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Sero-Prevalence of Bovine Brucellosis, Associated Risk Factors, and Owners' Knowledge, Attitudes, and Practices in Selected Districts of the Eastern Bale Zone, Oromia Region, Ethiopia

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ABSTRACT

Brucellosis is a bacterial zoonotic disease that has important veterinary and public health consequences as well as economic impact in sub Saharan Africa including Ethiopia. A cross-sectional study was carried out from November 2023 to June 2024 in selected districts of the Eastern Bale Zone, Oromia, Ethiopia. The objective of the study was to ascertain the current serological prevalence and the risk factors associated with it. Simple random sample techniques was used, and a standardized questionnaire was created and distributed by the local study participants who gave their agreement. The Rose Bengal Test (RBT) was used to screen 384 cattle serum samples for brucellosis; the Complement Fixation Test (CFT) verified the positive results. Data analysis and the logistic regression model were conducted using SPSS, version 22. We have detailed how explanatory variables and Brucella seroprevalence are significantly correlated. The overall animal-level prevalence rate was 1.6% (6/384), and 1.0% (4/384) had seropositive results for Brucella in RBPT and CFT, respectively. The result of the seroprevalence study showed that statistically significant variation was observed in animals with abortion histories since animals with a history of abortion had a nearly 12-fold higher chance of testing positive for Brucella than animals without a history of abortion (P = 0.019; OR = 11.81; CI = 1.513-92.157). However, the seroprevalence of Brucella with respect to host-specific risk factors (sex, age, body condition, and parity) in multivariable regression analysis did not show a statistically significant association with the seroprevalence of Brucella (p > 0.05).In conclusion, the current study demonstrated that brucellosis was common in the cattle in the study area, resulting in production losses, economic loss, and public health importance. Therefore, in order to develop suitable and successful control and prevention strategies, sero surveilance and monitoring systems need to control the diseases.

Keywords: Brucellosis, Bovine, Eastern Bale, Risk factor, Seroprevalence

1. INTRODUCTION

Bovine brucellosis is an infectious disease caused by a group of bacteria in the genus *Brucella* (Mufinda *et al*., 2017; and Migisha *et al*., 2018). The disease has significant consequences for animal health, public health, and international trade (OIE, 2018). Brucellosis is one of the major zoonotic and a wide spread livestock disease in the world Gwidaet et al,.2010. The disease has a major socio-economic impact in the livelihoods of communities who depend on animal production. The losses due to the disease are associated with abortion, neonatal death, reduced fertility, decreased milk production, costs of preventive measures, and trade restrictions imposed on animals and animal products (Dosa, et al,.2023; Ulvevadet and Hausner, 2011). The World Health Organization (WHO) ranks brucellosis among the seven most neglected zoonosis (Bundle and McGiven, 2017).

Bovine brucellosis is an infectious and contagious disease that mostly affects sexually mature animals. It is typically brought on by *B. abortus*, and at least nine biotypes (1–9) are recognized, as well as

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several variants (Radostits *et al*., 2007). However, sheep, goats, and other domestic animals can also be infected. Cattle are also infected with *B. suis* and *B. melitensis* when they graze together with infected pigs, goats, or sheep-(Godfroid et al. 2011). The principal symptoms of *Brucella* infection are abortion in the last stage of pregnancy in female cattle and orchitis and bursitis in male cattle. *Brucella* infection results in abortion, stillbirths, retention of the placenta, weak calves and infertility. Cattle with a chronic Brucella infection often exhibit hygromas on their leg joints as a symptom of the disease (Radostits et al., 2007).

Typically, brucellosis is spread to other cattle by direct or indirect contact with sick animals or their excrement (OIE, 2009; Lemos et al., 2018). Cattle can contract brucellosis by consuming contaminated feed and drinking water that contains the bacteria that is found in large quantities in uterine discharge and birth products (Acha and Szyfres, 2001). However, artificial insemination has been shown to spread the infection from infected cattle to healthy cattle (Robinson 2003). Humans typically acquire *Brucella* infection via the ingestion of unpasteurized milk or milk products. Interaction of the mucosa/abrasions with the fluid or tissues of aborted fetuses of diseased cattle can also be a source of disease in humans (Fugier et al., 2007). Work-related contact with cattle or their products is the major risk for human brucellosis. Abattoir, farm, and laboratory workers, as well as veterinarians, are known risk groups for *Brucella* infection (Memish and Mah 2001)

The isolation and identification of the *Brucella* organism offer a definitive diagnosis of brucellosis. This is important for epidemiology and to monitor the progress of vaccination programs in cattle. The identification and isolation of Brucella from mammary secretions, post-mortem tissues, aborted materials, or patient blood is required for the diagnosis of the disease. Serological techniques used to detect specific antibodies: by evaluating particular cell-mediated or serological reactions to Brucella antigens, a preliminary diagnosis can be established (PAHO-WHO, 2001). Although the nature of brucellosis makes it very difficult to treat, the longer treatment with antibiotics results, the longer the chance of recovery (Falagas and Bliziotis, 2006; Revue, 2013).

Brucellosis is a global disease that primarily affects developing nations like Ethiopia (FAO, 2010). In developing nations, this disease has a significant economic impact on livestock productivity. In addition to having a substantial impact on cattle and public health, brucellosis also has wide-ranging socioeconomic effects, especially in nations where the production of dairy products and livestock is the main economic activity. Therefore, the purpose of this study was to evaluate the associated risk factors related to bovine brucellosis and to ascertain the present seroprevalence status of brucellosis in the study area.

2. MATERIALS AND METHODS

2.1 Description of Study Area

The study was conducted in three districts of the East Bale zone in Ethiopia, specifically Ginnir, Rayitu, and Dawe Kachen. The zonal town is located 555 kilometers southeast of Addis Ababa, the capital of Ethiopia, situated between latitudes 7.45°N, and 39.47°E longitudes. The range rains 1500 ml to 3500 ml annually. This region experiences two separate rainy seasons: the larger one, which spans from September to November, and the primary one, which extends from March to May. The annual average temperature ranges from 27 to 33 °C. The animal population in the zone is estimated to be 276,318 cattle, 5246 sheep, 55742 goats, 12582 donkeys, 2452 horses, 9465 mules, 34957 camels, and 36946 poultry (CSA, 2019).

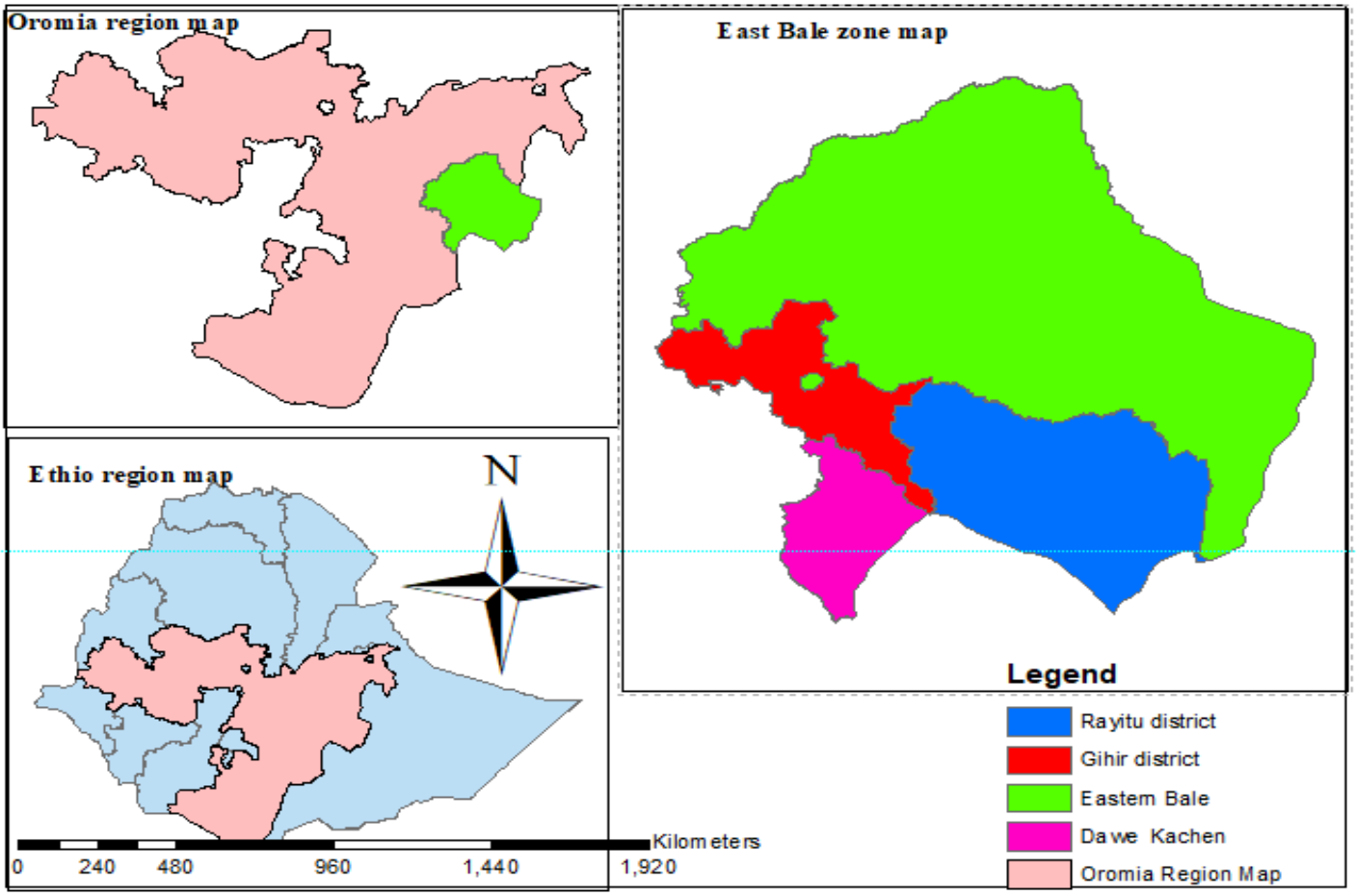

Figure 1: Map of the study area

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2.2 Study Population

The study population was all cattle kept under a traditional extensive farming system in selected districts of the Eastern Bale Zone. Cattle with no history of vaccination and above 6 months of age were used as sources of sera samples for this study. The age of animals was categorized as young (<3 years) and adult (>3 years). Moreover, the parity of the study population was categorized as low, medium, and large size. The study population was also owners of bovines in selected districts of the eastern Bale Zone, and the study was conducted at the household level.

2.3 Study Design

A cross-sectional study was conducted from November 2023 to June 2024 to determine the sero prevalence of bovine brucellosis and its associated risk factors in the study area. A structured questionnaire was prepared and administered to the respondents to collect relevant information.

2.4 Sampling Methods and Sample Size

Both purposive and simple random samplings were used. The purposeful sampling technique was applied for selecting the study of districts and villages, Depending on the availability of infrastructure, the number of cattle's population, and the agro ecology of the area, a total of 3 districts (Ginir, Rayitu, and Dawe Kachen) were selected for this study. A simple random sampling technique was used to select study animals for blood sample collection. The required sample size for the study was determined based on the formula given by Thrusfield (2018).

$$n = \frac{1.96^2 P_{exp}(1-P_{exp})}{d^2}$$

Where,

n = Required Sample Size
Pexp = Expected Prevalence
d = Desired Level of Precision at 95% confidence interval

There was no documentation on the prevalence study of Brucellosis yet in the selected districts of Bale Zone; therefore, 50% expected prevalence, 5% absolute precision, and a 95% confidence interval were used, and 384 animals were sampled randomly for blood collection. Households in three districts of the eastern Bale zone were simply randomly selected for KAP purposes, and interviews were conducted using the Arsham (2002) questionnaire survey.

$$N = 0.25/SE^2 = 0.25/(0.05)^2$$

$$=100$$

Where

N = Sample size
SE = Standard error

Hence, assuming a 5% standard error at a precision level of 0.05 and a 95% confidence interval, a total of 100 respondents were taken into account for questionnaire survey

2.5 Study Techniques

2.5.1 Serum samples Collection

Each animal must be securely tied and have its jugular vein cleansed before a sample is taken. Then, using simple vacutainer tubes, blood samples were extracted from each animal's jugular vein in order to do a serological analysis on brucellosis. Five to seven milliliters of blood were extracted from each animal in a sterile vacuum sealer that was not heparinized. After being kept at room temperature in a slant position for six hours, obtained blood samples were centrifuged for five minutes at 2500 rpm to produce clear serum. Each sample is labeled. The sera samples were packed into an icebox with pre-cut blocks of ice in order to be transferred to the Animal Health Institute (AHI), Sebeta. All samples were kept at -20°C until processing.

2.5.2 Rose Bengal plate test (RBPT)

The manufacturer's instructions and OIE's 2004 criteria were followed when using ID.vet, RSA-RB-016, 0112 GB, 310, rue Louis Pasteur, Grables, France. Blood serum was subjected to RBPT screening using Brucella antigen strain 99. Before the test, the sera and reagent samples were taken out of the refrigerator and given 30 minutes to come to room temperature. On a Rose Bengal plate, the mixture was combined with the antigen solution and then shaken for four minutes. Agglutination was considered a positive outcome, while no agglutination was considered a negative outcome. The results were recorded as 0, +, ++, and +++.

2.5.3 Complement fixation test (CFT)

A confirmatory complement fixation test (CFT) was performed at the Animal Health Institute (AHI) in Sebeta, Ethiopia, on all samples that tested positive for RBPT. We acquired the standard Brucella antigen for CFT from the Veterinary Laboratories Agency in Addlestone, UK. A working dilution of 1:10 was used to standardize the antigen. All sera samples that tested positive were de-complemented for 30 minutes at 56°C before the test. In U-bottom microtiter plates, the test sera were serially diluted (1:2, 1:4, 1:8, and 1:16, up to 1:128). Following the addition of the complement and antigen, the plates were incubated for 30 minutes at 37°C. Lastly, equal amounts of 1/700 hemolytic serum and 3% sensitized sheep red blood cells were added to microplates and incubated for 30 minutes. Full hemolysis was observed in the complement, antigen, and negative control wells to verify the validity of the controls before the findings were read. Sheep red blood cell sedimentation occurred in the bottom of the U microplates in the positive wells and hemolytic system controls. Finally, the results were interpreted. Complete lysis of sheep RBC at 1:2 dilution indicates negative results, and 100% sedimentation of sheep RBC at 1:2 dilution and complete fixation of complement show positive results.

2.5.4 Questionnaire survey

A structured questionnaire was created to gather information on potential risk factors related to bovine brucellosis prevalence in a study area. The questionnaire focused on dairy cattle origin, knowledge of brucellosis transmission, management techniques, disposal of dead aborted calf, handling retained placentas, and raw milk consumption.

2.6 Data Management and Analysis

The study utilized Microsoft Excel 2007 for data entry and SPSS version 22 for descriptive statistics. Logistic regression analysis was used to evaluate correlations between independent and dependent variables, with significance level of $P<0.05$.

3. RESULTS

Six samples were found to be seropositive against *Brucella*, with an overall sero prevalence of 6 (1.6%). Out of 6 positive sera samples by RBPT, a proportion of 2 (1.4%), 4 (3.4%), and 0 (0.0%) were recorded in Ginir, Rayitu, and Dawe Kachen districts, respectively. However, further confirmatory tests done by using the CFT test indicated an overall prevalence of (1.0%), in which 2 (1.4%) in Ginir and 2 (1.7%) in Rayitu districts were recorded. The result indicated that there was no statistically significant difference among districts observed (Table 1).

Table 1: Sero Prevalence of bovine brucellosis by RBPT and CFT in the study area.

District	Number	Number	Number	Chi-	P

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	Examined	positive (RBPT)	positive (CFT)	Square	value
Ginnir	138	2(1.4%)	2(1.4%)	3.629	0.163
Rayitu	119	4(3.4%)	2(1.7%)		
Dawe Kachen	127	0(0.0%)	0(0.0%)		
Total	**384**	**6(1.6%)**	**4(1.0%)**		

3.1 Prevalence of Brucella on the Basis of the Predisposed Risk Factors

3.1.1 Effect of predisposed risk factors

A study of 384 cattle examined in Ginir, Rayitu, and Dawe Kachen districts of the East Bale zone found varying prevalence of bovine brucellosis, with no significant difference observed between the three districts. The study found that bovine brucellosis prevalence varies among age groups, with the highest prevalence (1.4%) in adult, followed by young (0.6%) Female animals had a higher prevalence (1.9%) than males. Both age and sex categories have no statistically significant variation ($p>0.05$).

The study found that brucellosis prevalence was highest in animals with medium body conditions (3.8%), while good body conditions had a low prevalence (0.6%). Additionally, larger parity animals (2.7%) and those with abortion history had the highest prevalence (6.3%). There was statistically significant variation observed among body condition, abortion history, and the parity of animals ($p<0.05$). (Table 2).

Table 2: Sero prevalence of bovine brucellosis among different risk factors

Variables	Categories	No. Examined	No. Positive	Prevalence	X^2	P-value
Districts	Ginnir	138	2	1.4%	2.031	0.362
	Rayitu	119	2	1.7%		
	Dawe kachen	127	0	0.0%		
Age	Adult	214	3	1.4%	0.608	0.435
	Young	170	1	0.6%		
Sex	Female	206	4	1.9%	3.493	0.062
	Male	178	0	0.0%		
BCS	Good	331	2	0.6%	4.452	0.035
	Medium	53	2	3.8%		
Parity	Small	271	1	0.4	4.042	0.044
	Larger	113	3	2.7		
Abortion history	No	360	2	0.6	13.204	0.00
	Yes	24	2	6.3		

3.1.2 Multivariable logistic regression analysis

Following univariable logistic regression analysis, all variables (abortion history and parity) with significance or P-values less than 0.05 were subjected to multivariable logistic regression analysis and model fitting. Thus, among the risk factors taken into account in the analysis, the abortion history of the cattle was associated with Brucella seropositivity in the study area, as shown by the fitting of a multivariable regression model. According to the findings, animals with a history of abortion had a nearly 12-fold higher chance of testing positive for Brucella than animals without a history of abortion (P = 0.019; OR = 11.81; CI = 1.513-92.157) (Table 3).

Table 3: Multivariable logistic regression analysis results

Variables	Categories	No. Examined	No. Positive (%)	OR (95%CI)	P-value
	No	360	2(0.6%)		-
Abortion history	Yes	24	2(8.3%)	11.81 (1.513-2.157)	0.019

3.2 Questionnaire Survey Results

3.2.1 Socio-demographic characteristics of the study participants

The study involved 100 owners, 70% males, 30.0% females, 45.0% aged 45-64, 30.0% educated, and 60.0% engaged in farming activities. (Table 4).

Table 4: Socio-demographic characteristics of the respondents

Socio-	Categories	Frequency	Percent

Demographic			(%)
Sex	Male	70	70.0
	Female	30	30.0
Age	18-44	35	35.0
	45-64	45	45.0
	Above 65	20	20.0

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Marital Status	Married	65	65.0
	Unmarried	35	35.0
Educational Status	Not read and write	25	25.0
	Read and Write	30	30.0
	Grade (5-8)	20	20.0
	Grade (9-12)	20	20.0
	Certificate and above	5	5.0
Occupation	Government	20.0	20.0
	Private	10.0	10.0
	Farmers	60.0	60.0
	Student	10.0	10.0
Total		**100**	**100.0**

3.2.2 Livestock and husbandry practices

The study found that 50.0% of 100 respondents owned local cattle and Cross breeds, while 25% owned cattle and sheep, 20% cattle and goats (Table 4). The majority of respondents holds local breeds of cattle's and free grazing was more practiced in the study area. The main purposes of keeping livestock were milk, meat and draft production (Table 5).

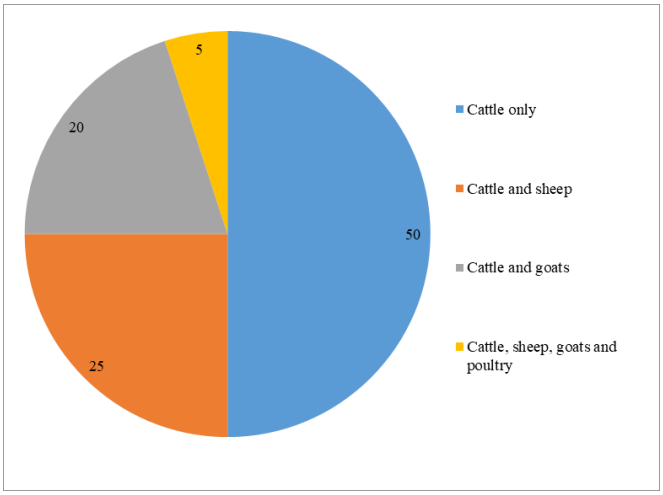

Figure 2: Owned animals species of households in the study area

Table 5: Species of animals owned and purpose of rearing cattle by the respondents

Variables	Categories	Frequency	Percent (%)
Breed of cattle	Local	80	80.0
	Cross	5	5.0
	Both	15	15.0
Purpose of cattle holding	Milk	25	25.0
	Meat	10	10.0
	Milk, meat and draft	65	65.0
	Less than 10	65	65.0
No.of cattle owned	10-20	25	25.0
	Greater than 20	10	10.0
Cattle management	Free grazing	95	95.0
	Semi-intensive	5	5.0
Total		**100**	**100.0**

3.2.3 Knowledge of participants about brucellosis

From the total number of study participants, only 25.0% had heard about Brucellosis. However, about 40.0 % had a misconception of etiology of the disease and attributed it to bad weather and 15% of the respondents did not know the causative agent. About 30.0% of the participants mentioned that Brucellosis could have been transmitted from animals to humans (Table 6).

Table 6: Knowledge about Brucellosis and source of information for study participants

Indicative Questions	Responses	Frequency	Percent (%)
Heard of bovine brucellosis	Yes	25	25.0
	No	75	75.0
Source of knowing Information of Brucellosis	Mass Media	10	10.0
	Health Extension	15	15
	No information	75	75
Causative agent of Brucellosis	Yes	5	5.0
	No	95	
modes of Transmission in Cattles	Abortion secretion	25	25.0
	Share grazing	10	10.0
	Don't know	65	65.0
symptoms of Brucellosis in cattle	Abortions	10	10.0
	Weak calves	10	10.0
	Bull infertility	5	5.0
	Don't know	75	75.0
Total		**100**	**100.0**

3.2.4 The attitude and practices of communities towards the disease

The study reveals that brucellosis can be transmitted from animals to humans, making cattle dangerous. Most respondents take action by contacting veterinarians when cows should abort. 75% of participants did not consider raw milk and contaminated meat as sources of brucellosis. (Table 7).

Table 7: Attitude and Practices of respondents towards brucellosis in the study area

Indicative question	Characteristics	Frequency	Percent
A. Practices of respondents on brucellosis			
Action taken if a cow abort	Visiting vet. Doctor or clinic	15	15.0

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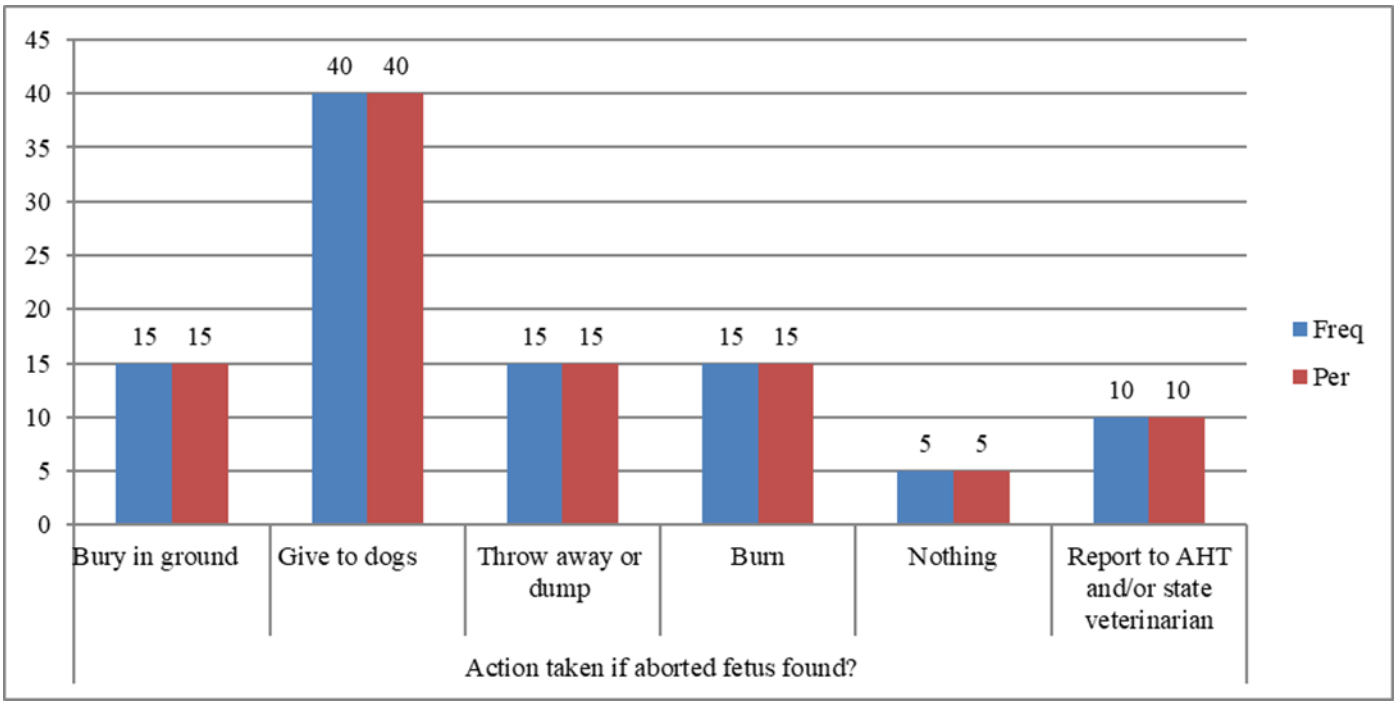
	Self-medicate	15	15.0
	The traditional healer	5	5.0
	Nothing	65	65.0
B. Attitude of the respondents on brucellosis			
Raw milk and meat as a source of bovine brucellosis	Yes	25	25.0
	No	75	75.0
Sharing the drinking raw animal product	Yes	75	75.0
	No	25	25.0

The table shows farmers' husbandry practices in consuming raw animal products, with 10.0% consuming boiled or pasteurized milk and 70.0% consuming raw milk, while 20.0% both. Over half consume raw meat, with 45.0% getting milk from their own cows and 25.0% from commercial stores. (Table 8).

Table 8: Animal product consumption practices of respondents

Indicative	Characteristics	Frequency	Percent
Question			**(%)**
Habit of milk drinking	Boiled/pasteurized	10	10.0
	Raw milk	70	70.0
	Both	20	20.0
Meat consumption	Raw meat	65	65.0
	Cooked meat	15	15.0
	Both	20	20.0
Milk sources	Own cow's	80	80.0
	From informal store	20	20.0
Care taker for cattle	Owner	70	70.0
	Shepherd and/or laborer	20	20.0
	Other family member	10	10.0

The questionnaire survey revealed that 40.0% of households donate aborted fetuses to dogs, while 15.0% engage in actions like burying, throwing, or dumping and burning in the study area. (Figure below).



4. DISCUSSION

The current serological study revealed that the overall prevalence of bovine brucellosis in the study area was 1.0%. This finding was in agreement with findings of Hailu *et al.* (2011) in Jig-Jiga zone of the Somali Regional State, Gebreyohans (2004) in Addis Ababa, and Dinknesh *et al.* (2019) in Becho District, who reported 1.38%, 1.5%, and 1.04%, respectively. High seroprevalence was recorded as compared to previous study Garoma, 2018 with 0.73% in Jimma zone, Western Ethiopia; Sarba *et al*., 2016 with 0.49% in Western Shewa; Asmare *et al.*, 2007 with 0.4% in urban dairy farms of Northern Ethiopia and Sebeta;(Bashitu *et al*., 2015) with 0.2% in Debrebirhan and Ambo Towns; (Degefa *et al*., 2011) with 0.05% in Arsi zone.

In contrast to our study higher sero-prevalence rate of bovine brucellosis was reported by (Dinka and Chala, 2009) with 11.2% in pastoral and agro-pastoral areas of East Shewa Zone, (Kebede *et al.*, 2008) with 11.0% in Wuchale-Jida district, central Ethiopia, (Megersa *et al*., 2011 with 10.6% in Borana, (Eticha *et al*., 2018) with 9.87% in Asella organized dairy farm, South East Ethiopia, (Megersa *et al*., 2012) with 8.0% in pastoral region of the country, (Hailesilassie *et al*., 2011) with 4.9% in Western Tigray, (Tibesso *et al*., 2014) with 4.3% in Adami Tulu, central Ethiopia, (Berhe *et al*., 2007) with 3.19% in the Tigray region, (Ibrahim *et al*., 2010) with 3.1% in Jimma Zone of Oromia region. Similarly higher sero-prevalence were reported in African countries: Mensah et al. (2011) reported 21.9% in Ghana; Matope et al. (2011) reported 5.6% in Zimbabwe; Swai and Schoolman (2010) reported 5.3% in Tanzania; and Angara et al. (2004) reported 24.5% in Sudan; Mai et al. (2012) reported 24.0% in Nigeria. These variations in seroprevalence may be due to factors like agro-geographical factors, sample size, serological test method, management, and availability of maternity pens (Radostits, 2000).

In this study, there was no statistically significant difference in

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seroprevalence between males and females. This findings was in line with Tadele (2004) (0.00% and 0.97%), Bashitu et al. (2015) (0.00% and 0.2%), Dinknesh et al. (2019) (0.00% and 3.13%), Gebawo et al. (2014) (0.00% and 3.1%), and Bashahun et al. (2015) (0.00% and 1.8%), The absence of positive male animals in the current study may be because males are kept in smaller flocks than females and are therefore less common, or it may be because of the explanation provided by Kebede et al. (2008), who claimed that low erythritol levels in male animals make them less susceptible to Brucella infection This result variation may be due to the small sample size of male animals.

The study found no significant association between age categories and bovine brucellosis seroprevalence, contradicting previous research findings of Tadele (2004), Bulcha *et al*. (2020), and Nuraddis *et al*. (2010), who reported significant variation between age groups in cattle. The comparative high occurrence of bovine brucellosis in adult animals could be due to sexual maturity, which is a very important condition for the rapid multiplication of *Brucella* organisms (Mohammed, 2009; Tolosa *et al*., 2008). Cattle that are sexually mature and pregnant are more vulnerable to contracting Brucella infection than cows who are not sexually mature. Furthermore, it has been observed by Radostits et al. (2000) that younger animals are often more resilient to infection and that latent infections may be cleared out. As noted by Garoma (2018) and Berhe et al. (2007), animals that are sexually matured are more likely to contract Brucella infection. This increased susceptibility during sexual maturity and the gestation period may be attributed to the influence of sex hormones as well as the elevation of fetal fluid and erythritol sugar in the placenta. According to Asgedom et al. (2016), Hileselassie et al. (2008), and Radostitis et al. (2007), this promotes the bacteria's growth and multiplication in the reproductive organs.

Cows with a history of abortion were shown to be significantly more infected than cows without a history of abortion. Similar to this study, cows with a history of abortion had considerably higher rates of bovine brucellosis Hika *et al*. (2018) (14.63% and 2.82%), Dinknesh et al. (2019) (17.4% and 0.00%), and Bulcha et al. (2020) (19.05% and 0.00%). Brucellosis may be a factor in abortion and stillbirth, as evidenced by the association between the sero-prevalence of the disease in cows and the history of abortion. Furthermore, the abortion rate in infected animals is determined by a variety of factors, including the duration of infection, management practices, the sensitivity of pregnant females, and other environmental factors (Bishop *et al.*, 2004).

The observed difference in sero-prevalence on parity was statistically significant. This strong correlation between parity and seropositivity for brucellosis suggests that bigger parity groups (2.7%) had higher sero-prevalence than small parity-sized cattle (0.4%). In contrast to this findings Geresu et al. (2016) and Berhe et al. (2007), reported there was no discernible difference between multiple and single parturition.

The questioner results showed that 75% of the participants had not heard of the disease brucellosis, and 25% of the respondents knew that humans can be infected by animals. This high discrepancy of the disease in the community could be due to their level of knowledge, and the prevalence of the disease is less pronounced in the community. In contrast to our findings reported in Uganda by Kansime *et al. (*2014) among pastoral communities living along Lake Mburo; in Egypt among cattle and buffalo farmers in a village in the Nile Delta region (Holt *et al*., 2011); and among small ruminant farmers in the peri-urban areas of Dushanbe Tajikistan (Lindahl *et al.*, 2015), in which 99.3%, 83.2%, and 57% of the respondents' had heard of Brucellosis and its zoonotic importance. Less information sources from animal health professionals, however, highlights the limited roles veterinarians play in providing the area's herders—who typically lack equitable access to basic healthcare and education with critical animal health messages.

Regarding the clinical manifestations of brucellosis in animals, 10.0% of participants recognized abortion, 5.0% bull infertility, and 75% did not. This result is consistent with that of the current study Lindahl et al. (2015) found that just 11% of respondents from Tajikistan recognized abortion as a clinical sign of animal Brucellosis. As opposed to studies conducted in the Egyptian state of Holt et al. (2011) and the Nigerian state of Kaduna (Buhari et al., 2015), where 94.4% and 59.5% of respondents, respectively, named abortion as the most significant clinical symptom Most of the owners ate raw meat and unpasteurized dairy products, which are recognized risk factors for infections in humans (Lindahl et al., 2015). According to Lindahl et al. (2015), who documented such practices because of owners' ignorance of the zoonotic role of brucellosis, they did not wear protective gloves when helping with delivery, handling cows having an abortion or with aborted materials, nor did they properly wash their hands.

5. CONCLUSION AND RECOMMENDATIONS

In smallholders in the eastern Bale zone, the study indicated a low prevalence of bovine brucellosis and a high correlation between parity seropositivity and abortion. Increased animal-to-animal and zoonotic disease transmission was caused by a lack of knowledge and unsafe behaviors among communities. The attitudes and knowledge of livestock keepers were lacking. As a result, the following recommendations were made based on the conclusion above:

- Community awareness creation about the impact of the diseases, modes of transmission, risk factors, and methods of prevention of the diseases should be important.
- Collaboration as in one health approach to control such an important disease in the country.
- A coordinated surveillance and monitoring system for bovine brucellosis should be carried out to design appropriate and effective control and prevention strategies.
- Further detail and fully fledged research is very important to have full and all-round information regarding the epidemiology of the brucellosis.

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