely unknown. Therefore, the present hospital-based retrospective study aimed to determine the seroprevalence of T. gondii infection among reproductive-aged Saudi women residing in Jeddah region of Saudi Arabia. The study was conducted at three governmental hospitals in Jeddah region of Saudi Arabia; King Fahad, King Abdulaziz and East Jeddah hospitals, from January 2019 and March 2021, and included 2431 reproductive-aged Saudi women (15-49 years old) who were screened by enzyme linked immunosorbent assay (ELISA) for the seroprevalence of anti-T. gondii IgG and IgM antibodies. Among the 2431 studied women, 378 (15.5%) were seropositive for anti-T. gondii IgG antibodies, while 43 (1.8%) were seropositive for anti-T. gondii IgM, and 13 (0.53) were seropositive for both anti-T. gondii IgG and IgM antibodies. Moreover, the highest proportion of seropositive for anti-T. gondii IgG antibodies (4.77%) was detected in 30-34 years old women, while the highest proportion of seropositive for anti-T. gondii IgM antibodies (0.69%) was in women with age of 25 to 29 years, and the highest proportion of co-seropositive for both anti-T. gondii IgG and IgM antibodies (0.21%) was in the 25-29 years old women. Taken together, the present findings identified the seroprevalence situation of toxoplasmosis among reproductive-aged women in some Saudi communities and raise the importance to increase the screening programs and implements to control toxoplasmosis in Saudi Arabia.

Key words: Toxoplasma gondii, Seroprevalence, reproductive-aged Saudi women.

INTRODUCTION

Toxoplasmosis is a globally widespread food and water borne zoonotic disease caused by an infection with

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Toxoplasma gondii, which is an intracellular protozoan parasite that is able to infect humans and virtually all warm-blooded animals (Hoummadi et al., 2020). According to epidemiological estimations, approximately one-third of the world’s human population is infected by this protozoan parasite (Milne et al., 2020), and around 30 to 50% of its overall worldwide infection is localized in The Middle East regions (Flegr et al., 2014; Alzaheb (2018). Clinically, toxoplasmosis, as an opportunistic disease, can potentially cause a serious threat to human health particularly in pregnant women, neonates, and immune-compromised individuals. For instance, maternal toxoplasmosis causes abortion in pregnant women – and congenital and perinatal toxoplasmosis are leading causes of fetal stillbirth, neonatal malformation, mental retardation and blindness (Hoummadi et al. (2020, The Lancet Infectious Diseases (2012); Hassan (2018); Mohammad et al., (2012); Iddawela et al., (2017).

The life cycle of T. gondii consists of two stages: a sexual stage that arises in cats and in all felids (that is, primary hosts) and asexual stages which occur in the secondary hosts such as humans and warm-blooded animals (Hill and Dubey (2018). Each infected cat can excrete >20 million oocysts of T. gondii within 4-13 days and these oocysts survive in the soil and on the earth for long period (Dubey 2001; Hussain et al., 2017). As a zoonotic disease, T. gondii is a critical protozoan infection in meat- and milk-producing farm animals such as goats, sheep and cattle. Eating or direct contact with the raw/undercooked meat, un-boiled milk, and other food products of these infected animals seems to be the central key in the horizontal transfer of human toxoplasmosis (Cenci-Goga et al., 2011 Guo et al., 2015). Human to human transmission of T. gondii via blood transfusion and organ transfer also cannot be neglected (Robert-Gangneux and Darde 2012; Karimi et al., 2014).

Although the underlying definitive reasons have not yet been fully established, the global seroprevalence of toxoplasmosis is extremely diverse from 1 to 100%, and such variation is also significant between different regional countries and even within a country (Iddawela et al., 2017; Hill and Dubey (2002); Pappas et al., 2009). Impacts of environmental and climate factors, host immune status and susceptibility, health care and hygiene facilities, nutritional behavior, food safety and other socioeconomic factors, besides the complex patterns of T. gondii transmissions and its co-evolutions with multiple hosts, have been strongly suggested to be behind these significant variations (Lamberton et al., 2008; Meerbong and Kijlstra 2009; Yan et al., 2016). Most importantly, T. gondii infection can affect all human ages, and the unavailability of an effective vaccine may further increase the impacts toxoplasmosis on the human health, particularly in developing countries. Nevertheless, the epidemiological status of toxoplasmosis among Saudi population remains largely unknown. Thus, the present study was conducted to evaluate the seroprevalence of T. gondi infection in a population of reproductive-aged Saudi women living in Jeddah province in the Western region of Saudi Arabia.

MATERIALS AND METHODS

Study area and population

The present hospital-based retrospective study was carried out by analyzing the medical records of a total of 2431 reproductive-aged Saudi women (15-49 years old) who were seek for healthcare check-up in three governmental hospitals in Jeddah region: King Fahad Hospital (KFH), King Abdulaziz Hospital (KAH), and East Jeddah Hospital (EJH), from January 2019 to March 2021. The referred age is based on the WHO estimation that women of reproductive age refer to all who have age between 15 and 49 years (World Health Organization (2006). Jeddah is the largest city in the Western region of Saudi Arabia with high population densities and a unique situation on the Red Sea coast. Additionally, the above mentioned 3 hospitals were selected in order to maximize the variety of our study sample as they are the main clinical, teaching and training healthcare medical services in Jeddah. The minimal study sample size was estimated according to the previously published worldwide reports, and an ethical approval for the study was obtained from the Institutional and Hospitals Ethics Committees.

Serological detection of T. gondi infection

The hospital-based serological detection of T. gondi infection was carried out by using the ELISA-based test to measure the specific anti-T. gondii IgG and IgM antibodies in serum Samples. Commercial ENZYWELL TOXOPLASMA IgG and IgM Kits (Siemens Healthcare Diagnostics Products GmbH, Marburg, Germany) were used and following manufacturer’s instructions, (Alghamdi et al., 2016; Fenta (2019). According the manufacturer’s recommendations, samples with absorbance higher than the Cut-off value (that is, > 1.3 for IgG and > 1.2 for IgM) were considered as seropositive, while those with absorbance of <0.7 for IgG and <0.8 for IgM were considered as seronegative. Samples with borderline values (0.7-1.3 for IgG and 0.8-1.2 for IgM) were considered as doubtful (Equivocal) results and repeated 2-3 weeks later to be verified as positive or negative (Alghamdi et al., 2016; Fenta (2019).

Statistical analysis

Data entry and analysis were done using SPSS software Package version 20.0 (SPSS Inc. Chicago, Illinois, USA). The Chi-square (χ2) test and Student “t” test or Mann-Whitney test were used for the categorical data and continuous variables as appropriate. A P-value of <0.05 was considered statistically significant.

RESULTS

In the present study, we retrospectively analyzed the seroprevalence of anti-T. gondi antibodies of 2431 reproductive-aged Saudi women (15-49 years old) who were seek for healthcare check-up at the King Fahad, King Abdulaziz, and East Jeddah hospitals between January 2019 to March 2021. The present data
Table 1. Seroprevalence of anti- \textit{T. gondii} IgG antibodies among the studied women

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Anti- \textit{T. gondii} IgG Antibodies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Seronegativity</td>
</tr>
<tr>
<td></td>
<td>No (%)</td>
</tr>
<tr>
<td>15-19 Y</td>
<td>10 (0.41)</td>
</tr>
<tr>
<td>20-24 Y</td>
<td>28 (1.15)</td>
</tr>
<tr>
<td>25-29 Y</td>
<td>67 (2.76)</td>
</tr>
<tr>
<td>30-34 Y</td>
<td>116 (4.77)*</td>
</tr>
<tr>
<td>35-39 Y</td>
<td>81 (3.33)</td>
</tr>
<tr>
<td>40-44 Y</td>
<td>61 (2.51)</td>
</tr>
<tr>
<td>45-49 Y</td>
<td>15 (0.61)</td>
</tr>
<tr>
<td>Total</td>
<td>378 (15.5)</td>
</tr>
</tbody>
</table>

*P <0.05 vs other women’s age sets.

Table 2. Seroprevalence of anti- \textit{T. gondii} IgM antibodies among the studied women.

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Anti- \textit{T. gondii} IgM Antibodies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Seronegativity</td>
</tr>
<tr>
<td></td>
<td>No (%)</td>
</tr>
<tr>
<td>15-19 Y</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>20-24 Y</td>
<td>7 (0.29)</td>
</tr>
<tr>
<td>25-29 Y</td>
<td>17 (0.69)*</td>
</tr>
<tr>
<td>30-34 Y</td>
<td>9 (0.37)</td>
</tr>
<tr>
<td>35-39 Y</td>
<td>7 (0.29)</td>
</tr>
<tr>
<td>40-44 Y</td>
<td>2 (0.08)</td>
</tr>
<tr>
<td>45-49 Y</td>
<td>1 (0.04)</td>
</tr>
<tr>
<td>Total</td>
<td>43 (1.8)</td>
</tr>
</tbody>
</table>

*P <0.05 vs other women’s age sets.

demonstrated that the overall seropositivity rate for \textit{T. gondii} infection was 17.85% (434/2431) among the studied women and sub-described as: 378/2431 (15.5%) women had seropositive for anti- \textit{T. gondii} IgG antibodies (Table 1), 43/2431 (1.8%) women had seropositive for anti- \textit{T. gondii} IgM antibodies (Table 2), and 13/2431 (0.53) women exhibited co-seropositivity for both anti- \textit{T. gondii} IgG and IgM antibodies (Table 3). Additionally, the proportion of women who were IgG seropositivity but IgM seronegativity (IgG+/ IgM-) was 365/2431 (15.01), while those who had IgG seronegativity but IgM seropositivity (IgG-/ IgM+) was 30/2431 (1.23%) (Table 4). Next, we explored the possible influence of woman’s age in the seroprevalence rates of toxoplasmosis. As shown in Tables 1 to 4, in comparison with other women’s age sets, the highest proportion of IgG+ (Table 1) and IgG+/IgM- (Table 4) women was recorded in those of age of 30 to 34 years, while the highest proportion of IgM+ (Table 2), IgG+/IgM+ (Table 3), and IgG-/IgM+ (Table 4) was observed in 25-29 years old women.

DISCUSSION

The present hospital-based retrospective study was carried out to determine the seroprevalence of toxoplasmosis (that is, \textit{T. gondii} infection) among reproductive-aged Saudi women residing in Jeddah province in the Western region of Saudi Arabia. Our results showed that the seropositivity rates for anti- \textit{T. gondii} IgG, IgM, and IgG/IgM antibodies were 15.5, 1.8 and 0.53%, respectively, among the 2431 studied women. The screening of toxoplasmosis was primarily based on the detection of anti- \textit{T. gondii} IgM and IgG antibodies in patient’s serum using the ELISA technique (Hill and Dubey (2018); Alghamdi et al., 2016; Fenta (2019); Puccio et al., (2014); Kaul et al., (2004) which each of them has its own interpretation Puccio et al., (2014); Kaul et al., (2004). At that respect, seropositivity for anti- \textit{T. gondii} IgM antibodies denotes that the infection in its acute phase, while seropositivity for IgG antibodies indicates a state of past infection, and co-seropositivity for both IgG and IgM antibodies necessitates second-level of assessments to identify the timing of infection (Alghamdi et al., 2016; Fenta (2019); Puccio et al., (2014); Kaul et al., (2004). Our present findings are in harmony with those previously reported from different regions in Saudi Arabia. For instance, the seropositivity for anti- \textit{T. gondii} IgG antibodies was found to be ranged from 9.13% in the Hail region to 39.43% in the Eastern region, while the seropositivity for anti- \textit{T. gondii} IgM antibodies was from 0.44% in the northern region to 17.7% in the eastern region of Saudi Arabia (Mohamed (2020). As a further support, in a meta-analysis study of data drawn from eligible Saudi articles published between 2000 and 2017, and included a total sample of 13,597 women of reproductive age (that is, 15- 49 years old) living in different regions of Saudi Arabia, the overall seroprevalence of \textit{T. gondii} infection was about 27.8% and the seropositivity of anti- \textit{T. gondii} IgG and IgM antibodies was ranged between 8.6 to 51.4% and 0 to 8.8%, respectively (Alzaheb (2018). The present findings are also in consistency with those of some of the previous studies that were conducted in other countries around the world (Puccio et al., (2014); Avelino et al., (2004); Wilking et al., (2016). In contrast, they are remarkably lower than those previously reported in reproductive-aged and pregnant women living in neighboring countries whereas the overall seroprevalence of \textit{T. gondii} infection among these studied women was 77% in Iran (Mizani et al., (2017), 72.6% in Egypt (El Deeb et al., (2012), 52.6% in Turkey (Ocak et al., (2007), 47.1% in Jordan (Jumaian (2005), and 45.7% in Kuwait (Iqbal et al., (2003). At that aspect, these obvious differences in the prevalence of \textit{T. gondii} infections could be credited to multi-environmental, cultural, hygienic, social and sanitary circumstances (Alzaheb (2018); Iddawela et al., (2017); Lamberton et al., (2008); Meerburg and Kijistra (2009).
Several reports have suggested that human age is one of the cardinal variables associated with the prevalence of toxoplasmosis (Mohammad et al., 2012; Al-Qurashi et al., 2001; Elsheikha et al., 2009). Moreover, a significant number of studies in various Arab and African contexts has been reviewed and reached to a conclusion that the seroprevalence of *T. gondii* infection being apparently relate with a woman’s age (Alsammani, 2016). In consistency, we herein found that the highest proportion of anti-*T. gondii* IgG seropositivity was in women with age of 30-34 years, and the highest proportion of anti-*T. gondii* IgM seropositivity was in 25-29 years old women. Our findings are nearly in matching with those reported previously in pregnant Saudi women (Almushait et al., 2014), and also support a hypothesis that the prevalence of *T. gondii* infection might be increased in women during their golden child-bearing age (4,26). The underlying reasons for this phenomenon remain obscure and require further explorations; however, it may attribute to the increased exposure to – and contact with the various types of *T. gondii* transmission routes and infected materials during this period of women reproductive age (Mohamed, 2020; Mizani et al., 2017). Oppositely, other studies have recorded a higher prevalence of *T. gondii* infection in older age individuals than in younger ones and attributed this observation to the general low hygienic awareness and more prolonged exposure to the various risk factors of this protozoan parasite among the older age groups (Alanazi et al., 2017; Ali et al., 2017; Al-Mohammad et al., 2010).

### Study limitations

This study inevitably contains some important limitations such as there was a notable lack in identifying the possible correlations between the seroprevalence of *T. gondii* infection and the various socio-demographic variables of the studied women. Additionally, the present seroprevalence data were drawn from limited samples of reproductive-aged Saudi women resident in the Western region of Saudi Arabia that in turn may not necessarily have represented the overall national seroprevalence rate of Toxoplasmosis. Coherently, further large scale and multi-centers screening studies are required to...
assess the immunological status of the Saudi female population in regards to *T. gondii* infection; in which second level of examinations such as IgG avidity, Immunoblotting, Polymerase chain reaction (PCR), are added. The same can be also said for the estimation of the neonates who are at risk of congenital infection.

**Conclusions**

The present findings showed that the seropositivity prevalence of anti-*T. gondii* IgG, IgM, and IgG/IgM antibodies among the 2431 studied reproductive-aged women were 15.5, 1.8 and 0.53%, respectively. This study provides insight into the seroprevalence status of toxoplasmosis among reproductive-aged Saudi women who are resident in Jeddah province and in turn, it raises the importance to increase and sustain the screening and controlling measures against this serious protozoan disease in The Kingdom of Saudi Arabia.

**CONFLICT OF INTERESTS**

The authors have not declared any conflict of interests.

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