

Assessment of Livestock Owners' Knowledge, Attitudes and Practices (KAP) Toward Bovine Brucellosis in Selected Districts of Jimma Zone, Oromia, Ethiopia

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Abstract: Brucellosis is one of the most common neglected contagious zoonotic diseases caused by bacteria of genus *Brucella*. Even though numerous findings of seroprevalence of bovine brucellosis are reported in Ethiopia, there is no separate and detailed study of livestock owners' knowledge, attitudes and practices toward the disease. Therefore, this research was designed to assess livestock owners' knowledge, attitudes and practices toward bovine brucellosis in selected districts of Jimma zone. Cross sectional study design and multistage sampling techniques were employed to select 110 households. From this finding, only 7.3% of respondents knew about the disease. Among these, 50% and 75% understood that the disease can be transmitted between cattle and from cattle to humans. On the other hand, 87.3% and 77.3% handlers of placental membranes and aborted fetus were with bare hands and those having good knowledge, positive attitude and good practice score were of 6.4%, 40% and 12.7% respectively. This indicates that awareness creation campaign is important so as to equip the farmers with the knowledge of the disease and to change their malpractice in order to protect themselves from exposure to the disease and take appropriate control activities and establishment of preventive approaches of the disease.

Key words: Attitudes • Bovine Brucellosis • Jimma Zone • Knowledge • Practices

INTRODUCTION

Bovine brucellosis is a zoonotic disease of main economic and public health significance in most countries of the world [1-3] and the second most important zoonotic disease of the world after rabies [4]. The disease remains challenging widespread in cattle population and causing enormous economic and public health problems in developing countries [5-7]. It is documented as the world's most common laboratory-acquired infection [8]. This is credited to the low infectious dose (10-100 bacterial cells by aerosol or subcutaneous route) [9-11]. Although brucellosis is the most widespread zoonosis worldwide, it remains severely neglected as a potential cause for chronic, debilitating conditions, due to its non-descript clinical presentation in human populations [11].

Most human infections are picked up through direct contact with diseased animals, placentas, fetal membranes, vaginal discharges or aborted fetuses, as well as, inhalation and indirect transmission through raw milk and milk products, undercooked meat or blood had occurred [12-15].

Crop livestock mixed farming is a common practice in Ethiopia and particularly in the study areas. This practice creates a good opportunity for rural peoples to advance their lives but might also pose a hazard to animal and public health if zoonotic pathogens like brucella species are present [16, 17]. Lack of sanitation, occurrence of the infection in animals and practices that expose humans to infected animals or their products can considerably [18] escalate the risk of the occurrence of the disease in humans [18-20]. Hence, satisfactory knowledge of bovine brucellosis is of great public health significance [19],

predominantly amongst high-risk groups, thus impressively supporting the advancement of brucellosis control strategies [21, 22].

Brucellosis is an occupational disease to farmers, herders, veterinarians, slaughterhouse workers, butchers and laboratory personnel who commonly get into contact with the animals or animal by-products in the course of their work [15, 23-25]. Therefore, Knowledge, attitudes and practice studies are useful for recognizing such knowledge gaps across study districts and different demographic profiles of livestock owners since there is no separate and detailed study of livestock owners' KAP toward the disease in the current study areas. Hence, this research was conducted with the goal of assessment of cattle owners' knowledge, attitudes and practices concerning bovine brucellosis in designated districts of Jimma zone, south western Oromia, Ethiopia.

MATERIALS AND METHODS

Explanation of the Study Area and Period: The study was commenced at nominated districts of the Jimma zone which is located at the South western direction of the country with the distance of 346km from Finfinne (Addis Ababa) the capital of Oromia regional state, Ethiopian government and center of headquarter of African Union. Jimma zone has elevation ranging from

880 up to 3360 meters above sea level with 7°40' - 8°2'N latitude and 35°85' - 37° 62' E longitude. Jimma zone has 21 districts and one town administration. Out of them, this study was conducted at Kersa, Mana and Seka Chokorsa districts (Figure 1). The study was conducted between the periods of March to August 2021 on selected livestock owners in the study districts.

Study Design and Sampling Techniques: The study was commenced to evaluate the knowledge, attitudes and practices of livestock owners toward bovine brucellosis in the study area using a cross-sectional study design and multistage sampling techniques. The three districts were selected purposively and simple random sampling strategy was employed for the sampling of the study villages and households.

Sample Size Determination: The sample size was calculated by the formula recommended by Arsham [26]. Accordingly, $(N=0.25/(SE)^2)$, where N= sample size and SE represents a standard error, the total number of households or livestock owners to be included in the study were 100 by assuming the standard error of 5% at a precision level of 5% and the confidence interval of 95%. However, to increase the accuracy of the result, Whitley and Ball [27] formula (which is $N''=N/1-q$, where N'' is the final sample size to be collected, N= the first

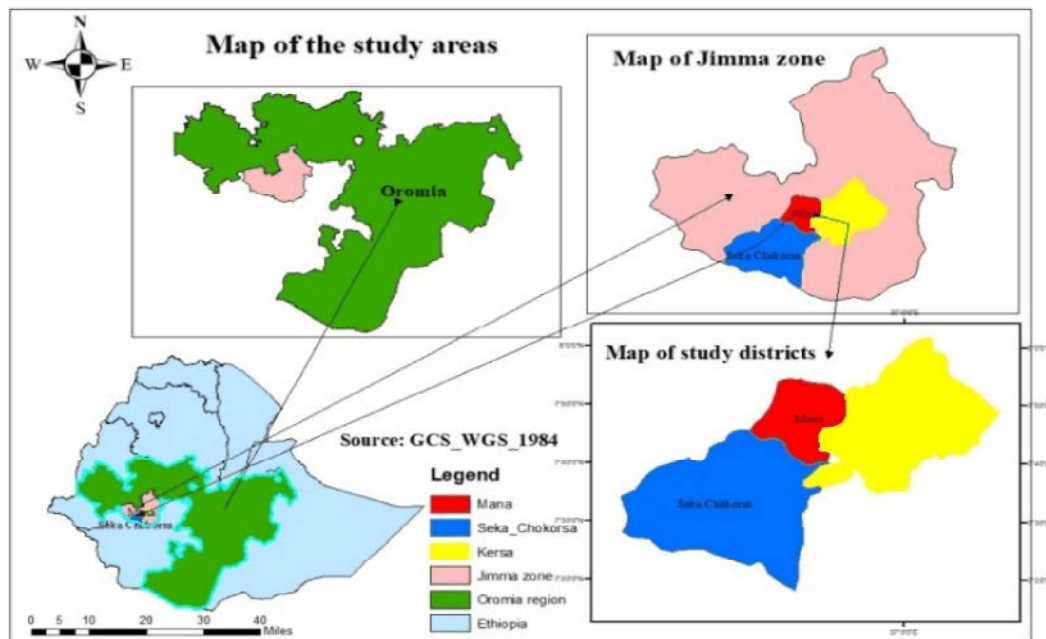


Fig. 1: Map of the study areas.

sample size calculated by Arsham [26] and q (proportion of attrition) was used. Therefore, a total of 118 livestock owners were taken part in the questionnaire survey by using a 15% of participants that were estimated to refuse to participate or to drop out before the study ends. However, complete data were collected only from 110 households (41, 27 and 42 from Kersa, Mana and Seka Chokorsa districts respectively because of withdrawal of response before the end of the study. Eight respondents were excluded from data analysis due to incomplete information.

Data Collection: For this study, the questionnaire survey was organized in English and converted into the local language (Afaan Oromoo). Hence, 36 semi-structured pre-tested questionnaire surveys were presented to the respondents for assessment of their knowledge, attitudes and practices to identify the existence of the information, attitudes and implementation gap between the livestock owners. Demographic features like gender (male and female); level of education (illiterate, basic education, primary school, secondary level, diploma, degree and above), place of residence (villages and districts); previous knowledge of the disease (yes, no); management of the aborted fetus and retained fetal placenta; consumption of raw milk and meat and in general perception and their daily activities toward bovine brucellosis of respondents were recorded. Basic education is a form of informal education provided for those who did not get a chance of attending formal education regularly in order to enable them to write and read. Then knowledge, attitudes and practices of the livestock owners toward the disease were evaluated to assess their adherence to control measures that are largely affected by their knowledge, attitudes and practices.

Data Analysis: All collected data were entered into MS excel spread sheet version 2010. Then after, the data were checked for errors and corrected. Statistical package for social sciences was used for statistical analysis of the data. Knowledge, attitudes and practices of this study participant were analyzed by descriptive statistics by showing their proportion. Livestock owners' knowledge, attitude and practice score was computed according to Kothalawal *et al.* [28]. Accordingly,

$$\text{Knowledge score}_k = \frac{CA_k}{QE_k}$$

where QE_k is the number of questions against farmer and CA_k is the number of individual correct answers. Then, after calculating the mean for all respondents, it was multiplied by 100 and if the mean of the individual farmer was found below 50%, it was concluded that the knowledge score of the farmer was poor, but if found above or equal to 50%, it was taken as a good knowledge score. The attitude and practice scores were calculated in the same manner. Associations of KAP score across the animal owners' demographic characteristics and knowledge about the disease with the daily practices of the respondents were analyzed by Fisher's exact test and an association was considered statistically significant if the p -value ≤ 0.05 .

RESULTS

The socio-demographic status of the participants showed that 91 (82.7%) were males and 19 (17.3%) were females from which 64 (58.2%) were found between the age of 41 and 60 years while 45 (39.5%) attended basic education (Table 1).

The descriptive analysis of livestock owners' knowledge regarding the disease had shown that only 8 (7.3%) respondents from the total of 110 participants knew about a disease called bovine brucellosis. Almost all respondents who knew about the disease were heard from veterinary services and all of them understood that the disease can affect animals. On the other hand, 6 (75%) of the participants knew that the disease can transmit from animals to humans, out of which 4 (66.7%) responded that the disease can transmit from animals to humans through handling abortion, 2 (33.3%) through drinking raw milk. Beside these, 6 (75%) of respondents believed that the disease is preventable mainly through avoiding drinking raw milk 4 (66.7%) and careless handling of the fetus (Table 2).

Analysis of the attitudes of the livestock owners indicated, 11 (10.0%) believed that personnel's working mostly with the cows exposed to the brucella infection are at high risk of infection. Out of the total participants of this study, all of them need to know more about the disease mostly from public health professionals (38 (34.5%)) and veterinarians (45 (40.9%)). Likewise, 38 (34.5%) of respondents ensured the health status of the animals by relying on their own experience when receiving new cattle into their herd. Majority of the participants, 65 (59.1%), 80 (72.7%) and 73 (66.4%) believed that selling of cows that frequently abort as a correct practice,

Table 1: Socio-demographic features of the study participants (N=110)

Variables	Category	Kersa (%)	Mana (%)	Seka Chokorsa (%)	Total (%)
Gender	Male	34	21	36	91 (82.7)
	Female	7	6	6	19 (17.3)
Age category	18-25	5	3	6	14 (12.7)
	26-40	5	4	6	15 (13.6)
	41-60	23	17	24	64 (58.2)
	>60	7	3	7	17 (15.5)
Educational status	Illiterate	11	8	12	31 (28.2)
	Basic education	17	7	20	45 (39.5%)
	Primary	10	10	7	27 (24.5)
	High school	4	2	3	9 (8.2)
Marital status	single	6	3	5	14 (12.7)
	Married	31	23	33	87 (79.1)
	Divorced	1	0	3	4 (3.6)
	Widowed	3	1	1	5 (4.5)

Table 2: Descriptive results of farmers' knowledge toward bovine brucellosis among the study districts

Knowledge questions	Category	Kersa	Mana	Seka Chokorsa	Total (%)
		N (%)	N (%)	N (%)	
Do you know a disease called bovine brucellosis? (Q1)	Yes	2 (1.8)	3 (2.7)	3 (2.7)	8 (7.3)
	No	39 (35.5)	24 (21.8)	39 (35.5)	102 (92.7)
If Q1 is yes, from where did you hear about it? (Q2)	Vet. Services	2 (25.0)	3 (37.5)	3 (37.5)	8 (100)
If Q1 is yes, do animals infected with brucellosis? (Q3)	Yes	2 (25.0)	3 (37.5)	3 (37.5)	8 (100)
	No	0	0	0	0
If Q3 is yes, which group of animals? (Q4)	Cattle	1 (12.5)	2 (25.0)	1 (12.5)	4 (50.0)
	All animals	1 (12.5)	1 (12.5)	2 (25.0)	4 (50.0)
If Q1 is yes, is brucellosis transmitting between cattle? (Q5)	Yes	1 (12.5)	2	1 (12.5)	4 (50.0)
	No	1 (12.5)	0	1 (12.5)	2 (25.0)
	I don't know	0	1 (12.5)	1 (12.5)	2 (25.0)
If Q5 is yes, how brucellosis transmits between cattle? (Q6)	Abortion	0	2 (50.0)	2 (50.0)	4 (100.0)
If Q1 is yes, what are the symptoms do you know in cattle? (Q7)	Abortion	1(12.5)	2 (25.0)	1 (12.5)	4 (50.0)
	weak calves	0	0	1 (12.5)	1 (12.5)
	RFP	1(12.5)	0	1(12.5)	2 (25.0)
	I don't know	0	1 (12.5)	0	1 (12.5)
If Q1 is yes, do you know that brucellosis transmits from animals to a human? (Q8)	Yes	2 (25.0)	2 (25.0)	2 (25.0)	6 (75.0)
	No	0	1 (12.5)	0	1 (12.5)
	I don't know	0	0	1 (12.5)	1 (12.5)
If Q8 is yes, by what mechanisms the disease transmits from animals to a human? (Q9)	Drinking raw milk	2 (33.3)	0	0 (0)	2 (33.3)
	Handling abortion	0	2 (33.3)	2 (33.3)	4 (66.7)
	I don't know	0	0	0	0
If Q1 is yes, do you think that brucellosis is preventable? (Q10)	Yes	2 (1.8)	2 (1.8)	2 (1.8)	6 (75.0)
	I don't know	0	1 (12.5)	1 (12.5)	2 (25.0)
If Q10 is yes, how? (Q11)	Avoiding drinking raw milk	1 (16.7)	1 (16.7)	2 (33.3)	4 (66.7)
	Avoiding careless handling of aborted fetus and/or RFP	1 (16.7)	1 (16.7)	0	2 (33.3)

N= number of observations, Q= question, RFP= Retained fetal placenta

importance of cleaning calving pen after parturition and keeping of a cow that does not conceive as a correct action respectively (Table 3).

Through their daily activities, the practices of livestock owners toward bovine brucellosis were assessed. The statistical analysis of the risky practices of the livestock owners' shown that 89 (80.9%) drunk raw milk and its products whereas 99 (90.0%) practiced the habit of raw meat consumption. Separation of cows during parturition was not being practiced by 78 (70.9%) of respondents and even 87 (79.1%) mixed their cattle with

other herds like sheep, goats and equines. On the other side, 96 (87.3%) handled placental membranes bare hand. Regarding the personnel assisting the cattle during delivery, more than half of the respondents (53.6%) responded that household members assisted their cattle during delivery. Half of the respondents washed their hands immediately after handling abortion. Ninety-three (84.5%) and 81 (73.6%) of this study participants threw away or dumped aborted fetuses and placental membranes into the environment respectively (Table 4).

Table 3: Descriptive results of farmers' attitudes on bovine brucellosis among the study districts (N=110)

Attitude questions	Category	Kersa	Mana	S/Chokorsa	Total
		N (%)	N (%)	N (%)	
Personnel's working most with the cows exposed to the brucella infection are at high risk of infection	Yes	4 (3.6)	3 (2.7)	4 (3.6)	11 (10.0)
	No	1 (0.9)	2 (1.8)	2 (1.8)	5 (4.5)
	I don't know	36 (32.7)	22 (20.0)	36 (32.7)	94 (85.5)
Requiring more information about the disease	Yes	41 (37.3)	27 (24.5)	42 (38.2)	110 (100)
Source from which they want the information about the disease	PHP	12 (10.9)	7 (6.4)	19 (17.3)	38 (34.5)
	Family	4 (3.6)	0	1 (0.9)	5 (4.5)
	Meeting	6 (5.5)	4 (3.6)	2 (1.8)	12 (10.9)
	Public media	4 (3.6)	5 (4.5)	1 (0.9)	10 (9.1)
	Veterinarians	15 (13.6)	11 (10.0)	19 (17.3)	45 (40.9)
	By veterinarians	6 (5.5)	2 (2.8)	4 (3.6)	12 (10.9)
	buying from known source	13 (11.8)	8 (7.3)	14 (12.7)	35 (31.8)
How health is ensured when receiving new cattle?	rely on experience	10 (9.1)	14 (12.7)	14 (12.7)	38 (34.5)
	I don't care	12 (10.9)	3 (2.7)	10 (9.1)	25 (22.7)
	Very good	10 (9.1)	8 (7.2)	14 (12.7)	32 (29.1)
	Good	18 (16.4)	10 (9.1)	16 (14.5)	44 (40.0)
What do you think about the general hygiene of the house of your herd?	Satisfactory	11 (10.0)	6 (5.5)	12 (10.9)	29 (26.4)
	Poor	2 (1.8)	3 (2.7)	0	5 (4.5)
	Do you believe that selling of cows that frequently abort is correct practice?	Yes	27 (24.5)	15 (13.6)	23 (20.9)
Do you think that cleaning calving pen after parturition is important?	No	14 (12.7)	12 (10.9)	19 (17.3)	45 (40.9)
	Yes	29 (26.4)	18 (16.4)	33 (30.0)	80 (72.7)
Do you believe that keeping of a cow that that does not conceive is correct action?	No	12 (10.9)	9 (8.2)	9 (8.2)	30 (27.3)
	Yes	26 (23.6)	17 (15.5)	30 (27.3)	73 (66.4)
Total respondents	No	15 (13.6)	10 (9.1)	12 (10.9)	37 (33.6)
		41 (37.3%)	27 (24.5%)	42 (38.2%)	110 (100)

N= number of observations, PHP= Health professionals

Table 4: Descriptive analysis of farmers' practices toward bovine brucellosis among the study districts (N=110)

Practice questions	Category	Kersa	Mana	S/Chokorsa	Total
		N (%)	N (%)	N (%)	
Drinking raw milk and its products	Yes	36 (32.7)	19 (17.3)	34 (30.9)	89 (80.9)
Habit of eating raw meat	Yes	36 (32.7)	24 (21.8)	39 (35.5)	99 (90.0)
Separation of cows during parturition	No	31 (28.2)	16 (14.5)	31 (28.2)	78 (70.9)
Mixing animals (cattle) with another herd	Yes	30 (27.3)	21 (19.1)	36 (32.7)	87 (79.1)
How to handle placental membranes	Bare hand	38 (34.5)	19 (17.3)	39 (35.5)	96 (87.3)
	Using gloves	3 (2.7)	3 (2.7)	3 (2.7)	9 (8.2)
	Washing hands after handling	0	5 (4.5)	0	5 (4.5)
How to handle aborted fetus	bare hand	16 (14.5)	12 (10.9)	22 (20.0)	85 (77.3)
	by gloves	3 (2.7)	1 (0.9)	1 (0.9)	5 (4.5)
	Washing hand after handling	22 (20.0)	14 (12.7)	19 (17.3)	20 (18.2)
Personnel assisting cattle during delivery	Veterinarians	17 (15.5)	4 (3.6)	18 (16.4)	39 (35.5)
	Shepherds	3 (2.7)	8 (7.3)	1 (0.9)	12 (10.9)
	HH member	21 (19.1)	15 (13.6)	23 (20.9)	59 (53.6)
Keeping dogs with cattle	Yes	20 (18.2)	15 (13.6)	17 (15.5)	52 (47.3)
What to do if aborted fetus found	Burial	8 (7.3)	3 (2.7)	6 (5.5)	17 (15.5)
	Throw away	33 (30.0)	24 (21.8)	36 (32.7)	93 (84.5)
What to do if placental membranes found	Burial	3 (2.7)	3 (2.7)	0	6 (5.5)
	Give to dogs	6 (5.5)	5 (4.5)	12 (10.9)	23 (20.9)
	Throw away	32 (29.1)	19 (17.3)	30 (27.3)	81 (73.6)

HH=Household, N= number of observations

Table 5: Factors affecting knowledge, attitudes and practices score of livestock owners (N=110)

Factors	Category	Knowledge score		Attitude score		Practice score	
		Poor N (%)	Good N (%)	Negative N (%)	Positive N (%)	Poor N (%)	Good N (%)
District	Kersa	39 (35.5)	2 (1.8)	21 (19.1)	20 (18.2)	35 (31.8)	6 (5.5)
	Mana	25 (22.7)	2 (1.8)	11 (10.0)	16 (14.5)	24 (21.8)	3 (2.7)
	S/Chokorsa	39 (36.4)	3 (2.7)	34 (30.9)	8 (7.3)	37 (33.6)	5 (4.5)
	P-value	0.985		0.001**		0.937	
Age of livestock owners	18-25	14 (12.7)	0	9 (8.2)	5 (4.5)	14 (12.7)	0
	26-40	14 (12.7)	1 (0.9)	10 (9.1)	5 (4.5)	13 (11.8)	2 (1.8)
	41-60	60 (54.5)	4 (3.6)	37 (33.6)	27 (24.5)	54 (49.1)	10 (9.1)
	>60	15 (14.5)	2 (1.8)	10 (9.1)	7 (6.4)	15 (13.6)	2 (1.8)
	P-value	0.760		0.940		0.530	
Gender	Male	86 (78.2)	5 (4.5)	56 (50.9)	35 (31.8)	79 (71.8)	12 (10.9)
	Female	17 (16.4)	2 (1.8)	10 (9.1)	9 (8.2)	17 (15.5)	2 (1.8)
	P-value	0.348		0.608		0.995	
Level of education	Illiterate	30 (27.3)	1 (0.9)	21 (19.1)	10 (9.1)	28 (25.5)	3 (2.7)
	BE	39 (36.4)	4 (3.6)	24 (21.8)	19 (17.3)	36 (32.7)	7 (6.4)
	Primary	25 (22.7)	2 (1.8)	15 (13.6)	12 (10.9)	23 (20.9)	4 (3.6)
	High school	9 (8.2)	0	6 (5.5)	3 (2.7)	9 (8.2)	0
	P-value	0.752		0.703		0.678	
Caretaker	Owner	90 (82.7)	5 (4.5)	59 (53.6)	36 (32.7)	87 (79.1)	8 (7.3)
	Shepherd	13 (11.8)	2 (1.8)	7 (6.4)	8 (7.3)	9 (8.2)	6 (5.5)
	P-value	0.243		0.272		0.004**	
Total		103 (93.6)	7 (6.4)	66 (60.0)	44 (40.0)	96 (87.3)	14 (12.7)

**= statistically significant, BE= Basic education, N= number of observations

Table 6: Association of knowledge of livestock owners with their practices (N=8)

Risk factors	Categories	N (%)	Univariable analysis	
			Fishery's Exact test	P-value
How to handle placental membranes	bare hand	5 (62.5)	18.112	0.000
	using gloves	3 (37.5)		
Personnel assisting cattle during delivery	Veterinarians	6 (75)	4.783	0.092
	HH members	2 (25)		
How do you handle the aborted fetus?	bare hand	3 (37.5)	5.645	0.060
	using glove	2 (25)		
	washing hands after handling	3 (37.5)		
Keeping dogs with cattle	Yes	1 (12.5)	4.185	0.064
	No	7 (87.5)		
What to do if aborted fetus found	Burial	3 (37.5)	14.614	0.002
	throw away	5 (62.5)		
What to do if placental membranes found	Burial	3 (37.5)	9.662	0.008
	give to dogs	1 (12.5)		
	throw away	4 (50)		
What do you do with brucella infected animals?	Culling	3 (37.5)	4.288	0.077
	Slaughter	3 (37.5)		
	Treating	1 (12.5)		
	wait for recovery	1 (12.5)		

HH= household

Descriptive analysis of factors affecting the knowledge, attitude and practice score of livestock owners indicated that from the total of the respondents, only 6.4% have a good knowledge score toward the disease. Moreover, attitude score analysis of the respondents showed that 40% of them have a positive attitude toward bovine brucellosis which was found statistically significant across the districts (P= 0.001). On the other side, 12.7% of respondents had good practice score

relating to bovine brucellosis. The practice score of the respondents showed a statistically significant difference with caretakers of the animals (P = 0.001 Table 5).

Positive attitude score was found relatively better in Mana district (13.8%) from those owners having seronegative animals (represented by 0) whereas 5.5% of respondents in Kersa district have positive attitude score from livestock owners owing seropositive animals (Figure 2).

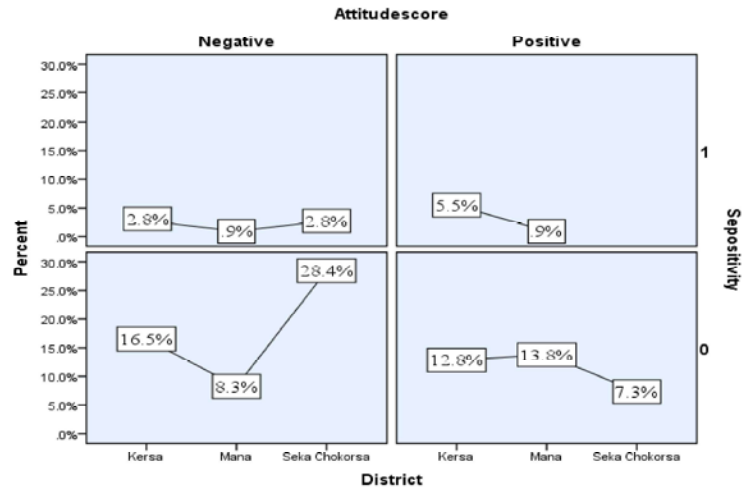


Fig. 2: Diagram showing relationship between the districts, seropositivity and attitude score.

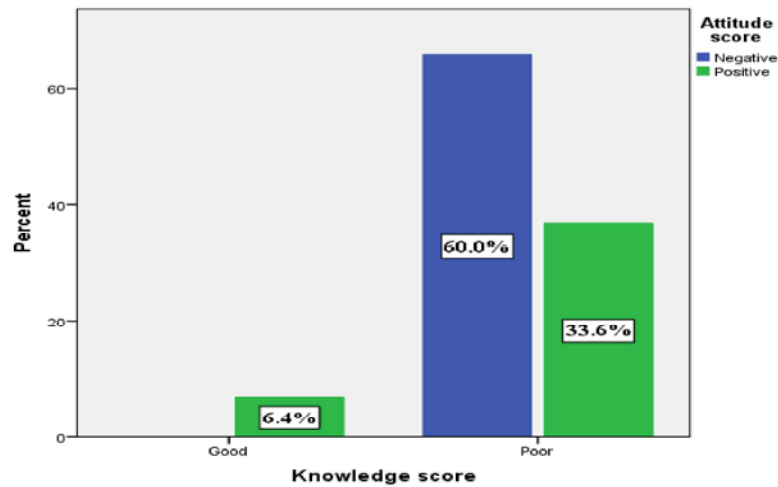


Fig. 3: Diagrammatic representation of attitude score and knowledge score of the respondents.

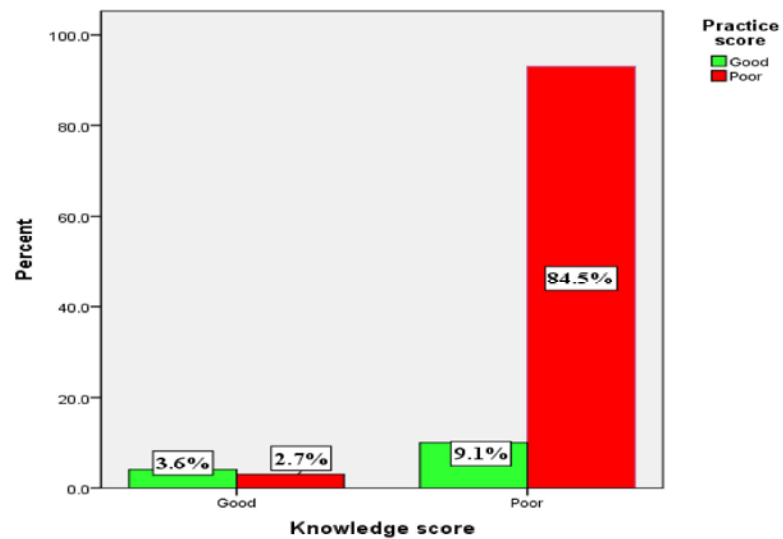


Fig. 4: Diagram of practice score and knowledge score of the respondents.

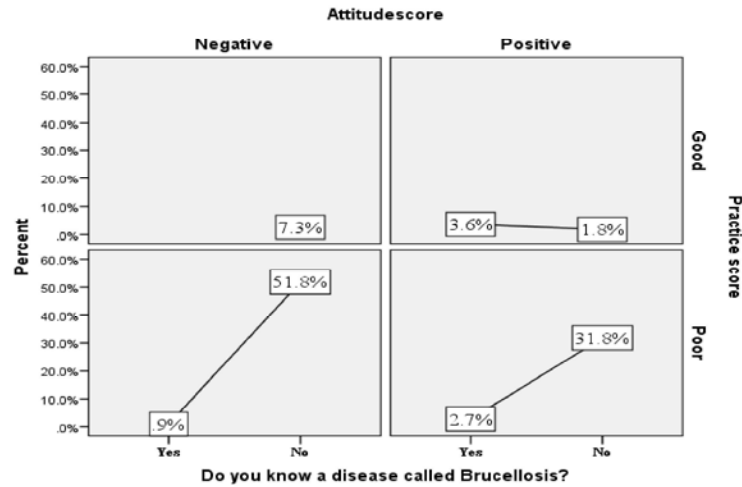


Fig. 5: Pictorial presentation of knowledge, attitude score and practice score of the study participants.

Univariable analysis of the practices of this study respondents concerning their knowledge indicated a statistically significant associations were observed between mechanism of handling placental membranes, disposal ways of aborted fetus and placental membranes ($P \leq 0.05$; Table 6).

Analysis of the association between attitude score and knowledge score of livestock owners who participated in this study showed that all (6.4%) of the respondents having good knowledge score had positive attitude score whereas, 33.6% had a positive attitude score toward bovine brucellosis from the respondents having poor knowledge score about the disease (Figure 3).

Knowledge score and practice score of the respondents of this study finding shown that, 3.6% and 9.1% of the respondents had good practice scores out of the respondents having good and poor knowledge scores respectively (Figure 4).

The association of the attitude score, practices score and knowledge level analysis report indicated that out of the respondents that knew about the disease, 3.6% have positive attitude score and good practice score. On the other hand, out of the respondents who did not know about the disease, 31.8% have positive attitude score but poor practice score (Figure 5).

DISCUSSION

The socio-demographic status of the participants shown that 82.7% were males and 17.3% were females. On the other hand, the age category exhibits that the preponderance of the respondents (58.2%) was found

between the age of 41 and 60 years while 18-25, 26-40 and >60 years of age were 12.7%, 13.6% and 15.5% respectively. The educational background of this study participant indicated that most of the respondents (39.5%) attended basic education. Likewise, illiterate, primary and high school attended participants were 28.2%, 24.5% and 8.2% respectively (Table 1). From this result, it can be concluded that the majority of respondents of this study were literate which may be important to adopt and implement health education particularly zoonotic diseases.

The overall results of descriptive analysis of livestock owners' knowledge regarding bovine brucellosis in targeted districts shown that only 8 (7.3%) of respondents from the total of 110 participants knew about the disease called bovine brucellosis. This result indicated that the majority of livestock owners (92.7%) did not know what bovine brucellosis is and the mechanisms of its transmission (Table 2). The present result is in line with the finding of 7.7% by Desta [29] in Afar Regional State and 8.1% by Deka *et al.* [30] from peri-urban and rural areas of Assam and Bihar in India. However, this result is by far lower than the results of 79% by Obonyo and Gufu [31] in Pastoral Community in Kenya; 21.6% by Abera *et al.* [32] in and around Asella, 70% by Arif *et al.* [33] in smallholder dairy livestock owners in Pakistan and 59.9% by Cloete *et al.* [34] in communal cattle keeper group in South Africa.

Likewise, a study conducted by Guan *et al.* [35] indicated the lowest level of knowledge of brucellosis in Ethiopia (17.3%) from African countries. No matter how the knowledge of the livestock owners' in the present study is poor, it is found better than the finding of Kuma *et al.* [36] in which none of the respondents aware about

brucellosis in Jimma; Rajkumar *et al.* [37] who reported 2.6% in Sri Lanka, Girma [38] which is 2.2% in Debre-Birhan Town, Lakew *et al.* [39] who reported 2.0% in the Somali region and Gichamo *et al.* [40] of 3.8% in Southern Ethiopia. Such variation across different countries and areas in terms of knowledge may be due to differences in access to formal education, previous experience of bovine brucellosis, health education program and extension services, communication and cooperation between the animal and human health sectors [35], the intention of the society to participate on the awareness creation meeting, accountability of health extension workers and attention of government and health professionals (both human and veterinary medical professionals) to provide health education.

All respondents who knew about the disease were heard from veterinary services. In this regard, the report of Cloete *et al.* [34] is nearly similar to the present result in which more than half (53.7%) of the source of information was veterinary services. This finding implies the powerful role the veterinarians play in terms of relaying important health messages to the livestock owners presenting their animals for treatment and vaccination programs. From this research, it is concluded that all of the respondents who knew about brucellosis understood that the disease can affect animals, from which 50% of them responded that the disease can infect cattle whereas the rest 50% understood that it infects all animals (Table 2). In contrast to this finding, a study in Tajikistan by Lindahl *et al.* [17] where 82% of the study participants knew that cattle, sheep and goats could be affected and the study in Egypt by Holt *et al.* [41] 98.1%, 86.0% and 85.0% of participants were very assured that cattle, sheep and goats can have brucellosis, respectively. However, the report of Deka *et al.* [30] in India indicated that 3.4% of respondents responded that cattle are the major animals infected by bovine brucellosis.

Of the total respondents that know about the disease, 50% know that brucellosis can transmit between cattle, but 25% responded that the disease does not transmit between cattle and the others did not know whether the disease transmits between cattle or not and all of the respondents (100%) that knew transmission of brucellosis between cattle responded that abortion is the major mechanism in which the disease can transmit between cattle (Table 2). In contrary to this finding, Deka *et al.* [30] reported that only 0.6% of respondents know that brucellosis can transmit between animals and Buhari *et al.* [42] reported the major transmission route of the disease between cattle as 33.3% by contaminated pasture, 26.2%

by contaminated water, 19.1% by mating and the rest did not know major mechanisms of transmission of brucellosis between cattle.

Half of the respondents responded that the major symptom they know in animals is abortion, whereas 12.5% and 25% responded as weak calves and retained fetal placenta are the major clinical manifestation of the disease. But, 12.5% did not know the symptoms of the disease in animals (Table 2). In agreement with this study, abortion was the most known clinical manifestation of bovine brucellosis as reported by Musallam *et al.* [43] in Jordan and Buhari *et al.* [42] in Nigeria. However, a study conducted in Uganda by Kansime *et al.* [44], in Nigeria by Hezekiah *et al.* [45] and in Tajikistan by Grahn [46] reported that 14%, 11% and 11% of respondents perceived as abortion is the major clinical manifestation in animals. This variation may be due to the different attitudes that livestock owners have regarding infertility, reduced milk production and abortions since the insight of risk is influenced by such factors as life experience, culture [47] and insufficient knowledge of the disease in animals [44].

On the other hand, unlike the report of 16.7% of Buhari *et al.* [42] in Nigeria, 3.0% of Arif *et al.* [33] in Pakistan and 0.8% of Deka *et al.* [30] in India, 75% of the participants of this study responded that the disease can transmit from animals to humans, out of whom 66.7% responded that the disease can transmit from animals to humans through handling abortion and 33.3% through drinking raw milk (Table 2). In line with the current study, the results of previous studies conducted by Holt *et al.* [41] in Egypt, Adesokan *et al.* [18] in Nigeria and Lindahl *et al.* [17] in Tajikistan in which the results were indicated that handling abortion was the major transmission route of bovine brucellosis from animals to humans. However, 97% of the respondents of study participants of Kansime *et al.* [44] responded the major route of transmission of brucellosis as consumption of unpasteurized dairy products. Since low knowledge of brucellosis in animals poses a zoonotic risk to public health, it is vital to deliver health education on animal brucellosis because, the source of human infection exist in in the domestic or wild animal reservoirs [44] and therefore, prevention of human brucellosis be determined by mainly on the control of the disease in livestock [48-50].

On the other side, in comparison with the finding of 26.2% of Buhari *et al.* [42], 75% of this study participants responded that the disease is preventable mainly through avoiding drinking raw milk (66.7%) and careless handling of the fetus and aborted materials (33.3%) but, the rest

25% did not know whether the disease is preventable or not. However, the study of Kansime *et al.* [44] in Uganda reported that 89.8% of respondents were aware of the possibility of preventing brucellosis in both humans and animals.

Descriptive analysis of the attitudes of the livestock owners' relating to bovine brucellosis in Kersa, Mana and Seka Chokorsa districts indicated that 10.0% of them believed that personnel's working most with the cows exposed to the brucella infection are at high risk of infection. On the other side, 4.5% did not believe and 85.5% did not know that personnel's workings mostly with the cows exposed to the disease are highly at risk of infection (Table 3). In this regard, similar to the present result, the finding of Lindahl *et al.* [17] indicated the proportion of respondents who believed that Personnel's working most with the cows exposed to the disease are highly at risk of infection was 14.7%.

Out of the total participants of this study, all of them need to know more about the disease from which 34.5%, 4.5%, 10.9%, 9.1% and 40.9% want the information about the disease from public health professionals, family and friends, meeting at the village, public media and veterinary professionals respectively (Table 3). Even though there is variation in the preferences of the sources of information which may be due to variation of availability and reliability of the sources, regarding the need for further knowledge, this result was found similar to the report of Obonyo and Gufu [31] in Kenya that indicated 97% of respondents need to know more information about the disease particularly from the local FM radio stations (39%), religious leaders 25%, local community meetings 20% and community health workers and/or community animal health workers 16%. In contrary to this finding, Lindahl *et al.* [17] reported that only 63% of the households wanted more information about brucellosis.

From the total of this study participant, 34.5% of respondents ensured the health status of the animals by relying on their own experience when receiving new cattle into their herd. But, 10.9% required veterinary advice and 31.8% buy from people known and/or trusted sources. However, 22.7% did not care when introducing new animals into their herds (Table 3). Likewise, according to the finding of Lindahl *et al.* [17], 63% of respondents indicated not taking any specific action to make sure the animal was healthy and 32% used more experienced people in the village for help. Unlike this result, regarding the method of addition of animals into the herd, 50% of respondents reported adding those animals immediately

after purchase while 47.6% reported adding the animals only after quarantining such animals [42]. Moreover, Cloete *et al.* [34] reported that 37.5% of respondents stated that they sought veterinary advice to ensure cattle health but, 28.8% bought from people they knew or trusted and 22.5% relied on their own experience. This variation may be resulted from difference in previous experience of the disease, knowledge about the disease, management practice and public education program provided in different countries.

Among the total of this study respondents, 65 (59.1%) of participants considered that selling of cows that frequently abort as correct practice whereas 45 (40.9%) of them did not take as a correct action (Table 3). Such attitudes initiate livestock owners to practice in wrong manners that facilitate transmission of bovine brucellosis. Similar to this finding, in the endemic areas of Egypt, livestock owners might sell animals that abort to the butcher and some farmers may sell animals in marketplaces if they consider they are infected with brucellosis. This may escalate the spread of brucellosis, between villages and even larger geographical areas as animals bought at a market can be relocated without limitation to anywhere in the country [41]. In the present study, the attitude of livestock owners toward bovine brucellosis was relatively better when compared to their knowledge, however, the provision of health education regarding zoonotic diseases particularly bovine brucellosis further improves their perception toward the diseases so that they would be ready to take part in the prevention mechanisms of the disease.

The practices of livestock owners toward bovine brucellosis were assessed in the current study. The statistical analysis of the risky practices of the livestock owners' had shown that 80.9% drink raw milk and its products (Table 4). This result slightly agrees with the work of Abera *et al.* [32] who reported a proportion of raw milk consumer respondents as 87%, but it was better than the report of 100% by Desta [29] in the Afar region, 96% by Obonyo and Gufu [31] in Kenya and 99% by Lakew *et al.* [37] in Somali regional state of Ethiopia. In contrary to this result, a much lower proportion of raw milk consumption habit was reported as 57.1% in Arsi-Negele district by Amenu *et al.* [51], 30% in Tajikistan by Lindahl *et al.* [17] and 36.96% in Jinka by Abebe *et al.* [52]. Such practices need intensive awareness creation campaigns particularly public health education and behavioral change communication to safeguard the public from the danger of raw food consumption.

Separation of cows during parturition is not being practiced by 70.9% of respondents (Table 4) which is unlike the report of Jilo [53] in which 21.21% of interviewed pastoralists do not separate animals during parturition. Moreover, 79.1% of current study respondents mix their cattle with other herds like sheep, goats and equines (Table 4). Similarly, Desta [29] reported a high chance of mixing herds with other herds and/or ruminants in watering points, pasture, night resting and market and during migration and Arif *et al.* [33] reported that most livestock owners share calving space with other animals. Moreover, Cloete *et al.* [34] reported 98.2% of respondents showed that their animals shared grazing and/or water with other livestock and 91.5% of respondents claimed that they could not keep their cattle separate from other livestock. Several brucella organisms are shed during the 10 days after calving or at abortion, polluting the atmosphere and enhancing the risk of other cattle consuming the organism [54].

In the current study, 87.3% handle placental membranes bare hand; 8.2% using gloves and the rest by washing their hands after handling. Moreover, 77.3% of the respondents handle aborted fetus bare hand, 18.2% wash their hands immediately after handling aborted fetus while the rest handle by using gloves (Table 4). In line with this finding, 90.5% of respondents in the Yabello districts of Borena Zone Oromia regional state handle aborted fetus and retained placenta by bare hand [55] and according to Musallam *et al.* [43] only 6% of livestock owners used protective clothing when handling placentas and aborted fetuses. In contrast to this result, the report of Lindahl *et al.* [17] showed that 78% of study participants washed their hands after dealing with cows having an abortion or with aborted materials whereas 21% used protection like gloves. Furthermore, it was speculated that herders never wear protective clothing or masks in Egypt when assisting with parturition or while handling placentas and aborted fetuses [56, 57]. These practices could be the major predisposing factors of human brucellosis, however; the livestock owners were practicing due to poor knowledge and lack of access to protective equipment like gloves.

Regarding the personnel assisting the cattle during delivery, more than half of the respondents (53.6%) responded that household members assist the cattle, whereas one-third (35.5%) of them contact veterinarians and 10.9% responded that shepherds assist cattle during delivery (Table 4). Likewise, Holt *et al.* [41] reported large numbers of respondents (94.4%) assisting their animals during delivery usually by pulling the calf out or

removing fetal membranes. Therefore, there is a high risk of spread of the pathogen between animals and from animals to humans through direct contact with contaminated materials such as fetal membranes and aborted fetuses [31]. The bacterium can go in through skin abrasions and the mucous membranes of the eye and mouth while assisting and even the bacteria could be inhaled resulting in infection [58]. Due to low/lack of knowledge of personnel assisting the cow, environment may be contaminated since they do not use disinfectants.

Out of this study participants, 84.5% throw away or dump aborted fetuses into the environment that may facilitate environmental contamination, but only 15.5% bury in the ground. Likewise, 73.6% throw away placental membranes into the environment, 20.9% give to dogs but, 5.5% bury in the ground (Table 4). In line with this result, the report of Jilo [53] in the Pastoral community in Borena indicated that 87.88% of the respondents dispose of the aborted fetus in the environment. In opposing to this finding, Lindahl *et al.* [17] reported 94% of Tajikistan's dairy owners bury aborted fetuses and birth materials. Likewise, in Pakistan, 34% by Arif *et al.* [33]; in Mongolia 47.6% by Chuang *et al.* [57] and in South Africa 35% by Cloete *et al.* [34] bury aborted and placental membranes, as well as Kothalawala *et al.* [28] reported as 61.1% of livestock owners buried the placenta which is by far greater than the number of respondents that bury aborted fetus in present study areas. Brucella species have been shown to survive in aborted fetuses, manure and water for periods of up to 150 to 240 days [59] and moist environment (manure and soil) for several months [60] hence disposing into the environment is among the major predisposing factors of human brucellosis and facilitators of transmission and maintenance of the pathogen. Therefore, such risky practices should be tackled by an awareness creation program for the livestock owners and the whole community of the study areas.

Descriptive analysis of factors affecting the knowledge, attitude and practice scores of farmers indicated that from the total of the respondents, only 6.4% have a good knowledge score whereas, 93.6% of them have poor knowledge score about bovine brucellosis (Table 5). In line with this study, poor knowledge score had been reported in Tajikistan by Lindahl *et al.* [17], northern Uganda by Nabirye *et al.* [61] and Nigeria by Buhari *et al.* [42]. However, Holt *et al.* [41] in Egypt and Musallam *et al.* [43] in Jordan reported good knowledge scoring of their study participants. Therefore, health education relating to zoonotic diseases including bovine brucellosis, targeting all groups of the community in

general and people most exposed to livestock and livestock products should be given by the government and other concerned bodies such as NGOs, print and broadcast media communication channels. In this study, knowledge score did not significantly associate with livestock demographic characteristics' which agrees with the works of Diez and Coelho [62] and Deka *et al.* [30] who did not find any significant association between knowledge about brucellosis with livestock owners' age and gender.

Moreover, the Attitude score analysis of the respondents showed that 40% of them have a positive attitude score toward bovine brucellosis which was found statistically significant across the study districts ($P=0.001$; Table 5). The attitude score is by far better than the knowledge and practice score of this finding. Similar to this study, Nabirye *et al.* [61] and Cloete *et al.* [34] reported average to good overall attitude scores of participants in South Africa unlike the negative attitude among community participants in Kenya [31]. The result of this study indicated that age, sex and education had no significant influence on attitude score. In general, the result of the current study revealed that the livestock owners in this study area had a better perception toward bovine brucellosis even if their awareness about the disease is very low.

Furthermore, 12.7% of respondents of this study participants had good practice score relating to bovine brucellosis but, 87.3% were in the manner of risky practices that may expose them to the disease (Table 5). According to the report of Cloete *et al.* [34] in South Africa, the total practice scores of respondents were found poor to average, with several high-risk behaviors identified in the community. Studies conducted in Egypt by Holt *et al.* [41], in Tajikistan by Lindahl *et al.* [17], in Jordan by Musallam *et al.* [43], in Nigeria by Buhari *et al.* [42] and in northern Uganda by Nabirye *et al.* [61] also revealed high-risk activities, including the handling of abortion and placental membranes without protection as well as consumption of raw milk and its products resulting in low practice score. The practice score of the respondents showed that from the caretakers of animals, owners were found better than the shepherds and hence there is a statistically significant difference between the two ($P\text{-value}=0.004$) (Table 5) which may be due to lack of knowledge about possibilities of disease transmission from animals to human and obligatory tasks given to them without facilitating protective mechanisms and necessary awareness in case of shepherds.

The attitude score of this study participants showed that there is a relatively good level of positive attitude score in Mana district which is 13.8% from those owners having seronegative animals followed by Kersa (12.8%) and Seka Chokorsa districts (7.3%) whereas 5.5% and 0.9% of respondents in Kersa and Mana districts have positive attitude score from livestock owners owing seropositive animals. However, the greatest proportion (28.4%) of respondents in Seka Chokorsa district have negative attitude score from the owners having seronegative animals followed by Kersa (16.5%) and Mana (8.3%; Figure 2). From this scenario, it can be determined that attitude score toward bovine brucellosis was found better in owners having seronegative animals than those owing seropositive herds. This variation may be due to variation of their knowledge levels about the disease, their daily practices and interest of attending public health education given in different channels like meeting in the village.

Based on comparison of mechanisms by which livestock owners handle placental membranes with their knowledge indicated that 62.5% used bare hand and 37.5% gloves. Likewise, 37.5% and 62.5% respondents dispose of aborted fetus by throwing away and burying in the ground respectively from the respondents who knew about the disease. On the other side, out of the respondents that knew about the disease, half of them throw away, 37.5% bury whereas 12.5% give to dog's placental membranes. There is a statistically significant variation between knowledge about the disease and practice of handling placental membranes, disposal mechanisms of an aborted fetus and placental membranes ($P<0.05$, Table 6). In agreement with this finding, in Mongolia, herders with a higher level of knowledge were more likely to correctly dispose of aborted fetuses and birth materials compared to those with a lower level of knowledge [57]. Likewise, in Egypt, Hegazy *et al.* [56] associated a lack of knowledge regarding brucellosis transmission with throwing aborted materials into water canals. Farmer's lack of awareness about brucellosis, improper handling of aborted materials and the habit of consuming raw milk, among other factors, might contribute to further spread of brucellosis in their livestock and expose the community to a public health hazard [63].

In the present study, association between the variety of livestock owners' practices and their knowledge level assessed. Hence several variables included for this analysis did not show statistically significant association (Table 6). This may be to mean that, the existence of

relatively similar risky practices among livestock owners of this study participant whether they know about the disease or not. Respondents that knew about bovine brucellosis similarly act like those who did not know about the disease that would be due to neglecting the disease, low levels of education and under consideration of the public health and economic significance of the disease. Poor knowledge and high-risk behaviors strengthen the logic for including health education as part of control programs. Studies to detect high-risk behaviors among livestock owners could prove to be valuable in order to develop cost-effective strategies that minimize the risk of exposure to the disease [17].

Moreover, attitude score and knowledge score of livestock owners showed that all the respondents that had good knowledge score have positive attitude score toward bovine brucellosis whereas, 33.6% and 60% of the respondents having poor knowledge score about the disease have a positive and negative attitude score respectively (Figure 3). This finding concluded that one-third of the participants of this study have a positive perception of bovine brucellosis even if they did not know about the disease, which shows that they are eager to know and be trained about the disease and hence needs public health education intervention to improve the awareness of the livestock owners so that their perception toward brucellosis will be relatively increased. Poor knowledge may have resulted in negative attitudes, which may probably lead to unnecessary practices that may be ended up with the occurrence of the diseases in the community and then devastating the socioeconomic condition of a particular area and country in general.

Analysis of knowledge score and practice score of livestock owners showed that the practice score of the respondents that have good knowledge scores was 3.6% good and 2.7% poor practice score. Moreover, out of the respondents having poor knowledge scores 9.1% and 84.5% have good and poor practice scores toward bovine brucellosis respectively (Figure 4). Therefore, strategies of improvement of the knowledge of livestock owners should be designed to educate them about zoonotic diseases particularly bovine brucellosis in order to reduce risky practices among livestock owners to save the society and the country from public health impacts and socioeconomic deterioration due to the disease.

Diagrammatic representation of the relationship between the attitude score and practice score of livestock owners toward bovine brucellosis and their knowledge level analysis report showed that from the respondents that knew about the disease, only 3.6% have positive

attitude score and good practice score. Moreover, out of the respondents who did not know about the disease, 31.8% have positive attitude score but poor practice score (Figure 5). This indicates that several respondents have good perception of the disease even though they do not have good practice score which could be due to a lack of awareness about the disease. More than half (51.8%) of the respondents without knowledge of the disease, have poor practice score and negative attitude score toward bovine brucellosis (Figure 5) which indicates the importance of public health educations.

CONCLUSION

This study disclosed that only very few numbers (7.3%) of livestock keepers knew about the disease. Even though several respondents had positive attitude score on bovine brucellosis, due to poor knowledge score, most of this study participant was in malpractices such as handling of fetal membranes bare hand and throwing away aborted materials and fetal membranes into the environment, which worsen contamination of environment and facilitate maintenance as well as transmission of the pathogen. Therefore, public health education campaigns such as biosafety measures and zoonotic transmission of bovine brucellosis need to be undertaken by the government and other responsible bodies so as to reduce exposure of the high-risk groups to the disease and environmental contamination. Additionally, an integrative and collaborative approach of government and non-governmental organizations, as well as combined efforts of veterinary and public health professionals should be implemented for effective control of the disease.

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