Seroprevalence of Toxoplasma Gondii Infection in Chickens and Humans in Beni Suef, Egypt

S.M. Aboelhadid, A.E. Abdel-Ghany, M.A. Ibrahim and H.A. Mahran

Abstract: This study was performed to determine the seroprevalence of T. gondii infection in both domestic chickens and humans in Beni-Suef area, Egypt. The sera of 215 (90 free-range and 125 farmed) chickens were examined using the modified agglutination test kits (MAT). Besides, 250 human sera samples were also examined for IgG by ELISA kit. The obtained results revealed that antibodies against T. gondii were detected at a rate of 20% and 9.6% in free-range and farmed chickens respectively. Statistically, the difference between the two groups was significant (P<0.05). Regarding humans, the seroprevalence of T. gondii infection was 35.2%. Although statistically non significant (P>0.05), a higher seroprevalence of T. gondii antibodies in poultry contacts (37.5%) than non-poultry contacts (30.5%) was recorded. No significant difference between males (34.7%) and females (35.8%) was found (P>0.05). Regarding the age, the highest seropositivity of 45.0% and 41.66% was observed among individuals of 41-50 years and >50 years respectively. From this study, preventive measures to avoid transmission of infection to humans and animals must be done.

Key words: Toxoplasma Gondii • Chickens • Humans • Seroprevalence

INTRODUCTION

Toxoplasma gondii (T. gondii) is an important intracellular protozoan parasite widely prevalent in humans and animals, including poultry, throughout the world [1, 2]. The infection caused by T. gondii is generally transmitted to humans either congenitally, or via ingestion of undercooked or raw meat from infected animals, or ingestion of food or water contaminated with oocysts excreted by infected felids [3].

In Egypt, the role of domestic chickens (Gallus domesticus) in the transmission of T. gondii was investigated only in a few studies. Poultry meat is an important part of cuisine, consumed widely allover the world; therefore, consumption of uncooked or not properly cooked poultry meat may pose a risk factor for T. gondii infection in humans or animals [4].

Free-range (FR) chickens are considered important intermediate hosts of T. gondii, as cats preying on these infected animals can shed millions of environmentally resistant oocysts on the ground surrounding human households. Chickens feeding from the ground are, therefore, a good indicator of the prevalence of T. gondii in the environment and are used as sentinel animals in areas where the prevalence of human infection is high [5-7]. The role of farmed chickens in Toxoplasma transmission to humans is of low importance, since their breeding is fast and contact with felines is not allowed, in contrast to domestic breeding in low scale, where the birds live for years in the same ecosystem as felines [8, 9].

It has been estimated that one third of the world population has been infected with T. gondii [10]. Most infections in immunocompetent humans are asymptomatic (latent) and in up to 10% of infected individuals, cervical lymphadenopathy or ocular disease occur (3). On the contrary, toxoplasmosis is most dangerous to two populations: immunocompromised persons and fetuses whose mothers acquire acute infection during pregnancy [11]. In immunocompromised individuals, it can cause life-threatening infections such as encephalitis, pneumonia and chorioretinitis [12]. Acute maternal infection during pregnancy can lead to transplacental transmission and subsequent infection in the fetus causing abortion or severe damage to the fetus at birth or later in life (11). The rising prevalence of toxoplasmosis and the increasing clinical cases in

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immunocompromised patients and patients with congenital toxoplasmosis should draw attention to address toxoplasmosis as a serious public health problem.

The occurrence of *T. gondii* in poultry and their role in spread of infection to humans is still a disputable matter. In addition, little information is available on infection rates in domestic birds in Egypt. Therefore, this study was performed to throw lights on the epidemiologic aspects of *T. gondii* infection in chickens and humans in Beni-Suef Governorate, Egypt.

**MATERIALS AND METHODS**

**Sample Collection:** The samples were obtained from different localities in Beni-Suef Governorate (30°13' N, 31°40' E), situated 120 kilometers south to Cairo, Egypt with an average altitude of 46 meters. A total of 465 samples including chickens (215) and humans (250) were collected during the period from July 2011 to March 2012. The samples were investigated serologically in the department of Parasitology, Faculty of Veterinary Medicine, Beni Suef University for detection of *T. gondii* antibodies.

**Chicken Samples**

**Free-Range Chickens:** A total of 90 free-range chickens were purchased from rural households. They were approximately 1 year old, kept free ranging on ground and had free access to feed and water. Chickens were transported to the laboratory where about 5 ml blood was taken from each after slaughtering and serum was obtained by centrifugation of coagulated blood.

**Farmed Chickens:** Blood samples were collected from 125 broiler chickens which were slaughtered at poultry shops. The broilers were about 45 days old and came from different farms. Samples were transferred in ice tank to the laboratory where serum samples were obtained. The sera were stored in -20°C until further analyzed.

**Human Samples:** A total of 250 blood samples were taken from apparently healthy individuals consisted of 144 men (92 poultry contacts and 52 non-poultry contacts) and 106 women (76 poultry contacts and 30 non-poultry contacts) of different age groups. Most of the sampled subjects were found in the age range 20-50 years old. The blood samples were collected from farmers’ houses and inhabitants related to poultry rearing. All poultry contact individuals were residents in rural areas from which poultry (free-range chickens) samples were collected. The blood samples were transferred in ice tank to the laboratory where serum samples were obtained and stored in -20°C until further analyzed.

**Serological Examination of Serum Samples:**

**Chicken Sera:** Sera from chickens were diluted two-fold starting at 1:40 to 1:2560 and assayed for *T. gondii* antibodies with the modified agglutination test (MAT) conducted as previously described by Dubey and Desmonts [13] using TOXO-HAI FUMOUZE® kit. MAT titers of 1:80 or higher were considered positive for *T. gondii* antibodies.

**Human Sera:** Serum samples were examined by ELISA to identify the presence of IgG, using *Toxoplasma* IgG enzyme immunoassay test kit®, catalog number: IGGT-96. Kit. Antibody levels were evaluated by following the instructions of the set manufacturers and the results were expressed in titers [14].

**Statistical Analyses:** Differences in the seroprevalence of *T. gondii*-infected FR chickens and farmed chickens and between the different groups of the examined humans were analyzed using a Chi square test in SPSS for Windows (Release 18.0 standard version, SPSS Inc. Chicago, Illinois). The differences were considered statistically significant when *P*<0.05.

**RESULTS AND DISCUSSION**

In this study, investigation of the prevalence of *T. gondii* infection in chickens (both free-range and farmed) and humans in Beni-Suef Governorate was determined serologically.

The results obtained in Table (1) indicated that, by using MAT, the overall *T. gondii* seroprevalence in chickens was 13.95%. The seroprevalence in FR chickens and farmed chickens was 20% and 9.6% respectively. Statistically, the difference between the two groups was significant (*P*<0.05). MAT was chosen because it is sensitive and specific for detecting *T. gondii* antibodies in bird species compared to other serologic methods [4, 15]. Several studies indicated serologic prevalence of *T. gondii* MAT antibodies in chickens at a rate of 47% from Egypt [16], 36.5% from Brazil [5], 39.5% from India [17] and 7.26% from China [18]. However, these studies are not strictly comparable because little was known about the husbandry methods used to raise the chickens. The seroprevalence of *T. gondii* infection in FR chickens in this study was corroborated with that reported in many
Table 1: Seroprevalence of *T. gondii* infection in chickens by modified agglutination test (MAT)

<table>
<thead>
<tr>
<th>Chickens</th>
<th>No. examined</th>
<th>Total (%)</th>
<th>1:80</th>
<th>1:160</th>
<th>1:320</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free-range</td>
<td>90</td>
<td>18 (20.0)</td>
<td>3 (16.66)</td>
<td>7 (38.88)</td>
<td>8 (44.44)</td>
</tr>
<tr>
<td>Farmed</td>
<td>125</td>
<td>12 (9.6)</td>
<td>9 (75.0)</td>
<td>2 (16.66)</td>
<td>1 (8.33)</td>
</tr>
<tr>
<td>Total</td>
<td>215</td>
<td>30 (13.95)</td>
<td>12 (40)</td>
<td>9 (30.0)</td>
<td>9 (30.0)</td>
</tr>
</tbody>
</table>

Table 2: Seroprevalence of *T. gondii* antibodies among humans in each category investigated during the study (n = 250)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>No.examined</th>
<th>No. Positive</th>
<th>% of positive individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact with poultry</td>
<td>Poultry contacts</td>
<td>168</td>
<td>63</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td>Non-poultry contacts</td>
<td>82</td>
<td>25</td>
<td>30.49</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>144</td>
<td>50</td>
<td>34.72</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>106</td>
<td>38</td>
<td>35.85</td>
</tr>
<tr>
<td>Age group (years)</td>
<td>&lt;20</td>
<td>18</td>
<td>2</td>
<td>11.11</td>
</tr>
<tr>
<td></td>
<td>21-30</td>
<td>83</td>
<td>26</td>
<td>31.33</td>
</tr>
<tr>
<td></td>
<td>31-40</td>
<td>65</td>
<td>23</td>
<td>35.38</td>
</tr>
<tr>
<td></td>
<td>41-50</td>
<td>60</td>
<td>27</td>
<td>45.0</td>
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<tr>
<td></td>
<td>&gt;50</td>
<td>24</td>
<td>10</td>
<td>41.66</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>250</td>
<td>88</td>
<td>35.2</td>
</tr>
</tbody>
</table>

countries allover the world [4]. The lower seroprevalence of *T. gondii* antibodies observed in farmed chickens was expected, since the confinement, management and certain hygiene measures reduce or even extinguish the contact with sources for *T. gondii* infection. The same was not true for FR chickens, since they spend some time inside the sheds, have free access to grazing areas and therefore were more susceptible to the contact with different infection sources of the parasite. Moreover, the FR chickens were slaughtered later, aged about one year old, which increased the chance of getting into contact with possible sources of infection. Although lower than that of FR chickens, the seroprevalence of *T. gondii* antibodies in farmed chickens should be taken into account. It can be explained by the improper hygiene demonstrated in these farms which might have allowed contamination of the environment, including feed and water by oocysts.

The role of broilers raised on an industrial scale was discussed by Garcia et al. [19], considering them of minor importance in *T. gondii* transmission to humans, not only because of the fast raising system, but also because it did not allow contact with cats. However, the results presented in this paper show that the broilers can and should be considered as a source of infection.

FR chickens exhibited higher levels of antibody titers than farmed ones (Table 1) which may be related to the age of birds (about 1 year in FR chickens and about 45 days in those farmed). This can be better explained in light of the report of Dubey [20] who indicated that *Toxoplasma* antibodies were detected within 3 weeks of infection and persisted in high titers for 5 years even in the absence of re-infection.

In many instances, especially in developing countries, FR chickens are slaughtered at home or in unsupervised slaughter facilities and their viscera are left for scavengers or improperly disposed off. *T. gondii* infection can be transmitted if care is not taken to wash hands thoroughly after cutting and during cooking of meat; however, risk assessment studies have not been undertaken [4].

The overall seroprevalence of *T. gondii* antibodies in the study population was 35.2 % as shown in Table (2), a result which is similar to that reported by Yaneza and Kumari and Ibrahim et al. [21, 22]. On the other hand, this result was lower than that found by [23- 26] who could detect *T. gondii* infection in humans at a rate of 54%, 56.7%, 51.8% and 59% respectively. The result of this study demonstrated a wide evidence of human exposure to *T. gondii* in Egypt as previously reported by Elsheikh et al. and Ibrahim et al.and. Ghoneim et al. [26-28]. Globally, there is a wide geographic variation in the prevalence of latent *T. gondii* infection. Studies from different continents such as Latin America, Europe, Asia and Africa have reported a range of prevalence estimates of 30%-75%, whereas prevalence estimates from USA studies have had a range of 3%-42% [29]. The prevalence of *T. gondii* infection changes according to social and cultural habits, geographic factors, climate and transmission route [30].

Table (2) also indicated that poultry contacts show a higher seroprevalence of *T. gondii* antibodies (37.5%) than non-poultry contacts (30.49%), although the difference was not statistically significant (*P*=0.05). The high seroprevalence of *T. gondii* infection in poultry
contacts might be related to the fact that most of the examined individuals were peasants that having the chances of contact with animals including poultry and cats, beside their living style such as poor sanitary habits and probably low level of hygiene during food preparation [10]. It is worth mentioning that the high seroprevalence of *T. gondii* in poultry contacts does not necessarily indicate that the occupational exposure to chickens has a correlation with seropositivity of *T. gondii* infection in humans, as there are other important risk factors may contribute to the prevalence of *T. gondii* infection including food handling and preparation hygiene, eating habits (establishment of restaurants serving a quick meat meals which may be insufficiently cooked or eating raw vegetables without washing), level of natural immunity, level of environment contamination with oocysts and the degree of contact with cats [31, 32].

This might be the explanation of the seropositivity of *T. gondii* in non-poultry contacts.

In this investigation, no significant difference in the seroprevalence of *T. gondii* infection between males (34.72%) and females (35.85%) was found (P>0.05), suggesting that sex does not influence exposure to and/or immune response to *T. gondii* [33, 34]. This finding correlates with that of Carmen et al. [35] who found that there is no difference in the seropositivity of toxoplasmosis between males and females. In contrast, [36] found higher percentage of seropositivity to toxoplasmosis in males (66%) than females (58%) and Coelho et al. [37] reported a seroprevalence of 79.9% in men and of 63.4% in women. Also Uneke et al. [34] indicated that men are more prone to *T. gondii* infection than women. However, Hamadato et al. [38] found that *Toxoplasma* antibodies were more in females than males especially above 40 years old.

Regarding the age of the examined population, the highest seropositivity of 45.0% and 41.66% was observed among individuals of 41-50 years and >50 years respectively, while the lowest (11.1%) was amongst the ≤20 year's age group (Table2). Similar age-related increases in *Toxoplasma* seroprevalence have been reported in numerous studies of various populations worldwide [39]. On the contrary, Swai and Schoonman [32] reported that the higher seroprevalence rates of toxoplasmosis were found in age group (≥20 years) as compared to age group (51-60 years). The increased seropositivity of toxoplasmosis with age might be due to probability of contact with oocysts of *Toxoplasma* during professional activity, gardening, etc. The age trends could also be explained by a cohort effect [40] as the risk of *Toxoplasma* infection may have been higher in the past because the use of frozen meat was less common and animal rearing practices have subsequently improved [41].

**CONCLUSION**

The present work revealed the seroprevalence of *T. gondii* in chickens (both free-ranged and farmed) beside human population resident in Beni-Suef Governorate, Egypt, which indicated that the distribution of *T. gondii* in the living environment of local people is quite high and, moreover, suggested that the potential risk of domestic birds as a source of *T. gondii* infection in humans and animals in this region, so preventive measures might be very necessary to avoid transmission of infection to humans and animals.

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**REFERENCES**


