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Original Research Article

A study on knowledge, attitude, and practices related to brucellosis among small-scale dairy farmers in a rural area of Belagavi, Karnataka

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ABSTRACT

Background: Brucellosis remains a significant zoonotic disease affecting livestock productivity and human health in India. Despite the high burden in Karnataka, little is known about farmers' knowledge, attitudes, and practices (KAP) in rural Belagavi. This study aimed to assess KAP related to brucellosis among small-scale dairy farmers to identify behavioural gaps influencing disease transmission.

Methods: A community-based cross-sectional study was conducted among 188 small-scale dairy farmers in rural Belagavi. Data were collected using a pre-tested structured questionnaire covering socio-demographic characteristics and KAP components. Descriptive statistics were used to summarise responses, and associations were assessed using Chi-square or Fisher's exact tests.

Results: Awareness of brucellosis was limited, with 53.2% having never heard of the disease and 52.4% demonstrating poor knowledge scores. Most participants were unaware of zoonotic transmission (84.6%) or human symptoms (76.1%). Despite these gaps, attitudes were predominantly positive, with all participants scoring within the favourable range. Several risky practices were identified: 93.6% sold unpasteurized milk, protective measures during handling of aborted materials were minimal, and only 6.9% reported adopting any preventive or vaccination-related precautions. Although 96.8% sought veterinary care for sick animals, most relied on family advice for general animal health decisions.

Conclusions: Farmers exhibited substantial knowledge gaps and unsafe practices despite positive attitudes toward disease prevention. Strengthening community-based education, improving awareness of zoonotic risks, and promoting safe livestock-handling behaviours are essential for effective brucellosis control in this high-risk population.

Keywords: Attitude, Brucellosis, Dairy farmers, Knowledge, Practices, Zoonosis

INTRODUCTION

Brucellosis is a major bacterial zoonotic disease that continues to threaten both livestock productivity and human health worldwide. In cattle, it causes abortions, prolonged calving intervals, and reduced milk production, leading to considerable economic losses for farmers and the dairy sector. Humans may acquire the infection through consumption of unpasteurised dairy products or through direct contact with infected animals and contaminated materials such as placenta, urine, dung, or carcasses.[1-4] In many low- and middle-income countries, including those in South and Central Asia, brucellosis remains endemic and contributes significantly to the burden of disease among rural communities.[2-4]

Human brucellosis presents with non-specific symptoms such as fever, sweating, weakness, joint pain, lymphadenopathy, and weight loss, which often leads to delayed recognition and underdiagnosis.[3] In India, the

disease affects multiple livestock species including cattle, buffalo, goats, sheep, and pigs, and those working closely with animals-such as farmers, veterinarians, animal handlers, and abattoir workers-are at particularly high risk of exposure[4]. Risky farming behaviours linked to poor knowledge, attitudes, and practices (KAP) further contribute to the disease's persistence and spread at the community level.[4]

India carries one of the highest burdens of brucellosis globally. Karnataka is among the most affected states, and recent investigations reported prevalence ranging from 4% to 18% across districts, with Belagavi district recording the highest prevalence at 18%.[5] Given Belagavi's prominence as a major milk-producing region, this high disease burden is especially concerning. Yet, despite the public health and economic implications, there is limited community-level evidence on farmers' understanding of brucellosis and their preventive behaviours. This lack of locally relevant data represents a significant barrier to designing effective interventions.

Although the Government of India launched the Brucellosis Control Programme in 2010 to reduce transmission and economic losses, the success of such efforts depends heavily on farmers' awareness, perceptions, and adoption of safe practices.[5] Studies from different settings-including Palestine, Ethiopia, Iran, South Africa, Sri Lanka, Bangladesh, Uganda, and others-consistently show that farmers often have low awareness of zoonotic transmission, inadequate attitudes toward prevention, and engage in high-risk behaviours such as consuming raw milk, handling aborted materials without protection, and improper disposal of foetuses.[1-15] Similar patterns have been reported in Indian studies as well, where poor knowledge, lack of protective measures, and high-risk practices remain common among dairy farmers.[16-18] These findings highlight the importance of understanding the local behavioural and knowledge context in high-burden areas.

Belagavi, with its high prevalence of bovine brucellosis and large population of small-scale dairy farmers, represents a critical setting where targeted KAP assessments are essential. However, little is known about how farmers in this region perceive the disease, manage sick animals, or implement preventive measures such as vaccination and hygienic practices during milking or while handling aborted materials. Addressing these knowledge gaps is crucial for improving disease control and reducing transmission risks at the human-animal interface.

In this context, the present study was conducted to assess the knowledge, attitudes, and practices related to brucellosis among small-scale dairy farmers in a rural area of Belagavi, Karnataka. The findings from this study aim to generate evidence needed to inform locally appropriate health education strategies and strengthen brucellosis prevention and control efforts in this high-risk population.

METHODS

Study design

A community-based cross-sectional study was conducted to assess the knowledge, attitude, and practices (KAP) related to brucellosis among small-scale dairy farmers residing in a rural area of Belagavi, Karnataka.

Study setting

The study was conducted in selected rural villages of Belagavi district, Karnataka, India. Data collection was conducted from July 2023 to February 2024, and the overall study period spanned March 2023 to March 2024. The setting primarily consisted of smallholder dairy households engaged in cattle rearing. Recruitment, interviews, and data collection took place at the farmers' residences or cattle-rearing sites.

Inclusion criteria

Small-scale dairy farmers involved in cattle rearing. Family members aged ≥18 years involved in cattle-related activities.

Exclusion criteria

Individuals unwilling to provide informed consent.

Sampling strategy

Participants were selected using a convenience sampling technique from eligible households in the study area. A total of 188 participants were included.

Variables

The primary outcome variables included knowledge, attitude, and practice scores related to brucellosis. Knowledge was assessed through questions on transmission, causative organism, symptoms, vaccination, and treatment. Attitude was measured using statements answered on a three-point Likert scale (agree, neutral, disagree), and practice was assessed based on daily cattle-handling and biosecurity-related behaviours. Socio-demographic variables such as age, gender, religion, education, marital status, family income and family size served as predictor variables, while factors such as education level, age, and income were considered potential confounders.

Data sources and measurement

Data were collected using a pre-designed and pre-tested structured questionnaire administered through face-to-face interviews. The tool comprised four sections: socio-

demographic characteristics, knowledge regarding brucellosis, attitude towards brucellosis, and practices related to cattle handling and milk consumption. The questionnaire was validated through a pilot study involving 10% of the sample, and appropriate revisions were made before final use. All participants received the same questionnaire, ensuring uniformity of measurement across the study.

Bias control

Multiple steps were taken to minimize bias. The use of a validated questionnaire reduced measurement bias, while face-to-face interviews ensured clarity of questions and prevented incomplete responses. Confidentiality was maintained to minimize socially desirable answers, particularly for practice-related questions. No incentives were offered to avoid coercion or participation bias.

Study size

The required sample size was estimated using a 95% confidence interval and an allowable error of 15%. The formula applied was:

$$N = \frac{Z_{1-\alpha/2}^2 \times SD^2}{(0.15 \times SD)^2} \times 1.1$$

Where $Z_{1-\alpha/2} = 1.96$ for a 95% confidence level, and the multiplication factor 1.1 accounts for an anticipated 10% attrition rate. Based on these parameters, the initial calculated sample size was 170. After adjusting for attrition, the final sample size required for the study was 188 participants.

Quantitative variables

Knowledge scores were categorized as poor (0-2), average (3-6), and good (7-10). Attitude scores were classified as positive (22-45) or negative (0-22). Practice scores were categorized as good (5-8) or poor (1-4). Socio-demographic variables such as age, income, and education were grouped into meaningful categories to facilitate analysis and interpretation.

Statistical methods

All responses were coded and entered into Microsoft Excel and subsequently analyzed using SPSS version 20. Descriptive statistics in the form of frequencies and percentages were used to summarize all categorical variables. Associations between socio-demographic characteristics and knowledge, attitude, and practice scores were explored using the Chi-square test, and Fisher's exact test was applied where cell counts were small. There were no missing data because all questionnaires were interviewer-administered and checked for completeness at the time of data collection. Sensitivity analyses were performed by re-running statistical tests using Fisher's exact test for validation in cases of small expected frequencies.

RESULTS

A total of 188 participants were included in the study. The socio-demographic characteristics of the participants are presented in Table 1.

The study included a total of 188 participants. The age distribution showed that 16.9% were between 18-25 years, 31.7% were 26-35 years, 15.4% were 36-45 years, 12.7% were 46-55 years, 16.8% were 56-65 years, and 6.5% fell within the 66-80 years age group. Regarding gender, 51.9% of participants were male and 48.1% were female. In terms of religion, 96.8% of the participants belonged to the Hindu community, whereas 3.2% were Muslims. With respect to education, 33.7% had completed primary schooling, 34.0% had completed secondary schooling, 14.8% were graduates, and 17.5% were illiterate. A majority of participants (82.6%) were married, 14.9% were unmarried, and 2.5% were widowed. Monthly household income distribution revealed that 73% earned below ₹25,000; 19.2% earned between ₹25,000-50,000; 3.4% earned between ₹50,000-1,00,000; and 4.4% earned above ₹1,00,000. Family size showed that 54% resided in households consisting of 1-5 family members, while 46% lived in households with 6-9 members.

Table 1: Socio-demographic profile of participants (n=188).

Variable	Category	Frequency	Percentage
Age group (years)	18-25	32	16.9
	26-35	60	31.7
	36-45	29	15.4
	46-55	24	12.7
	56-65	31	16.8
	66-80	12	6.5
Gender	Male	98	51.9
	Female	90	48.1
Religion	Hindu	182	96.8
	Muslim	6	3.2
Education	Primary school	63	33.7
	Secondary school	64	34.0
	Graduate	28	14.8
	Illiterate	33	17.5
Marital status	Married	156	82.6
	Unmarried	28	14.9
	Widow	4	2.5
Monthly household income (INR)	Below 25,000	138	73.0
	25,000-50,000	36	19.2
	50,000-1 lakh	6	3.4
	Above 1 lakh	8	4.4
Family size	1-5 members	102	54.0
	6-9 members	86	46.0

Table 2: Knowledge-related responses of participants (n=188).

Knowledge Item	Category/response	Frequency	Percentage
Heard about brucellosis	Yes	88	46.8
	No	100	53.2
Source of information	Book	26	13.8
	Relatives/Friends	37	19.7
	Television	4	2.1
	Veterinarian	19	10.1
	Do not know	102	54.3
Animals that can be infected	Cattle/Sheep/Goat	50	26.6
	All mammals	35	18.6
	Do not know	103	54.8
Brucellosis infects humans	Yes	49	26.1
	No	9	4.8
	Do not know	130	69.1
Transmission: Animal to animal	Yes	83	44.1
	No	105	55.9
Transmission: Animal to human	Yes	29	15.4
	No	159	84.6
Causative organism	Virus	1	0.5
	Bacteria	29	15.4
	Do not know	158	84.0
Symptoms in humans	Fever	22	11.7
	Skin lesions	20	10.6
	Headache	3	1.6
	Do not know	143	76.1
Awareness about animal vaccination	Yes	167	88.8
	No	20	10.6
	Do not know	1	0.5
Cattle infected previously	Yes	49	26.1
	No	139	73.9
Treatment given for infected cattle	Antibiotic/operation/vaccine	49	26.1
	Not applicable	139	73.9
Overall knowledge score	Poor (0-2)	99	52.4
	Average (3-6)	42	22.2
	Good (7-10)	47	24.9

In Table 2, awareness of brucellosis showed that 46.8% had heard of the disease, whereas 53.2% had never heard of it. Among those who were aware, sources of information varied: 13.8% reported books, 19.7% cited relatives or friends, 2.1% television, 10.1% veterinarians, and 54.3% stated they did not know any source of information. When asked which animals could be infected, 26.6% mentioned cattle, sheep, or goats, 18.6% believed all mammals could be infected, and 54.8% reported not knowing. Regarding infection in humans, 26.1% stated it could infect humans, 4.8% believed it could not, and 69.1% did not know. Knowledge of routes of transmission showed that 44.1% believed animal-to-animal transmission occurs, while 55.9% did not. For animal-to-human transmission, 15.4% responded yes, whereas 84.6% responded no. Knowledge of the causative organism indicated that 0.5% thought a virus was responsible, 15.4% correctly identified bacteria, and 84% did not know. Regarding symptoms in humans, 11.7% identified fever, 10.6% identified skin lesions, 1.6% identified headaches, and 76.1% could not identify any symptom. Awareness of animal vaccination was high, with 88.8% reporting that they were aware, 10.6% unaware, and 0.5% uncertain. About 26.1% reported that their cattle had previously been infected, while 73.9% reported no prior infection. Treatment methods reported by those with infected cattle showed 26.1% used antibiotics, operations, or vaccines, while 73.9% marked this category as not applicable. Based on knowledge scoring, 52.4% demonstrated poor knowledge (0-2 score), 22.2% had average knowledge (3-6 score), and 24.9% had good knowledge (7-10 score).

In Table 3, regarding attitudes toward the economic impact of brucellosis, 4.3% strongly agreed, 30.3% agreed, and 65.4% remained neutral, with no participants disagreeing.

Table 3: Attitude-related responses of participants (n=188).

Attitude statement	Response category	Frequency	Percentage
Brucellosis causes economic loss	Strongly agree	8	4.3
	Agree	57	30.3
	Neutral	123	65.4
	Disagree	0	0
	Strongly disagree	0	0
Brucellosis is common in India	Strongly agree	7	3.7
	Agree	44	23.4
	Neutral	137	72.9
	Disagree	0	0
	Strongly disagree	0	0
Spread from bovine to sheep/goat	Strongly agree	14	7.4
	Agree	37	19.7
	Neutral	133	70.7
	Disagree	4	2.1
	Strongly disagree	0	0
Spread from sheep/goat to bovine	Strongly agree	12	6.4
	Agree	22	11.7
	Neutral	149	79.3
	Disagree	4	2.1
	Strongly disagree	1	0.5
Control programme will be successful	Strongly agree	7	3.7
	Agree	76	40.4
	Neutral	104	55.3
	Disagree	1	0.5
	Strongly disagree	0	0
Submit infected cattle to slaughterhouse	Strongly agree	1	0.5
	Agree	20	10.6
	Neutral	76	40.4
	Disagree	78	41.5
	Strongly disagree	13	6.9
Tagging helps track disease	Strongly agree	10	5.3
	Agree	61	32.4
	Neutral	117	62.2
Willing to pay for vaccination if cheaper	Strongly agree	72	38.3
	Agree	101	53.7
	Neutral	15	8.0
	Disagree	0	0
	Strongly disagree	0	0
Insured farmers more likely to vaccinate	Strongly agree	10	5.3
	Agree	71	37.8
	Neutral	106	56.4
	Disagree	1	0.5
	Strongly disagree	0	0
Overall attitude score	Negative (0-22)	0	0
	Positive (22-45)	188	100

Responses regarding brucellosis being common in India showed that 3.7% strongly agreed, 23.4% agreed, and 72.9% were neutral. For disease spread from bovine to sheep/goat, 7.4% strongly agreed, 19.7% agreed, 70.7% were neutral, and 2.1% disagreed. Similarly, for spread from sheep/goat to bovine, 6.4% strongly agreed, 11.7% agreed, 79.3% remained neutral, 2.1% disagreed, and 0.5% strongly disagreed. Regarding control programmes, 3.7% strongly agreed, 40.4% agreed, 55.3% were neutral, and 0.5% disagreed. When asked about submitting infected cattle to slaughterhouses, 0.5% strongly agreed, 10.6% agreed, 40.4% were neutral, 41.5% disagreed, and

6.9% strongly disagreed. For tagging infected cattle, 5.3% strongly agreed, 32.4% agreed, and 62.2% were neutral.

Regarding willingness to pay for a cheaper vaccination, 38.3% strongly agreed, 53.7% agreed, and 8% were neutral. For the item about livestock insurance influencing vaccination decisions, 5.3% strongly agreed, 37.8% agreed, 56.4% were neutral, and 0.5% disagreed. Overall attitude scoring showed that 100% of the participants fell within the positive attitude range (22-45 score), and none fell into the negative range (0-22 score).

In Table 4, regarding milk-related practices, 93.6% reported selling unpasteurized milk, while 6.4% did not. For personal consumption, 6.4% consumed unpasteurized milk, whereas 93.6% did not. During calving, 28.2% reported that males assisted, 62.8% that female assisted, and 9% reported assistance from both. When facing animal health issues, 48.9% discussed them with family members, 3.7% with neighbours, and 47.3% with veterinarians. The handling of aborted fetuses showed that 91.5% buried them, 7.4% threw them away, and 1.1% called a veterinarian. During animal abortion, 88.8% reported calling a veterinarian as the protective measure, 2.7% washed hands, and 8.5% used gloves. Regarding measures taken when purchasing new livestock, 47.9% relied on the advice of other farmers, 3.7% consulted experts, 29.8% consulted veterinarians, and 18.6% relied on their own knowledge. When cattle became sick, 96.8% sought veterinary care, while 3.2% did not know what to do. Only 6.9% reported taking vaccination or personal precautionary measures, while 93.1% reported no such measures. Among those taking precautions, 2.1% used injections and 4.8% used tablets, while 93.1% reported this as not applicable. Based on practice scoring, 46% demonstrated poor practices (1-4 score), and 53.4% demonstrated good practices (5-8 score).

Table 4: Practice-related responses of participants (n=188).

Practice Item	Response	Frequency	Percentage
Sell unpasteurised milk	Yes	176	93.6
	No	12	6.4
Consume unpasteurised milk	Yes	12	6.4
	No	176	93.6
Person assisting during calving	Male	53	28.2
	Female	118	62.8
	Both	17	9.0
Discussion of animal health problems	Family	92	48.9
	Neighbours	7	3.7
	Veterinarian	89	47.3
Handling of aborted foetus	Bury	172	91.5
	Throw away	14	7.4
	Call veterinarian	2	1.1
Protection during abortion	Call veterinarian	167	88.8
	Wash hands	5	2.7
	Use gloves	16	8.5
Measures for new livestock	Advice from farmers	90	47.9
	Expert opinion	7	3.7
	Veterinarian advice	56	29.8
	Own knowledge	35	18.6
Action when cattle are sick	Seek veterinarian	182	96.8
	Do not know	6	3.2
Vaccination or precautions taken	Yes	13	6.9
	No	175	93.1
Type of precaution taken	Injection	4	2.1
	Tablet	9	4.8
	Not applicable	175	93.1
Overall practice score	Poor (1-4)	87	46.0
	Good (5-8)	101	53.4

DISCUSSION

The present study assessed the knowledge, attitudes, and practices related to brucellosis among 188 small-scale dairy farmers in rural Belagavi. The socio-demographic structure showed that most participants were within the younger and middle-aged categories, with nearly equal gender distribution and mixed educational backgrounds. Similar demographic profiles have been reported in farmer-based KAP studies in India and other low- and

middle-income countries, where cattle ownership is typically shared among male and female household members and education levels vary widely.[1,2]

Knowledge

The results showed that less than half of the participants (46.8%) had heard of brucellosis, and a substantial proportion lacked awareness regarding transmission routes, zoonotic risk, clinical symptoms, and causative organism. More than half (52.4%) demonstrated poor knowledge scores. These findings are consistent with several studies across South Asia, Africa, the Middle East and India that reported similarly low levels of awareness among livestock farmers.[3,4,6,10,18] For example, Deka et al found that only a small proportion of dairy farmers in Assam and Bihar had knowledge of brucellosis and very few recognised its zoonotic potential.[18] Likewise, Kothalawala et al in Sri Lanka reported that farmers rarely understood species susceptibility or the abortion-related symptoms associated with the disease.[11] Studies from Pakistan, Ethiopia and Thailand also reported limited farmer knowledge of brucellosis despite long-standing endemicity.[6,7,19] Study's finding that 84% did not know the causative organism further mirrors reports from Uganda and Tanzania where farmers similarly lacked basic etiological understanding.[15,20] The limited ability to identify human symptoms (76% reporting "don't know") is consistent with prior evidence showing that brucellosis is often misdiagnosed or misunderstood by both farmers and frontline workers.[11]

Attitude

Despite low knowledge, this study found a universally positive attitude score among all participants. Many expressed agreement that brucellosis causes economic loss, that control programmes could be effective, and that they were willing to pay for vaccination if affordable. This pattern-poor knowledge but positive attitudes-has been documented previously.[15,21] For instance, Hiremath et al. found that although farmers in Karnataka had minimal knowledge, many still demonstrated positive attitudes toward preventive measures.[17] Similarly, studies from Jordan and Uganda reported positive perceptions toward disease control despite low awareness, suggesting farmers may be receptive to interventions when adequately informed.[15,22] This study results also showed a large proportion selecting "neutral" for many attitude items, particularly regarding interspecies transmission and culling infected animals.

Practices

The study revealed several risky practices: 93.6% sold unpasteurised milk, use of protective equipment during handling of aborted materials was minimal, most farmers relied on family or peers rather than veterinarians for advice, and only 6.9% adopted preventive measures such as vaccination or personal protection.

These unsafe practices have been widely reported in literature.[5,7,20] Chowdhury et al found that Bangladeshi dairy farmers commonly sold and consumed raw milk despite risks.[5] Pakistan-based studies reported frequent handling of aborted material without gloves and inconsistent sanitation practices similar to those observed in this sample.[7] Studies in Africa (Tanzania, Kenya, Ethiopia) also found farmers relying on informal community advice rather than professional veterinary guidance.[19,20]

However, one encouraging finding in this study was that 96.8% consulted veterinarians when cattle were sick. This aligns with evidence from Myanmar and Uganda showing that when accessible, farmers do tend to rely on veterinary services for treatment, even if they lack preventive practices.[15,16]

Interpretation of these results assumes that self-reported data accurately reflect actual farmer behaviour; however, social desirability bias may underestimate risky practices such as poor hygiene or unsafe disposal of aborted foetuses. Similar limitations have been reported in other KAP studies.[14,18] The cross-sectional nature of the study limits causal inference, and variations in local veterinary outreach, education levels, or cultural practices may influence KAP outcomes.

Contribution to knowledge

This study adds valuable evidence to the limited literature on brucellosis KAP among rural dairy farmers in Karnataka. By combining socio-demographic characteristics with detailed KAP findings, the study highlights specific deficiencies-particularly low knowledge levels and risky practices despite favourable attitudes. These results align with global trends but offer region-specific insight that can guide targeted intervention strategies for improving farmer awareness, biosecurity practices, and zoonotic disease prevention.

The findings reinforce the need for structured farmer education programmes, community-based awareness campaigns, and strengthened veterinary extension services. By clearly identifying gaps between knowledge, attitudes and practices, this study contributes to shaping future brucellosis control strategies in India and similar low-resource settings.

CONCLUSION

This study highlighted substantial gaps in knowledge and several high-risk practices related to brucellosis among small-scale dairy farmers in rural Belagavi, despite generally positive attitudes toward disease prevention. Most farmers were unaware of zoonotic transmission, human symptoms, and safe livestock-handling procedures, which contributes to ongoing risk of infection for both animals and humans. The widespread sale of unpasteurised milk, limited use of protective measures

during handling of aborted materials, and low uptake of preventive actions further underscore the vulnerability of this community. Strengthening targeted farmer education, improving veterinary extension services, and promoting accessible, community-based awareness programmes are essential to bridge the gap between attitudes and actual practices. Addressing these behavioural and informational gaps is critical for reducing brucellosis transmission, protecting farmer health, and supporting sustainable livestock productivity in high-burden regions such as Belagavi.

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