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Seroprevalence and Associated Risk factors of Bovine Brucellosis in South Omo Zone, Southern Ethiopia

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Abstract

Brucellosis is zoonotic disease with economic and public health significance in developing countries that rely on livestock production. The aim of this study was to determine the seroprevalence of bovine brucellosis and associated risk factors. A total of 1920 sera samples were collected from cattle and serially tested using Rose Bengal plate test, competitive enzyme linked immunosorbent assay, and complement fixation test to detect antibodies against natural infection by *Brucella* species. Data was analyzed using STATA version 14.0 and potential risk factors for seropositivity of brucellosis were analyzed using logistic regression.The study revealed an overall 5.26% (95% CI=1.73, 5.04) and 36.43% (95% CI=9.18, 12.02) seroprevalence of bovine brucellosis at individual and herd level, respectively. Age, sex, herd size, abortion, retained fetal membrane, and parity were statistically significant with seropositivity for brucellosis. Older aged animals 2-4 years (OR=5.75, 95% CI=40.30-45.45) were at higher risk of Brucella infection than young (0.5-2) years. Large herd size>50 animals (OR =7.08, 95% CI=17.00-18.05) and medium herd size (25-50) animals (OR=1.02, 95% CI=33.06-37.04) showed higher risk of *Brucella* infection than small herds<25 animals. Among seropositive animals, 93.07% were female (OR=2.10, 95% CI: 0.34, 0.58). Moreover, the findings established that pastoralists had low level of awareness about brucellosis and undertook risky practices that could expose them to brucellosis. In conclusion, the prevalence of bovine brucellosis in South Omo Zone was high which warrants the need for integrated intervention strategies in place to curtail the spread of the disease.

Keywords: Bovine Brucellosis; Seroprevalenc; South Omo Zone; Ethiopia

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Background of the Study

Brucellosis is one of the world's most widespread zoonotic diseases affecting both public health and animal production Kairu-Wanyoike et al. [1]. The significant economic losses due to brucellosis could be mainly related to losses through abortion, still birth, infertility, reduced milk production and economic losses from international trade bans [2].

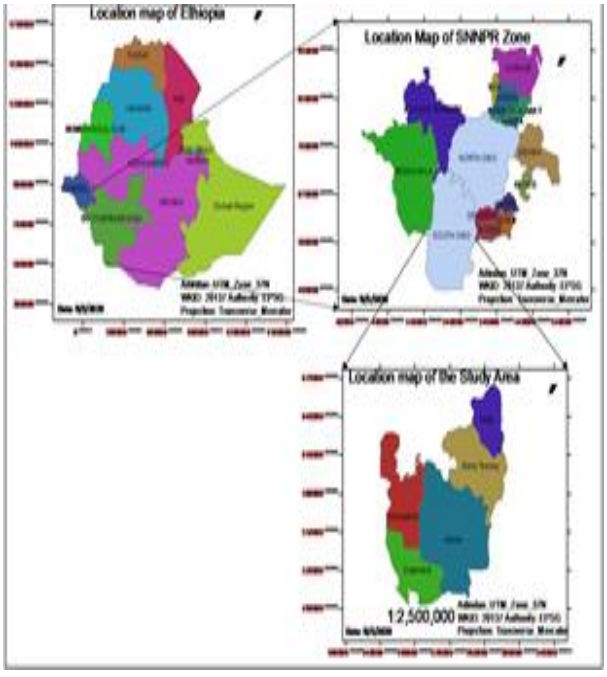
Brucellosis is caused by a Gram-negative bacterium of the genus Brucella which affects a wide host ranges including humans and wild life. Brucella includes six classic species such as Brucella abortus, Brucella melitensis, Brucella suis, Brucella ovis, Brucella canis and Brucella neotomae. Recently, other species such as Brucella ceti, Brucella pinnipedialis, Brucella microti and Brucella inopinata have been recognized [3].

Clinically it is characterized by abortion during late stage of pregnancy, epididymitis, and orchitis [4]. In humans, the disease is characterized by fever, sweating, anorexia, weight loss, depression, headache and joint pains and is confused with malaria and influenza [5]. This could impose serious problems in diagnosis of the disease especially in developing countries where there is lack of well established infrastructures. Sources of infection include aborted fetuses, fetal membranes, vaginal discharges and milk from infected animals. Ingestion of contaminated pasture, feed, fodder and water may also play a secondary role in the transmission of the disease [6]. It is transmitted to humans mainly by direct contact with infected livestock and the consumption of unpasteurized contaminated milk and dairy products [7]. In Ethiopia, the first case report of brucellosis was dated back to 1970s and still it is a major disease of socio-economic and public health significance

Since then, brucellosis in animals and humans has been reported from various parts of the country, mainly in cattle in urban and per urban areas with intensive production systems [9]. However, epidemiological studies of brucellosis in pastoral settings of the country are limited though pastoralists' lively hood relies directly on their livestock. In pastoralist communities of Ethiopia, habit of consumption of raw milk and milk products, and rarely consumption of blood are practiced. These conditions are potential risk factors for transmission of zoonotic diseases such as brucellosis [10]. Moreover, in pastoral community handling of aborted materials, manipulation of reproductive excretions with bare hands and herding of a large number of animals mixed with other animals, frequent contact among different species of livestock at communal grazing land and water sources are widely practiced [11]. The lifestyle and strong dependence of the pastoral communities on their livestock would highly favor the transmission and persistence of zoonotic diseases like brucellosis in pastoral area.

In Ethiopia, the prevalence of bovine brucellosis has been intensively investigated in state owned dairy farms [12], in smallholder farms in some parts of Ethiopia [13] and in the central highlands of the country [14]. However, there was little attempt in the past to determine the status of bovine brucellosis in cattle populations kept under pastoral management systems in the current study area. Thus, this study was carried out with the objectives:

- To determine the sero-prevalence of bovine brucellosis in pastoral area of South Omo Zone, southern Ethiopia,
- To assess the potential risk factors associated to bovine brucellosis in the study area, and
- To find out awareness and practices of pastoral communities about brucellosis in the study area.



Materials and Methodology

Description of study area

The present study was conducted in five pastoral districts (Benatsemay, Male, Hamer, Dassenech and Gnangatom) of South Omo zone. South Omo zone is located in the Southern Nations, Nationalities, and Peoples Region (SNNPR) (Fig. 1) of Ethiopia. The study area is located at 750 km south of Addis Ababa.

The altitude of the zone is about 400 m above sea level. The average annual temperature ranges between 18 to 32°C and the average annual rainfall is about 390 mm. In the study area, rain is erratic and usually bimodal occurring from September to November and from March to May. The weather condition is characterized by semi-arid and arid climate. The major livestock production system in the Zone is pastoral and comprises the higher livestock population of the region [15].

Study animals and management

The study animals were indigenous cattle kept under pastoral farming system. Livestock production system is generally predominated by extensive pastoral or agro-pastoral system in which indigenous animals are allowed to forage freely during day time and kept in barn during the night time. All cattle in the study area with the age of 6 months or above were considered as the study animals. Cattle population of the study area is estimated to be 1, 068, 120 Pastoralists in the study area keep a diverse composite of livestock species as part of a coping mechanism for uncertainties and risks. Such conditions certainly increase aggregation and interaction of different animals at villages, grazing fields and water points. This circumstance could facilitate transmission of various contagious diseases among different species of livestock and human. Furthermore, the frequent migration of pastoral herds in search for pasture and water might increase the chance of contact with other potentially infected herds and exposure to diseases.

Design

A cross-sectional study was employed to determine the seroprevalence and associated risk factors of brucellosis in cattle from January 2017 to June 2020. Age, sex, parity number, history of abortion and retained fetal membrane, herd sizes and other factors thought to be important determinants of the infection dynamics within and between herds were gathered according to Omer et al.. A pre-tested structured questionnaire was used to identify risk factors for the occurrence of brucellosis in the study animals. These determinant factors were obtained and recorded from animal attendants or owners while collecting samples . A multi-stage sampling strategy was implemented, with zone as highest and herd as lowest sampling stages, district and village in between the two stages. Selection of the study unit at each stage was based on a mixed design of convenience (zone and district selection) and random samplings (village, herd, and individual

animal selection). The zone was purposely selected as the study was intended to be carried out in pastoralist area with no or few similar studies conducted so far. Similarly, only pastoral districts were selected purposely for the study. Villages were randomly selected following having lists of villages in each district. Simple randomly sampling technique was applied to select individual animal.

Sample size determination

Sample size was determined according to Thrusfield [17] using 95% confidence level, 5% precision. The 50% expected prevalence of brucellosis was used since there was no reliable published prevalence of bovine brucellosis in the study area.

The formula used for sample size determination was:

$$n = \frac{(1.96)^2 * Pexp * (1 - Pexp)}{d^2}$$

Where: n = required sample size,
Pexp= expected prevalence and
d= desired absolute precision

Using the above formula, the minimum sample size calculated for the study was 384. However, to increase the level of precision, and considering the study covers wider area (five districts), the sample size was increased to a total of 1, 920 cattle. The determined total sample size was distributed to each district based the size of the cattle population using population proportion (Table 1). For the questionnaire survey data were obtained from each sampled animal.

Selection of Villages and Herds

Since almost there is no significant difference in the number of villages or pastoral association among the districts, five villages were purposely selected from each district. Based on sample size distributed for each district number of herds to be considered in the study districts were distributed purposely 15 herds for district with small sample size calculated and distributed, 45 herds for district with the highest sample size calculated, and 20 and 30 herds for the remaining districts within between the highest and lowest sample size distributed. Accordingly, number of herds assigned to each district 45 herds (Benatsemay), 30 herds (Male), 20 herds (Hamer), 30 herds (Dassenech), and 15 herds (Gnangatom).

Questionnaire Survey

During collection of serum samples, a pretested semi-structured questionnaire survey was administered to respondents or owner/herder of the cattle included in the study through interview by local language using local veterinary experts. The questionnaire was focused on age category, sex, herd size, abortion history, and history of retained fetal membrane, stage and frequency of abortion, body condition scores and parity number for each individual animal. Moreover, structured questionnaire survey was also carried out to assess understanding, awareness and practices undertaken by pastoralists on brucellosis. Accordingly, a total of 140 herds owners or herders were included in this study. The structured questionnaire interviewed with the respondents emphasized on awareness about brucellosis, knowledge of zoonotic disease transmitted from animals to humans through consumption of milk and other animal products, knowledge of pathogenic causes of abortion in animal, knowledge and understanding about disease transmitted during handling of infected animal and its product, knowledge about diseases transmitted during delivery assistance, ways of disposal of aborted materials, fate of frequently aborted cows in the herd, risk of assisting parturition with bare hands, and habit of Consumption of raw animals' blood and milk were assessed at the study area.

Conclusion

In conclusion, the present study revealed that the overall sero-prevalence of bovine brucellosis in South Omo Zone of SNNP regional state was moderately high both at individual (5.26%) animal and herd (36.43%) level. Moreover, a seroprevalence of 60% was recorded at village (pastoral association) level in the study area. There was strong and statistically significant association between putative risk factors such as age, sex, herd size, parity, abortion and retained fetal membrane and seropositivity for bovine brucellosis in the study area. Moreover, the findings confirmed a poor understanding and low level of awareness of brucellosis among pastoralist communities and a high level of risky practices such as drinking raw animals' blood, assisting parturition without any protective cloth, poor handling and disposal of aborted materials being undertaken by the pastoralists.

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