

Human and animal brucellosis in Yemen

Abstract

The aims of this review were to characterize human and animals brucellosis epidemiology in Yemen and also guide policy makers to draw sound decisions regarding brucellosis control policies. The Seroprevalence of human brucellosis in Yemen was ranging from 0.3 to 32.3%. Nevertheless, it is suggested that a stronger inter-sectoral collaboration among pregnant women, veterinary, medical and public health professionals and country level in terms of one-health approach should be promoted. In spite of this disease is reported in humans and all domestic animals of the country, Yemeni people lack awareness about the zoonotic potential of the disease with their existing habit of raw milk consumption and close contact with domestic animals.

Keywords: Brucellosis, Human, Animal, Review, Yemen

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Abbreviations: CC, Case-Control; CFT, Complement Fixation Test; CS, Cores Sectional; ELISA, Enzyme Linked Immunosorbent Assay; RBPT, Rose Bengal Plate Test; SAT, Serum Agglutination Test; STA, Standard Tube Agglutination

Introduction

Brucellosis is a worldwide zoonotic disease affecting both animals and humans. It also known as "Malta fever", "undulant fever", or "Mediterranean fever".¹ Brucellosis caused by *Brucella* which is a small, gram-negative, coccobacilli, aerobic, facultative intracellular, non-motile, non-fermenting, non-spore-forming, non-fermenting.^{2,3} Four species cause human disease: *B. abortus* in cattle and buffalo, *B. canis* in canine, *B. suis* in pigs, and *B. melitensis* in sheep, goats and camels which is the most virulent and the principle cause of human infection.^{1,4} *Brucella* can be found in both domestic and wild animals. It is transmitted to humans through direct or indirect contact with infected animals or their products.^{1,5,6} Portals of entry of the organism are the conjunctiva respiratory mucosa and damaged skin.⁷ The transmission from person to person is uncommon, but the infection from human sources may occur in the following ways:

- Vertical transmission with placental circulation, breast feeding, blood transfusion, bone marrow transplantation the and sexual contact.⁸
- Brucellosis is endemic in the Middle East, south and central Asia, north and east Africa, Mediterranean countries of Europe, and central and South America. Worldwide, reported incidence of human brucellosis in endemic disease areas varies widely, from <0.01 to >200 per 100,000 population⁵
- The incidence of human brucellosis in most countries is unknown and it has been estimated that the incidence may be 25 times higher than the reported incidence due to misdiagnosis and under-reporting.⁹

In Yemen, there is a little information of animal and human brucellosis. The serological investigations and bacteriological isolations of *Brucella* carried on the country are very scarce. In spite the disease is reported in all domestic ruminants of the country, Yemeni people lack awareness about the zoonotic potential of the disease with their existing habit of raw milk consumption and close contact with domestic animals. Destruction of human and animals brucellosis by test-and-slaughter is impracticable in developing countries including

Yemen because of limited resources to compensate farmers whose animals are slaughtered during such screening programs. Also, the national program is not available for prevention and control of brucellosis in the country. Only, there is one veterinary lab for animals which located in Sana'a. The main obstacles limiting the control of the disease are: security of the country, shortage of funds, laboratory facilities and trained manpower. So, this review article aims to describe an overview on brucellosis situation of the country and supports brucellosis interesting researchers to more understand the disease situation in the country. It also guides policy makers to draw sound decisions regarding brucellosis control policies.

Human brucellosis in Yemen

Until now, no attempts have been made of *Brucella* isolation, identification of genotypes and estimation of disease burden in human host in Yemen. The results of local prevalence studies done in human (Table 1) are summarized below.

Epidemiology

Studies on the prevalence of brucellosis in the general human population are limited in number. The Seroprevalence of human brucellosis in these studies was ranging from 0.3 to 32.3%. The first report was conducted a survey of *Brucella* antibodies among Yemeni blood donors. It investigated 1405 human serum samples using serum agglutination test (SAT) and revealed 0.4% positive. The prevalence founded from this study was in different localities which are Sana'a 0.7%, Taiz 0.8% and Hajja 0.35%.¹⁰ In Saleh,¹¹ Used STA to tested 385 human serum samples from slaughterhouse workers in different areas in Yemen, who reported a high prevalence of *Brucella* antibodies were 27%, 32.3%, 25.5%, 25.7%, 26.2% and 22.2% positive in Sana'a, Aden, Taiz, AL- Hodeidah, Ibb and Hajjah respectively. Another study conducted in Sana'a used STA to tested 215 of serum samples and it showed 10.1% and 24.4% positive for males and females brucellosis respectively.¹² The lower than prevalence of human brucellosis was conducted in Shabwah city with prevalence 2.2% in males and 1.6% in females.¹³ In Al- Dala'a city the crude sero-prevalence of brucellosis among tested individuals was 6.7% for male was 5.5%, lower than that of female 7.2%. Among 749 asymptomatic individuals from 3 randomly selected areas were included in the study.¹⁴

Risk factors

Epidemiologic studies have identified the following risk factors for *Brucella* infection in general population which conducted in

different localities in Yemen. The results of the studies on human brucellosis show significant risk factors for infection were found to relate to occupation as a farmer, shepherd and microbiologist.¹⁵ The highly significant risk factors for infection were related to be associated with ownership of livestock animals.¹⁴ Contact with placental membrane, clearing viscera of animals.¹² And direct contact with animals excretion or products (Milking, Handling new born, animal slaughter) and indirect contact with livestock (drinking

unpasteurized milk.^{12,14,15} Drinking labban.^{14, 15} Ingestion local chees, ingestion raw liver and ingestion raw spleen).¹⁴

Animals brucellosis in Yemen

The serological investigations of *Brucella* carried on the country are scarce. The results of local prevalence studies done in animals (Table 2) are summarized below.

Table 1 Studies reporting prevalence of human brucellosis in Yemen

Authors	Population	City	Sample Size	Type of Study	Methods	Duration of Study	Prevalence
Al- Shamahy [10]	Blood donors	Sana'a	300	CS	SAT	1993	0.70%
Al- Shamahy [10]	Blood donors	Taiz	240	CS	SAT	1993	0.80%
Al- Shamahy [10]	Blood donors	Hajjah	290	CS	SAT	1993	0.30%
Al- Shamahy [10]	Blood donors	Molalla	287	CS	SAT	1993	0%
Al- Shamahy [10]	Blood donors	Hodeidah	288	CS	SAT	1993	0%
Nasher [12]	Males	Sana'a	169	CS	STA	2005-2006	10.10%
Agrah [13]	Males	Shabwah	522	CS	STA	2010-2011	2.20%
Al-Haddad et al. [14]	Males	Al- Dala'a	237	CS	STA	2009-2010	5.50%
Nasher (12)	Females	Sana'a	215	CS	STA	2005-2006	24.40%
Agrah (13)	Females	Shabwah	522	CS	STA	2010-2011	1.60%
Al-Haddad et al. [14]	Females	Al- Dala'a	512	CS	STA	2009-2010	7.20%
AL-Shamahy et al. [15]	General population	Sana'a	253	CC	STA	1993	7.90%
Saleh [11]	Slaughterhouse	Sana'a	75	CS	STA	1999-2000	27%
Saleh [11]	Slaughterhouse	Aden	30	CS	STA	1999-2000	32.30%
Saleh [11]	Slaughterhouse	Taiz	90	CS	STA	1999-2000	25.50%
Saleh [11]	Slaughterhouse	Hodeidah	70	CS	STA	1999-2000	25.70%
Saleh [11]	Slaughterhouse	Ibb	84	CS	STA	1999-2000	26.20%
Saleh [11]	Slaughterhouse	Hajjah	36	CS	STA	1999-2000	22.20%

CC: Case Control; CS: Cores Sectional; SAT: Serum Agglutination Test; STA: Standard Tube Agglutination

Table 2 Studies reporting prevalence of animal brucellosis in Yemen

Authors	Type of animals	City	Sample size	Methods	Duration of study	Percentage
Hosie et al. [20]	Sheep	Sana'a	210	RBPT/CFT/SAT	1980- 1982	30%
Nagi [19]	Sheep	Sana'a	150	RBPT/ELISA	2003	2.00%
Nagi [19]	Sheep	Sa'ada	150	RBPT/ELISA	2003	4.00%
Nagi [19]	Sheep	Amran	150	RBPT/ELISA	2003	4.00%
Hosie et al. [20]	Sheep	Hodeidah	371	RBPT/CFT/ SAT	1980- 1982	44%
Hosie et al. (20)	Sheep	Dhamar	109	RBPT/CFT/ SAT	1980- 1982	16%
Agrah [13]	Sheep	Shabwaha	251	TSA	2010	3.30%
Al-Shamahy [17]	Sheep	-	12	ELISA	1992- 1993	0.60%
Hosie et al. [20]	Sheep	Other city	67	RBPT/CFT/ SAT	1980- 1982	10%
Hosie et al. [20]	Goats	Sana'a	259	RBPT/CF T/SAT	1980- 1982	48%
Nagi [19]	Goats	Sana'a	150	RBPT/ELISA	2003	1.30%
Nagi [19]	Goats	Sa'ada	150	RBPT/ELISA	2003	3.30%
Nagi [19]	Goats	Amran	150	RBPT/ELISA	2003	2.70%
Hosie et al. [20]	Goats	Hodeidah	143	RBPT/CFT/ SAT	1980- 1982	27%
Hosie et al. [20]	Goats	Dhamar	136	RBPT/CFT/ SAT	1980- 1982	1%
Agrah [13]	Goats	Shabwaha	270	TSA	2010	7.40%
Al-Shamahy [17]	Goats	-	26	ELISA	1992- 1993	1.30%
Hosie et al. [20]	Goats	Other	130	RBPT/CF T/SAT	1980- 1982	24%
Al-Garadi et al. [18]	Camels	Hodeidah	295	RBPT	2015	11%
Al-Garadi et al. [18]	Camels	Hodeidah	295	A-fibril antigen	2015	5%
Al-Garadi et al. [18]	Camels	Hodeidah	295	M-febrile antigen	2015	6%
Al-Garadi et al. [18]	Camels	Hodeidah	295	MRT	2015	5.10%
Agrah [13]	Camels	Shabwah	15	TSA	2010-2011	6.70%
Al-Shamahy [17]	Camels	-	105	ELISA	1992- 1993	0
Nagi [19]	Cattle	Sana'a	150	RBPT/ELISA	2003	3.30%
Nagi [19]	Cattle	Sa'ada	150	RBPT/ELISA	2003	1.30%
Nagi [19]	Cattle	Amran	150	RBPT/ELISA	2003	0.70%
Al-Shamahy [17]	Cattle	-	1	ELISA	1992- 1993	0.06%

CFT: Complement Fixation Test; ELISA: Enzyme-Linked Immunosorbent Assay; RBPT: Rose Bangle Plate Test; SAT: Serum Agglutination Test; STA: Standard Tube Agglutination

Clinical brucellosis

Studies on the clinical of brucellosis in the general human population are limited in number. The only published paper on clinical brucellosis by Al-Shamahy et al.¹⁶ Who studied 235 cases of human brucellosis in Sana'a 132 cases were male and 103 female giving male: female ratio of 1.3: 1.0 % respectively. The overall clinical picture of brucellosis is very similar to that reported by other workers in this geographical area. These data suggest that male and female exposure to the risk of infection is about the same, and that the activities associated with exposure are performed by both sexes or that they are exposed to the same reservoir of infection animals but at different point in the cycle of contact.

Camel brucellosis

Only three serological investigations of camel brucellosis in Yemen were available. The first study reported the prevalence of camel brucellosis was not recorded any cases of this disease from 105 camels sample that tested by using ELISA.¹⁷ In Aghrah¹³ carried out sero-agglutination test on 250 serum samples from camels in Shabawah. Who estimated that 15 of 536 (6.7%) sera tested for positive *Brucella* antibodies in central regions of Yemen, Al-Garadi et al.¹⁸ investigated serologically 295 camels for brucellosis using RBPT, A-fibril antigen, M-febrile antigen, and MRT. Who found the prevalence of *Brucella* was 11%, 5%, 6% and 5.1% respectively. The highest prevalence of camel brucellosis was recorded 11% in Hodeida region of Yemen by using RBPT for detection of brucellosis.

Cattle Brucellosis

The prevalence of bovine brucellosis in the country was firstly carried out by Al-Shamahy,¹⁷ Which was recorded that out of 1645 cattle was 0.06% *Brucella* antibodies positive by using ELISA as a diagnostic test. Nagi¹⁹ carried out 450 serum samples from cattle of Northern parts of the country (Sana'a, Sa'ada and Amran). Who used RBPT and ELSIA for the presence of *Brucella* infection. The overall prevalence of regions under investigation was 3.3%, 1.3% and 0.7% in Sana'a, Sa'ada and Amran respectively. He found marked differences in regional distribution of bovine brucellosis. The highest sero-prevalence (3.3%) was recorded in the cattle population of the Sana'a city, but Sa'ada and Amran regions are comparable to each other, 1.3% and 0.7% respectively.

Sheep and goat brucellosis

In Yemen, there is a few information about isolation of *Brucella* from animal. Only one study conducted on isolation of *brucella*. It was reported that *B. melitensis* biotype 2 has been isolated from sheep (the isolate was confirmed by the FAO/WHO collaborating center for reference and research on Brucellosis, Weybridge, and Surrey, United Kingdom.¹⁷ Although the first report on the serological of *Brucella* antibodies in the country were recorded in 1985 by Hosie and his colleagues.²⁰ Who tested 690 sheep and 538 goat serum samples obtained from Hodeidah, Dhamar and Sana'a. They used three methods to determine the prevalence of brucellosis include; RBPT, CFT and SAT test. The results found were 30%, 44 % and 16% of the total number of samples examined positive for *brucella* respectively. Al-Shamahy¹⁷ used ELISA to examined 2045 sheep and 2014 goats kept on free range in the country who found the results revealed were 12 out of 2045 positive (0.6%) in sheep and 26 of 2014 (1.3%) in goats. In Nagi¹⁹ tested 450 sheep and 450 goats from Sana'a, Sa'ada and Amran in the north of the country. Who showed the prevalence of sheep brucellosis were 2.0% in Sana'a, 4.0% in Sa'ada and 4.0% in Amran of northern Yemen while the prevalence of goats brucellosis

were 1.3% in Sana'a, in Sa'ada 3.3% and 2.7% in Amran, Aghrah.¹³ Documented prevalence of 3.3% in sheep, and 7.4% in goats in Shabwah region of southern Yemen by using TSA.

Conclusion

In conclusion, this paper indicated that the knowledge of brucellosis is still very scanty and no epidemiological importance in Yemeni people. *Brucella* infection exists within the livestock of the country, and Yemeni people drink raw milk and have a close contact with domestic animals which are the risk factors of brucellosis. This review article recommends an educational program and leaflet should be established to aware the people by the risk of *Brucella* infection, further studies of serological diagnosis and bacteriological isolation of the disease and collaboration among general population especial in pregnant women, veterinary, medical and public health professionals in terms of research and extension services.

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Conflicts of interest

None.

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