ORIGINAL RESEARCH ARTICLE

Knowledge and Practices Among Livestock Owners Regarding Brucellosis- A Cross-Sectional Study

Kalluru Arjun Reddy[1], Sulakshana S Baliga[2*], Soumya S[3], Rangaveni Bogolu[4]

[1,2,3]Jawaharlal Nehru Medical College, Belagavi, India
[4]Siddhartha Institute of medical sciences and research center, Begur, India

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ABSTRACT

Background: Brucellosis is one of the earliest identified and most prevalent zoonotic diseases of bacterial origin with 5, 00, 000 human cases every year globally. Cases reported are only the tip of the iceberg because of the non-specificity in clinical manifestations and chronicity in complications. The study was conducted to determine the knowledge and practices regarding brucellosis among livestock owners and to determine the sero-prevalence of brucellosis in livestock owners.

Methods: A cross-sectional study was conducted among 256 livestock owners. Knowledge and practices were assessed using two-point assessment. Anti-brucellosis IgG and IgM antibodies were tested by slide agglutination test and in turn, were confirmed by standard tube agglutination test.

Results: Almost 70% of participants had poor knowledge and followed poor practices**.** Participants with intermittent fever (aOR: 0.2465), joint pains (aOR: 0.1418), and a history of abortions in their animals (aOR: 0.2303) were less likely to have poor knowledge. Illiterate participants (aOR: 11.9512) and those without a cowshed (aOR: 7.1445) were more likely to have poor knowledge about brucellosis. Participants with low socio-economic status (aOR: 17.3726), those who had heard about brucellosis through radio/television (aOR: 3.7746), those with primary-level education (aOR: 13.9779), and illiterate participants (aOR: 43.9506) more likely to follow poor practices. Participants with a history of symptoms like intermittent fever (aOR: 0.1338) and a history of abortions in their animals (aOR: 0.052) were less likely to follow poor practices related to brucellosis. ($p< 0.05$).

Conclusion: The study participants had a poor understanding of brucellosis and high levels of risky practices, all of which contributed to the risk of contracting brucellosis.

Keywords: Knowledge, Practices, Livestock Owners, Brucellosis

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***Correspondence:** Dr. Sulakshana Shridhar Baliga (Email: baliga1983@rediffmail.com)

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INTRODUCTION

Brucellosis (Malta fever, Undulant fever, Mediterranean fever) is one of the earliest identified diseases of bacterial origin with more than 5,00,000 human cases every year globally.[1] The Food and Agriculture Organization (FAO), World Health Organization (WHO) and World Organization for Animal Health (OIE) consider brucellosis as one of the most prevalent zoonosis in the world.[2] Brucellosis is endemic in Asia, Latin America, Mediterranean regions and Africa including India.[3] Human brucellosis global incidence varies from less than 0.01 to greater than 200 per 1 lakh population. In India, it varies from 0.8% in Kashmir to 26.66% in Ludhiana. The prevalence of animal brucellosis in India is 24.3% approximately.[4] Brucella is caused mainly by Brucella melitensis (goats), and B. abortus (cattle).[5]

In humans, the portal of entry of pathogens is by ingestion of raw milk/ milk products and meat of infected animals, inhalation by droplet/ aerosol route and direct contact with contaminated materials like aborted foetuses, foetal membranes and vaginal secretions.[6] So farmers, abattoir workers, veterinarians, butchers, and laboratory workers are at higher risk because of occupational exposure.[7] In animals brucellosis is characterized by late abortions, weak calves, infertility, placentitis and epididymitis.[1] In humans, symptoms and signs are nonspecific and are characterized by pyrexia of unknown origin, sweats, malaise, headache, anorexia, arthralgia, backache, arthritis and epididymal-orchitis.[4] In the long run, brucellosis can become a chronic disease with osteoarticular-related complications.[8] Disease is often under-reported and underdiagnosed because of nonspecific symptoms and similarity to malaria or typhoid fever clinical manifestations.[2] The cases reported are only the ' tip of an iceberg'. It was estimated that the incidence maybe 25 times more than the reported incidence.[9]

From many studies,[1,2,6] it was concluded that lack of knowledge and improper practices regarding brucellosis were the significant reasons for acquiring infection. For effective control of the disease, adequate knowledge regarding causes, mode of transmission, signs, symptoms, vaccination and appropriate practices regarding brucellosis are needed. For effective implementation of the National Control Program on Brucellosis (NCPB) and other disease control programs, it is essential to understand the brucellosis burden and awareness about the disease. Majority of the Indians live in close proximity to domestic animals, putting them at risk for brucellosis. Therefore, people who act as animal handlers are always at greater risk of contracting brucellosis because of their constant chances of exposure to the infected animals. Hence the present study is planned to determine knowledge and practices regarding brucellosis among high-risk groups (livestock owners) and the sero-prevalence of brucellosis among them to develop more effective management and control measures.

The study was conducted with objectives to determine the knowledge and practices regarding brucellosis among livestock owners and to determine the sero-prevalence of brucellosis in livestock owners.

METHODOLOGY

This is a Cross-sectional study conducted from October 2023 to January 2024. Sample size was calculated by using n= $4pq/d^2$ using prevalence of 20%[3], and absolute error of 5%. 256 livestock owners residing in Vantamuri village under the field practice area of the Department of Community Medicine, JNMC, KAHER, Belagavi were chosen as study participants.

Study participants were chosen by using simple random sampling method. Family member responsible for handling livestock was interviewed using a predesigned and pre-tested questionnaire. Information regarding socio-demographic details, knowledge about brucellosis in animals, potential routes of transmission to humans, preventive practices regarding processing of milk/ consumption of dairy products, regarding handling of suspected or aborted animals was enquired. Knowledge was assessed using a two-point assessment (1- yes, 2- no), and Practices were assessed using a two-point assessment (1- practising, 2- not practising).

5 ml of blood was drawn from each participant and transported in cold box with ice packs in it within 2-3 hours of collection to the microbiology department for serological analysis of brucellosis. Anti-brucellosis IgG and IgM antibodies were tested by slide agglutination test using the antigen (manufactured by Tulip Diagnostics, Goa) and in turn, were confirmed by standard tube agglutination test (titre ≥ 1:160 confirmed as significant).[5] Pilot study was done among 25 livestock owners to confirm that the questionnaire was appropriate. The Chronbach's alpha coefficient, a measure of internal consistency was 0.8, indicating good reliability. Written informed consent was obtained from each participant. Ethical clearance was obtained from the Institutional Ethics Committee, letter number: MDC/ JNMCIEC/ 227 dated 7/ 11/ 2022.

Data was entered into an EXCEL sheet and analysed using R software version 4.1.2. Categorical variables are given in the form of frequency table. Continuous variables are given in the form of Mean ± SD/median (minimum, maximum). 75th percentile of the knowledge and practice score was used to categorize into good and poor**.** To compare continuous variables over a group, t-test was used. To check the association between categorical variables, Chi-square test was used. To find the factors affecting knowledge and practices, logistic regression was used. Spearman's correlation test was used to determine the

correlation between knowledge and practices. P< 0.05 was taken as statistically significant.

RESULTS

In this study sero-prevalence of brucellosis in the participants was 2.3%. The mean age of the livestock owners was 39.93±10.26 years. Majority of them were male (72.27%). 49.22% were illiterate and more than half (57.03%) belonged to the socio-economic class III (57.03%) according to modified BG prasad classification (2023). Average number of family members was six. Majority (75.39%) had medium (3- 10) to large (> 10) sized farms but only 25.78% had cow sheds. Majority of the animal handlers did not vaccinate their livestock for brucellosis (84.38%) and reported a relatively high number of abortions in their livestock (21.09%). Only 25.78% of the farmers had heard about brucellosis and the sources of information were Radio/ television, local veterinarians, family members and other farmers.

Table 1: Factors associated with knowledge of livestock owners towards brucellosis

Variables	Knowledge category		Total	p-value
	Poor (score <16) (%)	Good (score ≥16) (%)		
Age (in years)	40.59±9.88	38.16±11.07	39.93±10.26	0.090[t]
Age category				
20-30	26 (13.98)	18 (25.71)	44 (17.19)	0.119[MC]
30-40	66 (35.48)	27 (38.57)	93 (36.33)	
40-50	60 (32.26)	13 (18.57)	73 (28.52)	
50-60	25 (13.44)	7 (10)	32 (12.5)	
60-70	7 (3.76)	4 (5.71)	11 (4.3)	
≥ 70	2 (1.08)	1 (1.43)	3 (1.17)	
Gender				
Male	132 (70.97)	53 (75.71)	185 (72.27)	0.449
Female	54 (29.03)	17 (24.29)	71 (27.73)	
Education				
Illiterate	106 (56.99)	20 (28.57)	126 (49.22)	<0.001*[MC]
Primary	56 (30.11)	26 (37.14)	82 (32.03)	
Secondary	21 (11.29)	15 (21.43)	36 (14.06)	
Collegiate	3 (1.61)	9 (12.86)	12 (4.69)	
No of Family members				
≤ 6	137 (73.66)	50 (71.43)	187 (73.05)	0.720
> 6	49 (26.34)	20 (28.57)	69 (26.95)	
SES				
I	8 (4.3)	6 (8.57)	14 (5.47)	0.419[MC]
II	46 (24.73)	19 (27.14)	65 (25.39)	
III	107 (57.53)	39 (55.71)	146 (57.03)	
IV	25 (13.44)	6 (8.57)	31 (12.11)	
No of cows				
≤ 5	174 (93.55)	58 (82.86)	232 (90.63)	0.008*
> 5	12 (6.45)	12 (17.14)	24 (9.38)	
No of buffaloes				
≤ 5	176 (94.62)	67 (95.71)	243 (94.92)	0.765[MC]
> 5	10 (5.38)	3 (4.29)	13 (5.08)	
No of goats				
≤ 5	153 (82.26)	47 (67.14)	200 (78.13)	0.009*
> 5	33 (17.74)	23 (32.86)	56 (21.88)	
Type of Farm				
Small	58 (31.18)	19 (27.14)	63 (24.61)	0.011*
Medium	94 (50.54)	26 (37.14)	131 (51.17)	
Large	34 (18.28)	25 (35.71)	62 (24.22)	
Cow Shed				
Absent	161 (86.56)	29 (41.43)	190 (74.22)	<0.001*
Present	25 (13.44)	41 (58.57)	66 (25.78)	
Intermittent Fever				
No	184 (98.92)	67 (95.71)	251 (98.05)	0.133[MC]
Yes	2 (1.08)	3 (4.29)	5 (1.95)	
Joint pains				
No	166 (89.25)	61 (87.14)	227 (88.67)	0.635
Yes	20 (10.75)	9 (12.86)	29 (11.33)	
Headache				
No	178 (95.7)	66 (94.29)	244 (95.31)	0.748[MC]
Yes	8 (4.3)	4 (5.71)	12 (4.69)	
Body pains				
No	176 (94.62)	68 (97.14)	244 (95.31)	0.526[MC]
Yes	10 (5.38)	2 (2.86)	12 (4.69)	

Variables	Knowledge category		Total	p-value
	Poor (score <16) (%)	Good (score ≥16) (%)		
H/O Brucellosis infection				
None	186 (100)	70 (100)	256 (100)	-
No	174 (93.55)	42 (60)	216 (84.38)	<0.001*
No of abortion				
Yes	12 (6.45)	28 (40)	40 (15.63)	
No	164 (88.17)	38 (54.29)	202 (78.91)	<0.001*MC
Was your livestock vaccinated for brucellosis				
1	5 (2.69)	4 (5.71)	9 (3.52)	
2	12 (6.45)	7 (10)	19 (7.42)	
3	1 (0.54)	7 (10)	8 (3.13)	
4	0 (0)	4 (5.71)	4 (1.56)	
5	2 (1.08)	7 (10)	9 (3.52)	
6	1 (0.54)	2 (2.86)	3 (1.17)	
8	1 (0.54)	1 (1.43)	2 (0.78)	
Have you heard about brucellosis				
No	157 (84.41)	43 (61.43)	200 (78.13)	<0.001*
Yes	39 (20.97)	27 (38.57)	66 (25.78)	
If yes, heard from				
None	157 (84.41)	43 (61.43)	200 (78.13)	<0.001*MC
Radio/ television	5 (2.69)	5 (7.14)	10 (3.91)	
local veterinarian	11 (5.91)	14 (20)	25 (9.77)	
Family members	4 (2.15)	1 (1.43)	5 (1.95)	
Other farmers	9 (4.84)	7 (10)	16 (6.25)	

Abbreviations: MC: Monte-Carlo's simulation used in Chi-square test; *- p <0.05

Table 2: Factors associated with practices of livestock owners towards brucellosis

Variables	Practice category		Total	p-value
	Poor (score <15.25)	Good (score ≥15.25)		
Age (in years)	41.35±10.07	35.66±9.69	39.93±10.26	<0.001*t
Age category				
20-30	25 (13.02)	19 (29.69)	44 (17.19)	
30-40	64 (33.33)	29 (45.31)	93 (36.33)	
40-50	63 (32.81)	10 (15.63)	73 (28.52)	<0.001*MC
50-60	30 (15.63)	2 (3.13)	32 (12.5)	
60-70	7 (3.65)	4 (6.25)	11 (4.3)	
≥ 70	3 (1.56)	0 (0)	3 (1.17)	
Gender				
Male	135 (70.31)	50 (78.13)	185 (72.27)	0.226
Female	57 (29.69)	14 (21.88)	71 (27.73)	
Education				
Illiterate	102 (53.13)	24 (37.5)	126 (49.22)	
Primary	68 (35.42)	14 (21.88)	82 (32.03)	<0.001*MC
Secondary	20 (10.42)	16 (25)	36 (14.06)	
Collegiate	2 (1.04)	10 (15.63)	12 (4.69)	
No of Family members				
≤ 6	138 (71.88)	49 (76.56)	187 (73.05)	0.464
> 6	54 (28.13)	15 (23.44)	69 (26.95)	
SES				
I	9 (4.69)	5 (7.81)	14 (5.47)	
II	42 (21.88)	23 (35.94)	65 (25.39)	0.028*MC
III	113 (58.85)	33 (51.56)	146 (57.03)	
IV	28 (14.58)	3 (4.69)	31 (12.11)	
No of cows				
≤ 5	177 (92.19)	55 (85.94)	232 (90.63)	0.137
> 5	15 (7.81)	9 (14.06)	24 (9.38)	
No of buffaloes				
≤ 5	184 (95.83)	59 (92.19)	243 (94.92)	0.319MC
> 5	8 (4.17)	5 (7.81)	13 (5.08)	
No of goats				
≤ 5	151 (78.65)	49 (76.56)	200 (78.13)	0.727
> 5	41 (21.35)	15 (23.44)	56 (21.88)	
Type of Farm				
Small	61 (31.77)	16 (25)	77 (30.08)	
Medium	90 (46.88)	30 (46.88)	120 (46.88)	0.430
Large	41 (21.35)	18 (28.13)	59 (23.05)	

Variables	Practice category		Total	p-value
	Poor (score <15.25)	Good (score ≥15.25)		
Cow Shed				
Absent	155 (80.73)	35 (54.69)	190 (74.22)	<0.001*
Present	37 (19.27)	29 (45.31)	66 (25.78)	
Intermittent Fever				
No	187 (97.4)	64 (100)	251 (98.05)	0.353MC
Yes	5 (2.6)	0 (0)	5 (1.95)	
Joint pains				
No	166 (86.46)	61 (95.31)	227 (88.67)	0.052
Yes	26 (13.54)	3 (4.69)	29 (11.33)	
Headache				
No	183 (95.31)	61 (95.31)	244 (95.31)	0.999MC
Yes	9 (4.69)	3 (4.69)	12 (4.69)	
Body pains				
No	180 (93.75)	64 (100)	244 (95.31)	0.078MC
Yes	12 (6.25)	0 (0)	12 (4.69)	
H/O Brucellosis infection				
None	192 (100)	64 (100)	256 (100)	-
Was your livestock vaccinated for brucellosis				
No	174 (90.63)	42 (65.63)	216 (84.38)	<0.001*
Yes	18 (9.38)	22 (34.38)	40 (15.63)	
No of abortion				
0	156 (81.25)	46 (71.88)	202 (78.91)	0.366MC
1	7 (3.65)	2 (3.13)	9 (3.52)	
2	14 (7.29)	5 (7.81)	19 (7.42)	
3	5 (2.6)	3 (4.69)	8 (3.13)	
4	2 (1.04)	2 (3.13)	4 (1.56)	
5	5 (2.6)	4 (6.25)	9 (3.52)	
6	1 (0.52)	2 (3.13)	3 (1.17)	
8	2 (1.04)	0 (0)	2 (0.78)	
Have you heard about brucellosis				
No	169 (88.02)	31 (48.44)	200 (78.13)	<0.001*
Yes	23 (11.98)	33 (51.56)	56 (21.88)	
If yes, heard from				
None	169 (88.02)	31 (48.44)	200 (78.13)	<0.001*MC
Radio/ television	3 (1.56)	7 (10.94)	10 (3.91)	
local veterinarian	9 (4.69)	16 (25)	25 (9.77)	
Family members	2 (1.04)	3 (4.69)	5 (1.95)	
Other farmers	9 (4.69)	7 (10.94)	16 (6.25)	

Abbreviations: MC: Monte-Carlo's simulation used in Chi-square test; *- p< 0.05

Table 3: Association of practices with knowledge of brucellosis among livestock owners

Variables	Knowledge category		Total	p-value
	Poor (%)	Good (%)		
Do you wash hands after milking the animals				
Never	24 (12.9)	3 (4.29)	27 (10.55)	<0.001*
Sometimes	132 (70.97)	26 (37.14)	158 (61.72)	
Always	30 (16.13)	41 (58.57)	71 (27.73)	
Do you boil the milk before consumption				
No	73 (39.25)	10 (14.29)	83 (32.42)	0.001*
Yes	113 (60.75)	60 (85.71)	173 (67.58)	
How do you handle or dispose the birth material				
Both	7 (3.76)	23 (32.86)	30 (11.72)	<0.001*
None	94 (50.54)	17 (24.29)	111 (43.36)	
Only Gloves	85 (45.7)	30 (42.86)	115 (44.92)	
What do you do with aborted foetus				
Bury or burn				
No	91 (48.92)	14 (20)	105 (41.02%)	<0.001*
Yes	95 (51.08)	56 (80)	151 (58.98%)	
Feed to dogs				
No	173 (93.01)	67 (95.71)	240 (93.75%)	0.557 MC
Yes	13 (6.99)	3 (4.29)	16 (6.25%)	
Throw in water canals				
No	174 (93.55)	68 (97.14)	242 (94.53%)	0.384MC
Yes	12 (6.45)	2 (2.86)	14 (5.47%)	

Variables	Knowledge category		Total	p-value
	Poor (%)	Good (%)		
Throw in streets				
No	145 (77.96)	67 (95.71)	212 (82.81%)	<0.001*MC
Yes	41 (22.04)	3 (4.29)	44 (17.19%)	
Sell in market				
No	186 (100)	70 (100)	256 (100%)	-
Sell to butcher				
No	107 (57.53)	52 (74.29)	159 (62.11%)	0.013*
Yes	79 (42.47)	18 (25.71)	97 (37.89%)	
Slaughter in the house				
No	186 (100)	70 (100)	256 (100%)	-
Measures taken if an animal detected with brucellosis/ disease				
Slaughter it				
No	159 (85.48)	33 (47.14)	192 (75%)	<0.001*
Yes	27 (14.52)	37 (52.86)	64 (25%)	
Call veterinarian				
No	61 (32.8)	5 (7.14)	66 (25.78%)	<0.001*
Yes	125 (67.2)	65 (92.86)	190 (74.22%)	
Vaccinate it				
No	63 (33.87)	6 (8.57)	69 (26.95%)	<0.001*
Yes	123 (66.13)	64 (91.43)	187 (73.05%)	
Isolation				
No	172 (92.47)	42 (60)	214 (83.59%)	<0.001*
Yes	14 (7.53)	28 (40)	42 (16.41%)	
Disinfection				
No	145 (77.96)	24 (34.29)	169 (66.02%)	<0.001*
Yes	41 (22.04)	46 (65.71)	87 (33.98%)	
Sell it				
No	56 (30.11)	42 (60)	98 (38.28%)	<0.001*
Yes	130 (69.89)	28 (40)	158 (61.72%)	
Local medicine				
No	65 (34.95)	48 (68.57)	113 (44.14%)	<0.001*
Yes	121 (65.05)	22 (31.43)	143 (55.86%)	
Where do you dump the dung of your animals				
Specific dumping area	84 (45.16)	11 (15.71)	95 (37.11)	<0.001*
surrounding areas	102 (54.84)	59 (84.29)	161 (62.89)	

Abbreviations: MC: Monte-Carlo's simulation used in Chi-square test; *- p< 0.05

In this study poor knowledge regarding brucellosis was documented among 186 (72. 66%) participants. Almost 41.8%, 77.3%, 59.77% and 63.67% of the respondents were not aware that abortion, retained placenta, infertility and decreased milk production respectively could be the symptoms in animals. Whereas, 34.77% and 50.78% of the respondents identified joint pains and intermittent fever respectively as the symptoms in humans. 23.83%, 60.16%, 60.94%, 23.05%, 38.67% and 31.25% of respondents believed that living in close proximity to animals, consumption of unpasteurized milk and milk products, eating improperly cooked meat, direct contact with an infected animal, and contact with birth products of an infected animal and mating with infected animals respectively as possible routes of transmission. 55.47% of the respondents believed that traditional medicine could treat brucellosis. 60.94%, 64.06%. 29.3%, 35.94%, 55.47% and 31.64% of the respondents believed that consumption of pasteurized milk products, proper cooking of meat, burying the carcasses, killing/ burning the infected animals, vaccination and isolation of the infected ones respectively could prevent the spread of brucellosis. In the present study total knowledge score was found to be 10.22±7.8 with a median score of 11 (range 0-28).

In this study poor practices were documented among 192 (75%) participants. Only 72.27%, 32.42% and 88.28% of the respondents were following poor practices like washing their hands always after milking the animals, boiling of milk before consumption and wearing protective gloves and masks when handling the birth material respectively. When asked about the disposal of an aborted foetus, burying/ burning it, feeding it to dogs, throwing it in water canals, selling it to a butcher and throwing it in streets were reported by 58.98%, 6.25%, 5.47%, 37.89% and 17.19% of respondents respectively. When an animal gets detected with brucellosis/disease, slaughtering it, calling veterinarian, vaccination, Isolation, disinfection, selling the animal and local medicine were reported by 25%, 74.22%, 73.05%, 16.41%, 33.98%, 61.72% and 55.86% of respondents respectively. 62.89% of the respondents dumped the animal dung in surrounding areas. Total practice score was found to be 11.9±4.46 with a median score of 13 (range 2-19).

In this study no association was found between the knowledge and the factors like age, gender, number of family members, socio-economic status and history of symptoms in livestock owners and in animals ($p > 0.05$).

Table 4: Logistic regression analysis for factors associated with poor knowledge towards brucellosis

Variables	UOR (CI)	p- value	AOR (CI)	p-value
Age	1.0247 (0.9967, 1.0553)	0.09	1.0124 (0.9562, 1.0725)	0.670
Gender				
Male	1	-	1	-
Female	1.2754 (0.6882, 2.4485)	0.450	0.7727 (0.2632, 2.2842)	0.637
No of Family members				
> 6	1	-	1	-
≤ 6	1.1184 (0.5976, 2.0451)	0.724	1.9772 (0.5944, 6.5298)	0.260
SES				
I	1	-	1	-
II	1.8158 (0.5343, 5.9467)	0.324	1.052 (0.1366, 7.6967)	0.960
III	2.0577 (0.6415, 6.2946)	0.207	0.87 (0.1004, 6.986)	0.896
IV	3.125 (0.7811, 12.9391)	0.107	1.684 (0.147, 19.9951)	0.674
No of cows				
> 5	1	-	1	-
≤ 5	3 (1.2674, 7.1133)	0.011*	0.822 (0.1355, 4.9836)	0.830
No of buffaloes				
> 5	1	-	1	-
≤ 5	0.7881 (0.1728, 2.6683)	0.723	0.3701 (0.0325, 4.0543)	0.410
No of goats				
> 5	1	-	1	-
≤ 5	2.2689 (1.2076, 4.2319)	0.010*	1.1109 (0.2896, 4.0434)	0.874
Type of Farm				
Small	2.2446 (1.0858, 4.7152)	0.030*	0.9386 (0.1966, 4.4197)	0.935
Medium	2.6584 (1.3554, 5.2491)	0.004*	1.021 (0.2398, 4.1855)	0.977
Large	1	-	1	-
Intermittent Fever				
No	1	-	1	-
Yes	0.0626 (0.0249, 0.1358)	<0.001*	0.2465 (0.0783, 0.7007)	0.011*
Joint pains				
No			1	-
Yes	0.077 (0.039, 0.1455)	<0.001*	0.1418 (0.053, 0.3534)	<0.001*
Headache				
No			1	-
Yes	0.7416 (0.2256, 2.8532)	0.635	1.013 (0.1209, 9.8989)	0.990
Body pains				
No			1	-
Yes	1.9318 (0.4931, 12.7784)	0.403	0.3715 (0.0419, 5.5552)	0.409
No of abortion				
No			1	-
Yes	0.0633 (0.0214, 0.1503)	<0.001*	0.2303 (0.0595, 0.7501)	0.020*
Have you heard about brucellosis				
Yes	1		1	-
No	3.3994 (1.8224, 6.3657)	0.001*	1.1478 (0.2623, 5.4822)	0.857
If yes, heard from				
local veterinarian	1	-	1	-
Radio/ television	1.2727 (0.2861, 5.7)	0.747	1.324 (0.1398, 13.7955)	0.808
Family members	5.0909 (0.6387, 107.4302)	0.170	0.9097 (0.0142, 114.328)	0.970
Other farmers	1.6364 (0.4645, 5.9714)	0.445	0.6984 (0.089, 5.67)	0.732
None	4.6469 (1.9772, 11.1955)	0.045*	NA	NA
Education				
Collegiate	1	-	1	-
Primary	2.4607 (1.2683, 4.8411)	0.008*	4.2757 (0.5204, 53.2319)	0.212
Secondary	3.7857 (1.6658, 8.6142)	0.001*	4.7371 (0.4981, 66.5877)	0.208
Illiterate	15.9 (4.3295, 76.5271)	<0.001*	11.9512 (1.4471, 150.6083)	0.033*
Cow Shed				
Present	1	-	1	-
Absent	9.1048 (4.879, 17.444)	<0.001*	7.1445 (2.4337, 22.8712)	<0.001*
Was your livestock vaccinated for brucellosis				
Yes	1	-	1	-
No	9.6667 (4.6417, 21.2524)	<0.001*	2.536 (0.7167, 9.0876)	0.147

Abbreviations: UOR- Unadjusted Odds Ratio; AOR- Adjusted Odds Ratio; CI- Confidence Interval; *- p< 0.05

Table 5: Logistic regression of factors associated with poor practices towards brucellosis

Variables	UOR (CI)	p-value	AOR (CI)	p-value
Age	1.0671 (1.0328, 1.106)	<0.001*	0.4858 (0.1779, 1.3113)	0.153
Gender				
Male	1	-	1	-
Female	1.5079 (0.7888, 3.0296)	0.229	1.1548 (0.372, 3.4379)	0.798
No of Family members				
> 6	1	-	1	-
≤ 6	0.7823 (0.3949, 1.4846)	0.465	0.3162 (0.0389, 2.2931)	0.264
SES				
I	1	-	1	-
II	1.0145 (0.2834, 3.3065)	0.981	0.8841 (0.1127, 6.809)	0.905
III	1.9024 (0.5528, 5.9096)	0.277	4.6805 (0.3842, 68.7891)	0.239
IV	5.1852 (1.0665, 29.6676)	0.046*	17.3726 (2.046, 208.8015)	0.013*
No of cows				
> 5	1	-	1	-
≤ 5	1.9309 (0.7732, 4.5889)	0.143	2.3609 (0.3847, 13.5652)	0.338
No of buffaloes				
> 5	1	-	1	-
≤ 5	1.9492 (0.5703, 6.0732)	0.257	0.275 (0.0675, 0.9944)	0.058
No of goats				
> 5	1	-	1	-
≤ 5	1.1274 (0.5618, 2.1775)	0.727	0.4733 (0.1191, 1.7269)	0.269
Type of Farm				
Small	1.6738 (0.7667, 3.6883)	0.196	1.2938 (0.4716, 3.6868)	0.621
Medium	1.3171 (0.6526, 2.6164)	0.434	0.8951 (0.2083, 3.7281)	0.879
Large	1	-	1	-
Intermittent Fever				
No	1	-	1	-
Yes	0.3688 (0.199, 0.6644)	0.011*	0.1338 (0.0412, 0.3877)	<0.001*
Joint pains				
No			1	-
Yes	0.2475 (0.1355, 0.4449)	<0.001*	0.7644 (0.0903, 7.4363)	0.808
Headache				
No			1	-
Yes	1 (0.2877, 4.6144)	0.999	NA	NA
Body pains				
No			1	-
Yes	NA	NA	1.3165 (0.455, 3.9217)	0.614
No of abortion				
No			1	-
Yes	0.3327 (0.17, 0.6207)	<0.001*	0.052 (0.0107, 0.2141)	<0.001*
Have you heard about brucellosis				
Yes	1		1	-
No	7.8219 (4.0977, 15.273)	<0.001*	1.1729 (0.0962, 12.7089)	0.895
If yes, heard from				
local veterinarian	1	-	1	-
Radio/ television	0.7619 (0.1377, 3.5351)	0.736	3.7746 (1.332, 10.9714)	0.013*
Family members	1.1852 (0.1366, 8.5129)	0.866	NA	NA
Other farmers	2.2857 (0.6424, 8.5473)	0.206	0.6442 (0.0562, 6.9084)	0.715
None	9.6918 (4.0125, 24.8098)	<0.001*	1.9699 (0.3518, 11.7436)	0.444
Education				
Collegiate	1	-	1	-
Primary	24.2857 (5.6606, 169.9137)	< 0.001*	13.9779 (1.7145, 169.3786)	0.020*
Secondary	6.25 (1.3972, 44.6029)	0.029*	1.3984 (0.2846, 6.7869)	0.676
Illiterate	21.25 (5.1887, 144.31)	< 0.001*	43.9506 (5.2158, 555.7663)	0.001*
Cow Shed				
Present	1	-	1	-
Absent	3.471 (1.8885, 6.4059)	<0.001*	0.7668 (0.2191, 2.5371)	0.668
Was your livestock vaccinated for brucellosis				
Yes	1	-	1	-
No	5.0635 (2.504, 10.3968)	<0.001*	2.536 (0.7167, 9.0876)	0.668

Abbreviations: UOR- Unadjusted Odds Ratio; AOR- Adjusted Odds Ratio; CI- Confidence Interval; *- p< 0.05

In this study no association was found between the practices and the factors like gender, number of family members, size of farm, history of symptoms in livestock owners and in animals and number of abortions (p>0.05).

Except the practices like feeding the aborted foetus to dogs and throwing them in water canals, all other factors were associated with the knowledge towards brucellosis (p< 0.05).

Participants with a history of symptoms like intermittent fever (aOR: 0.2465; p = 0.011), joint pains (aOR: 0.1418; p < 0.001), and a history of abortions in their animals (aOR: 0.2303; p = 0.0208) were 0.24 times, 0.14 times, and 0.23 times less likely to have poor knowledge about brucellosis, respectively. Illiterate participants (aOR: 11.9512; p = 0.0332) and those without a cowshed (aOR: 7.1445; p = 0.0005) were 11.95 times and 7.14 times more likely to have poor knowledge about brucellosis, respectively.

Participants with low socio-economic status (class IV) (aOR: 17.3726; p = 0.0130), those who had heard about brucellosis through radio/television (aOR: 3.7746; p = 0.0129), those with primary-level education (aOR: 13.9779; p = 0.0206), and illiterate participants (aOR: 43.9506; p = 0.0011) were 17.37 times, 3.77 times, 13.98 times, and 43.95 times more likely to follow bad practices related to brucellosis, respectively. Participants with a history of symptoms like intermittent fever (aOR: 0.1338; p = 0.0004) and a history of abortions in their animals (aOR: 0.052; p = 0.0001) were 0.13 times and 0.05 times less likely to follow bad practices, respectively.

A positive correlation was found between knowledge and practices (p < 0.0001; rho: 0.40639) that is as knowledge among livestock owners improved their practices also improved. (figure 1)

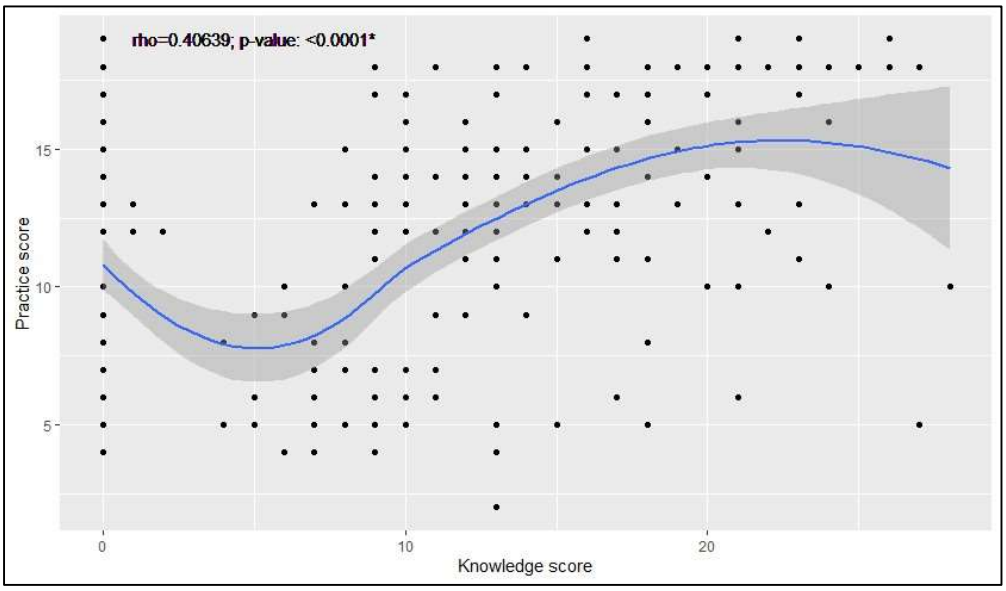

Figure1: Correlation between knowledge and practices towards brucellosis

DISCUSSION

The majority of the livestock owners who participated in this study were young, male, illiterate, and belonged to the lower-middle socio-economic status (SES) group (Table 1). The illiteracy rate among them was nearly 50%, which was consistent with the 48% reported by a study conducted in Kenya.[10] Most of the livestock owners had low to medium SES, indicating poor living conditions and limited access to health care and veterinary services in this region. Half of them had medium to large farms, but three-quarters lacked cowsheds and only 15.62% had vaccinated their animals for brucellosis. These factors increase the risk of transmission of the disease among animals and humans. The high prevalence of abortions among the animals (21.09%) suggested that brucellosis was present in their herds, as it was one of the main clinical signs. Only a quarter of the livestock owners were aware of brucellosis, which was much lower than the 59.9% reported in a study done in India.[11] This lack of knowledge hindered the prevention and control of the disease, as it could lead to delayed diagnosis and treatment, as well as insufficient biosecurity measures. In this study, most of the respondents had low awareness on brucellosis symptoms, transmission, prevention and control, and some had misconceptions and knowledge gaps. For example, many respondents thought that traditional medicine could cure brucellosis (55.47%), which is not scientifically proven. The level of knowledge in this study was higher when compared to a study conducted in Uttar Pradesh which is <40% but lower when compared to a study done in Ethiopia.[12,13] The possible reasons for the low knowledge level could be due to lack of education, public health campaigns, cultural beliefs and local prevalence of brucellosis. In addition, the respondents had limited access to vet-

erinary services and diagnostic facilities, which may affect their ability to detect and treat infected animals. This study also revealed that the respondents followed risky and unsanitary practices that exposed them and their animals to the risk of brucellosis infection and transmission. Nearly one-third of the respondents drank raw milk and very few wore gloves and masks when handling birth materials, which is consistent with previous studies 34.7% and 9.5% respectively.[12-15] However, the practices of disposing of aborted foetus, such as selling, throwing them on streets or feeding them to dogs, were better when compared to the study done in Uttar Pradesh.[12] Still, these practices are not optimal and may contaminate the environment and spread the infection to other animals and humans. Moreover, the percentage of respondents who isolated and disinfected the animals detected with brucellosis was similar to previous studies.[12-14] More than half of animal handlers used local medicine to treat the infection in their cattle, which may further increase the risk and complications. All these factors indicate that the respondents did not adopt adequate measures to prevent and control brucellosis in their animals. The farmers in this study had poor knowledge of brucellosis, as only 27.34% of them scored well. This is below the average score of > 30% found in a study done in Ethiopia[16] but above 20% reported by the study done in Ethiopia.[13] Factors positively associated with good knowledge were higher education, larger farms, source of information about brucellosis, presence of cowshed, vaccination and higher number of abortions (Table 1) and are similar to the studies conducted in India and Ethiopia.[12-14] These factors may reflect the level of exposure, interest, and access to information on brucellosis among the farmers. On the other hand, these factors may also imply that the farmers lacked awareness, motivation, and resources to learn about brucellosis. Only 25% of the animal handlers in this study followed good practices for brucellosis prevention, which is lower than the 38.3% reported by a study done in Ethiopia and Northeast Portugal,[13,17] but consistent with the study done in Tajikistan.[18] The younger participants, being more educated, having higher SES, having a cow shed, vaccinating their livestock, and had heard about brucellosis were more likely to adopt good practices than those who did not (Table 2) and these findings are similar to previous studies.[12,13] This study revealed that those with good knowledge were more likely to adopt good practices (Table 3). These practices are similar to the guidelines of the World Health Organization and the Centres for Disease Control and Prevention.[19,20] However, the adoption of these practices was lower when compared to other studies.[12-14] Interestingly, boiling milk before consumption, a good practice, was less common among those with good knowledge in the study done in Assam and Bihar.[14] Moreover, according to this study, disposing of animal dung in nearby areas, a poor practice, was more prevalent among those with good knowledge. These practices may reflect the socio-cultural and environmental factors that affect the behaviour of the respondents. On an overall basis, absence of at least one symptom, h/o abortions, low literacy status, absence of cowshed and low socio-economic status were significantly associated with good knowledge and practices on brucellosis after adjusting for other factors (Tables 4 and 5) and similar associations were documented in the studies done in India and Ethiopia.[12,17,18]

Limitations

This study has relied on self-reported data from the participants, which may be subject to recall bias or social desirability bias. This study is a cross-sectional design, which does not allow for causal inference or temporal relationship between the variables.

Conclusion

In this study, sero-prevalence of brucellosis was 2.3%. Absence of at least one symptom, poor literacy status, absence of animal shed, low socio- economic status and not having information about brucellosis from efficient channel were associated with poor knowledge and practices. A positive correlation was found between knowledge and practices towards brucellosis which shows that by improving knowledge towards brucellosis, practices also can be improved.

Recommendations

Knowledge can be improved among livestock owners regarding safe and hygienic practices for prevention and treatment of brucellosis through targeted interventions like customised campaigns and extension services which will in turn increase the adoption of preventive practices. More interaction with veterinarians and training on animal management may be an important tool in reducing transmission of disease. Setting up a strong system for monitoring of animals, recording of positive cases, and compulsory livestock vaccination can help in control of transmission of disease.

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