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Research Article

Knowledge and Practices Related to Brucellosis Among Farmworkers in Khartoum North, Sudan: A Cross-Sectional Assessment

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Abstract

Background: Brucellosis is a major zoonotic disease in Sudan, affecting both livestock productivity and human health. Farmworkers represent a high-risk group due to their close contact with animals and animal products. Despite the endemicity of brucellosis in Sudan, data on knowledge, attitudes, and preventive practices among farmworkers remain limited.

Methods: A cross-sectional survey was conducted among 105 farmworkers from dairy farms in Sudan. Data were collected using a structured questionnaire covering socio-demographic characteristics, knowledge of brucellosis, and farm-level preventive practices. Knowledge was assessed using ten core questions with a maximum score of 100 points, while preventive practices were scored out of 100. Chi-square tests were applied to examine associations between socio-demographic variables, knowledge, and practices.

Results: Participants were predominantly aged 19–25 years (36.2%) or over 40 years (23.8%). Nearly half (49.5%) were illiterate, and 75% resided on farms. The mean knowledge score was 30.5/100, with 85% classified as having poor knowledge, 14% moderate, and only 1% high knowledge. Key gaps included limited understanding of transmission routes and clinical signs in animals and humans. Preventive practices scored 47.5/100, with unsafe disposal of aborted materials and poor waste management being critical deficiencies. Knowledge was significantly associated with age ($p = 0.038$), residence ($p = 0.004$), and education ($p = 0.031$). Preventive practices were significantly influenced only by age ($p = 0.004$).

Conclusions: Farmworkers in Sudan demonstrated limited knowledge and suboptimal practices regarding brucellosis, highlighting the urgent need for targeted One Health-based education and capacity-building programs. Strengthening veterinary services, improving biosecurity, and promoting safe milk handling are critical to reducing zoonotic transmission risks.

Keywords: Brucellosis; Knowledge; Practice; Sudan; KAP; Farm Workers; Cross Sectional

Introduction

Brucellosis is the generic name used for the animal and human infections caused by several species of the genus *Brucella (Br)*, such as *Br. abortus, Br. melitensis,* and *Br. suis* [1]. Brucellosis considered as a biological weapon as it is highly contagious, and characterized by air-born transmission [2]. It is one of the common contagious and communicable zoonotic diseases with high rates of morbidity and lifetime sterility [3]. It has been described as one of the "great imitators" as it looks like clinical signs as many endemic diseases such as malaria and typhoid which makes it difficult to be diagnosed clinically. More than 500,000 new cases are reported in humans annually [4]. It is causing a big economic loss and public health burden especially in countries with no effective control programs [5]. Brucellosis incidence in humans was higher among those with poor knowledge and those who engage in unhygienic practices that expose them to the disease [4]. In humans, brucellosis is mainly caused by *B. meitensis* which is associated with occupational exposure or consumption of dairy products, followed by *B. abortus* and *B. suis*. The disease can show itself in three different clinical ways, which are classified according to the duration of symptoms: acute (initial 2 months), sub-acute (2-12 months), and chronic (>12 months). In Sudan, the main causative species are *B. meitensis* and *B. abortus* which are common strains in man and cause severe and prolonged disease with a disability risk [6]. Multidisciplinary interventions are needed to control the disease. Sectors such as Agriculture, Education, and Public Health officials should be included [7]. Due to the severe health impact of brucellosis in humans, especially those who are in direct contact with infected animals, with low level of education and poor existing services delivered to them, it is a must to study their level of awareness about this issue, to provide sufficient information, so the authorities should provide intensive extension services using the suitable means and putting policies and rules that help to increase their awareness. Brucellosis was found to be misdiagnosed as malaria or typhoid fever. Animal contact was found to be a significant risk factor [8]. A previous study in Sudan concerning the extension services and awareness for the smallholders showed that there are very few extension services provided and mostly by the ministries and universities [9].

Brucellosis remains highly endemic in Sudan, yet awareness and preventive practices among farmworkers—those at highest risk—are poorly understood; assessing their knowledge and behaviors is essential for designing effective public health interventions to reduce transmission.

This study aims to assess the level of knowledge and practices related to brucellosis among farmworkers in Khartoum North, and to examine how sociodemographic factors influence awareness and behaviors associated with disease prevention.

Materials and Methods

Study design and setting

This cross-sectional study was conducted between December-March 2023, in Khartoum North, Sudan, an urban area with intensive livestock activities and a high density of dairy farms and mixed-animal holdings. The study area was selected due to its known endemicity for brucellosis and the occupational risk posed to farmworkers.

Study population and sampling

Study population

The farmworkers of all ages who were doing the farm work including: Milking, cleaning, animals' welfare, and nursing.

Sample size calculation

According to [10] formula was used to calculate the unidentified population to know the sample size.

$n = Z^{2*} SD^2/e2$

n = required sample size

Z = Z-score corresponding to the desired confidence level (e.g., 1.96 for 95%)

SD = estimated standard deviation of the population

e = margin of error (the maximum allowable difference between the sample mean and the population mean).

The sample size 'n' was calculated as:

$$n = \left[\frac{1.96^2 \times 0.15^2}{0.05^2}\right] \times 3 = 105$$

Multiply by 3 causes of 3 area (east, west, north) in Khartoum North.

Data collection tools

A total of 105 farmworkers were selected. The data collection tool was a questionnaire. The questionnaire was designed by the investigator and contains; demographic characteristics, cattle on the farm, animals' brucellosis, knowledge of farmworkers about brucellosis and hygienic practice. To ensure the accuracy of the information, the data collection tool was translated from English to Arabic language. The questionnaire was revised by two consultants and a pilot study was conducted. The questionnaire was revised to make sure there were no missing data, then the data was coded and entered into SPSS.

Scoring system

The scoring system is divided into two main categories: knowledge about brucellosis and farm practices. The knowledge category comprises 10 questions assessing participants' understanding of brucellosis, while the practice category includes 8 questions evaluating participants' behaviors on the farm. The total possible score across both categories is 100. The score for each question varied depending on its importance.

Data analysis

Data of this study was analyzed using the program Statistical Package for the Social Sciences (SPSS) version 17. Crosstab used to display the variables relationships. Further descriptive statistical tests were used to determine the mode for the different studied variables and Chi-square for the significance of the association between knowledge, attitude, and practice variables. Results of the analysis presented by graphical presentation and tables based on statistical significance and correlations.

Ethical considerations

Ethical approval was obtained from the ethical committee at Ahfad University for Women, informed consent was obtained from each participant.

Results

A total of 105 farmworkers participated in the study. The largest age group was 19–25 years, representing 36.2% (n = 38) of the sample. Participants aged over 40 comprised 23.8% (n = 25), followed by those aged 31–40 (19%, n = 20). Only 4.8% (n = 5) were younger than 18 years (Figure 1). Regarding place of residence, 75% (n = 79) of participants lived on the farm premises, while the remaining 25% (n = 26) lived offsite. Nearly half of the participants were illiterate 49.5% (n = 52), 23% (n = 24) had primary education, 4.8% (n = 5) had completed intermediate school, 17.1% (n = 18) had secondary education, 1% (n = 1) held a diploma, and 3.8% (n = 4) had higher education (Figure 2). Milking was the primary occupation for 75.2% (n = 79) of respondents, while 23.8% (n = 25) were involved in animal welfare and nursing, and 1% (n = 1) worked in cleaning (Figure 3). Additionally, 46% (n = 48) reported having a secondary job besides their primary farm role. In terms of livestock breed, the majority (76.9%) managed hybrid breeds, 11.5% had local breeds, and the remaining 11.5% managed both types (Figure 4). Herd size varied, with 61% managing fewer than 200 animals and 39% managing more than 200.

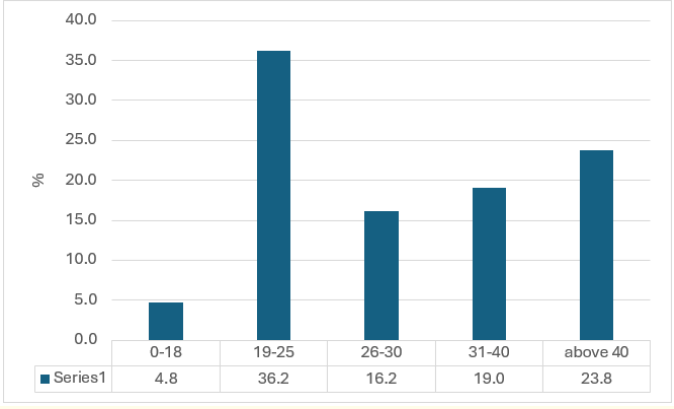

Figure 1: Distribution of Age Among the Participants (n = 105).

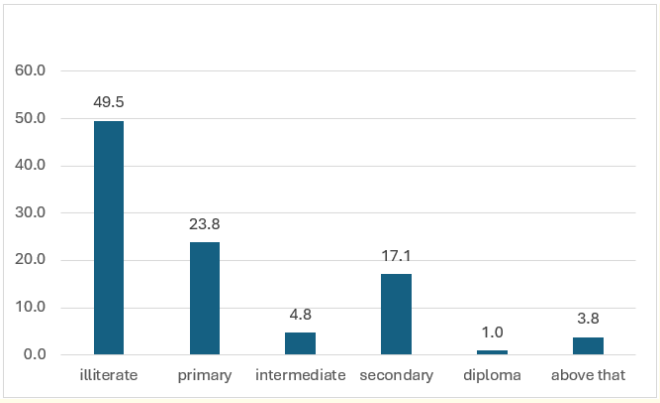

Figure 2: Distribution of the Educational Level Among Participant (n = 105).

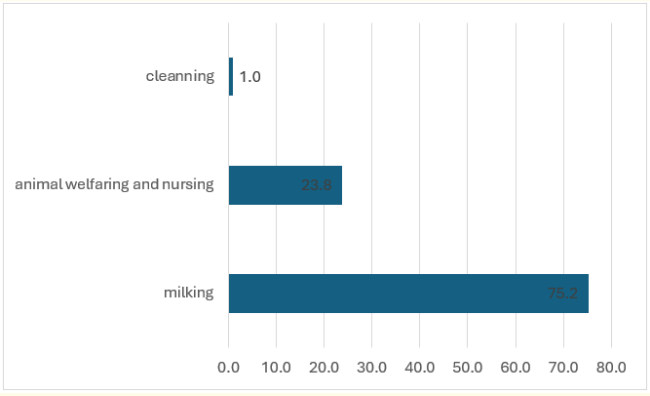

Figure 3: The Participants Main Job on the Farm (n = 105).

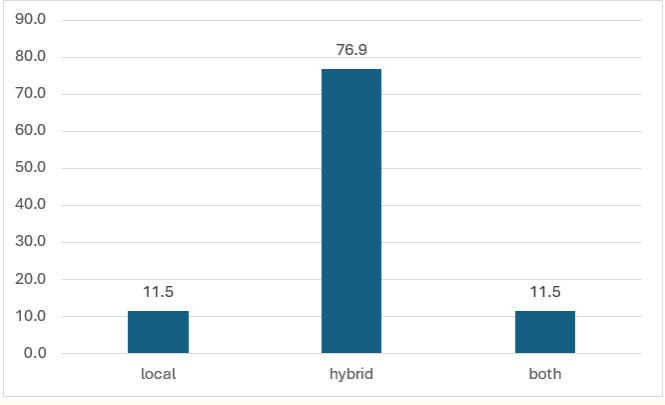

Figure 4: The Types of Breeds in the Participants' Herd (n = 105).

Participants were assessed on their knowledge of brucellosis through a structured set of ten questions, with a total maximum score of 100 points. Overall, the **total score achieved was 30.5 out of 100,** suggesting that participants had limited knowledge of brucellosis, awareness, understanding of the disease, and its transmission, symptoms, and impact on both animals and humans (Table 1). In terms of overall knowledge levels, 85% of participants demonstrated low knowledge, 14% had moderate knowledge, and just 1% showed high knowledge (Figure 5).

Activity	Maximum Score	Score Achieved
Do you hear about animal brucellosis?	10	6
What is the cause of animal brucellosis?	5	1
How does it transmit to humans?	25	10
How do you know you have brucellosis?	5	2
What are the signs of brucellosis in animals?	25	3
What animals are affected by brucellosis?	5	1
What are the symptoms in the infected person?	10	3
Do you know Malta fever?	5	3
Do you know how Malta fever affects humans?	5	1
Have you seen/heard of any person on this farm suffering from brucellosis?	5	0.5
Total	100	30.5

Table 1: Knowledge Activities, Scores, and Achievements.

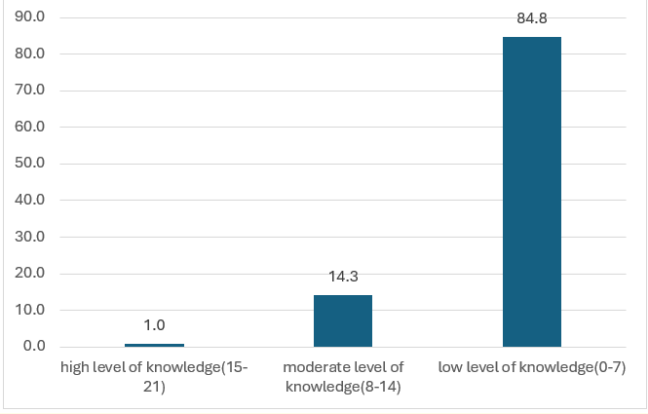

Figure 5: Distribution of knowledge among the participants (n = 105).

The participants were assessed on several farm practices related to brucellosis prevention. The maximum possible score for each question varied depending on its importance. The **maximum possible score was 100,** and the **total achieved score was 47.5,** which indicating that participants implemented less than half of the recommended practices to prevent brucellosis on farms (Table 2).

Cross-tabulation was used to examine the relationships between sociodemographic characteristics and participants' knowledge and practices. Knowledge levels showed statistically significant associations with: Age group (p = 0.038): Place of residence (on/off farm) (p = 0.004) : Educational level (p = 0.031). No statistically significant differences in knowledge were observed across other demographic variables (Table 3). Regarding preventive practices, only age group showed a significant association (p = 0.004). Other variables, including education and residence, did not show significant effects on reported practices.

Table 2: The Participants Practice in the Farms to Avoid Brucellosis.

Variables	Maximum Score	Score Achieved
What do you do if you have a fever?	5	4
Do you have a veterinary doctor on the farm?	5	3
How do you prepare for farm work?	5	3
How do you get rid of farm waste?	10	0.5
What do you do to the aborted fetuses and placenta?	35	6
What is the milking method used on the farm (for milkers)?	5	1
Do you milk cows if you have an injury in your hands (for milkers)?	5	3
How do you treat milk you produce before you consume it?	30	27
Total	100	47.5

Table 3: Crosstabulation of Knowledge *socio-Demographics of the Participants by Using Chi2 to Test Significance (n = 105).

Variable	Knowledge			P-value
	High Level of Knowledge (15-21)	Moderate Level of Knowledge (8-14)	Low Level of Knowledge (0-7)	
Age:				
0-18	0.0%	0.0%	5.6%	
19-25	0.0	0.0	42.7	0.038
26-30	0.0	33.3	13.5	
31-40	0.0	26.7	18	
above 40	100	40	20	
Residence:				
Inside farm	0.00	46.7%	80.9%	0.004
Outside farm	100	53.3	19.1%	
Educational level:				
Illiterate	0.0	13.3	52.8	
Primary	100	33.4	24.7	
Intermediate	0.0	13.3	3.4	0.031
Secondary	0.0	20	16.9	
Diploma	0.0	0.0	1.1	
Above that	0.0	20	1.1	

Discussion

Brucellosis is a neglected, zoonotic, pandemic bacterial disease [11,12]. It presents as acute febrile illness or chronic debilitating form. It affects both animals and humans [13]. Brucellosis is highly prevalent in developing countries, where poor hygiene, utilization of raw dairy products, and less well-developed public health programs are present [6].

The findings of this study highlight significant knowledge and practice gaps regarding brucellosis among farmworkers in Sudan. Although 80% of participants had heard of brucellosis, the overall knowledge score was low (30.5/100), with 85% of respondents demonstrating poor knowledge compared to [14] who reported 55.5% and 39.3% that indicated by [15] in Sudan. We can attribute this low level of knowledge to the high illiteracy rate among the study participants which was 49.5%, also the farmers are less likely to receive any form of educations whether formal or even in the form of health awareness campaigns. Regardless of this low level of knowledge, a high scoring (6/10) of the participants stated that they heard about brucellosis, this is a relatively high level of awareness towards the existence of the disease compared to the study done in Namibia province, Angola which is 11.5% [7], but it is similar to the study of South Africa which was found 60% [16], and its low compared to [17] who found 79% of the participants had heard of brucellosis, this level of awareness is due to the high endemicity of Brucellosis in Sudan. This mirrors earlier reports from Sudan, where awareness among high-risk groups such as dairy workers, pastoralists, and abattoir staff was consistently found to be limited despite the endemic nature of the disease [18-20]. Similar knowledge gaps have been reported in neighboring Ethiopia, where only 27% of livestock owners recognized brucellosis as a zoonotic disease [21], and in Kenya, where brucellosis was often confused with other febrile illnesses [22]. These consistent patterns underscore a regional challenge in translating veterinary and medical knowledge into community-level awareness.

Demographic factors were strongly associated with knowledge levels. Younger workers (19–25 years) and those with formal education performed better than older and illiterate workers. Residence on the farm was also linked with poorer knowledge, suggesting that isolation and lack of health information flow contribute to misconceptions. Similar socio-demographic influences have been documented in Uganda [23], where education and exposure to extension services determined awareness of zoonoses. Globally, studies from Asia and the Middle East, including Saudi Arabia and Pakistan, echo these findings, stressing that literacy and health education are key determinants of brucellosis awareness [24,25].

With regard to practices, the overall score (47.5/100) suggests that less than half of recommended preventive measures are followed. Critical risk behaviors included unsafe disposal of aborted materials, poor waste management, and continuation of milking while having hand injuries. These practices create opportunities for human infection and perpetuate herd-level transmission. Similar findings were reported in Khartoum and Gezira States, where poor biosecurity and lack of veterinary oversight contributed to high seroprevalence in cattle and recurrent human cases [26,27]. In Egypt, comparable deficiencies in farm-level hygiene and handling of animal products have been implicated in sustained zoonotic transmission [28].

The high reliance on unboiled or untreated milk poses a major public health concern, as raw milk consumption has been consistently identified as a leading route of infection in Sudan and across Africa [29,30]. Encouragingly, milk boiling practices scored higher in this study and previous study by [31] but gaps in other preventive measures suggest incomplete risk mitigation.

The significant association between age, education, and knowledge but not between education and practices indicates that knowledge does not always translate into behavior. This "knowledge-practice gap" is well documented in zoonoses research [32] and highlights the need for integrated interventions that combine awareness campaigns with structural changes such as better veterinary services, provision of protective equipment, and improved farm waste disposal systems.

From a One Health perspective, the results reinforce the interconnectedness of human, animal, and environmental health in brucellosis control. In Sudan and the wider region, brucellosis remains underreported and underdiagnosed, partly due to overlapping febrile illnesses such as malaria and typhoid [33]. Effective interventions must therefore bridge veterinary and public health systems, ensuring that farmers and farmworkers are actively engaged in surveillance, biosecurity, and safe practices. Globally, successful control programs such as those in Mediterranean countries—have demonstrated that community education, combined with livestock vaccination and strict food safety measures, can reduce brucellosis burden [34].

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