

Risk factors for human brucellosis in Mianeh, Iran

Mir-Hassan Moosavy¹, Mahsa Hallaj Salahipor¹, Ehsan Mostafavi², Seyed Amin Khatibi³

1- Department of Food Hygiene and Aquatic, Faculty of Veterinary Medicine, University of Tabriz, Tabriz, Iran

2- Department of Epidemiology, Pasteur Institute of Iran, Tehran, Iran

3- Department of Food Hygiene, Faculty of Veterinary Medicine, University of Tehran, Iran

*Corresponding author: mhmoosavy@gmail.com

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Summary

Brucellosis is the most prevalent zoonotic disease in the world, particularly in developing countries. Despite the high prevalence rate of brucellosis in Iran, little information is available regarding the transmission route of the disease. The objective of the present survey was to identify the major risk factors for brucellosis in Northwest of Iran and consequently, to make preventive and therapeutic recommendations for the population. A retrospective study was conducted and all participants were tested by standard tube agglutination test and culture method in districts of Mianeh, Kandovan, Kaghaz kanan and Torkamanchay. The data was obtained from 442 patients using a questionnaire. The majority (48.41%) of the patients aged 10-29 years old of which 63.80% were male. The highest number of cases was reported in 2012 (124 patients, 28.5%). The number of reported cases were significantly declined from 2012 to 2016 ($P=0.02$, $r=-0.92$). Consumption of raw milk and raw milk-derived cheese (61.76%) as well as having a family member infected with brucellosis (61.53%) were the main risk factors for the disease. In the present study, the most important risk factors were occupation, food consumption and having easy access to unpasteurized milk. These findings indicated that there is still insufficient knowledge about the disease, particularly in urban areas of the country.

Keywords: Human brucellosis, Risk Factors, Mianeh, Iran.

Introduction

Brucellosis is the world's most prevalent zoonosis, particularly in developing countries (Aloufi et al., 2016; Ducrotoy et al., 2016). This disease is caused by a bacterium from

the genus of *Brucella* (Huber et al., 2009; Schurig et al., 2002; Seleem et al., 2010). Four species of *Brucella* can infect humans which include: *B. abortus*, *B. melitensis*, *B. Suis* and *B. canis* (Probert et al., 2004). *B.*

melitensis is the most common and virulent *Brucella* species for humans (Seleem et al., 2010; Yumuk and O'Callaghan, 2012). In humans, consumption of raw milk and unpasteurized dairy products, and direct exposure to the infected animals are the main routes of disease transmission (Pei and Ficht, 2011; Sayin and Kutlu, 2012). Numerous studies have shown that occupational exposure to animals or meat and dairy products is the most frequently recognised risk factor for brucellosis (Ducrotoy et al., 2016; Wolfram et al., 2010; Seleem et al., 2010; Esmaeili et al., 2016). Among occupational groups, slaughterhouse workers, dairy workers, livestock herders and veterinary clinicians constitute the majority of high-risk groups (Gwida et al., 2015). The annual incidence of human brucellosis is estimated about 500,000 cases in the world; and in some countries, the prevalence rate exceed 10 cases per 100,000 of the population (Franco et al., 2007; Sayin-Kutlu et al., 2012).

In recent years, herd vaccination and animal eradication programs have led to a marked decrease of brucellosis in Iran. However, this disease is still endemic in this country. According to the data of the Ministry of Health, it occurs in all around the country. The number of patients with brucellosis in 2008 was 17,905 cases (Zamani et al., 2011). It has also been reported that the frequency of brucellosis in different parts of Iran has a considerable variation and the incidence rate varies between 98 and 130 cases per 100,000 populations (Mirnejad et al., 2017).

Determination of the major risk factors for brucellosis can provide a comprehensive knowledge about the nature of the disease and its transmission routes which is required for eradication of human brucellosis (Sofian et al., 2008). Several researchers identified the major risk factors associated with brucellosis in other counties (Al-Shamahy et al., 2000; Kozukeev et al., 2006; Shehada and Abu Halaweh, 2013; Li et al., 2013; Adesokan et al., 2016). Similar studies also have been carried out in various provinces of Iran such as Central (Sofian et al., 2008), Khorasan-e Razavi (Abbasi et al., 2016; Riabi et al., 2017), Kurdistan (Moradi et al., 2006) and Khuzestan (Alavi et al., 2014) provinces. In a study on human brucellosis in Khoy a district in North West of Iran, the cumulative incidence rate of the disease was 175 cases per 100,000. It was found that the most of the patients in this region were male (62.34%) aged 10-29 years old. In addition, housekeepers (29.53%) were at high risk of brucellosis among other occupations (Bokaie et al., 2009). Pakzad et al. (2016) in a research on 2585 of patients in the North and North-West of Iran found that 25.37% (656 of 2585) of cases were belonged to the East Azerbaijan province. The rate of disease incidence in men (61.28%) was higher than women (38.72%) and the most affected age group was 25 to 44 years old. Also, consumption of local raw milk (63.9%) and contact with live animals (54.3%) were the most frequent routs of disease transmission.

Despite the high prevalence rate of brucellosis in Iran, limited data is available about the risk factors of human brucellosis in East Azerbaijan province especially in Mianeh County. Hence, the objective of the present survey was to identify the major risk factors related to brucellosis in Mianeh County in order to instruct the preventive and therapeutic recommendations for the population in this region.

Materials and Methods

Demographic area

Mianeh lies in East Azarbaijan province (northern-west of Iran) and includes four districts; Mianeh, Kandovan, Kaghaz kanan and Torkamanchay. A retrospective study was conducted to identify the risk factors for brucellosis in this area. The sources of the reported cases were patients referred to the hospitals, health centres; and microbiological and pathological laboratories. The data used in the present study was monthly collected.

Patient selection

Patients were identified according to the clinical symptoms of brucellosis which were included fever over 37.5°C for more than 5 days, headache and arthralgia. The disease was confirmed using two tests: standard tube agglutination test (SAT=Wright), in titres $\geq 1:160$ and Rose Bengal plate test (RBPT) in the presence of 2-mercaptoethanol (2ME) agglutination ≥ 20 . A total of 442 patients diagnosed with brucellosis during the period from 2012 to 2016 and were included in the

study. Incidence rates were calculated based on the patients who were first diagnosed during the study period and had been residents at least for 1 year in the study area (incident cases).

Data collection

Information about the infected patients was obtained using a questionnaire. A detailed explanation of the study was provided for all patients, as well as to the physicians involved in the study. Each questionnaire was coded to ensure confidentiality of the participants' responses. Collected information included demographic area, age, sex, exposure to livestock, consumption of dairy products, education, occupation and infection of family member (s) with brucellosis (Avdikou et al., 2005; Earhart et al., 2009; Sofian et al., 2008).

Statistical analysis

Data analysis was performed using SPSS software for Windows version 16. Descriptive statistics (frequency and percentage) were used to examine specific demographics and risk factors. To compare the correlation between year and numbers of reported cases, Pearson correlation was used. A value of $P \leq 0.05$ was considered as statistically significance.

Results

Among 442 patients with brucellosis evaluated in this study, the highest number of disease was observed in 2012 (124 patients, 28.05%). The incident rate of disease was significantly declined from 2012 to 2016 ($P=0.02$, $r = -0.92$).

Demographic Area

The incidence rate of brucellosis was broadly varied among the four districts of Mianeh County. The highest and lowest annual incidence rates were belonged to the districts of Mianeh (38.34%) and Kaghaz Kanan (25.18%), respectively.

Age & sex

Most of the patients were male (63.80%) (Fig. 1) aged between 10-19 years of old (26.01%) (Table 1).

Table 1. Distribution of the patients with brucellosis by age group in Mianeh County during 2012–2016.

Age (years)	2012	2013	2014	2015	2016
0-9	5	10	6	2	3
10-19	30	40	26	10	9
20-29	33	21	25	12	8
30-39	25	23	22	10	8
40-49	15	7	9	3	4
50-59	13	8	10	5	4
60-69	3	7	8	5	1
70<	0	3	5	3	1
Total	124	119	111	50	38

Exposure to infected livestock & consumption of contaminated dairy products

In the present study, 84 cases of 442 patients had a direct exposure to the

contaminated livestock. Consumption of contaminated dairy products was mentioned by 273 patients (61.76%). Among them, consumption of raw milk was reported in 50.18% of cases, while 49.81% of them had consumed the cheese made from raw milk (Fig. 2). The direct exposure to infected livestock concurrent with the consumption of contaminated dairy products was mentioned by 241 patients.

Positive family history of brucellosis

During the study, 272 patients (61.53 %) had a history of infected family member.

Occupation

Regarding the occupation of patients, the highest reported numbers were among female housekeepers (34.16 %) and farmers (18.09%) (Table 2).

Education

A highest number (43.89%) and lowest number (3.39%) of infected persons were reported in illiterate and high school graduated groups, respectively (Table 2).

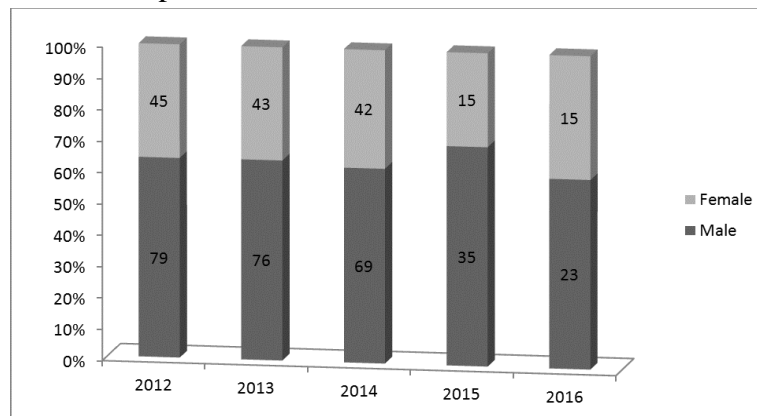


Fig. 1. Distribution (%) of brucellosis in male and female patients in Mianeh County during 2012–2016.

Table 2. Distribution of patients with brucellosis by education and occupation in Mianeh County during 2012-2016.

		2012	2013	2014	2015	2016	
Characteristics		N=124	N=119	N=111	N=50	N=38	Total numbers (%)
Education	Illiterate	54	51	48	22	19	194 (43.89)
	Elementary	43	40	43	16	11	153 (34.61)
	Secondary	13	16	15	6	5	55 (12.44)
	High school	7	9	3	4	2	25 (5.65)
	Diploma & college	7	3	2	2	1	15 (3.39)
Occupation	Housekeeper women	43	36	40	19	13	151(34.16)
	Farmer	29	22	13	8	8	80 (18.09)
	Student	23	28	16	4	5	76 (17.19)
	Husbandry	9	10	8	4	5	36 (8.14)
	Farmers-Husbandry	4	4	7	4	2	21 (4.75)
	Other	16	19	24	11	6	76 (17.19)

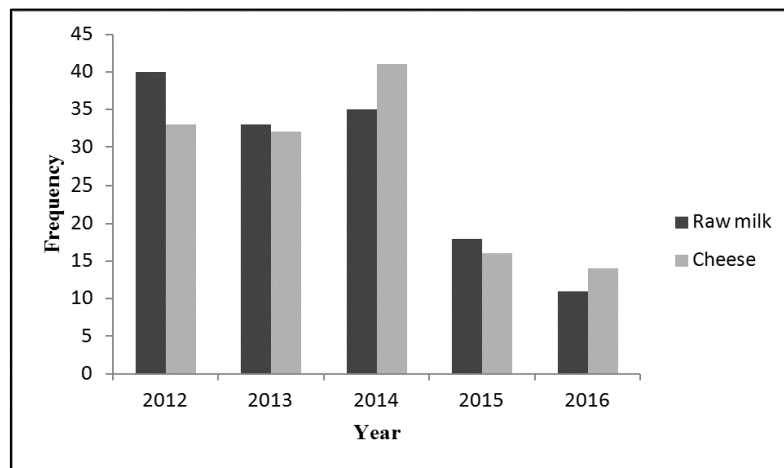


Fig. 2. The frequency distribution of brucellosis in patients by consuming raw milk and cheese made with raw milk in Mianeh County during 2012–2016.

Discussion

Demographic Area

The present investigation was designed to identify the major risk factors for human brucellosis in the region of Mianeh, located in East Azarbaijan province of Iran using a retrospective study. Brucellosis remains a serious public health problem and socio-economical concern in many countries including Iran (Kassiri et al., 2013). The main causative agent in most of the regions of this country is *B. melitensis* (Husseini et al., 2004). Based on the results of present study, 442 new cases of patients with brucellosis were diagnosed in Mianeh County, demonstrating that brucellosis still remains an important endemic disease in this area.

Age & Sex

Brucellosis cases have been reported at all ages, but most likely occurred in adolescents and young adults (Almuneef et al., 2004). The age and sex of patient may be correlated to the principal route of disease transmission (Avdikou et al., 2005). In the present study, the most patients fell into the group of 10-19 years of age (26.01%) (Table 1). In accordance with the results of the present study, Chegeni et al. (2014) reported that 10-19 years old age group was more affected (37%) than other groups to human brucellosis in Lorestan province of Iran. Also, the results of a research in Isfahan province showed that the disease was most common in individuals aged 15-20

years (Dastjerdi et al., 2012). Kassiri et al. (2013) in a study looking for the epidemiological, laboratory, diagnostic and public health aspects of human brucellosis in Azna county, western Iran, found that the most common age group associated with the disease was 15–24 years old (27.9%). This disease is most likely associated with the nomad young men who worked in ranch and have contact with domestic animals (Chegeni et al. (2014). So, the higher prevalence of brucellosis among young and middle-aged people may be due to more contact with cattle and consumption of unpasteurized dairy products (Avdikou et al., 2005; Kassiri et al., 2013).

In the present study, the incidence rate of brucellosis in male patients (63.80%) was more than females (36.20%). In accordance with the results of this study, Pourahmad et al. (2012) in a research on patients treated for brucellosis in Jahrom disease control center during 2005–2008, reported that 68.5% and 31.5% of the patients were male and female, respectively. The higher incidence of brucellosis in men have also reported by some other researchers (Bokaei et al., 2009); Kassiri et al., 2013; Chegeni et al., 2014; Pakzad et al., 2016; and Riabi et al., 2017). The difference in the rate of disease between males and females could be explained by the fact that most cases within ‘at risk’ categories are males. Because of social and occupational status, males are more exposed to the animals and contamination

resources than females. Therefore, males are more likely to become infected with *Brucella* (Pakzad et al., 2016).

Exposure to the infected livestock & consumption of contaminated dairy products

Generally, close contact with infected livestock, their tissues or secretions, herding, lambing as well as consumption of unpasteurized milk and dairy products may lead to the transmission of brucellosis (Sofian et al., 2008). It has been reported that the direct contact with infected animals and their products has greater risk for brucellosis transmission than the consumption of contaminated animal products (Shehada et al., 1996; Pérez-Rendón et al., 1997; De Massis et al., 2005). In a study on the epidemiology of human brucellosis in southern Saudi Arabia, direct contact with domestic animals and consumption of raw products of animal origin were identified as the main risk factors (Alballa, 1995).

It has been confirmed that the pasteurization of milk may be as the main control measure against brucellosis. However, such measures would be difficult to implement since the major changes in deeply rooted, traditional practices is required (Al-Shamahy et al., 2000). It is generally believed that some particular dairy products such as cheeses have pleasant flavours, which might be due to indigenous enzymes and microflora in the raw milk (Jakobsen et al., 2011).

In an investigation on the incidence rate of brucellosis in Tehran Province, fresh cheese and raw milk were reported as the major source of infection (Esmaeili et al., 2016). Findings of the current study regarding the consumption of raw milk and cheese produced from raw milk were also in agreement with those found by other researchers (Zamani et al., 2011; Husseini et al., 2004).

Positive family history of brucellosis

In the present study, person-to-person transmission of disease between family members was a risk factor for brucellosis, which is in accordance with the previous studies (Findik et al., 2006; Sofian et al., 2008; Earhart et al., 2009). The exposure of family members to the same epidemiological factors may lead to the infection of more than one member of the family. Thus, family members should be screened when a brucellosis case is diagnosed (Sofian et al., 2008). In order to control and prevent the disease, it is also necessary to educate family members with a comprehensive understanding of the transmission routes of infection (Esmaeili et al., 2016).

Occupation

Brucellosis, as an occupationally acquired disease, has long been investigated by many researchers and it was shown that educational level is a risk factor for brucellosis infection (Sofian et al., 2008). A high percentage of patients with brucellosis as a result of

occupational exposure, indicate that occupational exposure is one of the most significant routes of disease transmission. In fact, direct exposure to infected animals, particularly when handled their aborted fetuses or placentas, is believed to be the most important transmission route of the infection (Avdikou et al., 2005). Poor understanding of the disease, the presence of risky practices on the farm and at the household and incorrect perception, support the need of farmers for an educational awareness program (Arif et al., 2017).

In the present study, housekeeper women were the most frequent (34.16%) group associated with the disease. Similar results have also been reported by other researchers about housekeeper women in Iran (Moradi et al., 2006; Kazemi et al., 2008; Bokaie et al., 2009). The reason for the high prevalence of the disease in housekeeper women may be related to their frequent exposure to the livestock and their products. In village, they are frequently in contact with livestock because of daily activities such as milking and preparation of homemade dairy products. Even, sometimes they may help animals to deliver their newborn without usage of gloves.

Education

Risk factors for human brucellosis were studied in Yemen by Al-Shamahy et al. (2000). They stated that a lower number of brucellosis was found in university-educated groups. Direct

relation of lower educational levels with brucellosis has also been reported in previous studies in Iran (Sofian et al., 2008; Sharifi et al., 2016). In the present study, a lower number of infected persons were observed among high school graduate groups. The knowledge about the transmission route of brucellosis can be served for protection against infection, which highlights the significance of educational level in the prevention of brucellosis (Ramos et al., 2008). Thus, training programs are required in regard to the protective measures (such as wearing clothes especially when assisting in deliveries and having sick or aborted animals visited by a veterinarian) during contact with animals; and compliance with sanitary procedures (such as boiling or pasteurizing) during the processing of milk and dairy products (Earhart et al., 2009).

Conclusion

According to the present results, brucellosis still remains as a serious problem for human and animal health in Iran. In the present study, the most important risk factors for the disease were occupation, food consumption and having easy access to unpasteurized milk. These findings proved that there is still insufficient knowledge about the disease particularly in urban areas of the country. Hence, it is necessary to educate people about the risk of consumption of unpasteurized milk and dairy products.

Conflict of Interests

The authors declare that they have no conflict of interest.

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