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Original Article

Incidence, Mortality, and Burden of Human Brucellosis and Its Geographical Distribution in Iran during 2009-2015

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Abstract

Background: Human brucellosis is the most common zoonotic disease worldwide. This study aimed at estimating the incidence, mortality, and burden of human brucellosis as well as its distribution in Iran from 2009 to 2015.

Methods: Disability Adjusted Life Years (DALYs) index was used to estimate the burden of human brucellosis. To calculate DALYs, years lost due to disability (YLDs) was added to years of life lost due to premature death (YLLs); they were calculated based on the Global Burden of Disease (GBD) formula recommended by the WHO. The data on incidence and mortality were collected from the national surveillance system of brucellosis disease in the Center for Communicable Diseases Control (CCDC), Ministry of Health and Medical Education (MOHME), expert panels, and related literature.

Results: There is an increasing trend in human brucellosis-related DALYs (34.6 per 100,000 in 2009, and 71.4 per 100,000 in 2015), incidence (88450 in 2009, and 198030 in 2015), and mortality (244 in 2009, and 578 in 2015) from 2009 to 2015. Human brucellosis-related DALYs, incidence, and mortality were higher among males than females. About 51% of DALYs was attributed to YLLs. The burden of human brucellosis disease was not equally distributed among all provinces of Iran and it was largely concentrated in a number of provinces.

Conclusion: Burden of human brucellosis is significantly high in Iran, and it has also increased during the recent years. It is alarming for health system managers and policymakers, and they are recommended to pay more attention to this issue.

Keywords: Incidence; Mortality; Disability-adjusted life years; Brucellosis; Iran

Introduction

Human brucellosis is the most common zoonotic disease which is also one of the most important communicable diseases transmitted between human and animals worldwide, especially in Iran.

Overall, 500,000 new cases of brucellosis occur annually, however, there are four unknown cases per each diagnosed case (1). Human brucellosis is an endemic disease in most of the countries in the Eastern Mediterranean Region (EMR). This disease also is prevalent in Asia, Sub-Saharan countries, and Latin America (2-4). The incidence of human brucellosis is 605,9 in Mongolia and 211,9 in Kyrgyzstan and Tajikistan per one million population (1, 5). In Iran, despite the implementation of related health interventions and policies, brucellosis still remains as an endemic disease (6).

Because of under-reporting this disease in most of the countries, it is impossible to determine the exact prevalence of human brucellosis in the world. It is a problem observed in both developed and developing countries. In Iran, the problem of under-reporting is also an obstacle for correct estimation of disease prevalence. However, reports recently released by the human brucellosis surveillance system may help us to estimate the exact and actual incidence of this disease (7, 8).

Human brucellosis has a dramatic effect on public health and socio-economic status of people in developing countries; however, its effect has not been properly investigated yet (4, 8, 9). Because of the high prevalence of brucellosis in some counties and its long recovery period, it is expected to experience a high burden of the disease worldwide. Although human brucellosis is prevalent among all age groups in Iran, it is more prevalent among people aged between 20 and 30. In other words, this disease affects the most active age groups of working population (10). The history of brucellosis in Iran dates back to decades ago, and even the first cases of the epidemic disease are reported in Iran. Despite controlling other infectious diseases, because of the constant high incidence of brucellosis in Iran during the last two decades, it has become one of the most important concerns of Iran's health surveillance system (10, 11).

In spite of being indigenous and highly prevalent in Iran, it is currently impossible to eliminate this disease because of the following reasons: lack of enough resources and funds to eliminate brucellosis, low concentration on prevention and combating programs for zoonotic diseases, low priority of the disease from the perspective of health system managers and policy makers, weak intersectional collaborations, non-modern and non-industrial animal husbandry, serious problems and barriers in livestock vaccination, and sharing borders with Afghanistan, Pakistan, and Iraq which are suffering from the high prevalence of brucellosis and low-quality veterinary services (10).

In order to have a proper response against human brucellosis, it is necessary to obtain accurate and reliable information, especially about the burden of the disease. Estimating the burden of brucellosis makes it possible to compare its burden with those of other diseases and provides an opportunity to highlight the alarming status of the disease for health policy makers so that they pay more attention to this issue. In addition, estimating the burden of the disease at national and local levels helps to recognize its epidemic status as well as its trend over time, and facilitates the identification of areas where the disease may be a danger and threat to the public health.

In line with this and in order to depict a full picture of the disease, this study aimed at estimating the burden and trend of human brucellosis at national and provincial levels from 2009 to 2015.

Methods

Disability-Adjusted Life Years (DALYs) were calculated based on the Global Burden of Disease (GBD) formula recommended by the WHO. DALYs are calculated through adding Years of Life Lost due to premature death (YLLs) to Years of Life Lost due to disability (YLDs) (12).

DALY= YLL+ YLD Equation [1]

We did not consider age weights in the calculations; however, a discount rate of 0.03 was applied to discount health values for future years (13). YLDs is calculated through multiplying annual incidence rate of human brucellosis by its average period and disability weight. In the present study, after holding an expert panel with infectious diseases specialists, the average period of the disease was set to be nine months. In addi-

tion, based on the available literature, the disability weight was set to be 0.23 (14).

YLD= Number of incident cases× Disability weight× Average duration of case until remission or death Equation [2]

In addition, the burden of the disease was calculated and reported by age, time, and place for all the provinces of Iran. For each age group, the mean age of that group was considered as the death age for patients died from human brucellosis. However, average death age for age groups 0-1 and 1-5 was considered to be 0.1 and 2.6, respectively. The life expectancy remaining for each age group was calculated using life tables of Iranians reported by the WHO (14).

YLL= Number of deaths× Iranian life expectancy at age of death in years Equation (3)

The data on the incidence of and mortality from human brucellosis from 2009 to 2015 were obtained from the national surveillance system of Center for Communicable Diseases Control (CCDC), Ministry of Health and Medical Education (MOHME). All of the data had been collected and electronically recorded by health care centers located in various cities of every province. The actual incidence of human brucellosis is 10 to 25 times higher than its reported cases (1). Therefore, considering the possibility of underreporting or even imperfect coverage of human brucellosis surveillance system, after holding an expert panel, it was decided to multiply the reported cases of brucellosis by 10 in order to estimate its real incidence rate. Moreover, after reviewing the literature, its fatality rate was considered to be 0.005. The data on the population of Iran and its provinces over the years of the study was obtained from the Statistical Centre of Iran(15). Data were analyzed using Excel software (ver. 2010).

Results

Table 1 presents the incidence, mortality, and burden of human brucellosis for both sexes from 2009 to 2015. Human brucellosis incidence and mortality had increased sharply during the years of the study.

Fig. 1 presents the trend of the incidence of human brucellosis per 100,000 population by sex. The disease incidence had an increasing trend for both sexes; however, its incidence in males was higher than that of females. Fig. 2 presents the trend of adjusted burden of human brucellosis per 100,000 population. Burden of brucellosis increased in both sexes over the studied years.

Fig. 3 presents the share of YLLs and YLDs in the burden of human brucellosis over the studied period. In all the studied years, about 51% of DALYs was due to YLLs.

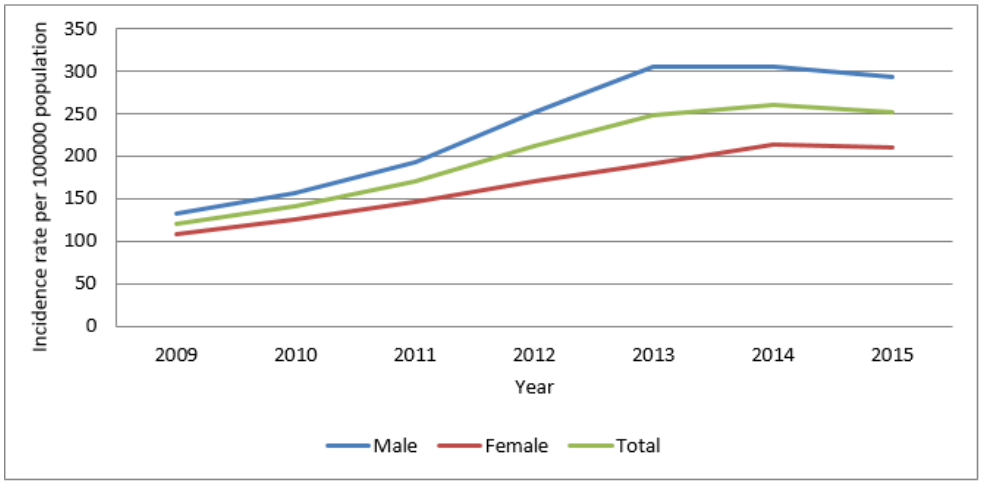

Fig. 1: Time trend of changes in the incidence of human brucellosis (DALYs) by sex during 2009-2015

Table 1: Incidence, mortality, and burden of human brucellosis by sex during 2009-2015

Year	*Estimated brucellosis case in males*	*Estimated brucellosis case in females*	*Estimated incidence rate per 100000 population*	*Case leading to death in Males*	*Case leading to death in Females*	*Male DALYs*	*Female DALYs*	*Total DALYs*	*DALYs per 100,000 population*
2015	115550	82480	251.43	578	412	33093	23318	56411	71.42
2014	118640	83260	259.37	594	416	34062	23596	57658	73.87
2013	117540	73490	248.30	588	368	33788	20956	54654	70.86
2012	95720	64790	211.10	478	324	27518	18493	46011	60.36
2011	72560	54930	169.65	362	274	20909	15638	36547	48.63
2010	58100	46750	141.30	290	234	16724	13355	30079	40.53
2009	48770	39680	120.74	244	198	14024	11343	25368	34.63

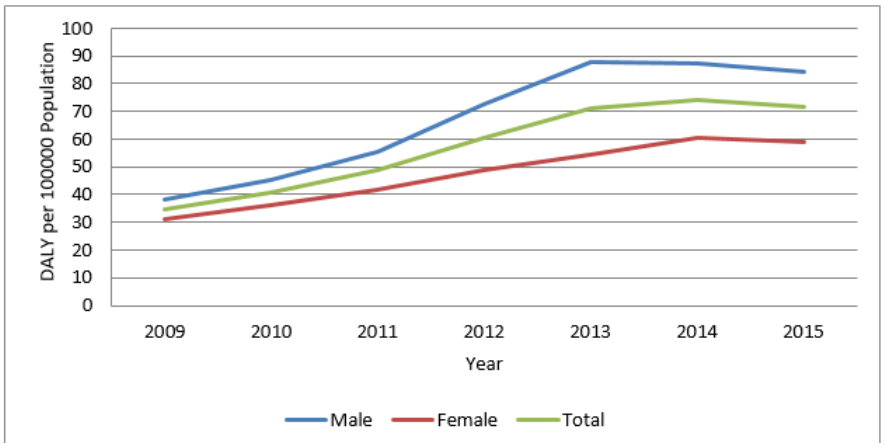

Fig. 2: Time trend of changes in the burden of human brucellosis (DALYs) by sex during 2009-2015

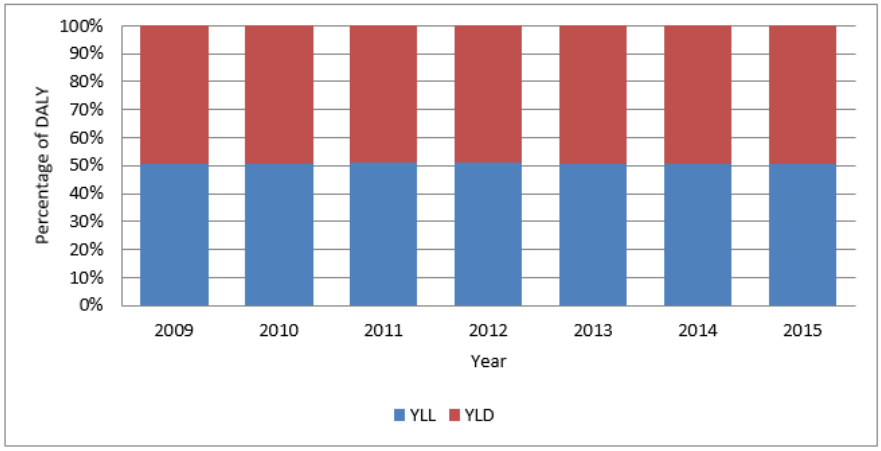

Fig. 3: Share of YLL and YLD in the burden of human brucellosis (DALYs) during 2009-2015

Fig. 4 presents the share of both sexes in the burden of human brucellosis in various age groups in 2015. The highest burden of the disease was observed in people aged 15-44 yr; moreover, the burden of the disease in makes was higher than that in females in most of the age groups. Fig. 5 presents the provincial distribution of the burden of human brucellosis in 2013,

2014, and 2015. In 2013, Hamadan and Lorestan had the highest human brucellosis-related DALYs (2.52 and 2.15 per 1000 population, respectively). On the other hand, Tehran and Gilan had the lowest burden of human brucellosis (0.07 and 0.09 DALYs per 1000 population, respectively). Moreover, this index (DALYs/1000) in the border provinces such as Sistan-and-Baluchestan, South Khorasan, Razavi Khorasan, North Khorasan, West Azerbaijan, Kurdistan, Kermanshah and Ilam in 2013 was 0.20, 0.10, 1.20, 1.27, 1.62, 1.75, 1.65, and 0.70, respectively.

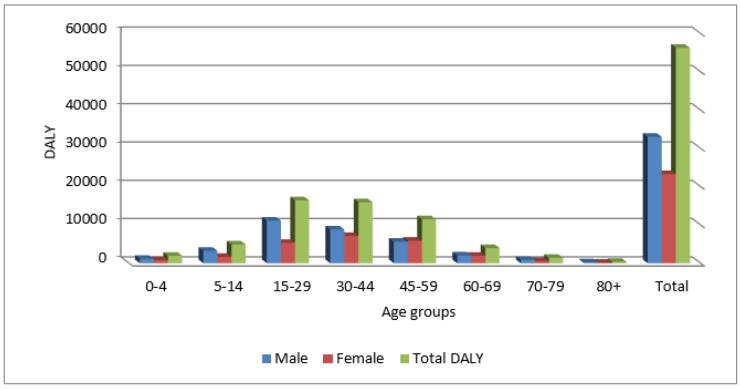

Fig. 4: Burden of human brucellosis (DALYs) by sex in different age groups in 2015

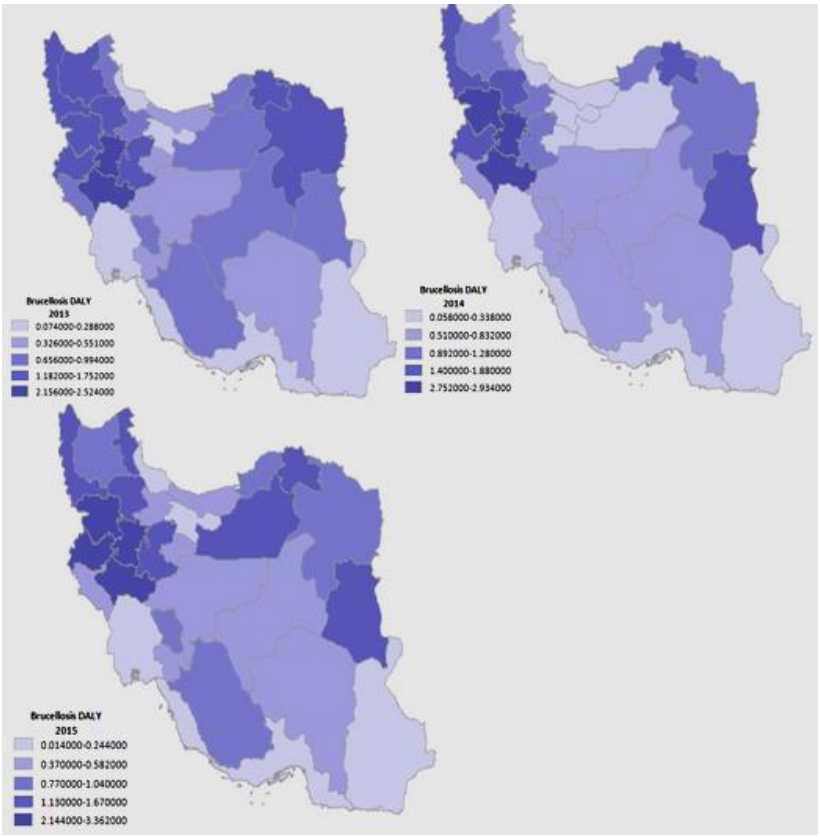

Fig. 5: Geographical distribution of human brucellosis-related DALYs per 1000 population in 2013, 2014, and 2015 in Iran

Furthermore, in 2014, Kurdistan and Lorestan had the highest human brucellosis-related DALYs (2.93 and 2.8 per 1000 population, respectively). On the other hand, Gilan and Hormozgan had the lowest burden of brucellosis (0.06 and 0.07 DALYs per 1000 population, respectively). In addition, this index (DALYs/1000) in the border provinces such as Sistan-and-Baluchestan, South Khorasan, Razavi Khorasan, North Khorasan, West Azarbaijan, Kermanshah and Ilam in 2014 were 0.10, 1.60, 1.15, 1.40, 1.48, 1.88, and 0.83 respectively. In 2015, Lorestan and Kurdistan had the highest population-adjusted burden of human brucellosis (3.36 and 2.48 DALYs per 1000 population, respectively). Hormozgan and Sistan and Baluchestan had the lowest burden of brucellosis (0.01 and 0.09 DALYs per 1000 population, respectively). In addition, this index (DALYs/1000) in the border provinces such as South Khorasan, Razavi Khorasan, North Khorasan, West Azarbaijan, Kermanshah and Ilam in 2015 was 1.22, 1.00, 1.41, 1.31, 2.15, and 0.58, respectively.

Discussion

According to the results of this study, over the studied period, theprevalence, incidence, mortality, and burden of human brucellosis increased dramatically in both sexes and in all the age groups. The incidence of human brucellosis increased from 125 to 250 cases per 100,000 population. Moreover, the disease mortality rate increased from 35 to 70 cases per 100,000.The annual incidence rate of human brucellosis per 100,000 in Iran's neighboring countries is as follows: 2386 cases in Iraq, 2622 cases in Turkey, 2144 cases in Saudi Arabia, 2119 cases in Tajikistan, and 16034 cases in Syria (1). However, the actual incidence of human brucellosis is 10 to 25 times more than the reported cases (1, 16). Therefore, the reports for Iran's neighboring countries may not represent the real incidence rates. In Syria, the number of cases with brucellosis doubles every year. This may be attributed to improvements in their surveillance system. Turkey has shown a similar increasing trend, like that observed in Syria (1, 17). The increase in the incidence of human brucellosis in Iran during the studied years may be partly attributed to the improvements in reporting system. Of course, it can be also attributed to a real increase in the incidence of this disease. Some of the most challenging issues hindering the control of human brucellosis in Iran are the following: non-modern and non-industrial animal husbandry, lack of constant livestock vaccination, shared borders with countries such as Afghanistan, Pakistan, and Iraq which have low-quality veterinary services, insufficient focus on prevention and combating programs for zoonotic diseases, inadequate intersectional collaborations, lack of enough resources and funds to eliminate brucellosis, lack of a proper regulation system to punish violators of animals health, weak quarantine system in the borders and smuggling livestock from neighboring countries, weakness of rural and nomadic livestock diagnosis system, and weakness of compensation system for those veterinarians who combat the disease.

According to findings, human brucellosis is more prevalent among males and causes higher rates of mortality among males than female. Previous studies in Turkey, India, and Kuwait are in line with this finding (18-20). Our results also indicated that the adjusted burden of brucellosis increased from 34.6 DALYs per 100,000 population in 2009 to 71.4 DALYs per 100,000 population in 2015. Contrary to other infectious diseases, the incidence of and mortality from brucellosis had an increasing trend during the studied years. It can be due to weak and interrupted provision of livestock vaccination, problems in the distribution and inoculation of livestock vaccines, and inadequate commitment of veterinary organization to combat the disease (10).

In the first national burden of disease study in 2003, burden of brucellosis was estimated as 437 DALYs that was quite lower than its actual amount (14), because the researchers used only the data reported by the brucellosis surveillance system. Brucellosis surveillance system was just established in 2003 and at that time it was not capable to cover all the data completely.

The results of our study showed that the highest burden of the disease was observed in people aged between 15 to 44 yr old. Although the disease occurs in all ages, it is more prevalent in this age group. Therefore, brucellosiscan be a threat to our active human forces. Studies carried out in other countries have shown that brucellosis can occur at any age, but adolescents and young adults are the most common age groups affected by the disease (21-23).

Results of our study also showed that the burden of human brucellosis did not have an equal distribution across the country and the main foci of the burden were observed in border provinces such as Kurdistan, Lorestan, Hamadan, Kermanshah, North Khorasan, and South Khorasan. In these provinces, farming and animal husbandry are the main occupation of many people, and as said earlier, job is a risk factor for the disease. In addition, these provinces are in the vicinity of Iraq, Afghanistan, and Turkmenistan, where the prevalence of brucellosis is high; they are recognized as the endemic countries for brucellosis without appropriate and targeted programs to control the disease. Hence, it can be considered as a factor that can affect and contribute to the high incidence of the disease in these provinces. The mentioned provinces are the main routes of smuggling livestock from neighboring countries to Iran. Brucellosis disease control requires intergovernmental, national, and international partnerships. At the national level, it is necessary to make plans and advocate co-operation between various organizations, such as police (to prevent smuggling animals), veterinary organization (to vaccinate livestock), the Ministry of Health (to train people and experts), and the Ministry of Commerce and other related organization. Reports from around the world also indicate that human brucellosis does not have an equal distribution, not only between the countries but also between various areas within a country (1).

Limitations

This study had two limitations. First, given the improper coverage of brucellosis surveillance system, we used expert panel to estimate the real incidence of brucellosis. This method might have resulted in some errors. Second, various strains of brucellosis can have different disease periods and disability weight; however, we used a similar period and disability weight for all strains when estimating the burden of disease.

Conclusion

The burden of brucellosis in the country is very high. Contrary to other infectious diseases, its incidence and mortality of the disease have had an ascending trend during recent years. This can be alarming for health policy makers and managers, requiring them to adopt a fast and appropriate response to the disease. Since brucellosis is an indigenous disease with a high incidence, our country should invest in providing preventive, treatment, and vaccination measures to combat this disease. Therefore, it is highly recommended to improve the disease surveillance system and enhance sustainable and continuous vaccination of livestock.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interests.

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