

# Trends of human brucellosis in Central Iran (2010–2018)

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**Background:** Brucellosis is one of the most common infectious diseases worldwide which is caused by direct contact with affected animals or their products. It puts a huge impact on the economy, society, and the environment. Iran is the fourth endemic country for brucellosis in the world. It has been described a new epidemiological feature of the disease and its trends in Isfahan province, as one of the endemic areas of brucellosis in Central Iran. **Materials and Methods:** This is a cross-sectional, population-based study. Data collection was performed using epidemiological questionnaires through Epi-2006 software from the private and public sectors in 22 districts of Isfahan province over 9 years (2010–2018). The results were obtained by the description statistics using the SPSS Statistics software version 20 (SPSS Inc., Chicago, IL, USA). **Results:** Altogether, 5751 new brucellosis patients were recorded over 9 years. About 70% of these cases were male. The majority of cases had occurred in the age group of 21–30 years. The average incidence of brucellosis over the 9 years was 14.1 cases/100,000 population including 8.8 in the urban versus 45.2 cases in the rural areas. During the 9-year study period, the incidence of brucellosis was increased between 2010 and 2014. From 2014 to 2017, the trend has been decreasing, but in the last year of the study, the trend has been increasing again. Seasonally, the incidence rate was variable between the lowest from October to January and the highest from June to July. **Conclusion:** According to the fluctuation of incidence trend of brucellosis during the 9-year study period in Central Iran, it seems some policy changes regarding to the control and prevention of brucellosis have a role, changes that should be fixed and corrected.

**Key words:** Brucellosis, epidemiology, health policy, Iran, Isfahan, trend

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## INTRODUCTION

Brucellosis is one of the most important infectious diseases in the world, which is transmitted to humans by contact with infected animals or livestock products.<sup>[1-5]</sup> Diagnosis is based on the clinical and laboratory findings such as ELISA.<sup>[6,7]</sup> Brucellosis usually shows a wide range of presentations, including cold-like to severe symptoms.<sup>[5,8,9]</sup> The prevalence of recurrent brucellosis has been increased.<sup>[9]</sup> Brucellosis puts a huge impact on the economy;<sup>[8,10,11]</sup> furthermore, its prevalence is one of the most important health measures in all countries.<sup>[3,12]</sup>

Rather than the physical disability, its cost is a great deal for each country, particularly in areas where the economy is dependent on livestock.<sup>[1,13,14]</sup>

Increasing the level of public awareness and improving intervention and preventive policies against brucellosis can reduce the incidence of the disease in high-risk areas.<sup>[11]</sup>

Brucellosis is still one of the most forgotten diseases in the world, so only a small portion of the patients are identified.<sup>[15]</sup> According to the WHO, annually about 500,000 people get brucellosis, owing to variation and

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inadequate surveillance systems between countries, the global annual incidence of human brucellosis is not truly known.<sup>[16-18]</sup> Although the overall prevalence of brucellosis has been declining in recent years, it is still endemic in some developing areas including the Western Mediterranean, the Middle East (including Syria, Iraq, Turkey, and Iran), Central and South America, and India.<sup>[1,8,17,19]</sup>

Iran is the fourth endemic country for brucellosis in the world.<sup>[16]</sup> Due to a large number of nomads, traditional livestock breeding methods, and no timely vaccination of livestock, brucellosis is still one of the most important infectious diseases in Iran. The prevalence of brucellosis depends on time and place, with the highest prevalence in the first half of the year.<sup>[19,20]</sup> Isfahan province is one of the endemic areas of brucellosis in Central Iran.<sup>[14]</sup> In this study, an epidemiological feature of brucellosis has been described in districts covered by Isfahan University of Medical Sciences (MUI).

## METHODS

### Study design

This is a cross-sectional and observational study employing the data of epidemiological questionnaires from the private and public sectors over 9 years (2010–2018). These places include all governmental rural and urban health centers, medical diagnostic laboratories, and also private offices throughout the province.

### Data collection

Information on brucellosis is routinely collected from the public and private laboratories by professional health workers from the Ministry of Health according to the Wright and Combs Wright laboratory criteria and 2ME using standard questionnaires. The collected data are routinely reported to the district health centers, at first, then to the provincial health center. Accordingly, we have collected and reported the raw information related to all general health centers under the auspices of the Isfahan University of Medical Sciences in Isfahan Province. Information within 2006–2011 has been already published in the PUBLIC HEALTH journal, and the current study is a continuation of the previous study in 2010–2018.

### Study population

The total population of 22 districts of Isfahan province (except Kashan and Aran-o-Bidgol) within 2010–2018 included the study population in the current research.

The inclusion criteria were both clinical signs and symptoms of brucellosis and a confirmed laboratory test including Wright test titer more than 1/80 or a fourfold or greater rise in titer between samples taken 2 weeks apart, or a positive

blood/bone-marrow culture for *Brucella* in the patients living in Isfahan Province. Meanwhile, the cases whose brucellosis exams did not meet the international standards were excluded from the study.

### Sampling method

All information sent to the provincial health center of Isfahan was included in this study.

### Study variables

The study variables include age, sex, occupation, habitat, history of animal contact, history of consumption of unpasteurized dairy products, the time interval between the onset of clinical symptoms and diagnosis, laboratory results of Wright, Coombs, and 2ME tests, and the time of diagnosis.

### Statistical analysis

After collecting data through Epi-2006 software, CDC, Ministry of Health and Medical Education, Tehran, Iran, it was transfer to SPSS Statistics version 20 software (SPSS Inc., Chicago, IL, USA), and results present by the description statistics.

The results were reported by the frequency distribution tables and trends were reported in different years. This article has evaluated the incidence trend of brucellosis based on the epidemiological variables during the years 2010–2018.

### Ethical aspects

The ethical permission was obtained from the Research Ethics Committee of Isfahan University of Medical Sciences (MUI) (ID: 289162).

## RESULTS

Altogether, 5751 brucellosis patients were recorded over 9 years. The age of the patients ranges between 1 and 95 years, and about 70% of these cases were (male/female = 2.3). Out of the patients, 57% were urban and others were rural or nomads. The mean age of the patients was  $36.02 \pm 18$  years,  $34 \pm 17$  years for males, and  $40.07 \pm 18$  years for females. The majority of cases had occurred in the age group of 21–30 years (23%). In the 11–35 years' age group, the incidence of brucellosis among men was higher than women. The age composition of patients in the urban, rural, and nomad areas was significantly different.

The incidence of brucellosis, on average, was increased from 8.7 cases/100,000 populations in 2010 to 13.1 cases in 2018 in the study area. However, the incidence of brucellosis over the 9 years was 14.1, including 8.8 in the urban and 45.2 in rural areas. The highest incidence of brucellosis is

in the mountainous areas west of Isfahan (Fereydan [92.2], Fereydounshahr [84.9], Chadegan [77.7] and Khansar [72.3], respectively), and the lowest incidence of brucellosis is in the desert areas of Eastern Isfahan (Khour-Biabanak: 0.64).

The most common occupational group among the patients was ranchers (30%) and homemakers (21%) in both urban and rural areas. The most common occupation among the male patients was livestock (45.0% in urban areas and 44.1% in rural areas).

The rate of recent direct exposure to the livestock was 70.4% in rural and 75.4% in urban and 100% in nomad patients, respectively. Overall, 39% of urban and 32% of rural patients had mentioned a history of recent consumption of raw milk. Meanwhile, most of the patients had consumed a combination of dairy products (42%).

About 39% of the cases had a history of recent contact with a vaccinated animal [Table 1].

The mean duration of disease diagnosis (the time between clinical onset and laboratory diagnosis) was  $1.06 \pm 2$  months in all registered patients, which was somewhat higher in the rural areas ( $1.08 \pm 2$  months vs.  $1.00 \pm 2$  months). The duration of diagnosis means in the 1<sup>st</sup> year of study (2010,  $1.00 \pm 2$  months) was 9<sup>th</sup> year (2018,  $1.04 \pm 1$  months).

Seasonally, the lowest incidence rate was related to October to January, and from June to July interval, the highest incidence rate had been registered.

## DISCUSSION

### Epidemiologic feature

#### Sexual distribution

Brucellosis is one of the endemic diseases in Iran, and Isfahan is one of the most prevalent areas in Central Iran.<sup>[14,16]</sup> Brucellosis is one of the diseases whose exact incidence

has been remained unknown in different areas.<sup>[16,18]</sup> As mentioned, the sex ratio of male-to-female patients in the current study was 2.3. This ratio is higher than other studies in Iran; for example, in the study of Marvi *et al.*, this ratio is 1.5, and it is much lower in developed countries. For example, in the San Diego study, the number of women with brucellosis was about twice that of men.<sup>[1,4,14,21,22]</sup> This difference could be justified by the high percentage of European women employed in livestock-related jobs against Iranian women.<sup>[11,14,23]</sup>

#### Age distribution

The highest frequency was in the age group of 21–30 years; however, a higher percentage of men was significantly young, so about 58% of men were under 35 years, compared to 41% in the women. It could be attributed to the higher prevalence of livestock contact and its products among the young men and middle-aged women, especially in the rural areas.<sup>[1]</sup> Moreover, 3.9% of the patients were older than 70 in the current study which was less than similar studies in Iran.<sup>[3,9,14]</sup> This difference may be attributed to the greater focus of care on the youth age group in health centers affiliated to MUI.

#### Urban versus rural areas

About 57% of all patients were urban, and others were rural or nomads. The urban patients were increased more than rural ones within 2016–2018, according to the results. One of the possible causes is the higher rate of livestock vaccination among rural than urban and another may be attributed to the low reporting of the disease in the rural areas [Figure 1].

The incidence rate of brucellosis among the rural patients was lower than the urban ones. It was against the results of other similar studies.<sup>[4,8,24]</sup> The probable cause is that the urban areas of the Western districts of the province, as the most endemic regions, have a rural texture, and livestock is the most prevalent job among their populations. In these areas with the highest incidence of disease, the

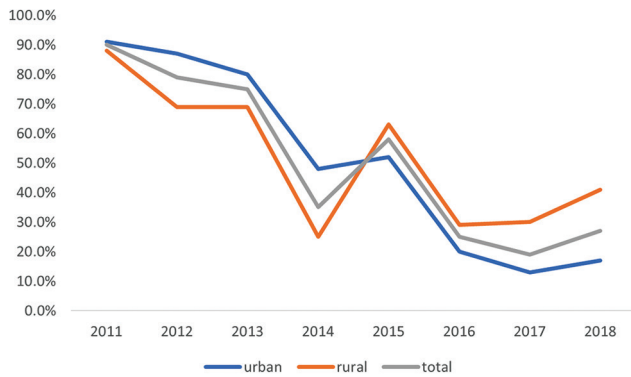
**Table 1: History of consumption of unpasteurized dairy products and contact with vaccinated animal by location and sex**

		Location			sex	
		urban	rural	nomad	male	female
Consumption of unpasteurized dairy products	Milk	609 (39%)	399 (32%)	17 (25%)	688 (36%)	337 (34%)
	Cheese	191 (12%)	155 (12%)	1 (1%)	213 (11%)	134 (13%)
	Ice cream	56 (3%)	53 (4%)	0 (0%)	57 (3%)	52 (5%)
	Cream	19 (1%)	16 (1%)	2 (2%)	32 (1%)	5 (0%)
	Top Milk	40 (2%)	35 (2%)	1 (1%)	52 (2%)	24 (2%)
	Butter	13 (0%)	14 (1%)	1 (1%)	15 (0%)	13 (1%)
	Mix of dairy	614 (39%)	563 (45%)	46 (67%)	815 (43%)	408 (41%)
History of contact with the vaccinated animal	Yes	1282 (47%)	946 (49%)	51 (51%)	1620 (48%)	660 (45%)
	No	578 (21%)	602 (31%)	29 (29%)	860 (25%)	423 (29%)
	No contact with the domestic animals	829 (30%)	355 (18%)	19 (19%)	846 (25%)	357 (24%)

direct contact with livestock is higher than in the other districts.

**Animal contact and dairy consumption**

The direct contact with livestock is one of the most important risk factors for brucellosis.<sup>[1,4]</sup> In the western districts with the most incidence, 54%–58% of the patients had livestock occupations, whereas in the districts with the lowest incidence, 28%–44% of the patients were involved in these jobs. Another risk factor for brucellosis is the consumption of unpasteurized dairy products.<sup>[1,25]</sup> Consumption of raw milk alone had been averagely reported in 36% of the patients, in a range of 75% in the most endemic district to 4% in the least one [Table 2].



**Figure 1:** The mean animal vaccination coverage against brucellosis in Isfahan Province within 2010–2018

**The time and season of diagnosis**

The mean time between the onset of symptoms and diagnosis in the urban areas was significantly lower than in rural which compared to the previous study had been shortened.<sup>[14]</sup> This difference is likely due to more diagnostic facilities in cities compared to the rural areas.

Seasonally, most of the incident cases have been reported from April to September, similar to other studies.<sup>[1,2]</sup> Given that the childbirth of livestock usually occurs in spring and lactation in summer and autumn, this seasonal distribution is likely due to more exposure to the livestock and their products at this time.<sup>[14]</sup>

**The livestock vaccination**

The rate of direct contact with vaccinated animals in the urban areas (40%) was lower than in rural and nomadic areas (42%–51%). The vaccination coverage had dropped from 90% in 2011 to 27% in 2018. It seems one of the most important factors in the raise of brucellosis during the study years is the decrease of the livestock vaccination.<sup>[5,16]</sup> Moreover, the higher incidence of the disease in urban areas than in rural may be due to the difference between vaccination coverages in urban and rural areas [Figure 1].

According to the Iranian Veterinary Organization (IVO),<sup>[24]</sup> the livestock vaccination was carried out regularly to control brucellosis within 2006–2009. This led to the lowest annual incidence of brucellosis in 2010 within the last 15 years.

**Table 2: History of consumption of unpasteurized dairy products by different districts of Isfahan province (2010-2018)**

District	Consumption of unpasteurized dairy products							Total
	milk	Cheese	Ice cream	cream	Top milk	Butter	Mix of dairy	
Ardestan	13 (46%)	5 (17%)	0 (0%)	0 (0%)	1 (3%)	1 (3%)	8 (28%)	28 (100%)
Ferayan	75 (32%)	15 (6%)	5 (2%)	3 (1%)	5 (2%)	1 (0%)	125 (54%)	229 (100%)
Feraydoun shahr	128 (75%)	7 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	34 (20%)	169 (100%)
Falavarjan	123 (44%)	35 (12%)	18 (6%)	2 (0%)	8 (2%)	6 (2%)	82 (29%)	274 (100%)
Golpayegan	68 (27%)	14 (5%)	22 (8%)	5 (1%)	21 (8%)	6 (2%)	115 (45%)	251 (100%)
Lenjan	39 (44%)	17 (19%)	2 (2%)	0 (0%)	2 (2%)	1 (1%)	26 (29%)	87 (100%)
Mobarake	20 (26%)	6 (7%)	5 (6%)	3 (3%)	7 (9%)	0 (0%)	35 (46%)	76 (100%)
Nayeen	4 (12%)	13 (41%)	0 (0%)	1 (3%)	0 (0%)	0 (0%)	13 (41%)	31 (100%)
Najaf abad	203 (57%)	56 (15%)	13 (3%)	7 (1%)	9 (2%)	3 (0%)	64 (70%)	355 (100%)
Natanz	3 (4%)	14 (21%)	2 (3%)	0 (0%)	0 (0%)	0 (0%)	46 (70%)	65 (100%)
Borkhar	15 (57%)	1 (3%)	0 (0%)	1 (3%)	0 (0%)	0 (0%)	9 (34%)	26 (100%)
Esfahan	50 (36%)	35 (25%)	6 (4%)	0 (0%)	1 (0%)	0 (0%)	45 (32%)	137 (100%)
Khomayni-shahr	18 (28%)	8 (12%)	4 (6%)	1 (1%)	4 (6%)	0 (0%)	29 (45%)	64 (100%)
Bouyin & miandasht	28 (38%)	7 (9%)	2 (2%)	2 (2%)	0 (0%)	0 (0%)	34 (46%)	73 (100%)
Tiran & karvan	61 (32%)	8 (12%)	5 (2%)	3 (1%)	3 (1%)	0 (0%)	105 (56%)	185 (100%)
Chadegan	51 (47%)	16 (14%)	0 (0%)	1 (0%)	5 (4%)	1 (0%)	34 (31%)	108 (100%)
Khansar	17 (20%)	21 (25%)	9 (11%)	7 (8%)	2 (2%)	0 (0%)	25 (30%)	81 (100%)
Dehaqan	15 (17%)	8 (9%)	7 (8%)	1 (1%)	5 (5%)	1 (1%)	49 (56%)	86 (100%)
Semirom	62 (23%)	16 (5%)	0 (0%)	0 (0%)	1 (0%)	6 (2%)	184 (68%)	269 (100%)
Mayme & Shahin shahr	13 (12%)	11 (10%)	8 (7%)	0 (0%)	1 (0%)	1 (0%)	73 (68%)	107 (100%)
Shahreza	19 (13%)	34 (23%)	1 (0%)	0 (0%)	1 (0%)	1 (0%)	88 (61%)	144 (100%)
Total	1025 (36%)	347 (12%)	109 (3%)	37 (1%)	76 (2%)	28 (0%)	1223 (42%)	2845 (100%)

In recent years, some factors such as a raise of livestock abortion after vaccination, insufficient allocation of funds to compensate farmers, and the raise of private tariffs for livestock vaccination has likely led to a decline in the livestock vaccination coverage.

**Brucellosis control and prevention program**

According to the Ministry of Health and Medical Education (MOHME), control of Brucellosis in Iran within 2010–2018 was planned with strategies such as using vaccines and various diagnostic methods.<sup>[24,26]</sup> However, this program has changed due to economic limitations and vaccine deficiency. These changes have affected the livestock vaccination program within 2010–2015. Brucellosis control programs in Iran are currently performed in four general areas, including health education, quarantine

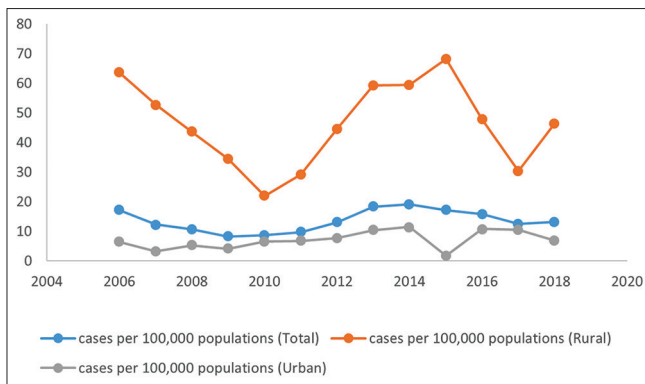
regulations, livestock vaccination, and sanitary slaughter.<sup>[24]</sup> According to the current rules in industrial livestock farms, if brucellosis-infected animals are identified, they should be separated from other livestock and taken to a slaughterhouse, otherwise, a heavy penalty is imposed, while these rules are not properly enforced in nonindustrial livestock farms.<sup>[24,26]</sup>

**The fluctuated incidence of brucellosis**

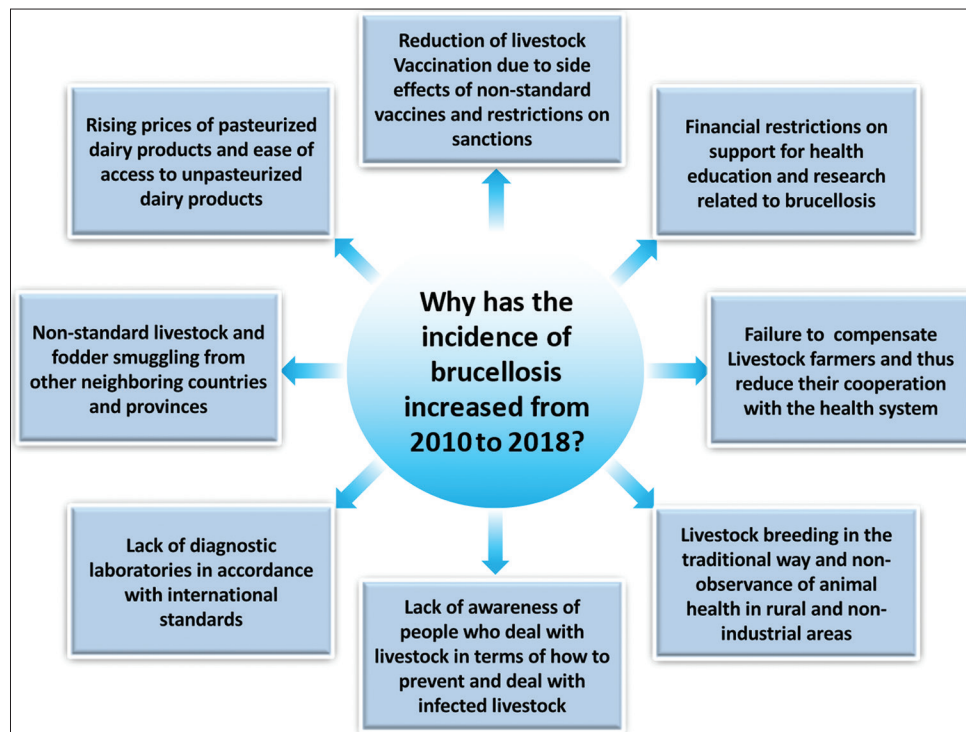
During the 9-year study period, the incidence of brucellosis was increased between 2010 and 2014. From 2014 to 2017, the trend has been decreasing, but in the last year of the study, the trend has been increasing again [Figure 2]. According to the MOHME and IVO Brucellosis Control Program,<sup>[24,26]</sup> as well as interviews with officials of the MOHME in the field of brucellosis, it seems some reasons such as raising the prices of pasteurized dairy products, lack of vaccines, and lack of enough knowledge about brucellosis could justify this increasing trend [Figure 3].

**Strengths, limitations, and suggestions for the next studies**

This is a multi-year study on the significant number of brucellosis patients in one of the endemic areas of the disease in Iran which can be helpful for policy making to control brucellosis. Due to the lack of information of some patients, especially patients whose information had been collected during the early years of the study, the authors were forced to exclude these patients from the study, and this is one of the limitations of the study. The current study was designed to describe the collected information,



**Figure 2:** The incidence rate of brucellosis per 100,000 population in Isfahan Province, Central Iran, within 2006–2018 in the urban and rural areas



**Figure 3:** Causes of increasing the incidence of brucellosis during the years 2010 to 2018 in Isfahan (Central Iran)

so more accurate statistical analyzes such as interrupted time series analysis are recommended in future studies to uncover the different aspects of brucellosis in Iran.

## CONCLUSION

The incidence of brucellosis has been variable over a period of 9 years, increasing during 2010–2014, decreasing from 2014 to 2017, and increasing again in the last year of the study. For uncovering the current situation, this study was run to describe the collected findings. Meanwhile, it is recommended to perform studies with more accurate statistical analysis. Moreover, given the direct impact of livestock vaccination on reducing the brucellosis incidence, the maximum coverage of livestock vaccination should be considered by the Ministry of Agriculture of Iran.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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