Toxoplasmosis is an important zoonosis caused by an obligate intracellular parasitic protozoon *Toxoplasma gondii*. The disease is distributed worldwide and can affect all warm-blooded vertebrates including humans. To determine the prevalence and associated risk factors of the parasite infection in cattle, across-sectional study was conducted in Shargelnile and Omdurman localities, Khartoum State, Sudan. One hundred and sixty-two serum samples were taken from cattle and tested by Latex agglutination test (LAT). Data regarding the potential risk factors associated with pre-designed questionnaire. It is divided to host characteristics [age, sex breed] and environmental factors [localities, herd size, other animals, cats in farm, source of water, hygienic condition] and filled through face to face interviews with cattle owners. The overall prevalence of *Toxoplasma gondii* in cattle was 14.8% in two localities. When the multivariate logistic regression was done to risk factors after univariate analysis, the results revealed that sex, herd size and present of cats were factors more associated with the disease \([P<0.5]\). While age, breed, localities and hygienic condition were also associated with the disease \([P<0.25]\). The present study found that *Toxoplasma gondii* is prevalent in cattle in Khartoum State. This infection has an important implication for livestock industry and public health.
are then shed in the faces and spread in the environment (Woudt, 1990). Transmission can be classified as horizontal or vertical. The horizontal transmission between different host species or from the environmental reservoirs which can be food borne, water borne, milk-borne, soil transmitted, cat-litter box-derived, iatrogenic consumption of tissue cysts in meat is one of the primary means of the parasite infection in both humans and meat-eating worm-blooded animal [Weill and Kim, 2011].

In general, the clinical signs of toxoplasmosis in cattle are often nonspecific and considered mild (Canada et al., 2002). The signs are observed in calves as an increased respiratory rate and febrile response (Estiban-Redondo et al., 1999). But in human the majority of the cases the signs are asymptomatic (Pappas et al., 2009). During pregnancy acquired infection may cause severe damage to the fetus. In immunocompromised patients, reactivation of latent disease cause life-threatening encephalitis (Montoya and Liesenfeld, 2004). Toxoplasmosis do not cause any symptom (up to 90%), but a few cases develop painless swelling of lymph nodes, headache, malaise, fatigue and low-grade muscle aches, sore throat, abdominal pain, rash or neurological symptoms (Harvad, 2019).

The treatment of toxoplasmosis by using combination of pyrimethamine and sulfadimidine in sheep has been effective (Buxton and Losson, 2007). The aim of this paper was to estimate the overall prevalence of antibodies against T. gondii in cattle and the risk factors associated with the disease.

Materials and Methods

Study area and animal population

Across sectional study was conducted to estimate the prevalence of bovine toxoplasmosis in Shargelnile and Omdurman localities, Khartoum State, Sudan. The animals were kept in intensive management system. All information regarding the potential risk factors associated with occurrence of bovine toxoplasmosis were collected through pre-designed questionnaire. It is divided to host characteristics (age, sex, breed) and environmental factors (localities, herd, size, other animals, cats in the farm, source of water, hygienic condition). The questions were recorded for each examined cattle through face to face interviews with cattle owners.

Collection of the blood

A total of 162 blood samples were taken from cattle by vein puncture of jugular vein. Sera were harvested following centrifugation of clotted blood then labeled and stored at 20ºC until tested.
Diagnosis of toxoplasmosis

Latex agglutination test (TOXO Latex) was used to screen the sera basically (SPINRER EACT, S. A. Ctra-Santa Coloma, Spain). The reaction was based on latex particles coated with soluble T. gondii antigen and positive result depended on formation of clear agglutination due to the presence of Toxoplasma antibody in sera.

Statistical analysis

All data were entered in spread sheet and then transferred to Package for Social Science (SPSS) version 16.0. Data were analyzed by simple descriptive statistic method and expressed as frequencies and cross tabulation.

A univariate analysis has then been used to assess the risk factors and the diseases. Then a univariate analysis using chi-square test (x2) to assess the association between risk factors and the disease. AP-value less than 0.05 was considered statistically significant.

Results and Discussion

From a total of 162 examined cattle, 24 were found positive (14.8%) for Toxoplasma gondii. This is the overall prevalence of bovine toxoplasmosis generally in Khartoum State.

Risk factors analysis

In young animals (18.8%) the prevalence was high than old animals (13.2%). There was no significant association observed (x2= 0.837; P=0.247). Also, the prevalence was high in female animals (18.7%) than in males (7.3%) and there was significant difference between two different sexes (x2 = 3.752; P=0.040). According to breed, local animals shown less prevalence (8.3%) than cross animals (17.5%) and there was no significance association between toxoplasmosis infection and different breeds (x2 = 2.271; P = 0.100).

Cattle located in Shargelnile had a higher prevalence of toxoplasmosis (17.5%) than that located in Omdurman (8.3%) and Chi-square test shown (Table 1) there was no significant association with examined cattle and T. gondii infection (x2 = 2.271; P = 100). Small size of the herd revealed high prevalence (20.0%) than the large herd (8.8%) and there was a significant association observed (x2 = 4.606; P = 0.026). Concerning presence of other animals species, farms that included sheep and goats were recorded lower prevalence (14.3%) than those had only cattle (15.4%) and there was no significant association observed (x2 = 0.039; P = 0.509). Higher prevalence of T. gondii and presence of other animals’ species within the herd were cats (19.0%) that compared to farms that no cats present (7.0%). This result indicated that presence of cats within the herd is considered risk factor (x2 = 4.237; P = 0.030). There was no significant difference in the number of T. gondii positive animals in the farms that used well system for drinking (14.8%) than that used tap water (15.0%) (x2 = 0.0015; P = 0.574). The high prevalence of toxoplasmosis was detected in farms with high hygienic condition (26.1%). There was no significant association observed (x2 = 4.161; P = 0.125).

Multivariate logistic regression was done for all variables that showing statistical significance in the univariate analysis (P<0.05). The factors more associated with bovine toxoplasmosis were sex, herd size and presence of cats. Also, age, breed, localities and hygienic condition (P<0.25) were associated with the disease (Table 2).

In sufficient data until now available on cattle toxoplasmosis in the herd and there have been limited number of reports on cattle toxoplasmosis from Sudan. Khalil and
Elrayah (2011) found that seroprevalence of toxoplasmosis in camels, cattle, and sheep was 32% in Khartoum State. Also, the parasite was detected in cattle (12.7%) in Khartoum State and (14.9%) Algezira State (Elfahal et al., 2013). But these results were slightly lower than the present study (14.8%) when using LAT among cattle in Shargelnile and Omdurman localities.

The result was (14.8%) higher than those reported in cattle (2.68%) in Brazil, France (7.8%), Portugal (7q.5%), West Indies (7.8%) and Iran (2.3%) (Grlot – Fromont et al., 2009; Hikweto et al., 2011; Fajardo et al., 2013; Lopes et al., 2013; Garekhani, 2014). While this result was lower than that recorded (76.3%) in Serbia (Klun et al., 2006) and Algeria (28.7%) (Abdallah et al., 2019). The difference in proportions among countries may be due to the sample size of the different studies, the wide geographic area concerned or covered, management practice (Traditional, semi-intensive and extensive) and also geographical variations among different countries.

| Risk factor | No. of tested animals | No. of positive | % of positive | Chi-square | P value |
|-------------|-----------------------|-----------------|---------------|------------|---------|
| Age group:  |                       |                 |               |            |         |
| Young       | 48                    | 9               | 18.8          | 0.837      | 0.247   |
| Adult       | 114                   | 15              | 13.2          |            |         |
| Sex:        |                       |                 |               |            |         |
| Male        | 55                    | 4               | 7.3           | 3.753      | 0.040   |
| Female      | 107                   | 20              | 18.7          |            |         |
| Breed       |                       |                 |               |            |         |
| Local       | 48                    | 4               | 8.3           | 2.271      | 0.100   |
| Cross       | 114                   | 20              | 17.5          |            |         |
| Locality:   |                       |                 |               |            |         |
| Shargelnile | 114                   | 20              | 17.5          | 2.271      | 0.100   |
| Omdurman    | 48                    | 4               | 8.3           |            |         |
| Other animal|                       |                 |               |            |         |
| Present     | 48                    | 12              | 14.3          | 0.039      | 0.509   |
| Absent      | 78                    | 12              | 15.4          |            |         |
| Cats in farm:|                      |                 |               |            |         |
| Yes         | 105                   | 20              | 19.0          | 4.237      | 0.30    |
| No          | 57                    | 4               | 7.0           |            |         |
| Source of water:|                 |                 |               |            |         |
| Well        | 122                   | 18              | 14.8          | 0.001      | 0.574   |
| Tap water   | 40                    | 6               | 15.0          |            |         |
| Size of herd:|                      |                 |               |            |         |
| Large       | 80                    | 7               | 8.8           | 4.606      | 0.026   |
| Small       | 82                    | 17              | 20.7          |            |         |
| Hygienic condition: |        |                 |               |            |         |
| High        | 23                    | 6               | 26.1          |            |         |
| Moderate    | 41                    | 3               | 7.3           | 4.161      | 0.125   |
| Low         | 98                    | 15              | 15.3          |            |         |
Table 2 Multivariate Association of Antibodies Positive Status of Toxo-Latex Agglutination Test in Khartoum State

| Risk factor                      | No. of tested animals | No. of positive | % of positive | Chi-square | P. value |
|----------------------------------|-----------------------|----------------|---------------|------------|----------|
| Age group:                       |                       |                |               |            |          |
| Young Adult                      | 48                    | 9              | 18.8          | 0.567      | 0.372    |
| Adult                           | 114                   | 15             | 13.2          |            |          |
| Sex:                             |                       |                |               |            |          |
| Male                             | 55                    | 4              | 7.3           | 1.303      | 0.999    |
| Female                           | 107                   | 20             | 18.7          |            |          |
| Breed:                           |                       |                |               |            |          |
| Local                            | 48                    | 4              | 8.3           | 3.330      | 0.998    |
| Cross                            | 114                   | 20             | 17.5          |            |          |
| Locality:                        |                       |                |               |            |          |
| Shargelnile                      | 114                   | 20             | 17.5          | 3.330      | 0.998    |
| Omdurman                         | 48                    | 4              | 8.3           |            |          |
| Cats in farm:                    |                       |                |               |            |          |
| Yes                              | 105                   | 20             | 19.0          | 0.000      | 0.999    |
| No                               | 57                    | 4              | 7.0           |            |          |
| Size of herd:                    |                       |                |               |            |          |
| Large                            | 80                    | 7              | 8.8           | 0.556      | 0.462    |
| Small                            | 82                    | 17             | 20.7          |            |          |
| Hygienicc ondition:              |                       |                |               |            |          |
| High                             | 23                    | 6              | 26.1          | 0.561      | 0.433    |
| Moderate                         | 14                    | 3              | 7.3           |            |          |
| Low                              | 98                    | 15             | 15.3          |            |          |

The prevalence of young cattle was higher (18.8%) than adult (13.2%) in this study, and no significant association between the age of animals and toxoplasmosis. This finding differs from the finding of Abdallah et al., (2019) and Tilahun et al., (2019) who reported that the disease was high in adult than young animals due to a longer exposure of the adults to T. gondii infection (Tenter et al., 2000). With regard to the sex risk factor, the study showed that the seroprevalence of anti-T. gondii antibody is higher in cattle females (18.7%) than in cattle males (7.3%) and these was a significant difference between two sexes ($p = 0.040$). This is in agreement with that reported by Ahmed and Qayyum (2014) and Abdalla et al., (2019) and disagreement with result reported by Fajerdo et al., (2013) and Elfahal et al., (2013) who confirmed that toxoplasmosis was higher in males than females. There was no significant of protozoan parasite seroprevalence in examined cattle breed within different localities in the study area. There were previous studies in agreement with the present study (Elfahal et al., 2013; Ahmed and Qayyum, 2014).

The small size of the herd showed positive result in this study. Klun et al., (2016) and Gilot-Fromnot et al., (2009) found a positive correlation between herd size and seroprevalence. Also, the result of this study revealed that no relationship between the disease ad presence of other animals in farms and seropositive cattle. But this result...
in contract with Fajardo et al., (2013) who found there were significant differences in positive animals in relation to the variable amount of different species. The explanation that the presence of other animals in farm is increased the chance of finding of positive bovine. Higher number of positive animals in farms where cats were present in the vicinity (19.0%) compared with farms free of cats (7.0%).

This result confirmed significant association between presence of cats within farms and Toxoplasma infection (Ahmed and Gayyum, 2014). Direct contact with cats is less important than the presence of cats in the vicinity because cats shedding oocysts, and these are the source of infection rather than direct contact with cats (Dubey and Beattue, 1988).

In this study, there was no significant difference detected in the number of the T. gondii positive animals in the farms that depended on wells or taps water in drinking system (Fajardo et al., 2013). It was found in this study in farms with high level of hygiene contain a great number of positive animals followed by farms with a lower level of hygiene than the moderate one and there was no significant association observed (Table 1). It is possible that the information obtained from the owners of farms is not accurate in terms of disposal of animal dropping, and periodic hygiene. Other study found that the farms with poor hygiene conditions showed a significantly higher number of seropositive animals (Ahmad and Gayyum, 2014).

In conclusion, the present study confirmed that toxoplasmosis is prevalent (14.8%) among cattle in Shargenile and Omdurman localities and the risk factors like age, sex, herd size and the presence of cats in the farms are potential factors contributing the occurrence of bovine toxoplasmosis. Program of controlling and prophylaxis should be applied to reduce the disease in domestic animals.

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