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Sero-prevalence of brucellosis in extensively managed goats in Nyangatom District, South Omo zone, Southern Ethiopia

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Abstract

A cross-sectional study was carried out from March 2023 to March 2024 to assess the seroprevalence and risk factors of brucellosis in goats in the Nyangatom district, South Omo Zone, Southern Ethiopia. A total of 768 extensively managed local female goats of different age groups, were bled and data on hypothesized risk factors were collected using a semi-structured questionnaire. The preliminary screening of the sera for brucella antibodies was done using the Rose Bengal plate test (RBPT) and sera positive for RBPT were further examined by the complement fixation test (CFT). The overall seroprevalence of brucellosis was 12.9 %. Among the risk factors considered, seroprevalence was associated with parity, litter size, flock size, and history of occurrence of abortion ($p<0.05$). *Regarding Parity, Brucella seroprevalence was higher in goats with more than 3 parities than in goats with lower parity. Furthermore, higher seroprevalence of brucellosis was observed in goats with a litter size of two and goats with in medium flock size. The current seroprevalence revealed that brucellosis in goats continues to be an important disease in the study area. This in turn, entails the significant production loss and public health risk of the disease. Therefore, implementing control measures appropriate for the pastoral area and awareness creation in the community is important to control the spread of infection in the animal population. In addition, veterinarians, public health authorities, and other community leaders need to work in collaboration to control the disease in animals and human exposure.*

Keywords: *Brucellosis, goats, Nyangatom, seroprevalence*

One of the most important strategies to improve the living standards of the people in many developing countries is livestock rearing (Gebeyaw *et al*., 2020) and is important to the national economy in Sub-Saharan Africa, as it improves community livelihoods in rural (Fesseha and Abebe, 2020). Among Ethiopia's livestock farming and activity, goat production is an important aspect. The country has 52.5 million heads of the indigenous goat population (CSA, 2020). South Omo Zone is one of Ethiopia's pastoral areas with huge livestock resources. However, due to different factors, including ailments affecting the livestock population, the economic yield from the sector is very low (Tegegn *et al.,* 2021). Among these ailments that limit economic return from small ruminants like goats are reproductive diseases including brucellosis is the major disease that affects pastoral areas (ILRI, 2006). This disease causes significant reproductive losses in sexually mature animals (Miftha *et al*., 2021).

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Brucellosis is an important disease of farm animals. The species of Brucella and their principal farm animal hosts are *Brucella abortus* (cattle), *Brucella melitensis* (goats), *Brucella suis* (pigs), and *Brucella ovis* (sheep). The disease is transmitted by ingestion, penetration of the intact skin and conjunctiva and contamination of the udder during milking. The principal manifestations of brucellosis are reproductive failure, such as abortion or birth of an unthrifty newborn in the female, and orchitis and epididymitis with frequent sterility in the male. Persistent (lifelong) infection is a characteristic of this facultative intracellular organism, with shedding in reproductive and mammary secretions (Radostits *et al*., 2006). Brucellosis is a zoonotic disease which is transmitted by direct or indirect contact with infected animals or their products. The disease affects many domestic animals especially those producing food: sheep, goats, cattle, camels, and pigs (Gorvel, 2008). According to the World Health Organization (WHO), the disease is classified as one of the neglected zoonoses with serious veterinary and public health importance throughout the world (WHO, 2006). Because of the major economic impact on animal health and the risk of human disease, most countries have attempted to provide the resources to eradicate the disease from the domestic animal population. Control programs have employed two principal methods: vaccination of young or mature animals and the slaughter of infected and exposed animals, usually based on a reaction to a serological test (Gorvel, 2008).

Brucellae have been found worldwide in terrestrial and marine environments. The distribution of the individual organisms varies. *B. abortus, B. melitensis,* and biovars 1-3 of *B. suis* have been virtually eliminated from livestock in many developed countries. However, some of these organisms are common in parts of the Middle East, Asia, and Latin America. There is limited information from Africa, but brucellae have been reported from livestock and wildlife in some nations (CFSPH, 2023). In Ethiopia, most research work on brucellosis has been focused on intensive dairy cattle herds in urban and peri-urban areas (Sintayehu *et al*., 2015). As stated by Ashenafi *et al*. (2007), regarding seroprevalence of caprine Brucellosis, there are few works done in Ethiopia. Ashagrie *et al*. (2011) and Feyera and Maryam (2020) respectively reported 4.2% and 21% positive sera by CFT in Selected districts of South Omo Zone. But its distribution in the extensive production system, particularly in the South Omo Zone, Nyangatom district, has not been well studied for a longer period. Therefore, the objectives of this study were to study the seroprevalence of Brucellosis in extensively managed goats and its associated risk factors in the Nyangatom district of the South Omo Zone.

Materials and methods

Description of the study area

The study was conducted from March 2023 to March 2024 in the Nyangatom (Kangaten, capital city) district of South Omo Zone. Nyangatom district, which is located between $4^0$85'-$5^0$67' N latitude and $35^0$75'-$36^0$23'E longitude, bordering Dassenech woreda in the south, Bench Maji and Salamago woreda in the north, Hammer woreda in the east, Kenya and South Sudan in the West has a total land area of 2,652 Km^2 and is located 915 kilometers southwest of Addis Ababa. Nyangatom district is ecologically a lowland (kola/arid) with an altitude of 400-450 meters above sea level. The district's mean annual temperature ranges between 33 and 42 °C. The rainfall pattern of the district is erratic, with mean annual rainfall

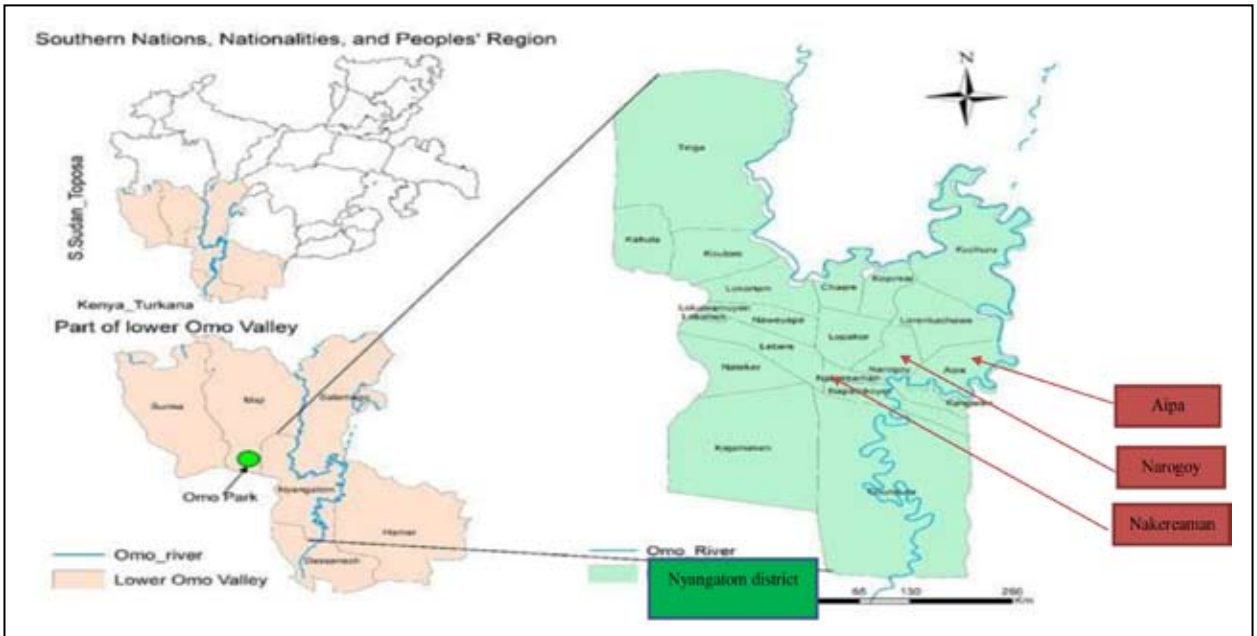

Figure 1: Map of the study area from the former SNNPR map (Gebeyehu *et al.*, 2021)

ranging from 350-500 mm. The district has a livestock population of 676,215 cattle, 246,728 goats, 193,393 sheep, 77,419 poultry and 24,171 donkeys (SOZADD, 2023).

Study population

The study involved 768 extensively managed goats that lived mixed with other animals. As female goats are an important source of milk in the area and will be a source of zoonosis for the community, only female goats with different age groups (minimum age of 18 months) were included in the study. The study animals had no history of vaccination against brucellosis, as vaccination against brucellosis is not practiced in Ethiopia.

Study design and sampling

A cross-sectional study was carried out to assess the seroprevalence and associated risk factors of brucellosis in goats in the Nyangatom district. Three kebeles of the district were purposively selected for the study based on their relatively high goat population. Accordingly, as there was no record for each female (an estimate of the total number of female goats was not available and their records were not sequentially available), female goats were selected via simple random sampling from different flocks. The three kebeles selected for the study were Aipa, Nakereaman, and Narogoy. This was done based on their high population of goats when compared to other kebeles which is believed to be representative of the district as reported by the district agricultural office.

Sample size determination

The number of animals required for the study from each kebele was calculated using an expected seroprevalence of 21 % (Feyera and Maryam, 2020), 95 % confidence interval and 5 % desired absolute precision (Thrusfield, 2005). Accordingly, the calculated minimum sample size was (255 in total). However, to increase accuracy, 768 female goats (3.01fold) were included in the study with 256 from each kebele.

Method of data collection

Individual animal data (age, parity, litter size (during the study time), flock size, and history of abortion were collected using a semi-structured questionnaire from each flock owner. By considering the average goat population of 41 goats per flock and owner, dividing the total (768) goats by 41 goats, approximately 19 owners were obtained and interviewed. During the interview, the questionnaire was administered to the respondents in common local languages in (Amharic and Nyangatom language). There was a brief discussion on the objective of the survey and respondents were asked for their consent before the interview was commenced.

According to the local community perception herd size was classified into three: small (1–15 heads of goats), medium (16–30), and large (>30).

Blood sample collection and laboratory tests

Blood samples were collected early in the morning as animals were moved out for grazing. Blood was drawn from the jugular vein into plain vacuum tubes after disinfecting the venipuncture area with 70 % ethanol. Each collected blood sample was labeled with the goat's identification information (age, parity, litter size, and flock size). After the tubes were stood until the clot and the serum were separated, the tubes containing the blood samples were centrifuged for the blood to clot at 5000 rpm and the serum was then collected into labeled cryo vials of 2 ml capacity using Pasteur pipettes. The sera samples were then transported to Jinka Regional Veterinary Laboratory, where they were stored at -20^{0}C. By following the standard procedures described by the OIE (2018), sera were analyzed serially for the presence of Brucella antibodies using the Rose Bengal plate test (RBPT) and then the complement fixation test (CFT) for screening and confirmation, respectively. The screening with RBPT was performed at Jinka Regional Veterinary Laboratory, and positive sera were transported to the Animal Health Institute (AHI), Sebeta, Ethiopia, for CFT. Sera were always kept cold in an icebox during transportation.

Data Management and Analysis

All collected data were entered into the Microsoft Excel 2010 spreadsheet and imported to SPSS version 25 for statistical analysis. binomial and multinomial logistic regression tests were employed to observe the significant association between brucellosis and its risk factors. In all the analyses, the confidence level was held at 95%, and statistical analysis was considered significant at $p<0.05$.

Results and discussion

Sero prevalence and statistics

Among 768 female animals screened with RBPT 263 (34.2 %) were found to be positive for Brucella antibodies. However, the confirmatory test using CFT result revealed 99 (12.9%) positive cases. Higher seroprevalence was observed in Narogoy kebele (19.53%) followed by Nakereaman (11.72%). Goats with a higher number of parities (>3), and litter size 2 showed 23.2%, and 18.4% seroprevalence of brucellosis, respectively. Regarding flock size, 36 flocks, 12 from each village were examined. Five small flocks, 20 medium flocks, and 11 large flocks with a total of 119, 220, and 429 goats were examined. The medium-sized flock was with higher seroprevalence (30%) followed by small flock size (15.13). Among 78 cases of abortion, 68 (87.2%) were positive for Brucella antibody (Table 1).

Table 1: Prevalence of Brucellosis and its association with risk factors in Nyangatom district South Omo Zone from March 2023 to March 2024

Risk factors		Frequency	No Positive for CFT	Percent positive	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower boundary	Upper boundary
Kebele	Aipa	256	22	7.42	.000	4.010	1.878	8.562
	Nakerearman	256	37	11.72	0.028	1.991	1.079	3.675
	Narogoy	256	40	19.53	.	.	.	.
Over all prevalence		768	99	12.9				
Age	Young (<1yr)	287	37	12.9	0.626	.727	.201	2.625
	Adult (1-4yrs)	432	59	13.7	0.125	.373	.106	1.313
	Old (>4yrs)	49	3	6.1	.	.	.	.
Parity	Nulliparous	287	37	12.9				
	1-3	339	29	8.6	.000	4.275	2.375	7.698
	>3	142	33	23.2				
Litter size	Nulliparous	287	24	8.4	0.164	1.534	.840	2.801
	1	220	27	12.3	0.638	1.183	.588	2.381
	2	261	48	18.4				
Flock size (n=36)	Small	5 flocks	18 goats	15.13	0.692	.877	.458	1.679
	Medium	20 flocks	66 goats	30	0.004	.310	.138	.695
	Large	11 flocks	15 goats	3.5				
History of abortion	No	690	31	4.5	.000	6.033	3.594	10.128
	Yes	78	68	87.2				
a. The reference category is: yes.								
b. This parameter is set to zero because it is redundant.								

Among 768 tested goats, 99 (12.9%) were positive for brucella antibody for CFT (Table 1). Ashenafi *et al*. (2007) reported similar results from the Afar region (11.6%). The current result revealed higher seroprevalence than the previous reports of Asmare *et al.* (2013) who reported 7.6 % (95 % CI 5.1, 10.1 %) in pastoral systems in Ethiopia, Sintayehu *et al.* (2015) who reported 0.26% (95% CI: 0.0–0.56) in South Omo Zone, and Getachew *et al.* (2023) who observed 3%, 0.7%, 1.3% in Dassenech, Benatsemay and Debub Ari districts, Ethiopia respectively. In addition to this, Desalegn *et al*. (2022) also reported a prevalence of 5.3% in Kolme districts.

Yohannes *et al*., (2013), reported lower seroprevalence of 9.6% of brucellosis in small ruminants in Ethiopia. This might be due to the high number of goats tested during the current study. Moreover, pastoral animal husbandry and management practices could play a major role in the spread of brucellosis infection in the area. Other researchers like Feyera and Maryam (2020) reported 21% in Nyangatom and Dassenech districts, while Yibeltal (2005) reported 16%, in Afar and Somali regions, Ethiopia. A prevalence of 16.2% was reported from Sudan by El-Ansary *et al.* (2001). This might be because there is a low level of intensification, no breed differences, differences in flock size and composition, or the differences in the tests used to make the diagnosis in pastoral areas of Ethiopia (Sintayehu *et al*., 2015). This might also be due to differences in animal husbandry, communal grazing of range lands and water areas as well as the influence of climatic conditions (Teshale *et al*., 2006).

Association of brucellosis with its risk factors

Among the risk factors considered, seroprevalence was associated with, parity, medium flock size, and history of occurrence of abortion ($p<0.05$) (Table 1).

During the assessment of the risk factors of brucellosis in goats, the most important risk factors were age, parity, litter size, flock size, and history of abortion. The difference in the seroprevalence of brucellosis between age groups was not significant, though in adult age it was higher. This was a very similar finding with Umer *et al*. (2021), Sintayehu *et al* .(2015), Tsehay *et al.* (2014), and Godfroid *et al.* (2010). According to Berhe *et al*. (2007) and

El-Ansary *et al*. (2001), sexually mature animals are more susceptible to brucella infection than sexually immature animals. As stated by Walker (1999), sex hormones and erythritol, stimulating the growth and multiplication of brucella species tend to increase in concentration with age and sexual maturity. Furthermore, (Tsehay *et al*., 2014). reported that younger animals tend to be more resistant to infection.

Parity of 1-3 and frequency of abortion were significantly associated with brucellosis ($p<0.05$). This result is consistent with the report of Feyera and Maryam (2020) in Nyangatom and Dassenech. According to Desalegn *et al*. (2022), parity and history of abortion were significantly associated with seroprevalence of brucellosis, which is in line with the current finding. He also reported higher seroprevalence in large herd sizes, which is not in line with the current finding. This is due to the close contact between animals, which contributes to the contagious nature of the infecting agent getting access to affect large number (Umer *et al*., 2021). The difference in the level of intensification can be another reason. Parity and frequency of abortion are also reported by Kebede *et al*. (2008) and Tsegay *et al*. (2015) as the most important risk factors.

Conclusion

The current study has identified that there is considerable seroprevalence of caprine brucellosis in the Nyangatom district. Sexually mature goats, goats having a high number of parities, goats with a history of abortion, and in large herd size were more exposed to caprine brucellosis in the study area. Parity and frequency of abortion were among the risk factors significantly associated with caprine brucellosis in the study area. Since brucellosis in goats continues to be an endemic disease in the study area, it in turn causes significant production, economic loss, and public health risk. Therefore, the disease requires more attention and collaborative work for its prevention and control strategy. Accordingly, we recommend that there should be a nationwide survey to implement possible control measures, awareness creation in the community, and collaborative work of stakeholders like veterinarians, public health professionals, authorities, and other community leaders.

Conflicts of interest

The authors declare that there is no conflicts of interest.

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