Brucellosis Risk Factors in the Southwestern Province of Khuzestan, Iran

Seyed Mohammad Alavi 1; Sasan Mugahi 2; Ruhangiz Nashibi 2; Saeid Gharkholu 3

1Infectious and Tropical Disease Research Center, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, I.R. Iran
2Faculty of Medicine, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, I.R. Iran
3Hazrat Rasoul Hospital, Ramshir, I.R. Iran
*Corresponding author: Seyed Mohammad Alavi, Infectious and Tropical Disease Research Center, Jundishapur University of Medical Sciences, Ahvaz, I.R. Iran. Tel: +98-6113387724, E-mail: alavi.seydmohammad@yahoo.com

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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 referred. The diagnostic criteria of the disease were the Wright test and 2-Mercaptoethanol (2ME) agglutinin assay with titers greater than 1:80 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). 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-Mercaptoethanol 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                                | Male            | Female          | Male            | Female          |         |
|                                   | 48 (59.2)       | 33 (40.8)       | 49 (60.5)       | 32 (39.5)       | 1.0      |
| Age, y, Mean ± SD                  | 38.1 ± 18.1     | 37.7 ± 17.6     | 0.54            |
| Range, y                           | 11-80           | 14-79           | 1.0             |
| < 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           | Urban           | 0.01            |
|                                   | 48 (59.2)       | 33 (40.8)       | 32 (39.5)       | 49 (60.5)       |         |
| Familiar history of brucellosis    | 6 (7.4)         | 2 (2.5)         | 0.27            |

a P > 0.05 was considered statistically significant.
mals through cuts and abrasions in their skin, inhalation cause of direct contact with the skin or secretions of ani-
er parts of Iran (1, 3-6). Although meat is rarely the source
recorded in other reports throughout the world and oth-
This finding is consistent with the results
is not the sole independent risk factor for brucellosis in
fore, these circumstances place the nomads at increased
risk of exposure to infected goats and related dairy prod-
ucts. Similar results were reported by other investigators
in goats/sheep could be attributed to the
infection (3).
nomads in rural communities in the studied is likely to
cohabit living quarters with people (18, 19). Brucellosis in
homemade dairy products that have not been treated or
be transmitted by animals kept in homes, by the way of
nomads and rural communities in the studied is likely to
be transmitted by infected goats, the most prevalent domes-
tic animal for the nomadic populations in Iran. There-
home 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 Brucellae antigen is
very rare, and should not be considered as common (3).
Rare cases of brucellosis suspected of sexual transmis-
tion 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 strong-
ly 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. mellitensis 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 brucel-
loss 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 an-
ti-brucellosis programs in the region. In this study, con-
tact with pets and domestic animals, other than among
rural communities or nomads, was not associated with

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

<table>
<thead>
<tr>
<th>Variables a</th>
<th>Cases, No. (%)</th>
<th>Controls, No. (%)</th>
<th>OR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>48 (59.2)</td>
<td>32 (39.5)</td>
<td>2.23 (1.19-4.18)</td>
<td>0.01</td>
</tr>
<tr>
<td>Urban</td>
<td>33 (40.8)</td>
<td>49 (60.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiar history of brucellosis</td>
<td>6 (7.4)</td>
<td>2 (2.5)</td>
<td>3.16 (0.62-16.35)</td>
<td>0.27</td>
</tr>
</tbody>
</table>

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

### Table 1. Univariate Logistic Regression of Exposure to Animals and Food (n = 81)

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

5. Discussion

This study demonstrated that a great proportion of bru-
cellosis cases occurred among nomads (shepherds) and
high risk food consumers. Brucella melitensis is broadly
transmitted by infected goats, the most prevalent domes-
tic animal for the nomadic populations in Iran. There-
fore, these circumstances place the nomads at increased
risk of exposure to infected goats and related dairy prod-
ucts. 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, be-
cause of direct contact with the skin or secretions of ani-
mals 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 con-
sidered 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 con-
tact 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, report-
ed 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
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ti-brucellosis programs in the region. In this study, con-
tact 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.

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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.

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There was no conflict of interest.

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