Int J Entric Pathog. 2014 February; 2(1): e15610. DOI: 10.17795/ijep15610

Published online 2014 February 08. **Research Article**

Brucellosis Risk Factors in the Southwestern Province of Khuzestan, Iran

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Received: October 24, 2013; **Revised:** November 26, 2013; **Accepted:** December 4, 2013

Background: Brucellosis is an endemic infectious disease in Iran. Prevention strategies are based upon identification of risk factors for brucellosis.

Objectives: The purpose of this study was to determine the principal risk factors for brucellosis in Khuzestan Province, Southwestern Iran.

Patients and Methods: In this retrospective study, the medical records of 162 admitted patients, 81 brucellosis cases and 81 controls with other unrelated conditions, were reviewed. The study was undertaken in the Razi Hospital, Teheran, I.R. Iran, a university hospital where infected patients throughout Khuzestan are refereed. The diagnostic criteria of the disease were the Wright test and 2-Mercaptoethanol (2ME) agglutinin assay with titers greater than 1:160 and 1:80, respectively, and clinical symptoms compatible with brucellosis. Statistical analyses were performed with the SPSS 16.0 software. Univariate analysis was performed by calculating the odds ratio (OR) and the 95% confidence interval (CI) to compare cases and controls for each variable.

Results: Of a total of 81 patients with brucellosis, 38 (46.8%) had had direct contact with animals, 47 (58%) had consumed high risk foods, and 48 (59.2%) were from rural areas. Analysis showed that brucellosis had a significant association with untreated milk consumption (OR 5.57, 95% CI = 1.77–17.08, P = 0.002), slaughtered meat (OR: 8.77, 95% CI = 1.07–71.81, P = 0.03), direct contact with animals and individuals who had a nomadic lifestyle (OR: 3.57, 95% CI = 1.34–9.54, P = 0.01).

Conclusions: In the studied region, the main risk factors for brucellosis are: consumption of untreated milk/dairy products, slaughtered meat and direct contact with animals. Therefore, improved veterinary services and public health education are a requisite to control the disease.

Keywords: Brucellosis; Risk Factors; Zoonosis

1. Background

Brucellosis, an emerging infectious disease, is a major public health concern worldwide (1). Brucellosis represents a zoonosis typically transmitted directly or indirectly by exposure to animals (2). Human brucellosis is caused by the *Brucella* species. *Brucella melitensis* is the most common cause of disease in man. The main source of this infection is represented by sheep, goats and camels (3). Brucellosis has constituted an occupational risk for farmers, veterinarians, nomads, slaughterhouse workers, and laboratory personnel (1, 3-6). Brucellosis is also transmitted via unpasteurized milk or dairy products (3, 4, 7-10). Occupational exposure to animals, or animal products, and consumption of contaminated high risk foods, such as milk or other dairy products, are the most common risk factors for brucellosis (3). Human populations are infected with *Brucella* species in endemic areas such as the Middle East and Latin America (11). Brucellosis has been known as a prevalent zoonosis in Iran for years (12). *Brucella* culture is the golden standard of diagnosis. *Brucella* is isolated from blood, bone marrow or other tissue and cultured on Castaneda's medium (3, 13). However, isolation of the pathogen by culturing is time-consuming and hazardous. Therefore, clinicians often rely on the indirect proof of infection (13). Serological testing has therefore been suggested. However, at least two serological tests should be combined to confirm active infection. Typically, the standard tube agglutination test (Wright Test) is carried out and then the 2-Mercaptoethanole (2ME) test confirms the results (with 97.1% sensitivity and 100% specificity) (3, 13).

The Khuzestan province is located in the South West of Iran and because of the specific conditions, proximity to Iraq in the West and the high population of nomads in the Northern areas, is an important basin for brucellosis observation programs in the country. The total population of Khuzestan is 4586784 inhabitants. The main health concerns in nomads are related to their lifestyle, such as care for animals (especially sheep and goats) in

Implication for health policy/practice/research/medical education:
The results of this study are useful in the diagnosis of brucellosis as a major public health hazard in Khuzestan, an important area of Southwestern Iran. Also, the results have implications for the prevention of this pathology.

their homes, drinking of untreated milk (in the belief that boiling the milk decreases its quality), living in remote areas, possessing inadequate public health sanitation systems, and minimal veterinary services. Predicting the incidence of brucellosis in Khuzestan Province is difficult due to hospital-based surveillance and limitation of laboratory facilities for the infection. The actual prevalence rate of brucellosis at the province level is uncertain because of underreporting of data. Although risk factors for brucellosis, such as consumption of fresh cheese, undercooked meat and untreated animal milk, as well as skin contact with animals via slaughter and handling infected animal waste materials, are described in previous reports (11, 12, 14-16), however, the risk factors in each area vary according to the socioeconomic and life-style of the population living in that particular region. Knowing the risk factors for brucellosis helps the local health policy makers and involved physicians in both preventive intervention and rapid epidemiological diagnosis to perform serological investigations and initiate proper treatment to prevent severe complications.

2. Objectives

The purpose of our study was to evaluate risk factors for brucellosis among patients admitted to a university hospital.

3. Patients and Methods

3.1. Study Design and Identification Data

3.2. Study Population

Case subjects were those suspected of brucellosis infection with clinical presentation suggestive of brucellosis, associated with a Wright test titer ≥ 1:160, confirmed by 2ME > 1:80. For each case subject, one control subject was selected. The controls were identified and selected from patients with negative anti-*Brucella* serology, who were hospitalized due to reasons other than brucellosis during the study period. All control group members were similar to the actual cases in terms of sex, age group and residential region to the most feasible extent. Medical charts, including demographic data, animal exposure data, occupation, history of handling animal waste, slaughtering of animals, consumption of meat and dairy products, were prepared for all participants. All admitted patients diagnosed with brucellosis by infectious disease specialists during this time period were enrolled.

3.3. Data Analysis

The SPSS version 16.0 software (SPSS Inc., Chicago, Illinois, USA) was used for statistical analysis. The analysis was computed by the odds ratio (OR) with 95% confidence interval (CI) for comparison between cases and controls. The level of significance for P value was < 0.05.

4. Results

More than the half of the brucellosis cases enrolled in the study were males. The age range of patients was 11-80 years. The age of the control patients ranged from 14 to 79 years. Among the brucellosis patients, 34.5% had had direct contact with animals at the work place or at home, 16% had handled contaminated meat or waste tissue of animals, and 47 (58%) had had a history of consumption of high risk foods. Table 1 reveals the demographic variables in the cases and controls. As illustrated in the table, there was no significant difference in age, sex and history of similar disease in family members, except in residency. Demographic risk factors for brucellosis are shown in Table 2. Analysis showed that animal exposure in rural areas was most strongly associated with the risk of brucellosis infection (OR: 2.23, 95% CI = 1.19-4.18, P = 0.01). Table 3 depicts the variables of animal exposure and consumption of infected food in cases and controls. Comparing the results in both groups indicated that direct exposure to animals at the work place (OR 3.57, 95% CI = 1.39-9.54; P = 0.01), slaughtering (OR 8.77, 95% CI = 1.07-71.81; P = 0.03), consumption of untreated milk (OR 5.50, 95% CI = 1.77-17.08; P = 0.002) and consumption of untreated dairy products (fresh cheese) (OR 2.92, 95% CI = 1.38-6.16; P = 0.006) were strongly associated with brucellosis (Table 3). The analysis also revealed that handling animal waste, presence of brucellosis in family members, and exposure to animals at home were not considered as significant risk factors (P > 0.05).

Table 1. Epidemiological Comparison of Data Between Case and Control Subjects (n = 81) [a]

Epidemiological Feature	Cases, No. (%)	Controls, No. (%)	P value
Sex	48 (59.2)	49 (60.5)	1.0
Male			
Female	33 (40.8)	32 (39.5)	
Age, y, Mean ± SD	38.1 ± 18.1	37.7 ± 17.6	0.54
Range, y	11-80	14-79	
< 20	17 (21)	18 (22.2)	1.0
20-40	30 (37)	31 (38.3)	1.0
> 40	34 (42)	32 (39.5)	0.87
Residency			
Rural	48 (59.2)	32 (39.5)	0.01
Urban	33 (40.8)	49 (60.5)	
Familiar history of brucellosis	6 (7.4)	2 (2.5)	0.27

[a] P > 0.05 was considered statistically significant.

Table 2. Univariate Logistic Regression of Demographic Risk Factors for *Brucellosis* (n = 81)

Variables [a]	Cases, No. (%)	Controls, No. (%)	OR (95% CI)	P value
Residency				0.01
Rural	48 (59.2)	32 (39.5)	2.23 (1.19-4.18)	
Urban	33 (40.8)	49 (60.5)		
Familiar history of brucellosis	6 (7.4)	2 (2.5)	3.16 (0.62-16.15)	0.27

[a] Abbreviations: OR, odds ratio; 95% CI, 95% confidence interval. P > 0.05 was considered statistically significant

Table 3. Univariate Logistic Regression of Exposure to Animals and Food (n = 81)

Variables	Cases, No. (%)	Controls, No. (%)	OR (95% CI)	P value
Animal exposure				
At work	18 (22.2)	6 (7.4)	3.57 (1.34-9.54)	0.01
At home	10 (12.3)	5 (6.1)	2.14 (0.70-6.57)	0.27
Slaughtering	8 (9.9)	1 (1.2)	8.77 (1.07-71.81)	0.03
Handling animal waste	5 (6.1)	2 (2.5)	2.60 (0.49-13.80)	0.44
Food exposure				
Consuming untreated milk	18 (22.2)	4 (4.9)	5.50 (1.77-17.08)	0.002
Consuming untreated dairyproducts	29 (35.8)	13 (16.0)	2.92 (1.38-6.16)	0.006

5. Discussion

This study demonstrated that a great proportion of brucellosis cases occurred among nomads (shepherds) and high risk food consumers. *Brucella melitensis* is broadly transmitted by infected goats, the most prevalent domestic animal for the nomadic populations in Iran. Therefore, these circumstances place the nomads at increased risk of exposure to infected goats and related dairy products. Similar results were reported by other investigators (3, 17-19). We believe that slaughtering of infected animals is not the sole independent risk factor for brucellosis in Khuzestan (17). This finding is consistent with the results recorded in other reports throughout the world and other parts of Iran (1, 3-6). Although meat is rarely the source of infection, butchers and slaughterhouse workers, because of direct contact with the skin or secretions of animals through cuts and abrasions in their skin, inhalation of infected aerosols (in slaughter houses) or inoculation into the conjunctiva, are at risk of *Brucella* infection (3). In the present study, handling animal waste was not considered as a risk factor for brucellosis. This result is not consistent with medical literature and other previous reports (3, 8-10). Indeed, the placenta of infected animals contains a high number of these microorganisms, making it an important source for *Brucella* transmission to veterinaries and veterinary students through direct contact at work. The reason for this finding is not clear to us. We believe that a small number of veterinary students in our study may be biased to the findings. Untreated milk and dairy product consumption could be considered as the major risk factor for brucellosis in our patients. Our finding is in agreement with other studies, reported from under-developed areas in the Middle East and Latin America, but is in disagreement with the reports from developed countries, where all dairy products are pasteurized (3, 4, 7-10). As mentioned formerly, nomads, due to their life-style - for instance caring for their sheep and goats in their homes, untreated milk consumption believing that boiling the milk decreases its quality and preparing foods from untreated milk (e.g. fresh cheese) - are largely infected with *Brucella* (17). Transmission of brucellosis from person-to-person among family members was not confirmed in this study, which is similar to previous studies, except for a small number of reports. Person-to-person transmission of the *Brucella*e antigen is very rare, and should not be considered as common (3). Rare cases of brucellosis suspected of sexual transmission have been reported (5). In most reported brucellosis outbreaks within families, the common food source has been the cause (15, 16).

In the present study, residency in rural areas was strongly associated with the occurrence of brucellosis, which is similar to previous reports (7, 8, 20). Transmission of brucellosis in rural households is widespread, where close contact between human and domestic animals is high. Brucellosis is a prevalent disease in areas where *B. mellitensis* infection in animals is endemic and animals cohabit living quarters with people (18, 19). Brucellosis in nomads and rural communities in the studied is likely to be transmitted by animals kept in homes, by the way of homemade dairy products that have not been treated or obtained from neighboring or village shops. The spread of *B. melitensis* in goats/sheep could be attributed to the illiterateness of nomads or villagers. Rural families most probably do not receive the sanitary and health education required for prevention of transmission of brucellosis in humans. In addition, villagers/nomads who are the owners of sick animals do not refer to veterinary clinics when required, fearing their income may be lost because of the low prices paid for infected animals in anti-brucellosis programs in the region. In this study, contact with pets and domestic animals, other than among rural communities or nomads, was not associated with

increased risk of brucellosis. This finding is in agreement with a number of reports from industrialized countries, but is in contrast with studies conducted in under-developed countries, such as the Middle East regions (3). This difference may be due to our data regarding contact at home, restricted to urbanites that are aware of the risk of transmission of zoonosis from animals and who take into account the health of their pets. This study has several limitations in terms of retrospective design, restriction of inpatient numbers and the lengthy duration of the study. The reason for our study design is linked to the fact that brucellosis is, at present, an outpatient disease and the number of admitted patients per year is low. To minimize the effect of a small number of annual patients we reviewed the studies through a span of 10 years.

Acknowledgements

This article is derived from a medical student's thesis (no: OG-88112). We greatly appreciate the staff of the Infectious Diseases Department in Razi Hospital and the Infectious Diseases Research Center affiliated to Ahvaz Jundishapur University of Medical Sciences, for their kind cooperation.

Authors' Contribution

S. Mugahi and R. Nashibi performed data collection and writing of the manuscript. S.M. Alavi din the final revision of the manuscript and contributed to the primary design. S. Gharkholu contributed to the primary design and data analysis workup.

Financial Disclosure

There was no conflict of interest.

Funding/Support

This study was funded by the Research Deputy and the Infectious and Tropical Disease Research Center of the Ahvaz Jundishapur University of Medical Sciences, Ahvaz, I.R. Iran

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