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Research Article

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Prevalence of Brucellosis in livestock owners in Northern Red Sea Region, Eritrea: Community Knowledge, Attitude and Practice.

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Abstract

Background: *Brucellosis is an infectious zoonotic disease broadly spread worldwide. Brucellosis is endemic in Eritrea, however the prevalence rate, knowledge and practice of brucellosis among the livestock owners in the study area is unknown. The objective of this study was to determine the prevalence of brucellosis in livestock owners and evaluate the level of knowledge and practice of the community in Northern Red Sea region, Eritrea.*

Methods: *Community based cross sectional study was conducted from October 2020 to February 2021, where a total of 637 livestock owners from 29 villages were sampled for blood and data collection. Blood samples were tested using RBPT and positive samples further confirmed using c-ELISA. Data were collected using structured questionnaires.*

Results: *A total of 637 respondents were enrolled in the study. Study participants were dominated by males (74.9%), Tigre ethnic (73%) and farmers (70.5%). The overall sero-prevalence of brucellosis in the study area was 2.4% (95% CI:1.3 - 3.6) with the highest rate in Ghindae (3.9%). The comprehensive knowledge and practice was 58.4% and 10.5%, respectively.Comprehensive knowledge showed significant association with sub-region and age, while good practice indicated significant association with age (P=0.000). Sub-region Ghindae indicated odds (OR)of 3.27 (P=0.001) for comprehensive knowledge and odds of 3.12 (P=0.000) for good practice. Age group of ≥60 years revealed odds of 4.40 (P=0.000) for comprehensive knowledge.*

Conclusion: *The overall sero-prevalence of brucellosis in livestock owners in the study area was low, but considerable higher in some spot areas. The participants showed good level of knowledge but poor practice. Study sub-region and age were important factors associated with comprehensive knowledge and good practice of the participants.Respondents from Sub-region Ghindae showed relatively higher level of prevalence rate, comprehensive knowledge and good practice to wards brucellosis.*

The study recommends urgent educational campaign to increase the community knowledge and improve their good practice habit on brucellosis. Conduct regular testing of animals and implement feasible control measures against brucellosis.

Keywords: Brucellosis, Knowledge, Livestock owner, Practice, Prevalence

Introduction

Brucellosis is one of the most important zoonotic diseases distributed worldwide, which affects economically important domestic livestock species, wild animals and humans [1]. Globally, more than half a million new human cases are reported each year [2]. The World Health Organization considers brucellosis a neglected zoonosis, because, despite its widespread distribution and effects on multiple species, it is not prioritized by national and international health systems[3]. Brucellosis is caused by the genus *Brucella*, gram negative, coccobacilli, small, non-motile, facultative, strict intracellular bacteria. The genus *Brucella* is divided in to 12 species for epidemiological and diagnostic convenience [4]. However, the most important widespread species and their primarily infected host are *Brucell amelitensis* (sheep and goats), *Brucell aabortus* (cattle), *Brucell asuis* (swine) and *Brucella ovis* (sheep) [5]. *B. melitensis, B. abortus* and *B.suis* are considered the most pathogenic species for humans and can pose a great risk for people living in close proximity to animals and those who consume uncooked meat/milk products.

Brucellosis infected animals are mainly characterized by reproductive disorders; abortion, retained placenta and infertility. Most infected animals abort only once in their lifetime, but may remain infected and shed the agent during the remained of their life [6]. Human brucellosis begins as an acute febrile illness with non-specific flu like signs. If not identified and treated in time, can lead to chronic and debilitating illness with severe health consequences [7].In most low and middle-income countries, brucellosis is endemic, Physicians often misdiagnose brucellosis based on clinical symptoms due to lack of adequate laboratory facilities [8]. Effective use of preventive strategies like vaccination, test and slaughter methods and community awareness raising has helped in significantly reducing the prevalence of brucellosis, especially in developed countries [9].

In Eritrea, brucellosis is an important zoonotic disease listed as one of the prioritized livestock diseases considering its widespread distribution and established reports. Previously, prevalence of brucellosis in animals in Eritrea was reported as 8.2% in dairy cattle in Maekel region, 2.77% in dairy cattle in five regions, 5.0% in indigenous cattle in Gash-Barka region, 1.4% in sheep in NRS region, 4.3% in goats in Gash-Barka region, 3.8% in goats in NRS region and 3.1% in camels in pastoral and sedentary production systems [10,11]. Earlier, prevalence and risk factors of brucellosis was studied in three high risk occupational groups and the highest prevalence (7.1%) was found among dairy farm workers/owners followed by veterinary personnel (4.5%) and pastoralists (3.0%) [12]. Lately, *B.melitensis* DNA was detected from sheep and goat vaginal swabs using PCR technique. The animals were purposively sampled from human brucellosis sero-positives owning households[21]. Moreover, unpublished data and reports of the Ministry of Agriculture and Ministry of Health showed that human brucellosis was steadily increasing from 2014 to 2020 [13]. This indicates that brucellosis is infecting and threatening both humans and animals in the country.

Based on the everal hospital reports consulted, brucellosis is prevailing in livestock owners in the Northern Red Sea region. However, no systematic scientific study conducted in the area to better understand the prevalence and risk factors of brucellosis in humans. Similarly, awareness level of the community on brucellosis related risk factors has never been assessed. The aim of this study therefore to determine the prevalence of brucellosis was and assess knowledge, attitude and practice (KAP) of the livestock farming communities in the Northern Red Sea region. The finding of the study is believed to be helpful for decision makers and concerned experts to design feasible control measures against the disease.

Methodology

Study Area

This study was conducted in the Northern Red Sea (NRS) Region located in the Northern East of Eritrea between 14°23' N and 38°21' E. It borders Anseba, Maekel and Debub regions to the west, Red Sea to the Northern East and the Southern Red Sea (SRS) Region to the East (Fig 1). It has an area around 34,732 km². It extends from -72 meters below sea level to 2700 meters above sea level [22]. NRS has different agro-ecological zones with temperature ranging from 13°C to 50°C. Some of the sub-regions have two summers within a year (June-August and October-February). The region is inhabited with various domestic and wild animals. Many types of vegetation and crop are grown in the region. Livestock production in this area is mainly based on pastoralism. Depending on the seasons, they move to and from the eastern escarpment area [23]. The dominant animals are goats followed by sheep,cattle and camels, which are kept for milk, meat, cash generation and draught power purpose.

Study Population

The NRS has 10 sub-regions, 100 administrative areas, 303 villages, 89,000 house-holds, 390,900 estimated human population, 1547 dairy cattle, 88,133 local cattle, 677 748 goats, 169,075 sheep and 25,136 camels (13). This study was conducted in four selected sub-regions namely Afabet, Foro, Ghindae and Sheeb. They were selected based on accessibility and availability of livestock species in the sub-region. Within the selected Sub regions, there are 52 administrative areas, 154 villages, 51,212 households, 235,000-estimated human population, 63,000 cattle, 315,000 goats, 81,000 sheep and 25,136 camels.

Study Design

This is a cross-sectional survey study conducted from October 2020 to February 2021. The aim was to determine prevalence of brucellosis and the level of knowledge, attitude and practice of pastoral livestock owners in the NRS region of Eritrea. A list of villages in the four selected subregions was obtained from the respective sub-region administrative offices. From the list, all accessible villages owning the required livestock species (cattle, sheep, goats and camels) identified and 29 selected randomly from the listed villages.The numbers of villages proportionally selected were from Afabet (9), Foro (7), Ghindae (8) and Shieb [7]. Household (HH)selection was done on site visit. In each of the 29 selected villages, 22 HHs owning livestock species and a farmer who is above 18 years old, able to properly respond the questionnaire and willing to participate in the study was considered and selected on the visit day

Sample Size

There was no reliable previous study report on prevalence of human brucellosis in this study area. Therefore, to obtain the optimum possible sample size for the study, various related standard inputs and sample size adjustment factors were considered as follows:

First, an initial sample size was calculated using Epitools online software package (https://epitools.ausvet.com.au/prevalencess) assuming 50% expected prevalence, 95% confidence level, 0.05 desired precision, 1.5 design effect and 10% non-respondent rate which yielded an initial sample size of 634. Secondly, a two-stage cluster sampling design, (fixed sample size and unknown clusters for large populations) as describe by the author [14]was followed to calculate the number of villages to be sampled from infinite population using the formula:

$$g = 1.96^2 TsVc \ / \ d^2T - 1.96^2 P_{exp} (1-P_{exp})$$

where:

g = number of clusters (villages) to be sampled, P_{exp} = expected prevalence (50%), d = desired precision (0.05), T_s= total calculated sample size (634), V_c = Cluster variance (0.04) (14). The result further adjusted considering the finite number of accessible and livestock owning villages in the study area using the formula designed for finite population adjustment as follows:

$$g\text{-adj.} = Gxg \ / \ G+g$$

Where: g-adj= adjusted sample size, G= sample size calculated for infinite population and g= estimated finite number of accessible villages in the selected sub-regions. This calculation produced 29 sampling villages and 22 livestock owners to be sampled from each village. Thus, a total of 637 livestock owners were sampled for this study.

This sample size was considered for both KAP and prevalence study in the community.

Collecting and Handling Blood Samples

Approximately 5ml blood sample was collected from each participant using plain vacutainer tube and double ended needle. Each sample was labelled using a unique code number. The sample tubes were set tilted and left in a shed for 12-18 hours at a room temperature to allow separation of the serum from the other clots while protected from direct sunlight. When the serum was clearly separated, it was decanted to another serum tube and labelled with the same code number. The sera then transported in ice box, covered with cool ice packs to the National Animal and Plant Health Laboratory (NAPHL), Ministry of Agriculture, Asmara for analysis.

Questionnaire Data Collection

A pre-tested questionnaire was administered face to face to each participant for collecting relevant information on (a)socio-demographic characteristics (gender, age, level of education, ethnicity, family size, district), (b) level of knowledge and attitude of the participant related to brucellosis focusing on questions related to awareness about brucellosis, rout of its transmission, symptoms, about the disease before, routes transmission, infection, treatment, curability with traditional herbs, curing with conventional medicine, Vaccine for animals, vaccine for humans, positively diagnosed family member, positively diagnosed animals, eating uncooked meat and milk products.

(c) brucellosis risk practice variables including testing newly punched animals, habit of drinking/eating of raw milk products, boiling of milk before sailing or using it and informing the administrator of village when having the disease in his farm. The questionnaire was translated from English to local languages (Tigre, Tigrigna and Saho). The questionnaire was again re-translated back to English to keep its originality. The questionnaire was pre-tested by selecting 10 households in the study area and ‘’ the questionnaire adjusted before use.

Laboratory Investigation

Rose Bengal Plate Test (RBPT)

The blood sera were tested for brucellosis antibody using RBPT method following the manufacture`s (Animal Health and Veterinary Laboratory Agency (AHVLA), Newhaw Addle-stone Surry KT15 3NB, UK) procedures. Briefly, undiluted serum samples and antigen were adjusted to room temperature (18 - 25 °C), and gently mixed. Negative and positive controls for *B. abortus* and *B. melitensis* tested at the beginning of each testing session. 30 µl of serum mixed with an equal volume of antigen on a glass plate to produce a zone approximately 2 cm in diameter and thoroughly mixed using disposable stirring stick, spreading it over the full surface of the circle. The mixture plate was rotated manually for 4 minutes at an ambient temperature. The result for each sample was recorded by strength of agglutination observed for each antigen.

Competitive Enzyme-Linked Immuno-Sorbent Assay (c-ELISA)

All RBPT positive sera were further tested for confirmation using c-ELISA techniques following the kit`s manufacturer (INGNASA: AdevaDelaInstitucionLibre de Ensenanza,39-8, 28037-Madrid, Spain, www.ingenasa.er) instructions.

Data Management and Analysis

Laboratory serological test results were coded and entered into Microsoft Excel data sheet and questionnaire data coded and entered intoCSPro. The data was transferred to statistical package SPSS version 23 and analysed by descriptive statistics (frequencies, range and percentile) using simple chi-square tests. Serum samples tested positive to both RBPT and c-ELISA were considered as positive for brucellosis. Sero-prevalence was calculated by dividing sero-positive counts to the total number of humans samples tested. Confidence interval for sero-prevalence was determined by bootstrapping function using SPSS. Questionnaire data were analysed using Pearson's chi-square/Fisher exact test to determine the significance of association between sero-positivity and brucellosis risk factor variables, i.e. socio-demography and knowledge, attitude and practice described in the questionnaire data. Significance of association and simple logistic regression analysis was computed to determine association between socio-demography characteristics and comprehensive knowledge and good practice variables. Comprehensive knowledge and good practice was a summary score for good or poor response on 10 questions of knowledge and 11 questions of practice. Study participants who responded correctly were given one and zero for those with wrong response, for each question. Then results were summed and interpreted as percent. Participants who respond greater than 70% correctly were considered as having good knowledge and good practice. Those scored with less than 70 % as having poor knowledge and poor practice respectively.

Ethical Consideration

Research approval letter was obtained from Ministry of Health, Research Ethical Committee, Eritrea. The NRS local government also gave permission for the study on the subject. During the visits, each participant was asked, to read and sign on written consent form,for the required blood sample and data. Each participant was given a unique code to unrevealing his/her identity. All the information provided by the participant was kept confidential.

Results

Sero-Prevalence

From a total of 637 human serum samples tested,15 were sero-positive for brucellosis on both RBPT and c-ELISA tests. Consequently,the overall sero-prevalence of brucellosis in livestock owners in the study area was 2.4% (95% CI:1.3 to 3.6). Of the four sampled sub regions, Ghindae (3.9%) observed with the highest sero-prevalence followed by Shieb (3.6%) and Afabet (2.5%). No sample was positive from Foro subregion (Fig.1). Out of the 29 total sampled villages, 11 were sero-positive with varied from 4.3 % to 9.1 % (Fig. 2).Age wise, respondents between 20 to 39 years old were the most infected group (2.8%). Families having larger members (>9) showed the higher (3.7%) prevalence than less sized families. Participants attained secondary and above educational level were recorded with the highest infection rate (5.3%) compared to the less educated group.

In the current study, further statistical analysis could not be done on the sero-prevalence result as the number of positive samples was very low (n=15/637).

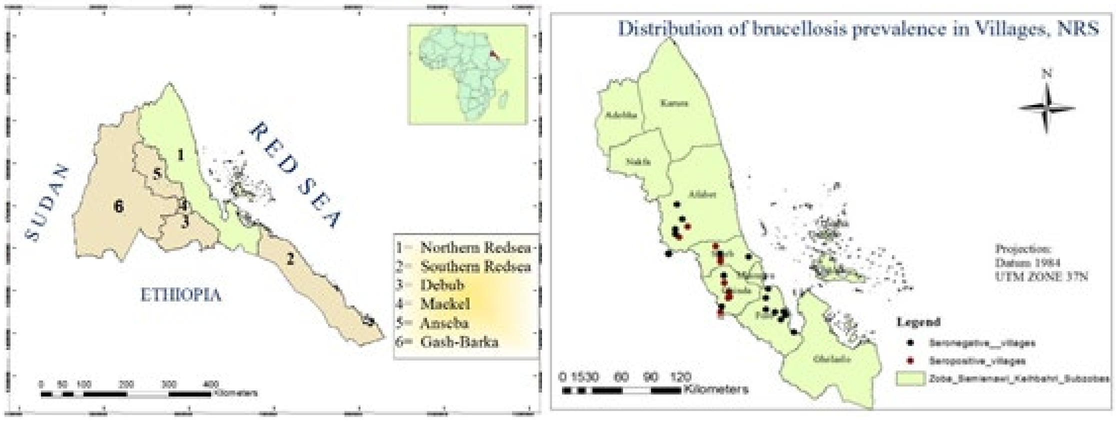

Figure 1: Map of Eritrea showing 6 administrative regions and the study region (region-1); Distribution of brucellosis sero-positive (Red dot) and sero-negative (Black dot) villages.
Source: Projection Datum 1984 UTM Zone 37 N

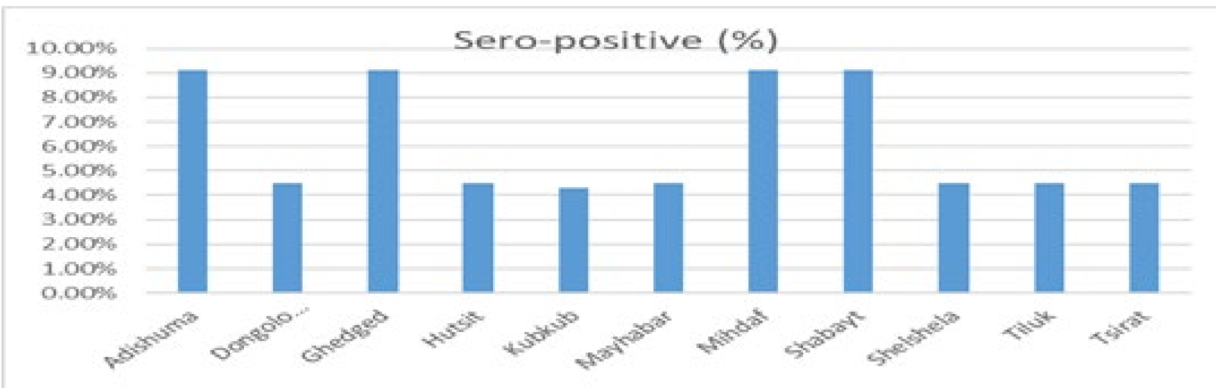

Figure 2: Human *Brucella* sero-positive villages in NRS region, Eritrea

Socio-Demographic Characteristics

A total of 637 study participants were enrolled in the study with a mean age of 42.96. The respondents were dominated by males (76.3%) and Tigre (74.5%) in ethnicity. Majority of the study participants (55.0%) were illiterate followed by primary (26.2%) level of education and nearly all (98.1%) were Muslim in religion. Majority (55.6%) of the participants household had 5-8 family size (table 1).

Table 1: Socio Demographic Factors and Prevalence of Brucellosis in NRS Region, Eritrea (2021)

Variable	Categories	Sample tested	Sero-positive (%)
Sub-region	Shieb	110 (18.1 %)	4 (3.6 %)
	Ghindae	154(24.9 %)	6 (3.9 %)
	Foro	174(26.4 %)	0
	Afabet	199(30.6 %)	5 (2.5 %)
Sex	Male	477(76.3 %)	14 (2.9 %)
	Female	160(23.7 %)	1 (0.6 %)
Age	≤ 20	46(7.6 %)	1 (2.3 %)
	20 - 39	234 (35.4 %)	8 (2.8 %)
	40 - 59	227(35.1 %)	5 (1.5 %)
	≥ 60	130 (22.0 %)	1(0.5 %)

Educational level	Illiterate	351 (55.0 %)	8 (1.7%)
	Primary (1-6th grade)	164 (26.2 %)	2 (1.1%)
	Junior (7-8th grade)	56 (8.2 %)	1 (0.4%)
	Sec. & above (≥9th)	62 (10.6 %)	4 (5.3%)
Religion	Muslim	625 (98.1%)	15 (2.4 %)
	Christian	12 (1.9%)	0 (0%)
Ethnicity	Saho	141(22.1%)	1 (0.7%)
	Tigre	465(73.0%)	13 (2.8%)
	Tigrinya	12(1.9%)	0 (0%)
	Rashaida	19 (2.0%)	1 (5.3%)
Family size	< 4	201 (31.6%)	6 (3 %)
	5 - 8	354 (55.6%)	6 (1.7 %)
	> 9	82 (12.9%)	82
Total		637 (100 %)	15 (2.4 %, 1.3 -3.6)

Community Level of Knowledge/Awareness on Brucellosis

Majority of the study participants (73.3%) had heard the disease brucellosis before and 71.1% knew that humans can be infected with brucellosis. About two third (68.8%) of the respondents knew that humans can be infected from animals and 69.5% answered that humans can be infected through consumption of raw milk and milk products (Table 2). Majority (66.7%) also respond that infected humans can be treated and animals vaccinated (61.7%) against the disease. Most (66.1%) knew that the disease can be cured by conventional medicine.

About half of the study participants reported that all livestock (cattle, goats, sheep and camel) can get infected with brucellosis. The participants reported that the main symptoms of brucellosis in humans were joint/back pain (42.9%) and intermittent fever (14.6%). Around 26.4% answered that abortion is the main clinical signs in animals diseased with brucellosis.

Table 2: Variables for Community Knowledge/Awareness on Brucellosis(N=637)

Variables	Yes (%)	No (%)
Have you heard of the disease Brucellosis?	467 (73.3)	170 (26.7)
Can humans be infected with Brucellosis?	453 (71.1)	14(2.2)
Do you know how humans can get infected from animals?	438(68.8)	29(4.6)
Do you know if there is treatment for Brucellosis in humans?	425(66.7)	42(6.6)
Do you know if there is vaccination for Brucellosis in animals?	393 (61.7)	74(11.6)
Has any of your family member been diagnosed positive for brucellosis?	60(9.4)	407(63.9)
Have any of your animals been diagnosed positive for brucellosis?	42(6.6)	425(66.7)
Brucellosis infected humans can be cured by local herbs	53(8.3)	414(65.0)
Brucellosis is transmitted by uncooked meat and/or milk.	435(68.3)	32(5.0)
Infected humans can be cured by conventional medicine	421(66.1)	46(7.2)

Community level of Attitude on Brucellosis

Most respondents (76.1%) believed that their family members are at risk of acquiring brucellosis.Majority (64.7%) of the participant perceived that their family are in a serious risk if their animals are infected with brucellosis. Almost all the study participants (97.5%) were interested to know more about brucellosis, and majority of them (57.6%)preferred to learn it from health professionals and community leaders (26.7%) (Table 3).

Table 3: Attitude towards brucellosis (N=637)

Variables	Category	N (%)
Do you believe that any family member is at risk of acquiring brucellosis?	Yes	485 (76.1)
	No	152 (23.9)
If an animal in your herd gets infected with brucellosis, how serious do you consider this to be?	Very serious	412 (64.7)
	Not serious	225 (35.3)
Do you like to know more about brucellosis?	Yes	621 (97.5)
	No	16 (2.5)
How would you like to receive the information on brucellosis?	Radio	81 (12.7)
	Community leaders	170 (26.7)
	Health professionals	367 (57.6)

Community Level of Practice on Brucellosis

Majority of the participant (78.8%) wash their hands before and after milking animals. Most respondents (56.2%) feed placenta and aborted materials to dogs.Majority of them (90.3%) handle and dispose birth materials and placenta of animals barehanded. About half of the study participants (52.4%) wash their hands to protect themselves when handling placenta and/or aborted fetus. Most (63%) respondents seek veterinary assistance when ever suspected that their are infected with brucellosis. Most(75%) of the participants take action to ensure that the animals are healthy when buy them. Large number (77.8%) of the respondent had never boiled the milk before selling/consuming it. Whenever animals with brucellosis are encountered 37.2% of the respondents claimed,that would be slaughtered and 19.6% preferred to sell them.About two third (77.9%) of the respondents would inform their administrators when their animals or themselves are contracted with brucellosis. Most, (60.1%) of the respondents used to dump the dung of their animals in specific dumping area. Greater than half(58.4%) of the respondents, showed good comprehensive knowledge but 89.6% had poor practice on brucellosis handling (Table: 4).

Table 4:Community level of Practice on Brucellosis in NRS region, Eritrea (N=637)

Variables	Frequency (N)	Percent (%)
How often do you wash your hands after milking your animals?		
Every time	502	78.8
Sometimes	105	16.5
Never	30	4.7
If your answer is “sometime or never”- what is your reason?		
Not necessary	61	9.6
No soap	21	3.3
No clean water	26	4.1
Other	47	7.4
What do you do with aborted fetus?		
Feed to dogs	358	56.2
Burn	16	2.5
Do nothing	150	23.5
Bury	113	17.7
How do you handle and dispose birth materials?		
Wearing protective gears	45	7.1
Bare hands	575	90.3
Other	17	2.7
What do you do to protect yourself from placenta/dead fetuses?		
Use gloves	12	1.9

Wash hands	334	52.4
Use nothing	239	37.5
Other	52	8.2
If you suspect an animal having Brucellosis, what do you do?		
Report to administrator	169	26.5
Seek veterinary assistance	401	63.0
Sell it	14	2.2
keep it	53	8.3
If you buy new animal, do you take an action to assure theanimal ishealthy?		
Yes	478	75.0
No	159	25.0
Do you drink untreated fresh (raw) milk or yoghurt?		
Yes	177	27.8
No	460	72.2
Do you boil the milk before selling/using it?		
Yes	141	22.1
No	496	77.9
What measures do you take to your animals with brucellosis?		
Slaughter it	237	37.2
Sell it	125	19.6
Other	275	43.2
Did you inform administrator if you have the problem?		
Yes	496	77.9
No	141	22.1
Where did you dump the dung of your animals?		
Specific dumping area	383	60.1
Leave in house	120	18.8
Other	134	21.0

Association of Comprehensive Knowledge and Practice with Background of Participants

The comprehensive knowledge of the participants showed statistically significant association with studied sub-regions (P=000) and age (P=0.000). The comprehensive good practice was also significantly associated with studied sub-regions (P= 0.000) (table 5).

Further logistic regression analysis also showed that participants from sub-region Ghindae had higher odds (OR=3.27; P=0.001) of comprehensive knowledge and good practice (OR=3.12; P=0.000). The odds of comprehensive knowledge of participants was higher in the age group of ≥ 60 years (OR=4.398; P=0.000) compared to the age group of 40-59 years (OR=4.346; P=0.000) and 20-39 years (OR=2.844; p=0.001)(Table 6, 7).

Table 5:Association of Comprehensive Knowledge and Practice to Background of Participants

Variables & categories	Comprehensive practice (n=637)		(P< 0.05)	Comprehensive		(P< 0.05)
	Good (%)	Poor (%)		Good (%)	Poor (%)	
Sub regions						
Shieb	3 (2.7)	107 (97.3)	0.000	7 (6.4)	103 (93.6)	0.000
Ghindae	143 (92.9)	11 (7.1)		33 (21.4)	121 (78.6)	
Foro	115 (66.1)	59 (33.9)		10 (5.7)	164 (94.3)	
Afabet	159 (79.9)	40 (20.1)		16 (8)	183 (92)	
Gender						
Male	315 (66)	162 (34)	0.923	44 (9.2)	433 (90.8)	0.133
Female	105 (65.6)	55 (34.4)		22 (13.8)	138 (86.3)	
Age						
< 20	15 (32.6)	31 (67.4)	0.000	5 (10.9)	41 (89.1)	0.931
20 – 39	147 (62.8)	87 (37.2)		23 (9.8)	211 (90.2)	
40 - 59	160 (72.1)	62 (27.9)		23 (10.4)	199 (89.6)	
≥ 60	94 (72.3)	36 (27.7)		15 (11.5)	115 (88.5)	
Educational level						
Illiterate	230 (65.5)	121 (34.5)	0.086	31 (8.8)	320 (91.2)	0.479
Primary	102 (62.2)	62 (37.8)		18 (11)	146 (89)	
Junior	35 (62.5)	21 (37.5)		8 (14.3)	48 (85.7)	
Secondary & above	49 (79)	13 (21)		9 (14.5)	53 (85.5)	
Total	420 (65.9)	217 (34.1)		66 (10.4)	571 (89.6)	

Table 6: Logistic Regression Analysis for Comprehensive Knowledge (Good/Poor)

Variables	Categories	Odds ratio	P - value	95 % CI.	
				Lower	Upper
Sub regions	Shieb	0.007	0.000	0.002	0.023
	Ghindae	3.270	0.001	1.617	6.615
	Foro	0.490	0.003	0.307	0.783
	Afabet	Reference			
Age	20 - 39	2.846	0.001	1.521	5.325
	40 - 59	4.346	0.000	2.294	8.234
	≥ 60	4.398	0.000	2.216	8.728
	< 20	Reference			

Table 7: Logistic Regression Analysis for Comprehensive Practice (Good/Poor)

Variables	Categories	Odds ratio	P - value	95 % CI.	
				Lower	Upper
Sub regions	Shieb	0.777	0.592	0.310	1.951
	Ghindae	3.119	0.000	1.617	6.615
	Foro	0.697	0.388	0.308	1.580
	Afabet	Reference			

Discussion

The objective of this study was to determine the prevalence, knowledge, attitude and practice of brucellosis in livestock owners in the NRS region. The overall sero-prevalence of brucellosis in the community was 2.4 % (CI: 1.3-3.6). The prevalence of brucellosis in the study areas was varied with the highest level (3.9 %) in Ghindae sub-region.To the contrary sub-regions Ghindae showed high odds of comprehensive knowledge (OR=3.27; P=0.001) and good practice (OR=3.12; P=0.000). This relatively good knowledge and practice of the participants can partly be linked with the broadly spoken information about brucellosis in Ghindae and its vicinity as the result of frequently had seen out breaks and hospitalization of brucellosis cases during the years 2019/20 [24]. The occurrence of comparatively highest (3.9%) sero-prevalence in the participants from the Ghindae sub-region, probability was due the presence of relatively higher animal brucellosis in this sub-region. However this needs further investigation to determine the real disease burden in animals in the studied areas.It is also worthy to note that in some of the study villages the sero-positivity rate was as high as 9.1% (Fig.2).The current study showed that the prevalence of brucellosis was slightly higher (2.8%) among male respondent aged 20 to 39 years compared to the other group of age. This result showed similarity to other study where a high prevalence of brucellosis (22.8%) among the study participants aged 16-35 years reported by the authors [8]. This could be mainly due to the high exposure of this age group resulting from frequent contact with their animals, animal products and birth materials. Family members in this age group are most commonly taking care of their animals and actively performing all related activities in the farms, as it is evidenced in this study.Notably, sero-prevalence obtained in this study was lower related to the result of a study conducted earlier in Eritrea [12]. In that previous study, a prevalence rate of 3.0% in the pastoral community and 4.5% in veterinary personnel was reported. Moreover, prevalence of the current study was very low compared to the results reported in a similar study conducted in Afar (48.3%) and in Somali (34.9%) regions, Ethiopia which has similar environmental setting and husbandry system [16]. In South Sudan sero-prevalence of 27.2 % was reported by the authors [18]. However, the result of the present study was higher than the result obtained (0.6%) from a similar study conducted in Tanzania [17]. In the current study, further statistical analysis could not be done on the sero-prevalence results as the number of positive samples was very low (n=15/637). In general, the low prevalence rate observed in the current study, may be was due to a low prevalence level of brucellosis in livestock species in the study area, which needs further investigation.

Majority of the study participants (73.3%) had heard the disease brucellosis before and about two third (71.1%) of them responded that humans can be infected from animals. Most of them(68.8%) knew the presence of treatment for humans and vaccination for animals.This implies that considerable high percentage of the live stock owners with in the studied are aware of the disease but still need more awareness raising campaign to further increase their knowledge to the level required and improve their good practice on handling the disease. A similar study in Egypt showed that 83.2% of the participants had heard of a disease named brucellosis and 96.3% of them correctly answered that brucellosis is transmitted from animals to humans (3). To the contrary, another study reported that 85% of the farmers had never heard of brucellosis [19].

According to the respondents' answer, largest proportion (90.3%) of them handled and disposed birth materials and placenta of animals bare-handed. This shows that,the majority of the community members are exposed to potential risks of brucellosis, as explained in similar study conducted and reported by the authors [3].Majority of the study participants (64.7%) believed that their family members are at risk of acquiring brucellosis if their animals are infected with brucellosis and said that would have serious consequence. Nearly all participants (97.5%) were interested to get more information about brucellosis and to acquire it through health professionals (57.6%). This record was higher compared to other study where only 63% of the participants were interested to get more information about brucellosis. This indicates that even though the farmers in our study have good level of knowledge and poor practice, they are keen to further improve their awareness on the subject. This suggests that the community would have good potential for contribution towards control of brucellosis in the study area [19].

Most of the study participants (56.2%) disposed aborted fetuses and /or fetal membranes by feeding to dogs and/or leaving them in the open field.Similar study showed that 62.5% of the farmers fed fetal membranes to dogs and never disinfected abortion sites [20]. In the same community, their comprehensive good practice was 10.4%. This could partly show that their level of practice on handling of aborted material was poor, which could pose to further risks of infection as dogs can mechanically drag the placenta and aborted materials leading to further contamination of the environment and increasing the risk of infection to other susceptible species [25].

Although majority of the study participants had the knowledge that brucellosis is transmitted by uncooked meat and/or milk but about one third of the respondents drank fresh milk or yoghurt and most of them do not boil the milk before selling/consuming it. This result was similar to other study where 92.5% of the farmers believed that brucellosis could be transmitted through drinking contaminated milk and had good knowledge on brucellosis. However, many of them processed the milk into cheese and other dairy products without pasteurizing it [3] which showed poor practice. This indicates that only knowledge without proper practice is not worthy enough to reduce transmission of brucellosis in a community. Finding of this study therefore may warrant for urgent intervention in terms of regularly educating the community and enabling them to take preventative measures in controlling the spread of brucellosis in animals and humans.

Conclusion

In this study, the livestock owners showed good level of comprehensive knowledge and poor practice towards brucellosis. Sub-region and age were found as important factors associated with comprehensive knowledge and practice of the participants. The overall sero-prevalence of brucellosis in livestock owners in the study area was low, but considerable high rate in some spot areas. Respondents from Sub-region Ghindae showed relatively higher level of prevalence rate, comprehensive knowledge and good practice to wards brucellosis.

Recommendations

The study recommends urgent educational campaign to increase the community knowledge and improve their good practice habit on brucellosis. Conduct regular testing of animals and implement feasible control measures against brucellosis. Illegal and unsafe milk product sellers must be controlled by the concerned competitive authority. Veterinarians, public health authorities and community leaders need to collaborate and work jointly to control the disease in animals and reduce the risk of human exposure.

List of Abbreviations

C-ELISA- competitive enzyme linked immunosorbent assay
CSPro - Census and Survey Processing System
NAPHL- National Animal and Plant Health Laboratory
MoA- Ministry of Agriculture
RBPT - Rose Bengal plate test
SPSS- Statistical Package for the Social Sciences

Declarations

Ethical Approval and Consent to Participate

Approval was obtained from the Ministry of Health Ethical Committee and written consent was obtained from the study participants

Consent for Publication

Authors agreed and approved for publication but consent not applicable

Availability of Data and Materials

Supplementary data will be available as needed by direct request to the corresponding author

Competing of Interest

Authors declare that they have no competing interest to disclose.

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Authors' Contribution

The proposal was first designed by BT, FK, SW and EG. Then, all the authors have participated on drafting the final form of the proposal. All authors have participated in supervision and coordinating during data collection. EG analyzed, supervised and coordinated blood sample tests. The sample size and CSPro design was done by FK. Data was entered in CSPro by BT and AD. The SPSS analysis of data was conducted by FK. All authors have contributed by analyzing and interpreting the results and editing the final form of the manuscript. Finally, all authors have read and approved the final form of the manuscript.

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