

## Modes of Transmission of Brucellosis in Anbar Governorate, Iraq

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### ABSTRACT

**Background:** Brucellosis is a common and endemic disease in the Anbar governorate. Besides, the Brucella microorganism has different ways of transmission.

**Objectives:** The study aimed to determine the ways of transmission of Brucella organisms to human beings in the Al-Anbar governorate.

**Materials and methods:** A retrospective study was carried out on patients visiting the two main Ramadi Teaching Hospitals in Ramadi city, Iraq for the diagnosis and treatment of Brucellosis. Patients with blood-culture-positive brucellae were enrolled in the study. The study included the period between February 2002 and March 2005. Data were collected and recorded regarding age, gender, and residence. The possible ways of acquiring the disease were recorded too. These included ingestion of possibly contaminated foods, butchering of animals, meat cutting, keeping animals in homes or nearby their livings, cleaning animal places, caring for, milking of them, aiding in their delivery and if they wear gloves, blowing in the mouth of delivered fetuses, their work, and possible laboratory worker exposure.

**Results:** A total of 312 patients with brucellosis were enrolled in the study. The disease appears to be more common in rural areas (P-value<0.001). More cases were females in all age groups, and it was more common in the age group 31-40 years. The main mode of transmission is direct or indirect contact with infected domestic animals (P-value<0.001). Lab workers and ingestion of raw milk and unsafe milk products were the least recorded expected risk for infection. Three risky behaviors for acquiring brucellosis were also recognized in this study: milking animals, aiding domestic animals in delivery, and blowing in the mouth of delivered fetuses to promote breathing of the newly delivered animals.

**Conclusion:** Direct or indirect animal contact was the main way of Brucella transmission in the Al-Anbar governorate.

**Keywords:** Brucellosis; Mode of transmission; Ramadi city.

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### INTRODUCTION

**B**rucellosis is one of the most important zoonosis across the globe and it is caused by Brucella bacterium. The annual incidence of the disease in some developed nations is 0.3 cases/million and > 1000 cases/million in endemic countries [1, 2]. Human is considered as an accidental host for this disease [3]. The Brucella

bacterium enters the body through the digestive tract, lungs, or other mucosal surfaces to cause the infection [3]. The Brucella transmission and its occurrence in the community depending on many factors as food habits, ways of preparing the milk and the milk products, social customs, husbandry practice, climate states, economic state, and environmental hygiene [4].

The possible means of acquisition of the brucellosis include one person to another mode of transmission, an infection that occurs from environmental contamination, occupational hazards that occur from direct contact with infected animals, and lastly from ingestion of foodborne microorganisms [5]. The

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infections which occur from environmental contamination are difficult to be documented but may be more than expected. Infected domestic animals that pass through human areas or even stayed near houses may be regarded as an important source of infections, especially if abortions occur. Inhalation of *Brucella* microorganisms may occur when the human is exposed to contaminated clouds of dust, or dried dung [6]. Infections can even occur when the person contacted the skin or conjunctiva with infected solid surfaces [5, 6]. The water supply sources, like wells, may also be contaminated from recently aborted animals or by bringing of microorganisms by rainwater from away contaminated areas [7].

The *Brucella* microorganisms are mostly transmitted by ingestion of unpasteurized dairy products, especially soft cheeses, unpasteurized milk, and milk products. These sources are the most frequent expected and recorded source of infections. Raw meat and liver, and bone marrow have also been regarded as a source of contamination [4].

Some occupational works can be considered as a high-risk factor for getting infections with brucellosis. Including, workers in the breeding of animals as cattle, sheep, or goats. Farmers are also considered a risk of getting infections. Farm laborers, animal attendants, stockmen, shepherds, use of dried dung as a fuel can be important unnoticed sources of infection in households. As important to know that infections with the *Brucella* organism may present as a cluster of cases inside the family or working groups, and this mostly related to the same infected sources, and this may due to an outbreak in animals [8]. The family members of farmers and animal breeders, also considered risky as their breeding breeders may indirectly transmit the infection to their families through their clothes or their instruments. Besides, the family can get the infection when the animals are put in the yards of the houses, and some families even put the animals inside their houses particularly in severe cold or rainy weather [9].

Individuals who are involved in the processing of animal products may be considered at a high exposure risk to brucellosis. Those include slaughter men, butchers, meat packers, collectors of fetal calf serum, processors of hides, skins, wool, and dairy workers. Directly contaminated environments may be hazardous after dust inhalation or even ingestion of contaminated substances or through skin contacts [7].

Laboratory workers involved in the handling cultures or infected samples are also at risk [10].

Human transmission of infections is uncommon and it can occur after blood transfusion [11] or bone marrow transplantation [12], and possibly during sexual intercourse [13]. Newborn infection with *Brucella* is rare and there are only a few reports of congenital brucellosis [14, 15].

We aimed to determine the expected ways of transmission of *Brucella* organisms to human beings in the Al-Anbar governorate.

## MATERIALS AND METHODS

This retrospective study was conducted at two main Ramadi Teaching Hospitals (Al-Ramadi Teaching Hospital and Al-Ramadi Maternity and Children Teaching Hospital), Ramadi city, Iraq. The data were collected from patients' records of 312 blood culture positive brucella, in the period between February 2002 and March 2005. The study was approved by the College of Medicine, the University Of Anbar as a requirement for a diploma in Internal Medicine. All the isolated types were from *Brucella melitensis*.

Blood (5 ml) was collected aseptically from each patient with suspicious features of the brucellosis like fever, headache, malaise, arthralgia, low back pain, and loss of weight and who had antibody titers  $\geq 160$  international units by the serum agglutination test). The blood put in a plastic, sterile bottle with a screw-capped with 6-7 glass beads of 2 mm diameter. The specimen was allowed to clot. The sample was centrifuged at 2000 rpm for 15 min; the separated serum was used for serology. The clots were freeze in the refrigerator for clot culturing as needed.

The patients were asked about the possible ways of acquiring the disease. These include boiling or pasteurization of the milk before use, ingestion of unpasteurized milk, ingestion of unsafe cheese, ingestion of unsafe yogurts, butchering of animals, cutting of meat for food processing, eating raw liver or spleen, presence of domestic animals in their homes, animals nearby their livings, cleaning animal places, caring for them, milking of them, aiding in the delivery of domestic animals and if they wear gloves, blowing in the mouth of delivered fetuses, their work and possible occupational exposure, like butchers, fresh leather workers, shepherds, meat processing workers, veterinary workers, and laboratory exposure. Detailed data concerning age, gender, and residence were recorded too. Patients with incomplete data were excluded from the study.

The data were entered and analyzed using SPSS (Statistical Package for the Social Sciences) version 22. The results were presented in simple tables of the frequencies and percentages. Chi-square was used to compare the categorical variables. P-value less than 0.05 was regarded significant difference throughout this study.

## RESULTS

Of 312 participants, there were 209 (67%) were females and only 103 (33%) were males, with a male to female ratio of 1/2. There was a highly statistically significant difference (P-value <0.0001) between the sexes Table 1.

Residence distribution of the cases showed that most of the diagnosed *Brucella* patients were from rural areas 217 (69.4%), while those diagnosed in urban area was 95 (30.6) with a highly statistically significant difference (P-value <0.0001) as shown in Table 1.

The age of the patients ranged from 6-72 year with a mean age of  $39.38 \pm 14.082$  year. The age distribution of the cases, showed that all age groups were affected with *Brucella* infection, with the highest age group affected was 31-40 years old (n=84, 26.9%), followed by ages between 41-50 years 81 (n=81, 26.0%), and the least was reported among ages less than 20 years (n=24, 7.7%) Table 2.

The details of recognized risky behaviors which could carry

**Table 1.** Distribution of the 312 patients according to gender\*† and residence †.

Variable	Female Number(%)	Male Number(%)	Total Number(%)
Urban	58 (18.6)	37 (11.9)	95 (30.6)
Rural	151 (48.4)	66 (21.2)	217 (69.4)
Total	209 (67.0)	103 (33.0)	312 (100)

\* P- value among genders <0.0001

† P-value among residences <0.0001

**Table 2.** Frequency of the symptoms of the 60 patients\* .

Age (Years)	Female		Male		Total
	Urban Number(%)	Rural Number(%)	Urban Number(%)	Rural Number(%)	
<20	5 (1.6)	12 (3.8)	3 (1.0)	4 (1.3)	24 (7.7)
21-30	8 (2.6)	27 (8.7)	6 (1.9)	17 (5.5)	58 (18.6)
31-40	17 (5.5)	34 (10.9)	11(3.5)	22 (7.1)	84 (26.9)
41-50	15 (4.8)	49 (15.7)	6 (1.9)	11 (3.5)	81 (26.0)
51-60	8 (2.6)	17 (5.5)	7 (2.2)	7 (2.2)	39 (12.5)
>60	5 (1.6)	12 (3.9)	4 (1.3)	5 (1.6)	26 (8.3)
Total	58 (18.6)	151(48.4)	37 (11.9)	66 (21.2)	312 (100)

\* P-value among different age groups≤0.001

**Table 3.** Ways of expected transmission of the Brucella in 312 patients\* .

Mode of exposure to Brucella	Female		Male		Total
	Rural Number(%)	Urban Number(%)	Rural Number(%)	Urban Number(%)	
Ingestion of raw milk or milk products	3 (1.0)	7 (2.2)	0	3 (1.0)	13 (4.2)
Caring for or cleaning animal or their places	87 (27.9)	5 (1.6)	22 (7.1)	0	114 (36.5)
Milking of animals	62 (19.9)	3 (1.0)	2 (0.6)	0	67 (21.5)
Aids in delivery	43 (31.8)	0	7 (2.2)	0	50 (16.0)
Blow in the mouth of delivered fetuses	21 (6.7)	0	5 (1.6)	0	26 (8.3)
Live with animals or nearby animals	119 (38.1)	7 (2.2)	43 (13.8)	3 (1.0)	172 (55.1)
Meat cutting	108 (34.6)	38 (12.2)	0	1 (0.3)	147 (47.1)
Lab worker exposure	0	0	7 (2.2)	9 (2.9)	16 (5.1)
Unidentified cause	0	5 (1.6)	3 (1.0)	13 (4.2)	21 (6.7)

\* P-value among different risk factors ≤0.001

a risk for Brucella transmission to humans among the studied diagnosed patients which may be one more risk factors for each patient showed that the living with animals was reported in 172 (55.1%) of studied cases, meat cutting 147 (47.1%), caring for or cleaning animal or their places 114 (36.5%).while, the least recorded was among the ingestion of raw milk or milk products behaviors 13 (4.2%). Rural areas also showed more and significant risk factors from urban areas in both sexes as living with animals, milking of animals, and cleaning animals or their places as shown in Table 3.

**DISCUSSION**

From the result of this study, we can draw the main lines of ways of Brucella transmission in the Al-Anbar governorate. Besides, it reveals that there are many risky behaviors conducted by peoples who carry a high risk for Brucella transmission.

In this study, the disease appears to be more common in females in all age groups in both rural and urban areas, a similar result was obtained in an Iraqi Kurdistan study [16]. A study from northern Saudi Arabia found that the male-to-female ratio was 1.7:1, this may be attributed to that men are getting an infection from their occupational exposure [17]. However, our study revealed that brucellosis was more prevalent in females than males (male/female = 1/2), the causes behind this are the women involved more in household and agricultural activities, more contact with domestic animals, and cutting of meat without gloves.

The disease was more common in the age group 31-40 years

old. In a study in Iran [18], most of the cases were diagnosed from 10-40 years old. These differences may be related to the differences in cultural habits and occupational age.

The disease was found to be more common in rural areas, the same result was found in a study in Turkey [2]. However, another study in Malaysia [19] showed that urban areas had more prevalence of brucellosis than rural areas. This may be explained by a lot of unpasteurized milk is transported from periurban and rural areas to the urban areas for human consumption because of increased demands for milk and milk products that are considered good for human health. Besides, there is a difference in the educational levels between rural and urban populations about the risk of the disease.

Regarding the expected mode of transmission of the infection to the human being, the living with animals in the present study was mostly recognized expected risk factor, similar studies were found in Jordan [20], and Egypt [21]. The least reported expected risk of transmission of infection to humans in the present study was the ingestion of raw milk or milk products, however, this was against the study conducted in Saudi Arabia [22], which revealed that consumption of unpasteurized sheep and goat milk are the main risk factors. Cutting of meat was highly reported as an expected risk factor for getting Brucella infection in this study. Another research in Italy [23], showed that handling and preparation of infected meat are a major expected risk factor. The muscle tissue of slaughtered animals contains a small number of microorganisms. However, it has been predicted that even 10-100 microorganisms are enough to cause the infection to humans. Therefore, the infected meat or meat products might

considered as a source of infection, especially if their source derived from animals butchered during the acute phase of the infection, or if they are eaten raw or undercooked. The handling and preparation of infected meat may also contaminate other foodstuffs and kitchen utensils [23].

Brucellosis is a zoonotic disease, and the main risk factors are animal dialing, exposure to infected meat with bare hands, or exposure to animal products, so it is usually considered an occupational disease [23]. In our city, most of the expected risk factors are related to domestic animal caring and meat preparation, the least was reported among ingestion of unboiled milk, this may reflect the educational state of the hazards of ingestion of unpasteurized milk as a source of transmission of this infection. But unfortunately, they are not educated well about the risk of direct or indirect animal contact. They clean domestic animal places, care for them, milk them with bare hands, aid delivery of domestic animals with bare hands, or blow in the mouth of delivered fetuses without understanding that it's a risk factor for brucella transmission. Laboratory worker's exposure was a minor expected reported factor in this study, however, another study in Iran [24] showed that laboratory and veterinary professions are major risk factors for Brucella.

There are two limitations of the current study small sample

size and the retrospective nature of the study make the results of the study are not powerful and less dependable.

In conclusion, animal caring and meat handling were the main ways of transmission of Brucella infection to humans in the Al-Anbar governorate. Women were more affected than men. Rural areas were significantly higher with brucellosis than urban. Education of people about ways of brucella transmission is recommended. Vaccination of susceptible animals, wearing gloves, glasses, and boots in the slaughterhouse or at home when dealing with meat, supervision of dairy and meat products, and effort of vaccination of high-risk groups with life attenuated vaccine (19-BA-vaccine) are also recommended.

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#### CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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