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Bovine Tuberculosis Magnitude and Associated Factors in Woliata Sodo Town, Southern Ethiopia

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Abstract: Bovine tuberculosis is a dangerous infectious disease that affects cattle and poses a public health threat. It's especially critical in Ethiopia, where there aren't many efficient control measures. However, in response to rising milk demand and the Ethiopian government's efforts to boost livestock output, intensive husbandry settings containing exotic and cross-bred animals have expanded in recent years. A cross-sectional study was undertaken in Woliata Sodo town from January 2019 to March 2020 to evaluate the prevalence of bovine tuberculosis (BTB) using the comparative intradermal tuberculin test. The total frequency of bovine tuberculosis in dairy cattle was 11.3 percent (n = 31) at the proposed cut off of > 4 mm. The CIDT was performed on 274 dairy cattle, including cross-bred (30.3%) and exotic cattle (69.7%). Using the SPSS software, the data was analyzed using descriptive statistics and the Chi square. The prevalence difference across herd size groups was statistically significant (x2 = 34.6152; df = 4; P 0.001). Furthermore, the prevalence of bovine TB was substantially linked (P 0.05) with animal breed categories, although the remaining factors were insignificantly associated (P > 0.05). Finally, this study demonstrated the significance of BTB in the study area in particular and the region in general.

INTRODUCTION

Tuberculosis is an infectious illness produced by Mycobacterium tuberculosis complex strains that has posed a significant health danger to humans and animals for over a century. It is extensively disseminated across the world, affecting humans and animals of all ages, generating enormous economic losses and making management difficult. Mycobacterium bovis causes bovine tuberculosis (TB), a chronic bacterial illness that affects both animals and humans. Bovine tuberculosis is a serious infectious illness that affects cattle, other farmed animals, and some wildlife populations in a number of nations[1-2].

Most of Africa, parts of Asia and the Americas, as well as numerous European countries, are infected with the disease. Many industrialised countries have used test-and-slaughter to reduce or eliminate bTB in their livestock industries, although substantial pockets of infection still exist in wildlife[3]. Due to a lack of control methods, the disease is endemic in Africa. This has economic ramifications for the animal industry, particularly the dairy industry, as well as the risk of zoonotic tuberculosis transmission, which is amplified by the presence of concomitant illnesses like HIV/AIDS [4]. Due to increased urbanization and population pressure, milk consumption

in Ethiopia is fast increasing; Ethiopia is Africa's second most populated country, with an estimated population of 110 million people . The dairy business has continuously grown since the beginning of intensive dairy production in central Ethiopia in the 1950s to supply milk to the Emperor and his establishment. This development has accelerated in the last 30 years, in order to meet the demand for milk and milk products as a result of rising urbanization and the necessity to deliver milk to city people[5].

Although the dairy business is most established in central Ethiopia, metropolitan areas around the nation have lately experienced an upsurge in dairy production.

Human TB caused by M. bovis has decreased significantly in industrialized nations as a result of required pasteurization of milk and tuberculin skin testing of cattle, followed by culling/slaughtering of diseased animals. However, it poses a possible health concern to both humans and animals in poor nations, notably in Africa. This is due to the fact that 82 percent of the human population and 85% of the livestock population reside in areas where BTB is widespread. According to studies, BTB is still prevalent in underdeveloped countries where routine milk pasteurization is not done, and M. bovis is responsible for 10–15 % of human tuberculosis cases[6-7].

Ethiopia has one of the greatest livestock populations on the African continent, with a total cattle population of 56.71 million[8]. The animal production is determined to be quite low, despite the vast livestock resources. Low genetic potential and performance, poor nutrition (in terms of quality and quantity) the prevalence of various illnesses, antiquated husbandry practices and insufficient qualified workforce are some of the key biological and socio-economic factors contributing to low production. BTB is a serious disease burden in animals in Ethiopia, as it is in many other African nations. BTB is an endemic infectious illness that has been documented in Ethiopia for a long time.

Bovine TB is one of the primary causes of death and morbidity in Ethiopian cattle. According to studies done in other regions of the nation, the prevalence of BTB infection as established by SCIDTT was 9.7%, whereas the prevalence of non-specific infection was 10.8%. For BTB and non-specific infections, the prevalence was 8.2 % and 11.3 % in the extensive system, respectively, and 22.1 % and 6.3 % in the intense system[9]. The aim of the present work was, therefore, to determine the prevalence and associated risk factors of M. bovis in cattle at Woliata Soddo town in southern Ethiopia.

MATERIALS AND METHODS

Study area: The settlement is located 383 kilometers southwest of Addis Ababa, at a height ranging from 1650 to 2980 meters above sea level. The town is flanked to the north by Damot Gale Woreda to the south by Humbo Woreda to the east by Damot Wide Woreda and to the west by Damot Sore Woreda. The area's yearly rainfall and temperature range from 1000-1200 mm and 25-35°C, respectively. The Woina Dega agro-ecological climate applies to the area. Although the dry season lasts from September to February and the wet season lasts from March to August, the weather in Addis Abeba which is located at 6°54 N, 37°45 E, fluctuates.

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Study animals: The study comprised cattle from state farms, private farms and small-holder dairy farms in Woliata Soddo. Cows of both sexes were sampled from cattle farms and small-holder farmer families that were older than 6 months and up to 14 years old.

Study design and sampling method: A cross-sectional research was undertaken in Woliata Soddo Town in South Ethiopia from January 2019 to March 2020. The offices of the Livestock and Fishery Department's rural development agents provided a list of dairy cattle-owning households and farms. As sampling frames, lists of families and farms were employed. Individual animals were considered secondary units, whereas households/farms were considered primary units. Based on herd size, animal herds in the research regions' households/farms were divided into three categories (small, medium and large herd size). Both herds and individual animals were chosen at random from each research region. Per household/farm two animals from a small herd size to eight animals from a large herd size over the age of six months were chosen at random. The animals were chosen using a lottery sampling procedure. During the research period, no samples were lost. Cattle that were one month pre- and post-partum were excluded from the research. Prior to injecting Pure Protein Derivatives (PPD), associated risk variables were documented at the animal and herd levels. Each tested animal was given a temporary unique identification number. The animals' Bodily Condition Score (BCS) was classified as low, medium, or good[10]. Extremely lean calves with protruding dorsal spines directed to the touch and individual visible transverse processes were regarded to have a poor body condition score. A medium body

condition score was assigned to cattle with normally visible ribs, minimal fat cover, and hardly visible dorsal spines. When fat cover is clearly evident in essential places and the transverse processes are not visible or felt, the animals have a satisfactory body condition score. The study farms' management conditions (sanitation status) were graded as low, medium (acceptable) or good[11].

Sample size determination: The sample size was calculated on the assumption that the predicted prevalence of bTB was 11.6% [1]. The desired sample size was calculated using the 95% confidence interval and at 5% absolute precision following the method of Thrus field. The research districts were carefully chosen based on their livestock numbers (both native and crossbred varieties) and convenience of access. Sample sizes of 158 cattle were sought based on the premise. A total of 274 samples were chosen at random from all of the study farms for sampling accuracy. Cattle populations of both sexes older than 6 months were included in the study with animals older than 2 years representing mature animals (used for breeding reasons) animals younger than 2 years and older than 6 months representing young animals.

Data collection : The number of positive reactors per 100 animals examined was used to calculate individual animal prevalence. The number of herds containing at least one reactor was divided by the total number of herds examined to calculate herd level prevalence. The Chi-square (c2) test was used to examine the differences between various parameters. The odds ratio (OR) was used to determine the strength of the link between various variables and the prevalence of BTB in cattle and the possible dangers to people. Doubtful findings were declared negative while analyzing the influence of several risk variables on the animals' TB status. A statistically significant P-value of 0.05 was considered.

Comparative intradermal tuberculin (CIT) test: On the right side of the mid-neck area, the animal's skin was shaved at two locations (12 cm apart). Before the tuberculin was injected, the skin thickness was measured with calipers. At these places, aliquots of 0.1 ml of 2,500 IU/ml bovine pure protein derivative (PPD) (Veterinary Laboratories Agency, Addlestone, United Kingdom) 0.1 ml of 2,500 IU/ml avian PPD (Veterinary Laboratories Agency, Addlestone) were injected into the dermis. The thickness of the skin at the injection sites was measured using calipers after 72 hours. The findings were interpreted in conformity with the OIE's recommendations [2]. The animal was judged positive for mycobacterial species different than the mammalian type when the change in skin thickness was larger at the avian PPD injection location (M. tuberculosis and M. bovis). The difference in thickness was taken into account when an increase in thickness was recorded at both sites. The animal was classified as negative for bovine TB if increase in thickness at the injection site for bovine PPD (B) was greater than that at the injection site for avian PPD (A) and B minus A was less than 2 mm. The animal was classified as suspect/doubtful or positive, depending on whether B minus A was between 2 and 4 mm or greater than 4 mm.

Identifying risk factors: Age, herd size, breed, management, bodily condition and sex were among the risk variables believed to impact the disease's spread. Dairy cattle chosen for the CIT-test were divided into three groups: those under one year old, those between one and three years old and those between four and six years old. Animals more than six years old were not included. Similarly, herd size was determined by categorizing the number of animals in a herd less than or equal to five between five and less than or equal to fifteen and higher than or equal to sixteen. Because the genetic composition of the animals influences the occurrence of the disease, it was classified as zebu, cross and Holstein dairy cattle. To observe the role of confinement, farm management was rated as excellent or poor. The animals were classified as lean, medium, or fat based on their bodily condition[11]. The sexes of animals and the farming system were also considered.

Data analysis: The total number of cattle with at least one CIDT positive per 100 animals investigated was used to calculate the herd prevalence of BTB. The number of positive reactors per 100 animals was used to calculate individual animal prevalence. The statistical program for the social sciences (SPSS) version 16 (2007) was used to analyze the data and p 0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

The tuberculin skin test conducted in the study areas indicated that of 274 animals tested, 31 (11.3%) were found positive for bovine TB (Table 1). The sex of the majority of the study animals was female (93.79%; 257/274). The composition of the breeds was cross-breed (30.3%) and exotic (69.7%). In this study, the effect of different kinds of risk factors (like breed type, sex, age and others) on the occurrence of bovine TB was investigated .Accordingly, even though there was no significant difference between the sexes

Table 1: Distribution of bovine Tuberculosis in soddo town dairy farms

CIDT response	Dairy farm
Negative	231(84.3%)
Doubtful	12(4.4%)
Positive	31(11.3%)
Total	274(100.0%)

Table 2: The impact of herd size on the prevalence of bovines

Herd size	Number of cattle tested	Number of positive	χ^2-value	p-value	Odds ratio (95%CI)
<5 cattle	5	4 (12.9%)	34.6152	0.000	0.3164 (0.16783-0.59652)
6-9 cattle	36	9 (29.0%)			
>10 cattle	233	18 (58.1%)			
Total	274	31 (100%)			

Table 3: Association of different factors to skin test positivity at 4mm cut-off BTB at Sodo Town Dairy Farm

Variables	Categories	No of negatives	No of doubtful	No of positive	Chi-square	p-value
Breed	Exotic	177 (76.6%)	11 (91.7%)	3 (9.7%)	77.8411	0.000
	Local	54 (23.4%)	1 (8.3%)	28 (90.3%)		
Body condition	Poor	16 (6.9%)	-	-	3.4222	0.490
	Medium	49 (21.2%)	2 (16.7%)	7 (22.6%)		
	Good	166 (71.9%)	10 (83.3%)	24 (77.7%)		
Age	Young	40 (17.3%)	11 (9.7%)	3 (9.7%)	3.4341	0.180
	Adult	191 (82.7%)	28 (90.3%)	8 (66.7%)		
Sex	Female	216 (93.5%)	10 (83.3%)	31 (100%)	4.3409	0.114
	Male	15 (6.5%)	2 (16.7%)	-		
	Total	186	57	31		

, a higher prevalence of bovine TB in female animals was recorded. The difference in prevalence among the different herd size classes was statistically significant (χ^2 = 34.6152; df = 4; $p<0.001$) (Table 2). The prevalence of bovine tuberculosis was significantly associated ($p<0.05$) with animal breed categories but the other variables were not ($p>0.05$). (Table 3).

The prevalence of bovine tuberculosis at animal level in the recent finding was 11.3% which was higher as compared to the Boji District of Western Ethiopia, reporting 5%[12]. And in agreement with the previous studies in Adama (11%) Hawassa (11.6%) . However it is lower than studies done by Ameni, Omer[13-18] in Wolaita soddo (14.2%) Asmara (14.5%) respectively[15-16]. The study's findings revealed that there was no statistically significant variation in prevalence across bodily condition, age and sex. Because the majority of animals submitted for CIDT in the research were adults (about 66.7%) the results suggest a greater prevalence of BTB in the adult age group than in the younger age group. Adults accounted for the majority of the positives and doubts. The fact that older animals had a higher and more frequent likelihood of contracting mycobacterial infection over the course of their lives might be the cause [17-18]. Some of the animals reacted with doubtful or a lack of specificity. Infection with M. avium or M. p aratuberculosis is the leading cause of non-specific reactors. Quinn[19]. discovered cattle with clinical Johne's disease (caused by M. paratuberculosis) reacting to avian tuberculin as a result of the close antigenic relationship between M. avium and M. paratuberculosis [19]. Herd size was identified as one of the herd level risk variables for bovine TB transmission in this study, which is consistent with prior research from across the world. BTB positive has been found to be greater in larger herds than in smaller ones[20-21]. This might be linked to a h igher risk of BTB transmission in larger herds, which could be caused by excessive stocking density combined with inadequate ventilation[13, 22]. At a 4 mm cut-off value, the current study found a substantial connection between breed type and tuberculin skin test positive, similar to other recent Ethiopian investigations[23-24]. The breed of cattle was one of the predictors of bTB positive in this study. It's worth noting that as multiple studies have shown, differences in bTB prevalence between breeds might be altered by various husbandry settings. However, genetic differences between cow breeds are likely to have an impact on susceptibility to M. bovis infection. Susceptibility to M. bovis infection is influenced by genetic differences across cattle breeds. The genomic regions INRA111 and BMS2753 were strongly related with bTB infection status in a variety of British cattle breeds[25]. In Holstein cattle, two additional loci, a variation in the TLR1 gene[26] and BTA 22, have also been related to vulnerability[27]. Another reason could be zebu cattle's stronger tuberculosis resistance than Holstein and other cross-breeds[11]. Our findings, on the other hand, differed from those of Addis Abeba and Central Ethiopia in that their research herds were largely made up of Holstein and cross-bred dairy cows that were only handled under an intense management regime[15].

CONCLUSION

Bovine TB is still a public health concern in Ethiopia. As a result, the current study in Woliata Soddo town suggests a greater individual prevalence of TB. In this study, females, cross-breeds and those with a medium body condition score were shown to have higher rates of TB infection. This happens in small herds, which is a warning indication of TB. Herd size is a risk factor for bovine TB. As a result, routine awareness creation and control measures should be implemented in the research field.

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