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Original Research

Epidemiological features of human brucellosis in central Iran, 2006–2011☆

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SUMMARY

Objectives: Brucellosis is still one of the most challenging issues for health and the economy in many developing countries such as Iran. This study investigated the epidemiological features of brucellosis in Isfahan province in central Iran.

Study design: This retrospective descriptive study was planned to determine the epidemiological features of brucellosis in central Iran, as this is one of the most endemic areas in the country.

Methods: Data collection was performed using epidemiological questionnaires from the private and public sectors over a 4-year period (2006–2009).

Results: In total, 1996 cases of brucellosis were reported. The incidence of brucellosis decreased from 17.1/100,000 in 2006 to 8.2/100,000 in 2009. The male:female ratio was 2.1, and the disease was most common in individuals aged 15–20 years. Sixty-eight percent of cases were from rural areas, and the animal contact rate was 81% in rural cases and 61% in urban cases. Raw milk was the most commonly consumed dairy product, consumed by 37% of cases.

Conclusions: Health-related interventions need to empower communities at risk, especially young men and adult women in the western districts of Isfahan province. Public health promotion is needed for control of risk factors in these areas.

Introduction

Brucellosis (Malta fever) is one of the most common diseases among humans and animals. It has been considered to be one of the most important issues for animal and human health since ancient times.[1] The importance of this disease is not limited to physical complications, and it is considered to be one of the most important challenges for economic development in many countries such as Iran, whose economic growth and employment still depend on livestock and agriculture.[1–3]

Direct contact with infected animals or their products is considered to be the most common route of infection, although consumption of raw milk and other non-pasteurized dairy products is the main route of transmission.[4–6]

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The prevalence of brucellosis is widespread in the world, but most cases are found in the Mediterranean basin, the Arabian peninsula, the Indian subcontinent and parts of Central and South America.[7–9] This disease continues to be endemic and undiagnosed in many developing countries.[10–12] The World Health Organization (WHO) estimates that half a million cases are reported worldwide every year, and that for every case diagnosed, four cases go undetected.[13–16]

Isfahan province has been one of the most important endemic areas of brucellosis in central Iran for many years. In 1964, nearly 80% of all cases reported to WHO were from this area.[17] In one of the first epidemiological studies on brucellosis in Iran, which was conducted in Isfahan province in 1974, the prevalence of disease was described as high in comparison with other areas of the country. However, the prevalence rate could not be estimated easily due to a lack of population statistics at that time.[17]

This article presents the epidemiological features of brucellosis in Isfahan province in central Iran.

Methods

This was a retrospective cross-sectional study. Data collection was performed using a standard questionnaire in current use by the health surveillance system. These data included demographic and epidemiological information, which were collected from all of the state-related health centres and private clinics and laboratories within Isfahan province over a 4-year period (2006–2009). The inclusion criteria in this study were both clinical signs and symptoms of brucellosis, and Wright test titre of >1/80 in cases who were living in Isfahan province. Data analysis was performed using Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA).

Results

In total, 1996 affected cases with brucellosis symptoms whose disease had been confirmed by diagnostic tests were identified. According to the authors' estimations, the incidence of brucellosis decreased from 17.1 cases/100,000 inhabitants in 2006 to 8.2 cases/100,000 inhabitants at the beginning of 2010. Meanwhile, the average incidence of brucellosis was 12.1/100,000 over the 4-year study in the province: 4.7/100,000 in the urban population and 48.6/100,000 in the rural population (Fig. 1).

The patients were aged 1–88 years, 67.2% were male (male:female >2.1) and 68% lived in rural areas.

Overall, the prevalence of brucellosis was higher in younger age groups than older age groups. The median age of cases was 31.3 years: 29 years in males and 35 years in females. According to this study, most cases of brucellosis were aged 15–20 years (21.3%). The age distribution was not significantly different between urban and rural areas (Fig. 2).

The findings indicated that housewives and farmers were more affected in both urban and rural groups (25.7% and 18.1%, respectively). Meanwhile, the most common occupations among male cases in both urban and rural areas were

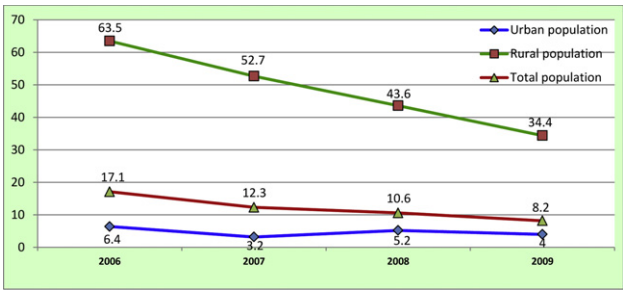

Fig. 1 – Trend of incidence rates of human brucellosis in Isfahan province, Iran in urban, rural and total populations (2006–2009).

agriculture (23.7% and 28.3%, respectively) and shepherd (18% and 24.5%, respectively). Other occupational groups of cases in this study (both men and women) were: students (15.2%), workers (6.7%), self-employed (5.8%) and employees (2.6%) (Table 1).

Eighty-one percent of rural cases and 61% of urban cases had a history of direct and continuous contact with livestock over the last 6 months, as did 74% of rural housewives and 40% of urban housewives ($P < 0.01$). The prevalence of direct contact with livestock was higher in rural students than urban students (77% vs 59%) ($P < 0.01$) (Table 2).

Raw milk (non-pasteurized) was the dairy product consumed most commonly by cases (37%). Overall, 33.5% of urban cases and 38.4% of rural cases had consumed raw milk recently. The rate of consumption of fresh cheese alone was higher in urban cases (14.6%) than rural cases (7.8%) ($P < 0.01$) (Table 3).

The average results over the 4-year study showed that brucellosis was most prevalent in western mountainous areas (112.4/100,000), and least prevalent in the centre of Isfahan province (2.5/100,000).

The median pre-diagnosis period (the interval between onset of symptoms until definitive diagnosis) was 33.2 days in all cases. It was slightly lower in rural cases than urban cases (32.4 days vs 35.0 days), but there was no significant difference between the first year of study (2006) and the last year of study (2009). The diagnosis was confirmed within 1 week of symptom onset for more than one-fifth of cases (21.7%), and

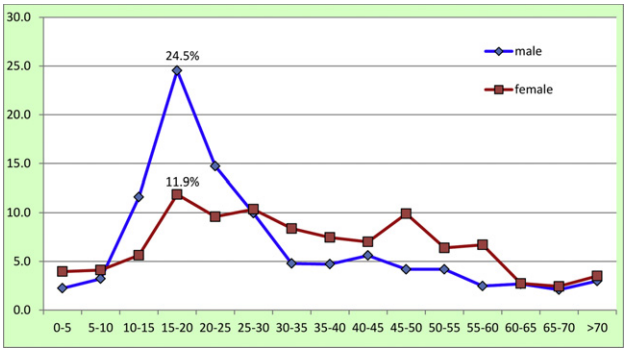

Fig. 2 – Age distribution of cases of brucellosis reported by public and private centres in Isfahan province, Iran by gender (2006–2009).

Table 1 – Occupational distribution of cases of brucellosis reported by public and private centres in Isfahan province, Iran for both urban and rural groups (2006–2009).

Job	Area		Total (%)
	Rural	Urban	
Housewife	26.4	24.2	25.7
Farmer	18.8	16.6	18.1
Shepherd	16.7	12.8	15.5
Student	16.1	13.4	15.2
Worker	5.5	9.2	6.7
Free job	3.7	10.3	5.8
Preschool	3.1	2.8	3
Staff	2.7	2.2	2.6
Butcher	1	1.9	1.3
Others	6.1	6.5	6.2
Total	100	100	100

within 3 weeks of symptom onset for more than half of cases (51.2%). Also, the diagnosis was confirmed by laboratory tests within 3 months of symptom onset in approximately 93% of cases (Table 4).

Cases of human brucellosis occurred throughout the year, but 82% occurred between April and November. There was no difference between urban and rural cases in this respect. Most cases occurred in June (14%), and fewest cases occurred in March (4%) (Fig. 3).

Discussion

The Eastern Mediterranean Region consists of 22 countries, including the Islamic Republic of Iran. This region is one of the most important endemic areas of brucellosis. According to WHO, more than 45,000 new cases of brucellosis infection are reported every year from countries in this region. However, it seems that only a small proportion of cases are reported due to lack of diagnostic facilities in the poor and remote countries of this region. The annual incidence of brucellosis in Middle Eastern and Mediterranean littoral varies between 1 and 78 cases per 100,000 population.[13,18]

Unfortunately, there is no precise information about the incidence of this disease in Iran. According to one study (2003), the average incidence of brucellosis in the Iranian population was 21 cases per 100,000 population, although this varied between 1.5 and 107.5 per 100,000 population in different parts of the country.[19]

Based on these findings, it seems that the incidence of brucellosis in Isfahan province is lower than the Iranian average. Although this area was one of the most important focuses of brucellosis in Iran nearly four decades ago,[17] it seems that its incidence has decreased compared with the rest of the country. Isfahan province has been the second most important province in Iran after the capital for many years.[20]

As the health surveillance system in Iran has improved in recent decades, it seems that only a small proportion of cases of brucellosis were reported in the past, particularly in poor and remote provinces. Obviously, by developing the health-care system, the number of new cases reported has increased. This is likely to explain the decreased incidence of brucellosis in Isfahan province compared with other provinces of the country as Isfahan province has undergone more development than other areas of the country in recent decades, although some deprived and less developed regions remain in this province, particularly in western and southern areas. Most new cases are currently reported from these areas.

The incidence of brucellosis shows a decreasing trend over this 4-year study, decreasing to less than half in the last year of the study. However, this decrease was more significant in rural areas: 45.8% in rural areas compared with 37.5% in urban areas. It appears that interventions such as promoting veterinary vaccination and community education have been effective.

The male:female ratio of cases was >2, and this ratio was slightly higher in urban cases than rural cases. It is also a little higher than in other provinces in Iran,[21–23] and much less than in developed countries according to similar studies.[24,25]

Table 2 – Distribution of cases of brucellosis who had been in direct contact with livestock (%) reported by public and private centres in Isfahan province, Iran for both urban and rural groups by occupation (2006–2009).

Job	Has the patient been in direct contact with livestock over the last 6 months?					
	Urban			Rural		
	Yes	No	Unknown	Yes	No	Unknown
Housewife	39.9	55.6	4.6	73.9	23.3	2.8
Preschool	44.4	44.4	11.1	66.7	33.3	0.0
Student	58.8	37.6	3.5	76.7	21.9	1.4
Worker	60.3	39.7	0.0	74.7	24.0	1.3
Staff	42.9	42.9	14.3	86.5	10.8	2.7
Free job	46.2	50.8	3.1	84.0	10.0	6.0
Farmer	79.0	18.1	2.9	79.8	17.1	3.1
Shepherd	100.0	0.0	0.0	100.0	0.0	0.0
Butcher	100.0	0.0	0.0	100.0	0.0	0.0
Others	43.9	51.2	4.9	77.1	20.5	2.4
Total	60.8	35.9	3.3	80.8	17.2	2.1

Table 3 – Consumption of dairy products by cases of brucellosis reported by public and private centres in Isfahan province, Iran for both urban and rural groups (2006–2009).

Type of dairy product	Area		Total
	Urban	Rural	
Raw milk	33.5	38.4	36.9
Fresh cheese	14.6	7.8	9.9
Cream	2.7	2.2	2.4
Ice cream	3.5	1.0	1.8
Mix	19.6	30.2	26.9
Others	26.1	20.4	22.2
Total	100	100	100

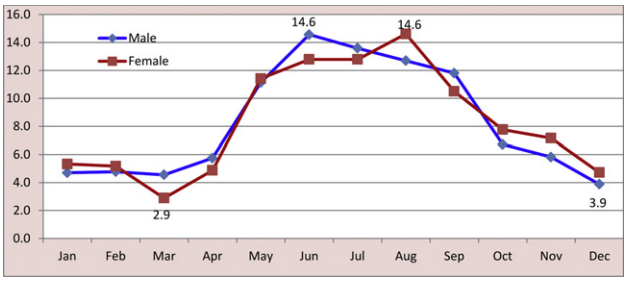

Fig. 3 – Monthly distribution of cases of brucellosis reported by public and private centres in Isfahan province, Iran by gender (2006–2009).

This result is probably due to the fact that women in developing countries such as Iran are more involved in livestock-related activities than women in developed countries.

Most cases, both male and female, were aged 15–20 years. However, the male cases were much younger than the female cases: 71% of men were aged <35 years compared with 54% of women. This probably implies that young men and middle-aged women have more contact with livestock and animal products, especially in rural areas. In addition, 16% of cases were aged <15 years and 17% were aged >50 years, which is in agreement with similar studies in other provinces of Iran.[19,21–23]

Direct contact with livestock and dairy products is one of the most important pathways for disease transmission.[1,4,10] It seems that infection is more prevalent in rural areas than urban areas due to more contact with livestock in rural occupations. As such, it was concluded that the incidence of brucellosis in rural populations was significantly higher than that in urban populations (more than 10 fold). Other studies have produced similar results.[7,10,18,19,21–23]

Direct contact with livestock is one of the important risk factors for brucellosis.[1,4,7,10] This study found that the rate of direct contact with livestock in large cities was much lower than that in small cities and rural areas. This is probably because most Iranian rural populations are involved in livestock-related occupations.

It also seems that climatic characteristics may affect the prevalence of brucellosis. The disease was most prevalent in the mountainous western districts of the province, and least prevalent in industrial areas such as Isfahan district.

The consumption of non-pasteurized dairy products is one of the most important factors in the transmission of brucellosis.[1,4,7,10] This study found that consumption of raw milk (non-pasteurized) and other dairy products was more common in the western districts than other districts due to more traditional livestock, and high production of milk and dairy products. The highest incidence of brucellosis was seen in these districts.

The median pre-diagnosis period in rural cases was slightly lower than that for urban cases. This may be related to more complete coverage of primary health care in rural areas in Iran,[26] which can lead to earlier detection of cases due to more education and higher sensitivity of health workers at public health centres compared with the private sector.

There is another interesting point regarding the median pre-diagnosis period. The results determined that this period was shorter in districts with a high prevalence of brucellosis than others. It seems the surveillance system is more sensitive in these districts than districts with low prevalence, which can lead to earlier and more extensive detection of cases.

Most confirmed cases were found between April and August and the fewest cases were found between November and April. However, Fig. 3 shows that there is a lag of approximately 2–3 months in peak prevalence between women and men. Peak prevalence in male cases was in June

Table 4 – Median pre-diagnosis period (interval between onset of symptoms until definitive diagnosis) in cases of brucellosis reported by public and private centres in Isfahan province, Iran for both urban and rural groups (2006–2009).

Median pre-diagnosis period	Urban cases		Rural cases		All cases	
	%	Cumulative %	%	Cumulative %	%	Cumulative %
<1 week	24.3	24.3	20.5	20.5	21.7	21.7
1–2 weeks	16.0	40.3	18.5	39.0	17.7	39.4
2–3 weeks	11.6	51.9	11.9	50.9	11.8	51.2
3 weeks–1 month	12.2	64.1	13.9	64.8	13.4	64.6
1–1.5 months	13.8	77.9	14.3	79.1	14.1	78.7
1.5–2 months	7.0	84.9	6.7	85.8	6.8	85.5
2–3 months	7.1	92.0	7.5	93.3	7.4	92.9
> 3 months	8.0	100.0	6.7	100.0	7.1	100.0
Total	100.0		100.0		100	

(14.6%) and peak prevalence in female cases was in August (14.6%). Also, lowest prevalence in male cases was in December (3.9%) and lowest prevalence in female cases was in March (2.9%). As the usual time for pregnancy and delivery of livestock is in the spring and their lactation period is in summer and autumn,[1] it seems that one of the main reason for the increased prevalence of brucellosis in men during spring is more contact with livestock and delivery products. The higher prevalence of brucellosis among women in the summer is probably due to more contact with livestock and dairy products during the milking process.

The findings of the present study reveal that there is a need to empower at-risk populations in order to control risk factors. These at-risk groups include young men and middle-aged women, especially housewives, students and farmers in western districts and rural areas of Isfahan province. Some other important conclusions are the need to observe health-related safety points in processes such as delivery and milking of livestock, and not consuming non-pasteurized dairy products. There is also a need to promote the health surveillance system, especially in the western districts. This can be achieved by training and sensitizing health workers in both the public and private sectors.

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Ethical approval

Ethical approval was received from the medical ethics committee of Isfahan University of Medical Sciences. Meanwhile, the principles of privacy and confidentiality were observed throughout the study.

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This study was implemented using current data in the primary healthcare system and did not impose any additional costs to the health system.

Competing interests

The authors work for Isfahan Provincial Health Centre.

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