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RESEARCH ARTICLE

Sero-prevalence of *Toxoplasma gondii* infection in domestic goats in western Iran

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Abstract

The main aim of this study was to determine the sero-prevalence of *Toxoplasma gondii* infection in domestic goats in western Iran. Three-hundred sixty blood samples of goats were collected in hamedan province. 14.4% of the sera were positive using ELISA. There was a significant differences between infection rate, history of abortion, and different climate; unlike to age groups and gender. In conclusion, this is the first report of *T. gondii* infection in goats in western Iran. The results indicate that toxoplasmosis may partly be responsible for abortion and economic losses in goat husbandry in this region.

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Introduction

Toxoplasmosis is a most common zoonosis in different climates worldwide, caused by *Toxoplasma gondii* an obligate intracellular coccidian parasite (Gharekhaniet al., 2014). All of felins, commonly domestic cats, are the final host. Humans, birds and wide variety of warm-blooded animals such as sheep and goats are intermediate hosts (Moazeni-Jula et al., 2013). The sexual and asexual cycle of the parasite can take place in the intestinal epithelial cell of the final host, but in the intermediate host only asexual cycle takes place (Abu-Dalbou et al., 2010). Toxoplasmosis may contaminate with the consumption of uncooked or raw meat containing parasite cysts; contact with food, water or sand involving the oocysts that are spread by infected cats and transplacentally (Gharekhani et al., 2014).

This parasite is responsible for major economic losses in livestock; also it is a public health problem owing its transmission to humans. Abortion is the most economic losses of toxoplasmosis in sheep and goats; and it may cause still births and neonatal death worldwide (Dubey, 2009).

The diagnosis of toxoplasmosis is based largely upon the application of histopathological, bioassay, and serological examination such as enzyme linked immune-sorbent assay (ELISA) (Gharekhani, 2013). Sero-diagnosis has been a more full and adequate tool for epidemiological studies in both human and animals. The sensitivity and specificity of ELISA is higher than other serologic techniques (Figueiredo et al., 2001).

Sheep and goats are widely used as food animals (meat and milk) in Iran. These animals infected by *T. gondii* represent source of human infection. Several serological surveys of toxoplasmosis performed in wide range of domestic animals such as cattle, sheep, horse, donkey, dog (Gharekhani, 2014), buffalo (Navidpour and Haghoooghi-rad, 1998), camel (Sadrebazzaz et al., 2006), cat (Hooshyar et al., 2007) and chicken (Asgari et al., 2006) in different regions of Iran. Also, Moazeni-Jula et al (2013) was isolated *T. gondii* in aborted fetus of sheep and goats from Tabriz, Northwest of Iran using molecular technique. Little is known concerning the sero-prevalence of *T. gondii* infection in goats in Iran; values ranging from 10.6% to 30% have been observed previously (Sharif et al., 2007; Moazeni-Jula., 2013); However, there is no published information on toxoplasmosis in goats in western Iran.

The main aim of this study was to determine the sero-prevalence of *T. gondii* in domestic goats (*Capra hircus*) from Hamedan province, western Iran using ELISA.

Materials and Methods

Study area: Hamedan province by mountainous and mild climate is located in west part of Iran (34.77°N and 48.58°E). The mean annual rainfall and temperature is 317.7 mm and 11.3°C, respectively. This province consists two parts of different geographical including plateau and dry-cold (North part of Hamedan province: Razan, Famenin and Kaboudarahang distinct) and mountainous and mild climate (Central and South part of Hamedan province: Bahar, Hamedan, Asadabad, Malayer, Nahavand and Toyserkan distinct). This region is economically impressed by an agricultural and animal husbandry such as cattle, sheep and goat. The domestic goat population in this region is 350,000.

Sample collection: A cross-sectional study was performed during May to July 2014. Three-hundred sixty blood samples (5ml by Jugular venipuncture) were collected randomly (Thrusfield, 1997) in domestic goats from different rural regions of Hamedan province (Table 2). All of animals had a direct contact with cat. Information about age (<1, 1-2 and >2 yr-old), gender, history of abortion (yes or no) and sampling location (I: plateau and dry-cold or II: mountainous and mild climate) were taken from owners and/or physical examiner (Table 1).

Serology: Blood samples were transported to the laboratory on the day of collection. The sera were obtained by centrifugation at 1200×g for 15 min and stored at -20°C until laboratory testing. Anti-*Toxoplasma* antibodies of samples were detected using a commercially available *T. gondii* ELISA kit (ID Screen® Toxoplasmosis indirect multi-species; ID.Vet company, France). The presence of antibody was determined by calculating of S/P% ($\geq 50\%$ = positive) according to the manual formula.

Statistical analysis: Statistical analysis was performed by using the software package SPSS version 16.0 for windows. Odds ratios (OR), confidence interval (CI), χ^2 and *p*-value were calculated separately for each variable. *P*-value of less than 0.05 was considered statistically significant.

Results

Antibodies to *T. gondii* were found in 14.4% (52/360) of sera (Table 1, 2). 32% of animals with history of abortion were seropositive ($\chi^2=4.771$, $p=0.028$, OR=2.6); also the infection rate in animals from plateau and dry-cold regions (20.8%) was higher than mountainous and mild climate (11.3%) ($\chi^2=5.945$, $p=0.014$, OR=2). This rate was reported 10.3% in <1yr, 13.8% in 1-2yr and 15.6% in >2yr age group. Regarding to gender, sero-prevalence rate was 9.1% in male and 15.2% in female animals. There was no statistical significant difference between infection rate, age groups ($\chi^2=0.505$, $p=0.776$) and gender ($\chi^2=1.162$, $p=0.280$).

Table 1. Sero-prevalence of *T. gondii* infection in domestic goats in different variables of Hamedan Province, western Iran.

| | Age groups (year) | | | Gender | | Abortion history | | Study area | | Total |
|----------------------------|-------------------|---------------|---------------|--------------|---------------|------------------|---------------|---------------|---------------|--------------|
| | <1 | 1-2 | >2 | M | F | Yes | No | I | II | |
| No. of sample (%) | 29 (8) | 145 (40.3) | 186 (51.7) | 44 (12.2) | 316 (87.8) | 25 (7.9) | 291 (92.1) | 120 (33.3) | 240 (66.7) | 360 (100) |
| No. of positive (%) | 3 (10.3) | 20 (13.8) | 29 (15.6) | 4 (9.1) | 48 (15.2) | 8 (32) | 44 (15.1) | 25 (20.8) | 27 (11.3) | 52 (14.4) |

M=male, F=female, I= plateau and dry-cold, II= mountainous and mild climate

Table 2. Sero-prevalence of *T. gondii* infection in domestic goats in different regions of Hamedan Province, western Iran.

| Region | No. of examined | No. of positive (%) | 95% CI |
|---------------|-----------------|---------------------|------------|
| Razan | 40 | 1(2.5) | 2.5±4.8% |
| Famenin | 40 | 6(15) | 15±11% |
| Kaboudarahang | 40 | 18(45) | 45±15% |
| Hamedan | 40 | 5(12.5) | 12.5±10% |
| Bahar | 40 | 6(15) | 15±11% |
| Asadabad | 40 | 7(17.5) | 17.5±11.7% |
| Malayer | 40 | 5(12.5) | 12.5±10.2% |
| Nahavand | 40 | 1(2.5) | 2.5±4.8% |
| Toyserkan | 40 | 3(7.5) | 7.5±5.2% |
| Total | 360 | 52(14.4) | 14.4±3.6% |

Discussion

Toxoplasmosis is common in many species of livestock (Dubey, 2009). *T. gondii* infection is widely distributed at a worldwide scale, with incidences from zero to 100% in the different countries (Prelezov et al., 2008). The sero-prevalence rate of *T. gondii* was reported 17% in Norway (Stormoen et al., 2012), 24% in Ethiopia (Negash et al., 2004), 25.1% and 28.9% in Brazil (Pita-Gondim et al., 1999; Cavalcante et al., 2008), 31% in Mexico (Alvarado-Esquivel et al., 2011), 52% in Pakistan (Tasawar et al., 2011), 59.8% in Bulgaria (Perlezov et al., 2008), 66% in Czech Republic (Bartova and Sedlak, 2012), and 67.9% in Zimbabwe (Hove et al., 2005).

In the previous studies from Iran, Hashemi-Fesharki (1996) was reported 19.25% of sero-positivity in Iranian goats. Also, this rate was detected 17.7% and 30% in northern Iran (Ghorbani et al., 1983; Sharif et al., 2007), 13.1% in South-western Iran (Hoghooghi-Rad and Afraa, 1993), 17% in North-western Iran (Ghazaei, 2005), and 15.8% in South-eastern Iran (Bahrieni et al., 2008).

In the present survey, the overall sero-prevalence was 14.4%; which was far less than those obtained by several researchers from different regions of the world. On the other hand, our prevalence results was similar to the 14.1% level of infection found in China (Zhao et al., 2011), and higher than the 10.6% prevalence reported in Tabriz, North-western Iran (Moazeni-Jula et al., 2013).

In our finding, sero-prevalence rate was 10.3% in <1yr, 13.8% in 1-2yr and 15.6% in >2yr age-old ($p=0.776$, Table 1). In a similar study from China, this rate found 9.7% in <1yr, 9% in 1-2yr and 16.3% in >2yr age-old ($p>0.05$) (Zhao et al., 2011). In Alvarado-Esquivel et al. (2011) study from Mexico, Sero-positivity to *T. gondii* in goats increased significantly ($p=0.04$) with age. Bahrieni et al. (2008) indicated that sheep >1 yr-old were significantly more infected than <1 yr-old ($p=0.0001$). In Cavalcante et al. (2008) finding, animals over 37 months had a 2-fold greater risk for *Toxoplasma* infection than younger animals.

Age is the most widely discussed variable in literature. An age-related difference in *T. gondii* infection is expected because older animals are exposed to *T. gondii* oocysts for longer periods (Figueiredo et al., 2001; Bahrieni et al., 2008; Cavalcante et al., 2008; Abu-Dalbou et al., 2010; Alvarado-Esquivel et al., 2011).

In the current survey, sero-prevalence was 9.1% in male and 15.2% in female animals ($p=0.280$, Table 1). In Zhao et al. (2011) study from China, the sero-prevalence in male goats (15.7%) was higher than females (14.0%); the difference was statistically significant ($p=0.023$). According to findings of other authors, the female hosts showed significantly ($p<0.05$) higher prevalence as compared to male hosts (Tasawar et al., 2011; Moazeni-Jula et al., 2013). Moreover, there are many reports that did not show significant correlation between *Toxoplasma* infection and gender, similar to our study (Abu-Dalbou et al., 2010; Alvarado-Esquivel et al., 2011). Alexander and Stinson (1988) reported that the female animals are more susceptible to protozoan parasites as compared to male. The hormonal differences between males and females play an important role in determining susceptibility to parasitic infection. Estrogen enhances antibody production and androgen suppress both T-cell and B-cell immune responses, but immunity in females can be broken down due to various factors e.g., nutrition, age, pregnancy and environmental factors (Tasawar et al., 2011).

Higher prevalence rates of toxoplasmosis in warm and moist regions compared to those which are cold and dry is attributed to the longer viability of *T. gondii* oocysts in moist or humid environments (Abu-Dalbou et al., 2010). Neghash et al. (2004) observed the higher prevalence in warm and moist regions than in cold or hot-dry. In Alvarado-Esquivel et al. (2011) study from Mexico, a significantly ($p=0.02$) higher sero-prevalence of *T. gondii* was observed in goats raised in the semi-desert region (32.7%) than those from the mountains region (18.6%). In our work, the infection rate in animals from plateau and dry-cold regions was 2-fold higher than mountainous and mild climate ($p=0.014$).

Detection of *T. gondii* antibodies in fetal fluids or serum is useful in the diagnosis of abortion in sheep and goats (Heidari et al., 2013). According to our finding, 32% of animals with abortion history were sero-positive ($p=0.028$, OR=2.6). *T. gondii* has been suspected as a cause of sheep and goats abortion in Morocco, Egypt, Turkey, and Uruguay using serological techniques (Dubey, 2009). Our result taken together with previous investigations supports the notion that the sero-positivity rate is correlated with abortion (Gharekhani, 2013; Heidari et al., 2013; Gharekhani et al., 2014; Gharekhani, 2014).

Discrepancies in the rates might be attributed to difference in diagnostic methods used such as serological assays, study design, experimental strategies, climatic variations, frequency of cats inside and suburb of the farms and farm management as well (Bahrieni et al., 2008; Dubey, 2009).

The extensive management system predominates in goat farms in Iran. In this system, the animals are allowed to roam free on pasture during the day and have a direct contact with cats. This may increase the chance of environment, food and water contamination (Abu-Dalbou et al., 2010).

In conclusion, this is the first report of *T. gondii* infection in goats in western Iran. The results indicate that toxoplasmosis may partly be responsible for abortion and economic losses in goat husbandry in this region.

Therefore, it is necessary to take integrated strategies for prevent and control of infection in animals, which could help to reduce human infection. Further comprehensive studies is recommended.

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The authors declare that there is no conflict of interests.

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