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Research Article

Knowledge, Attitudes and Practices Associated with Brucellosis in Small-holder Dairy Farms in Suburbs of Khartoum State, Sudan

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Abstract

Bovine brucellosis is an infectious reproductive disease of cattle and is zoonotic. The disease has drawn interest of economists and stakeholders of animal production community in many countries due to its socioeconomic impact. The disease proved endemic in Sudan early in the nineteenth century; however, neither sustainable control strategy implemented nor countrywide extension programs were delivered. The objectives of current study were to explore the knowledge, attitudes and practices (KAP) of farmers and farm workers regarding bovine and human brucellosis in the suburbs of Khartoum state, Sudan. A structured questionnaire was used to capture farmers' and dairy farm workers' KAP relating to brucellosis. One hundred and fifty participants were interviewed and the results revealed moderate knowledge, perception and practices regarding bovine brucellosis, but low and poor understanding of the zoonotic nature of the disease among smallholder dairy farms community in the study area. The study recommends more efforts to be exerted on raising awareness of people about brucellosis in Study area and beyond when possible. In addition, further studies to explore the extent of Knowledge, perception and practices relating to brucellosis among pastoralist, transhumance and sedentary animal production system along the country will be great asset for future brucellosis control programs.

Keywords: *Brucellosis; Knowledge Attitude and Practices (KAP); Khartoum-state Sudan*

Abbreviation

KAP: Knowledge Attitude and Practices

Introduction

Brucellosis is one of the most important pervasive zoonotic illnesses in the world [1], with more than 500,000 human cases annually [2]. Bovine brucellosis is the prevailing form of the disease and accounts for enormous economic losses in animals and high morbidity in humans [3]. According to the place "where brucellosis was first described" or clinical features, the disease has many names such as Malta fever, Mediterranean fever, Undulant fever in Man and Bang's disease and abortion storm in cattle [4]. Brucellosis is a bacterial disease caused by members of the genus *Brucella*. Currently, there are twelve species described. These are *Brucella abortus* (cattle), *B. melitensis* (goats), *B. suis* (pigs), *B. canis*, *B. ovis* (sheep), *B. neotomae*. Recently six more species were also added to the genus. This include *B. ceti*, *B. pinnipedialis*, *B. inopinata*, *B. microti*, *B. papionis* and *B. vulpis* [5,6]. These pathogens are facultative intracellular and persistence within host cell results in lifetime infection [7]. Animal brucellosis usually results in reproductive failure in sexually mature animals reflected in

late trimester abortions, weak calves and infertility characterized by placentitis and epididymitis [8]. Brucellae in infected animals are excreted in uterine discharge, vaginal discharge and milk and then the bacteria can spread to other animals through ingestion of contaminated material and the disease is principally a disease of animals, where humans are accidental hosts [9,10]. The first four mentioned species conventionally known as human pathogens, although some evidence showed that other members such as the sea mammals' pathogens could cause illness in humans [9]. The disease in humans develops after ingestion or inhalation of the pathogen, or the pathogen get direct entrance through cuts and abrasions in the skin [10]. People may contract brucellosis when they consume raw milk and/or raw milk products from brucellosis-infected animals and through direct handling of contaminated materials from infected animals such as aborted foetuses, foetal membranes and vaginal secretions. As a result, people who have frequent contact with animals in areas where brucellosis is endemic are at high risk of contracting the disease [11]. Symptoms of brucellosis in human are protean, nevertheless most patients during the acute phase of the disease report fever, sweats, malaise, anorexia, headache, arthralgia, arthritis, and backache. Serious complication such as epididymoorchitis might develop among affected male patients [12].

Eradication of bovine brucellosis was achieved in many rich developed countries such as Australia, Canada, Israel, Japan and New Zealand and in many European countries [13]. However, the disease remained uncontrolled in some areas such as Africa, the Middle East and Asia [14], where the disease is still endemic. In these settings, where the disease is still endemic, the prevalence of human and animal brucellosis may remain increasing, and factors such as low awareness, poor understanding of brucellosis and absence of control policies along with limited resources could be the main culprits. In low-income countries, including Sudan, livestock animals are important for the livelihood of rural communities [14]. In urban and peri-urban areas of African countries, including Sudan, dairying viewed as important source for increased income, employment generation, food and nutrition, organic waste recycling and uplifting social status [15,16]. The awareness and understanding of brucellosis among relevant stakeholders is an important asset for the success of this business and any prospective brucellosis control strategy. Previous studies showed the existence of human and animal brucellosis in Sudan [17-26]. Compared to other states, Khartoum state has the lion share regarding population size, dairy cattle farms and herd size [27].

Aim of the Study

The aims current study were to explore the extent of knowledge, perception and practices relating to brucellosis among people owning or working in dairy cattle farms in suburban areas in Khartoum state. We believe that the findings of our study will contribute to brucellosis control programs and one-health interventions in the future in Sudan.

Methodology

Study area, study population and sample size

The study was conducted in Khartoum state, which hosts the major modernized dairy farms that specialized in commercial milk production [28] (Figure 1). Khartoum state is located at almost the northeast center of the country between 15 and 16 degrees latitude north, and between 31 and 32 degrees longitude east [29,30]. This state marks the convergence of the White Nile and the Blue Nile, where they join to form the bottom of the leaning-S shape of the main Nile as it zigzags through northern Sudan into Egypt at Lake Nasser. The northern region of the state is mostly desert because it receives barely any rainfall, whereas the other regions have semi-desert climates. The weather is rainy in the fall, and cold and dry in the winter. Khartoum State is one of eighteen states constituting the Sudan (Figure 2). Livestock population estimate in Khartoum State in 2017 was 1, 369, 603 heads (cattle 249,083; camels 6,733; sheep 454, 501 and goats 659,286) as reported by Ministry of Agriculture [27]. As it is the most populous area, Khartoum state has the highest demand for milk and milk products. We believe that this high demand constitutes a key reason for the establishment of many private modernized cattle dairy farms. Herds raised in these dairy cattle farms are frequently infected with brucellosis and their milk or milk product present serious health hazard for in contact people as well as for the community. Structured questionnaire was used to collect data from participants. The questionnaire consisted of three parts. The first part consisted of demographic characteristics of the participants, part two contained questions about knowledge on human and bovine brucellosis, part three involved questions about attitude and risky practices relating to acquisition of brucellosis in both human and animals in the study area. The questionnaire was pretested for time and clarity and was

adjusted in line with feedback from the pilot questionnaire. The study subjects included farmers, people working or frequently attending visited dairy farms were invited to participate in this study. Verbal consent was obtained from each participant before launching each interview. All participants were informed that their identities will not be disclosed, and that they are allowed to quit the interview at any stage they wish. One hundred fifty participants were interviewed based on their intention to participate in this study. This study was conducted along with another survey to collected milk for isolating brucellae in the same study area during the period September 2014 - March 2015; however, data of that survey was not included here. The collected data from questionnaire was codded and entered in SPSS 16 software and analyzed.

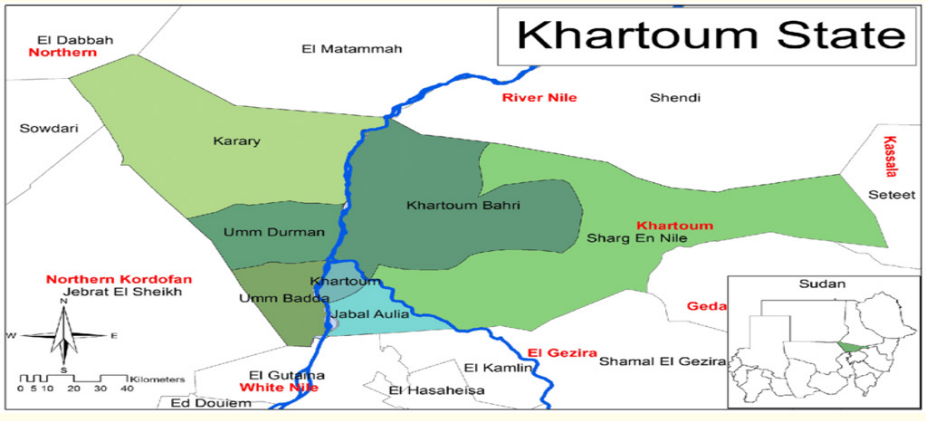

Figure 1: *Political map of Khartoum State.*

Source: https://www.google.com/search?q=khartoum+state+localities+map&tbm=isch&source=iu&ictx=1&fir=1xYv8TSzyjwHaM%253A%252CN6GAOX5V_zs39M%252C_&vet=1&usg=AI4_-kR5yhMthSZ9sfAc1XPhLkwOFMAu4A&sa=X&ved=2ahUKEwjQys6bobnhAhXM-aQKHaoCDJsQ9QEwAnoECAoQCA#imgrc=1xYv8TSzyjwHaM.

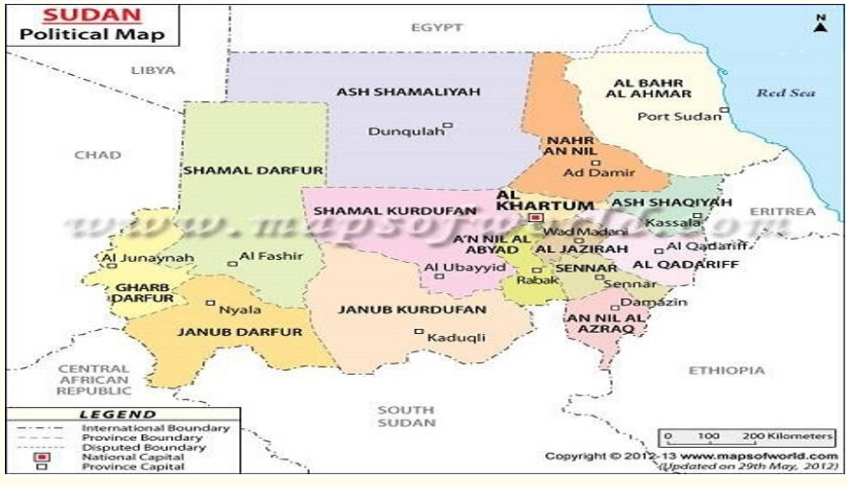

Figure 2. *Political map of Sudan.*

Source: https://www.google.com/search?tbm=isch&sa=1&ei=f3OnXKemBMPPwQKSzJjoDQ&q=sudan+political+map&oq=+sudan+political+map&gs_l=img.1.0.0j0i7i30j0i8i30.68436.68436..73598...0.0..0.319.319.3-1.....1....1..gws-wiz-img.yjazdAIIuuw#imgrc=WxRfWBU-3b3NzM.

Results

Demographic characteristics of participants

Demographic data showed that nearly all participants are males (99.3%), the majority of them (59.9%) of are married, the most dominant age range is 21 - 30 yr. (35.3%), shared housing with animals is the common mode of living (67.3%). Most of the participants (27%) have had primary education whereas 11.3% of them are university graduates (Table 1).

Feature	Category	Number	Percentage
Sex	Male	149	99.3
	Female	1	00.7
Age	11 - 20 years	31	20.7
	21 - 30 years	53	35.3
	31 - 40 years	35	23.3
	41 - 50 years	21	14.0
	51 - 60 years	6	4.0
	More than 60 years	4	2.7
Marital status	Married	89	59.3
	Single	61	40.7
Residence	Inside farm	101	67.3
	Outside farm	49	32.7
Education	Illiterate	25	16.7
	Pre-school	17	11.3
	Primary	57	38.0
	Intermediate	13	8.7
	Secondary university	21	14.0
	Graduate	17	11.3
Distribution by locality	Khartoum	41	27.3
	Jabel Awolia	9	6.0
	Bahri	9	6.0
	Shargalnile	41	27.3
	Karrari	30	20.0
	Umbada	20	13.3

Table 1: *Demographic information about the participants interviewed (n = 150).*

Herd management mal practices associated with acquisition of brucellosis in animals

Regarding risky practices associated with acquisition of brucellosis in animals, 85.3% (128 out 150) of respondents do not provide specific delivery space, 99.3 apply natural insemination for breeding their herds, 56.7% do not clean food troughs and they make no action towards abortion cases and abortion materials, 20% and 4% respectively (Table 2).

Practice	Responses	Number	Percentage
What type of herd raised	Singe breed	98	65.3
	Mixed breeds	52	34.7
Breed	Cross breed	100	66.7
	Local breed	50	33.3
Keeping animals	Mixed	40	26.7
	Age-separated	100	66.7
	Sex-separated	10	6.7
Presence of pets	yes	97	64.7
	no	53	35.3
Breeding	NI	149	99.3
	AI	1	.7
In case of NI	Have a bull	127	84.7
	borrow one	23	15.3
Specified delivery room	yes	22	14.7
	no	128	85.3
Cleaning of food trough	Yes	65	43.3
	No	85	56.7
In cases of abortion	use antibiotics	61	40.7
	consult a vet	59	39.3
	do nothing	30	20.0
Disposing abortion materials	By burying	14	9.3
	Take it to remote area	130	86.7
	Do nothing	6	4.0

Table 2: *Herd management mal practices associated with acquisition of brucellosis in animals (n = 150).*

Mal practices associated with acquisition of brucellosis in humans

The results show that 94.7% of respondents do not wash their hands before and/or after milking, 78.7 % of them milk animals without protecting gloves even when they have hand cuts, but fortunately only 29.3% and 38% of the participants do not consume raw meat and raw milk, respectively (Table 3).

Practice	Response		Number	Percentage
Consumption of raw milk	Yes		57	38.0
	No		93	62.0
Eating raw meat	Yes		44	29.3
	No		106	70.7
Do you milk animals if you have hand cuts	Yes but without gloves		118	78.7
	Yes using gloves		32	21.3
Hygiene measures	Washing hands before and after milking	Yes	8	5.3
		No	142	94.7
	Cleaning and washing udder before milking	Yes	9	6
		No	141	94

Table 3: *Mal practices associated with acquisition of brucellosis in humans (n = 150).*

Perception and knowledge about animal brucellosis

Regarding knowledge about animal brucellosis, the majority 71.3% (107 out of 150) of participants do not know any cause of abortion, although 55.3% of them have heard about brucellosis. Nevertheless, despite hearing about brucellosis, only 20% of those (53.3%) participants, claimed aware of brucellosis as a cause of abortion, and only one participant knows that the disease affects the fertility of infected animal (Table 4). This lack of knowledge about brucellosis reflected in that 70% of the participant cannot identify brucellosis-infected animals, 84% do not know how the disease is transmitted and 74.7% do not know how brucellosis could be prevented (Table 4).

Knowledge	Response	Number	Percentage
Do you know the causes of abortion	Yes	43	28.7
	No	107	71.3
If yes, what are the causes	Heat	2	4.7
	Cold	14	32.6
	Nutrition	12	27.9
	Diseases	13	30.20
	Trauma	2	4.6
Total		43	100%
Have you heard about brucellosis	Yes	85	56.7
	No	65	43.3
What are the signs of brucellosis in animals	Causes still birth	17	20.4
	Causes fever	1	1.2
	Causes abortion	53	64
	Causes diarrhea	1	1.2
	Affects man and animal	10	12.0
	Causes infertility	1	1.2
Total		83	100%
What animals affected by brucellosis	Cattle	83	55.3
	Cattle, sheep and goats	48	32.0
	Sheep and goats	19	12.7
How do you identify brucellosis-infected animal	By occurrence of abortion	85	56.7
	Decrease productivity	30	20.0
	By lab testing	9	6.0
	By animal death	4	2.6
	By loss of appetite	1	0.7
	Do not know	21	14.0
How brucellosis is transmitted	Not sure	126	84.0
	Natural insemination	11	7.3
	Contaminated food and water	13	8.7
How brucellosis could be prevented	Not sure	112	74.7
	Artificial insemination	5	3.3
	Vaccination	16	10.7
	Isolating infected animals	17	11.3

Table 4: *Knowledge about animal brucellosis.*

Perception and knowledge about human brucellosis

Regarding knowledge about human brucellosis, high percentages of respondents confessed that they used to milk animals without protective clothing even when they have hand cuts (78.7%). Moreover, they also used to consume raw milk and meat (62% and 70%%, respectively). Many participants (60.3%) also expressed that they have no knowledge that the disease is zoonotic nor it could be transmitted to humans (59.3%) and of those who claimed awareness of the zoonotic nature of brucellosis, only 58.7% do know its signs (Table 5).

Feature	Response	Number	Percentage
Milking while having hand cuts	Without gloves	118	78.7
	With gloves	32	21.3
Drinking raw milk	No	57	38.0
	Yes	93	62.0
Eating raw meat	No	44	29.3
	Yes	106	70.7
Does brucellosis infect people	yes	59	39.3
	no	91	60.7
How does it transmitted to humans	By insect bit	11	7.3 (18.6)*
	by drinking of raw milk	17	11.3 (28.9)*
	by contact with infected animal	19	12.7 (32.2)*
	By handling abortion remains	12	8 (20.3)*
	Total	59 out of 150	59.3%
What are the signs	Fatigue	6	4 (10.2)*
	fever	21	14 (35.6)*
	Back pain	1	0.7 (1.7)*
	Night sweating	3	2 (5.1)*
	Arthralgia	6	4 (10.2)*
	Headache	22	14.6 (37.8)*
	Total	59 out of 100	39.3

Table 5: *Knowledge about human brucellosis.*

Discussion

Animal health services delivered by the public-sector have greatly declined over the past 20 years in sub-Saharan Africa like Sudan [29,30]. Official reports on brucellosis control program in Sudan is not available. Not only so, but also this include most of sub-Saharan African countries, from where data control of, particularly, bovine brucellosis is dated back to 2000 [31]. Control programmes including vaccination, control of animal movements, stamping out of positive herds by slaughter has only been applied in southern Africa countries, while countries outside southern Africa vaccination is rarely conducted and if performed, it has been on an ad hoc basis, rather than as part of a coordinated national program [31]. Control programme for brucellosis in Sudan has not received the required attention, and consequently the disease has continued to spread within livestock herds. The current study tried to explore knowledge, attitude and practices relating to brucellosis among farmers and farm workers who represent an important component for any coordinated brucellosis control programme. The results of this study revealed moderate knowledge, perception and practices regarding bovine brucellosis, but

low and poor understanding of the zoonotic nature of the disease among smallholder dairy farms community. Previous studies on the magnitude of brucellosis in Khartoum state and other areas of the Sudan [17-26] indicating the existence of brucellosis almost in all the country, which would have represented a serious health hazard to both veterinary and public health communities in the country. Research studies like the current one are limited but more countrywide studies are needed to provide better understanding of the problem, and hence, contribute to better planning for surveillance, management and control of brucellosis in the country. Although more than half (56.7%) of the study population have heard about bovine brucellosis, however, only 12% were aware of its zoonotic nature. This finding could result in enormous human morbidity as farmers and workers would likely to perform risky practices in the farm level while milking or handling infectious materials. It is worth mentioning that despite 55.3% of participants who claimed have heard of bovine brucellosis, 56.7% recognized abortion as one of its clinical signs, nevertheless, the majority of them were not sure how the disease is transmitted (84%) nor how it could be prevented (74.7%). The later findings are paramount important elements for an integrated brucellosis control program [28]. It is crucial to raise the awareness of the farmers and animal workers about brucellosis if the disease spread to both animal and human hosts is to be avoided. A "One Health" framework applied to brucellosis should include stakeholders from farmers, the medical, veterinary, wildlife and sociological disciplines to provide their inputs as to come about all-inclusive perception of the disease [32].

Regarding human brucellosis, the results revealed that the majority of the participants have low knowledge and poor understanding of the disease. In this regard, 62% and 60.7% of the participants confessed that they used to drink raw milk and eat raw meat, respectively. This attitude does not seem strange as more than half (60.7%) were not aware that brucellosis infects people. Similar study in Ethiopia showed that none of the respondents to a study reported the zoonotic importance of brucellosis [33]. The zoonotic aspect of brucellosis is mostly favoured by the lack of awareness of the disease among pastoralists, the scarce collaboration between different sectors and the small investment in the control of the disease by governments in developing countries [34].

Livestock owners and animal workers in this study area were in need to be considered for education on brucellosis regarding its cause, ways of transmission, signs, control and prevention measures to minimize the risk of spread of the disease in both animal and human hosts. Further studies to explore the Knowledge, perception and practices relating to brucellosis among pastoralist, transhumance and sedentary animal production system along the country are recommended.

Conclusion

Livestock owners and animal workers in the study area have poor knowledge about brucellosis. They were in need to be educated about brucellosis, regarding its cause, transmission, signs, control and prevention measures. Such knowledge and awareness can help minimizing the risk of spread of the disease in both animal and human hosts. As the prevalence of brucellosis in Sudan is high [17-26] and considering the local context in terms of lack of funds and capacities to perform eradication programme, we recommend application of national brucellosis vaccination programme along with sero-surveillance for ten years and strict animal movements. This will pave the way for successful eradication of the disease when the prevalence drops to lower percentages. Further studies to explore the Knowledge, perception and practices relating to brucellosis among stakeholders in the existing animal production systems at national level are recommended.

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