

## Epidemiological Pattern and Trend of Brucellosis in Diagnosed Patients in Isfahan Province, Iran, during 2011-8

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### A-R-T-I-C-L-E-I-N-F-O

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### A-B-S-T-R-A-C-T

**Background & Aims of the Study:** Brucellosis is a bacterial infectious disease that can be transmitted between humans and animals through the consumption of unpasteurized dairy products or direct human contact with infected animals, placenta, or aborted fetuses. The present study aimed to investigate the epidemiological pattern and trend of brucellosis in diagnosed patients in Isfahan province, Iran, during 2011-9.

**Materials and Methods:** This descriptive cross-sectional study was conducted during 2011-9 in Isfahan province. Data analysis was performed in SPSS software (version 20) using descriptive tests.

**Results:** The total number of studied patients who were diagnosed with brucellosis was 5268, including 3650 males (69.3%) and 1618 females (30.7%). The mean incidence rate of the disease was estimated at 14.5 per 100,000 people during the research period. The mean age of the patients was  $35.98 \pm 18.1$  and most of the participants were within the age range of 15-29 years. Moreover, 51.7%, 1.6%, 46.7% of the patients lived in rural, nomadic, and urban areas, respectively. Furthermore, 67.3% of the patients had a history of contact with livestock, and 17.9% of them had a family history of brucellosis. Besides, 59.2% of the infected people had a history of using unpasteurized dairy products.

**Conclusion:** Based on the results, it can be concluded that interventions, such as the provision of appropriate training for young people, especially in rural areas, and housewives, as well as recommendations for the use of pasteurized dairy products, can be very helpful in controlling this disease.

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### Background

Brucellosis is a bacterial infectious disease transmitted between humans and animals. The disease is known in humans as Malta fever and

in animals as brucellosis (1). Brucellosis is also known by other names, such as undulant fever and Mediterranean fever. Moreover, it is known as a disease with a thousand faces due to its various long-term side effects (2). This disease is created by a type of bacteria named *Brucella*

whose subtypes, namely *B. melitensis*, *B. abortus*, *B. suis*, and *B. canis* cause more than 50,000 human infections worldwide each year (3). *Brucella melitensis* has three serotypes and the first serotype is one of the most pathogenic *Brucellas* in Iran (4). Brucellosis is one of the most common zoonotic infections worldwide (5) which can be transmitted through the consumption of unpasteurized dairy products and direct contact with infected animals, placenta, or aborted fetuses (6). Moreover, the consumption of raw liver due to its high blood volume can cause infections through the gastrointestinal tract (4).

This disease can also be transmitted to humans through their respiratory systems by infected particles existing in corrals, stables, and laboratories. If contact with the source of the infection persists, it will be difficult to determine the timing of the infection and the incubation period. However, if the infection has been caused by one particular contact, the incubation period might be a few weeks or even 6-17 months (7). There are no vaccines for the prevention of this disease in humans and no significant human-to-human transmission has been observed. Therefore, it can be prevented in humans by the control of animal brucellosis, milk pasteurization, and adherence to other food hygiene standards (8).

Brucellosis can cause severe disabilities and its symptoms include fever, sweat, fatigue, weight loss, headache, and joint pain for several months. Moreover, it can cause neurological complications, endocarditis, testicular swelling, or bone abscess. Besides, brucellosis by making the patients unable to perform their daily activities imposes a serious financial burden on them. It should be noted that this disease can seriously harm dairy industries (6, 9). Brucellosis, which is a re-emerging disease, is shared between humans and animals with a prevalence rate of about 10 per 100,000 people that has made it one of the most common human and animal diseases in some countries (3).

It can be said that per every identified

patient four others in the society are not identified (10). The World Health Organization estimates that about 500,000 people are infected with this disease annually, about 45,000 of whom are in the eastern Mediterranean countries, including Iran (2). This disease has a high incidence rate in the Middle East region and has remained endemic in Iran, regarding the prevalence of animal husbandry in this country. However, its incidence rate ranges from 1-108 per 100,000 people in different regions of Iran (11). The average annual incidence rate of the disease in Iran between 1990 and 2007 was estimated at 43.24 per 100,000 people (12). Therefore, considering the annual incidence of brucellosis in Isfahan province, Iran and the fact that it causes numerous problems for the patients and imposes an economic burden on them and the healthcare system, it is necessary to study the epidemiological pattern of this disease in recent years in Iran to identify high-risk groups and use the results to plan strategies against this disease.

## Materials & Methods

This descriptive cross-sectional study used the data on the care for contagious diseases provided by the zoonotic diseases control department (Portal of the Deputy of Ministry of Health and Medical Education) to evaluate the epidemiological aspects of brucellosis in Isfahan province during 8 years. The required data were obtained by the identification of brucellosis patients in public or private healthcare centers through the examination forms and their registration in the portal of the Ministry of Health in Isfahan province, during 2011-9.

One of the goals of the healthcare system is to assess the current situation and monitor the disease process. Therefore, it is necessary to collect initial and complete data on the infected people to obtain accurate information on this

disease and design appropriate interventions for the promotion of health.

For this reason, it is necessary to use the standardized definitions and specific criteria of the disease to achieve an accurate and standard diagnosis. Brucellosis is diagnosed by clinical symptoms, epidemiological contact with infected animals or animal products, and having a Wright titer or Coombs Wright  $\leq \frac{1}{80}$  or 2ME titer of  $\leq \frac{1}{40}$ .

The collected data were analyzed in SPSS software (version 20) using descriptive statistics, such as mean, standard deviation, frequency distribution, and percentage frequency distribution. In order to calculate the incidence rate of the disease in each city, a fraction was used with the numerator representing the number of diagnosed people in each year and the denominator showing the population of each city in that year. Moreover, in order to calculate the mean incidence rate during the research period, the total incidence of the disease in each city was divided by the years of the research period. The geographical distribution maps and GIS software (version 10.3) were used in order to manage and analyze the data to discover the geographical aspects of the disease. The final purpose was to make fundamental decisions based on the collected geographical data and also observe the geographical distribution of this disease in Isfahan province.

## Results

The present study investigated the collected information of 5268 brucellosis patients during 8 years (2011-9). The mean incidence of brucellosis was estimated at 14.5 per 100,000 people during the research period (Figure 3).

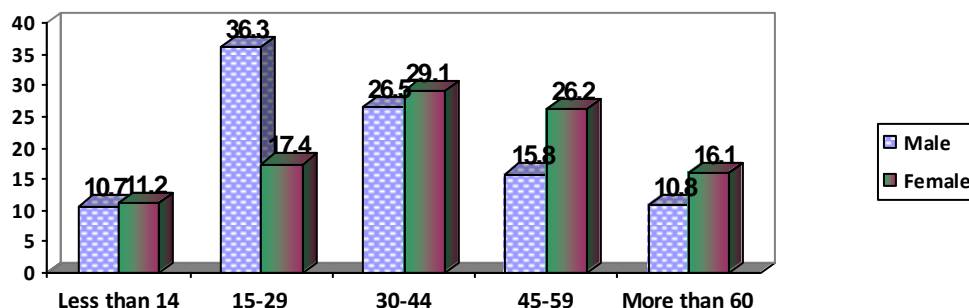
The participants of the present study consisted of 3650 males (69.3%) and 1618

females (30.7%). In total, 98.6%, 1.3%, and 1.1% of them were Iranian, Afghan, and Iraqi, respectively. Furthermore, 85% of them were recently infected, 5.1% of them had experienced treatment failure, and 9.9% of them had an unknown status. The patients were within the age ranges of >14 (n=565, 10.7%), 15-29 (n=1589, 30.2%), 30-44 (n=1421, 27%), 45-59 (n=990, 18.8%), and <60 years old (n=647, 12.3%). Therefore, the most and least frequency was observed in the age ranges of 15-29 and >14 years old, respectively. The age of 1.1% of the subjects was unknown. The mean age of the patients was  $35.98 \pm 18.1$  while the mean age of males and females was  $34.1 \pm 17.57$  and  $40.5 \pm 18.7$ , respectively. In addition, the mean ages of rural, nomadic, and urban women were  $41.3 \pm 18$ ,  $34.6 \pm 18.7$ , and  $40.5 \pm 18.4$ , respectively. On the other hand, the mean ages of rural, nomadic, and urban men were  $35 \pm 17.8$ ,  $30.8 \pm 16.58$ , and  $35.1 \pm 16.67$  (Table 1, Figure 1). In total, about 51.7%, 1.6%, and 46.7% of the patients resided in rural, nomadic, and urban areas (Table 1).

Based on the results, 67.3% of the patients had a history of contact with livestock in the past year. Rates of contact with livestock in rural, nomadic, and urban areas were 85.2%, 98.8%, and 61.2%, respectively. Moreover, 17.9% of the patients had a family history of the disease, which could be due to their usage of the same unpasteurized dairy as the patient or contact with infected livestock. Furthermore, 32.1%, 22.1%, and 15.8% of the participants living in nomadic, rural, and urban areas had a family history of this disease. In total, the results showed that 60.6%, 63.3%, and 78.6% of the subjects who lived in urban, rural, and nomadic areas, respectively, had used unpasteurized dairy products (Table 2). In total, 59.2% of the participants had a history of using unpasteurized dairy products.

**Table 1) Demographic characteristics of brucellosis patients in Isfahan province during 2011-8**

Demographic characteristics	Prevalence (percent)
<b>Age range</b>	
> 15 years	565 (10.7)
15-29	1589 (30.2)
30-44	1421 (27)
45-59	990 (18.8)
≤60	647 (12.2)
Unknown	56 (1.1)
<b>Gender</b>	
Male	3650 (69.3)
Female	1618 (30.7)
<b>Place of residence</b>	
Urban	2147 (40.8)
Rural	2152 (40.9)
Nomadic	84 (1.6)
Unknown	885 (16.7)
<b>Occupation</b>	
Rancher	1032 (19.6)
Housewife	1103 (20.9)
Farmer and rancher	635 (12.1)
Student	476 (9)
Clerk	76 (1.4)
Butcher	123 (2.3)
Child	149 (2.8)
Other	1156 (22.1)
Unknown	518 (9.8)

**Figure 1) Age and gender distribution of brucellosis patients in Isfahan province during 2011-8**

According to Figure 2, brucellosis was most prevalent in spring and summer and least prevalent in autumn and winter.

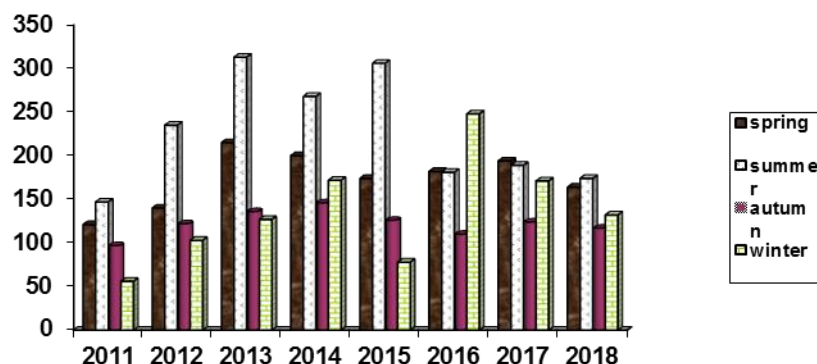
The results of the laboratory tests of patients are shown in Table 3. In this study, 4905 (93.1%) of patients had a Wright titer of  $\leq \frac{1}{80}$  and 4748 (90.1%) of them had 2ME titer of  $\leq \frac{1}{40}$ . Moreover, 1204 (22.8%) of the subjects had a Coombs Wright titer of  $\leq \frac{1}{320}$ . According to the

results, in Wright tests,  $\frac{1}{160}$  and  $\frac{1}{320}$  had the highest frequency with 29.4% and 25.5%, respectively. Furthermore, in 2ME tests,  $\frac{1}{160}$  was the most frequent (73%).

The results showed that the majority of infected people were male in both rural (67.6%) and urban (71.9%) areas due to their contact

**Table 2) Distribution of brucellosis patients in Isfahan province during 2011-8**

Studied variables	Prevalence (percent)
<b>History of using unpasteurized dairy products</b>	
Yes	3119 (59.2)
No	1368 (26)
Unknown	781 (14.8)
<b>History of contact with infected livestock in the past year</b>	
Yes	3545 (67.3)
No	1127 (21.4)
Unknown	596 (11.3)
<b>History of infection in the family</b>	
Yes	943 (17.9)
No	3519 (66.8)
Unknown	804 (15.3)

**Figure 2) Seasonal distribution of brucellosis disease in Isfahan province during 2011-8****Table 3) Test results of brucellosis patients in Isfahan province during 2011-8**

Variable	Values	Prevalence (percent)
Wright test	1.40	184 (3.5)
	1.80	916 (17.4)
	1.160	1549 (29.4)
	1.320	1341 (25.5)
	1.640	734 (13.9)
	1.1280	365 (6.9)
	Not performed	179 (3.4)
2ME test	1.20	29 (0.6)
	1.40	274 (5.2)
	1.80	323 (6.1)
	1.160	3885 (73.7)
	1.320	163 (3.1)
	1.640	83 (1.6)
	1.1280	20 (0.4)
Coombs Wright	Not performed	491 (9.3)
	1.40	80 (1.5)
	1.80	261 (5)
	1.160	468 (8.9)
	1.320	556 (10.6)
	1.640	307 (7.5)
	1.1280	251 (4.8)
	Not performed	3255 (61.8)



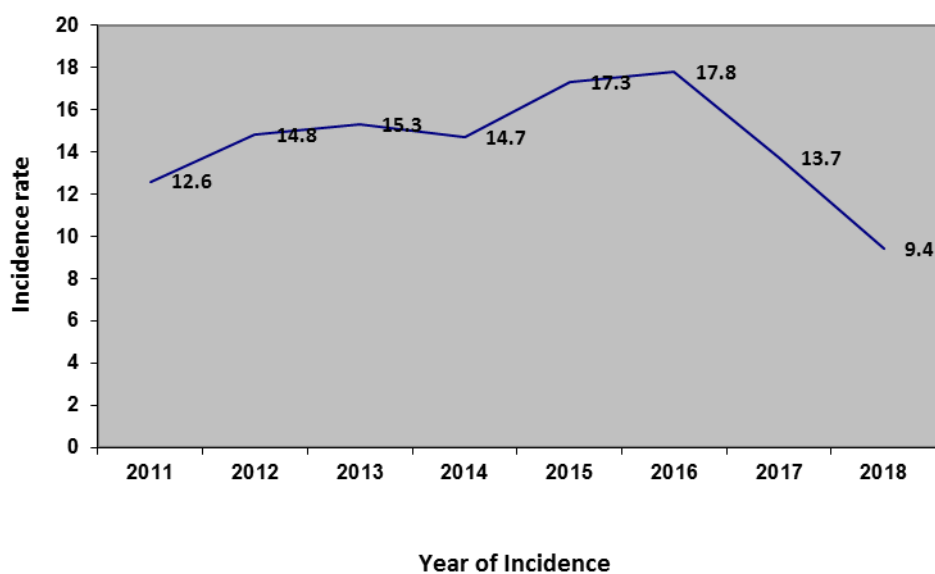


Figure 3) Mean incidence rate of brucellosis per 100,000 people in Isfahan province during 2011-8

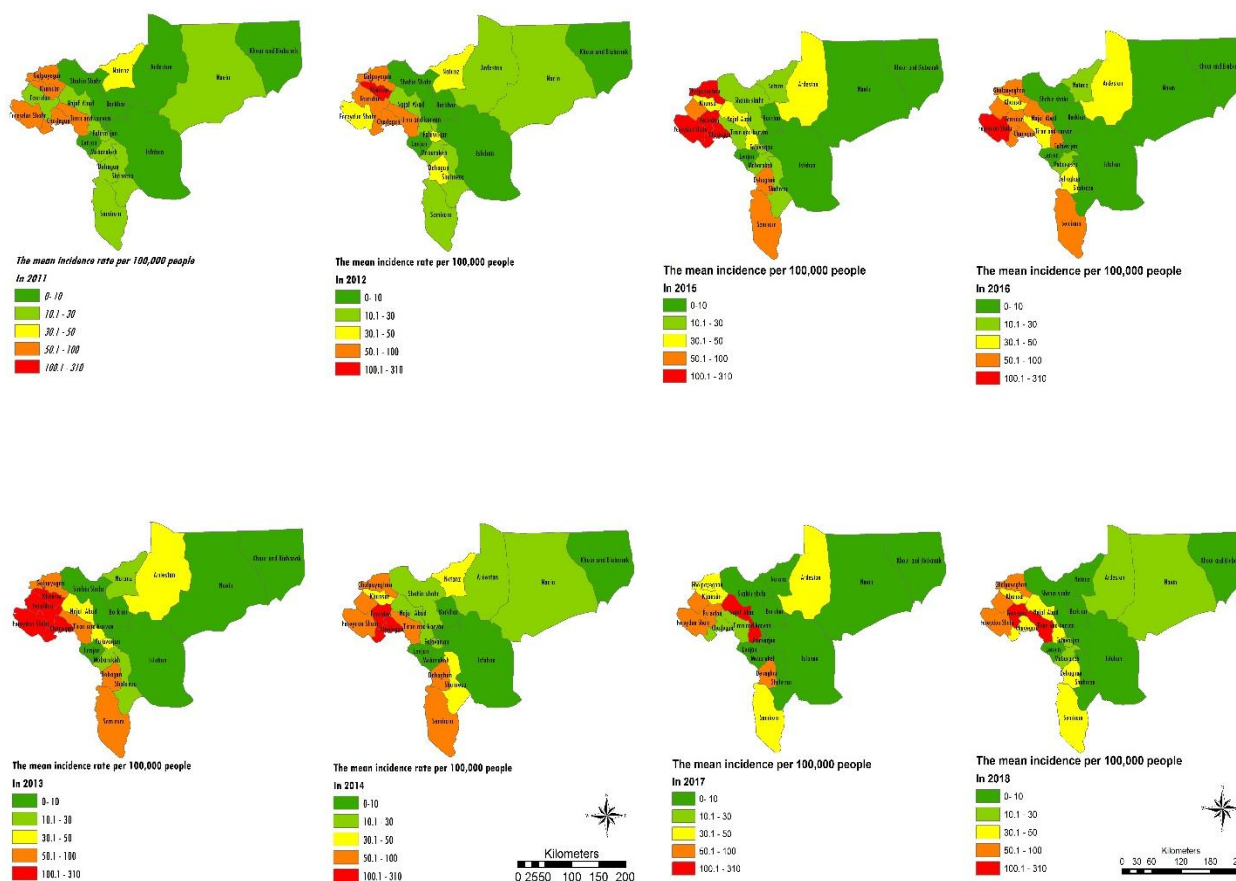


Figure 4A) Geographical distribution of brucellosis in Isfahan province during 2011-8

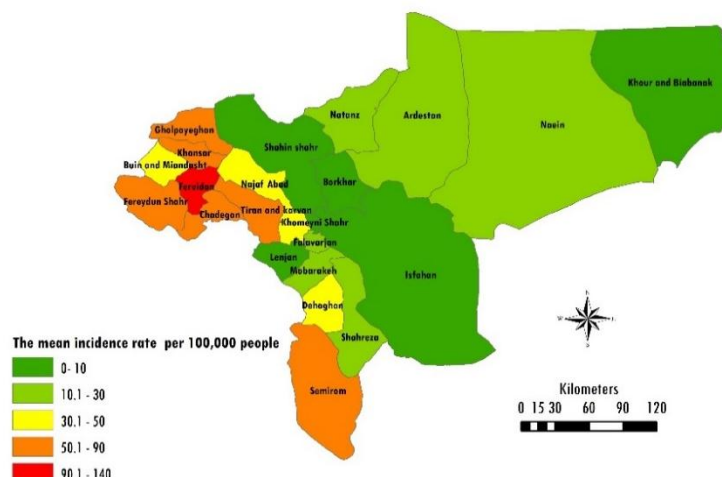


Figure 4B) Mean incidence rate of brucellosis in Isfahan province during 2011-8

Table 4) Incidence rate of brucellosis in Isfahan province during 2011-8

City	2011	2012	2013	2014	2015	2016	2017	2018	Mean incidence rate of the disease during the research period
Ardestan	4.8	21.7	48.5	26.2	35.7	44.3	34.2	12	28.4
Borkhar	2.8	2.8	0.9	7	3.4	7.9	3.2	1.6	3.7
Buin and Miandasht				73.5	83.4	71	94	66.2	48.5
Chadegan	76.6	76.6	103.2	138.7	120.4	58	26.2	33	79
Dehaghan	14.3	31.6	78	50.5	54.5	38.8	82	37.7	48.4
Isfahan	1.4	1.2	2.7	1.8	0.3	0.7	1.2	0.2	1.2
Falavarjan	20.6	32.6	35.5	22	13.6	8	9.5	11.2	19.2
Fereidan	28.8	85.4	103.5	307.4	203	98	74	144.3	130.6
Fereydun Shahr	62.6	38.2	140.2	98	106.3	118	62.8	81.8	88.5
Golpayegan	53.7	66.2	86.6	83.7	106.3	53.6	35.8	75.5	70.2
Khansar	92.5	123.7	106.2	40	40	39	47.3	42.4	66.4
Khomeyni Shahr	3.9	14.8	6.4	3.4	4	2.4	1.3	6	5.3
Khour and Biabanak	0	0	0	5.7	0	0	0	0	0.7
Lenjan	4.5	5.3	4/4	2.4	3.2	7.5	4.4	5.7	4.7
Mobarakeh	13.2	11.2	12.7	8.6	12.6	12	6.2	11.3	11
Naein	21	19	5.3	15.8	2.6	5.2	5.2	12.7	11
Najafabad	11.7	25	36.9	24.7	34.3	93	106	48.6	47.5
Natanz	38	36.9	22	35.7	13	18	6.7	6.8	22
Semirom	24.6	18.7	65	77.8	88	87.6	45.4	31	54.8
Shahin Shahr	4	4.8	5.6	16	14.6	4.7	7	3	7.5
Shahreza	11.4	20.3	17.9	30.6	22	4.5	8.6	4.4	15
Tiran and Karvan	53.6	71.3	96	54.5	16	31.5	18.4	102	55.4
Total	9.4	13.7	17.8	17.3	14.7	15.3	14.8	12.6	14.5

with livestock (e.g., milking) and unpasteurized dairy consumption, respectively. Moreover, 52.4% of the patients living in nomadic areas were female which could be due to their direct contact with livestock and their lochia.

The results show that the incidence rate of the disease is higher in the western and southern provinces of Buin and Miandasht, Feriedan, Fereidounshahr, Golpayegan, Khansar, Chadegan, Tiran and Karvan, and

Semirom which have a large nomadic and rural population (Figure 4, Table 4).

## Discussion

According to a report released by the Ministry of Health in 2012, the provinces with a mean incidence rate of 0-10 per 100,000 people and provinces with a mean incidence rate of 11-20 per 100,000 people were considered as mildly and moderately infected (7). The results of the present study showed that the mean incidence rate of brucellosis in Isfahan province was 14.5 per 100,000 people. This is inconsistent with the report of the Ministry of Health, which indicated that the mean incidence rate of brucellosis in Isfahan was very low. This shows that the prevalence of infection in Isfahan province has been increasing so that now it is considered moderately infected.

In another categorization by Ehsan Mostafavi *et al.* regarding the trend of brucellosis in Iran during 1991-2007, Isfahan with a mean incidence rate of 0-30 per 100,000 people had a very low level of infection (12). Moreover, according to a review study conducted during 1990–2010, the incidence rate of the disease in the Eastern Mediterranean region was between 0.73-149.54 per 100,000 people, which is consistent with the results of the present study (13). However, the prevalence of brucellosis in Isfahan province is probably due to differences in its population, the presence of livestock in the region, and the consumption of local dairy products.

In total, 53.3% and 46.7% of the patients lived in rural/nomadic and urban areas, respectively. Moreover, in the present study, 80% of the participants were residents of rural areas (14-17). Brucellosis is prevalent in all the cities of Isfahan province, but its prevalence rate varies in different regions, which can be due to the dispersion of the livestock and different risk factors of the disease. The results of the study performed by Mostafavi *et al.* indicate that there is a significant relationship between the mean annual incidence rate of

brucellosis and the population density of sheep and goats (12).

In the present study, the incidence rate of brucellosis was higher in males (69.3%) than females, which was similar to the results of most of the previous studies (14, 16-19). Moreover, the highest and lowest incidence rates belonged to the participants within the age ranges of 15-29 (probably due to more exposure to livestock) and  $\geq 14$  years old. In a study conducted by Hashtarkhani *et al.*, the majority of patients were 11-20 and 21-30 years old (15). It should be noticed that the results of this study were consistent with those of other studies in this regard (14,18). However, in a study performed by Pakzad *et al.*, the highest incidence rate belonged to the people within the age range of 25-44. This was probably due to the fact that in the above-mentioned study about 83% of the statistical population lived in rural regions and were at a higher risk of brucellosis due to their frequent contact with the sources of infection and the endemic nature of this disease (17). Nevertheless, in a study carried out by Ebrahimpour *et al.* people over 50 years old had the highest incidence rate which could be due to disease resistance leading to its continuation as well as agricultural activities (19).

The mean age of the patients was  $35.7 \pm 18.5$  while the mean ages of males and females were  $34 \pm 17.9$  and  $40 \pm 19$ , which is consistent with the results of other studies (14, 15,17). However, in a study conducted by Farazi *et al.*, the mean age of females was one year lower than that of males (20). Moreover, 29% of the statistical population were housewives and 19.6% were ranchers, whose infection could be due to their contact with dairy products and livestock and even milking, which is consistent with the findings of other studies (15,19). In a study conducted by Rezai *et al.* in Qom, farmers, ranchers, housewives, and students had the highest incidence rate of brucellosis (21).

In the above-mentioned study, 32.1% and 22.1% of the people living in nomadic and rural



areas, respectively, had a family history of brucellosis that could be due to their higher exposure to infected livestock or dairy products. Nevertheless, in urban areas, the incidence rate was 15.8% (15). In the present study, 60.6%, 63.3%, and 78.6% of the subjects lived in urban, rural, and nomadic areas. The majority of patients were residents of rural and nomadic areas which could be due to the consumption of unpasteurized dairy products. This result is similar to those of other studies (22, 23).

The findings of a study performed by Ismaili *et al.* indicated that routine vaccination and inoculation of livestock were performed by the ranchers. However, the lack of funds to pay the compensation caused the owners to keep their infected livestock. Nevertheless, it seems that encouraging people to vaccinate their livestock can be an important step towards the control of this disease (24). Moreover, based on a study performed by Rasouli *et al.*, livestock vaccination can reduce the damages caused by brucellosis in society (25).

Brucellosis was the least prevalent from November to May. On the other hand, it was the most prevalent between May and September which seems to be due to the breeding season, frequent contact of people with their livestock, and their consumption of dairy products. Other studies have also confirmed an increase in the incidence rate of brucellosis over the same period (14, 26). Among the performed Wright tests,  $\frac{1}{160}$  (29.4%) and  $\frac{1}{320}$  (25.5%) had the highest frequency, which is similar to the results of Hashtarkhani *et al.* in Khorasan Razavi (15).

Furthermore, by using the collected data and map on the provincial distribution of the disease, appropriate plans can be made to enhance provincial screening tests and conduct additional interventions in cities with high incidence rates.

### Limitations

Given that a number of cases are diagnosed

in private centers and hospitals and their information is unavailable, it was not possible to study all the brucellosis patients in the present research. Another limitation of this study was the lack of accurate and complete recording of the information of the patients which can influence the results of the study.

## Conclusion

Findings of this study indicate the necessity of appropriate interventions, such as vaccination and inoculation of the livestock for better control of the disease, as well as raising awareness and changing the attitudes of the public, especially vulnerable groups, including villagers, ranchers, and nomads regarding the proper use of dairy products and avoidance of touching the lochia and animal waste. Given the results of this study, the disease was the most prevalent within the age range of 15-29 years; therefore, due to the young age of this group and their capacity to be educated, great advancement can be achieved by reinforcing appropriate educational programs to control the disease.

## Footnotes

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## Conflict of Interest

The authors declare that there is no conflict of interest.

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