ORIGINAL ARTICLE

Trend and Epidemiological Characteristics of Human Brucellosis in Western Algeria during 2014-2019: Results from the Regional Notifiable Diseases Surveillance System

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Abstract

Background: Brucellosis, as a zoonotic disease, is widespread among humans and animal andcontinues to be a major public health problem. The present study aimed to analyze the trends and epidemiological characteristics of human brucellosis in Ain Témouchent (Western Algeria).

Methods: In this registry-based longitudinal study, data on the reported new cases of brucellosis for five years (2014 to 2019) were obtained from the provincial notifiable diseases surveillance system of Ain Temouchent. Using official population data, we calculated the incidence rate per 100,000 inhabitants.

Results: From 2014 to 2019, 599 cases of brucellosis cases were notified in Ain Temouchent province (mean annual incidence: 26.37 cases/100,000 inhabitants). The yearly notification peaked in 2014 (n=170 cases). The highest incidence was reported for males (56%) compared to females (44%) with a sex ratio of 1.29. Regarding age, the highest incidence of notified cases for brucellosis was in the group aged 25-44 years and over, accounting for 37,73% of all notified cases. The lowest incidence was found in the age group between 0-14 years with 11.52%. The disease peaked in May with 139 cases. The geographical distribution indicated that the highest risk area of human brucellosis was Hammam Bou Hadjar and Ain Larabaa region.

Conclusion: Our findings showed a high prevalence of human brucellosis in Ain Témouchent, with gender, age, and seasonal changes as the main risk factors for human brucellosis.

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Keywords: Epidemiology, Brucellosis, Human, Surveillance system, Algeria

Introduction

Brucellosis is a highly contagious zoonotic disease caused by infection with gram-negative bacteria of the genus *Brucella* and poses great challenges to human health.[1, 2] Brucellosis has been identified by the Food and Agriculture Organization of the United Nations, the World Health Organization, and the World Organization of Animal Health as one of the most significant neglected zoonotic diseases in the world.[3-5]

Although human is always an accidental host, both genders and all age groups are affected by the disease. The exact brucellosis incidence remains unknown, but it has increased substantially, with up to 500,000 new cases reported each year.[6]

Brucella is a facultative intracellular, non-motile, non-spore forming coccobacillus.[7] The three most common species causing brucellosis in humans are

Brucella (B.) Melitensis and B. abortus and B. suis.[8] Human infection generally occurs through direct contact with infected wild or domesticated animals or contaminated food (especially unpasteurized milk products) or inhalation of contagious aerosols.[9, 10] Human brucellosis has acute, sub-acute, localized, and chronic forms and causes long-lasting clinical symptoms and focal complications.[4, 5] It is characterized by significant clinical polymorphism and with nonspecific manifestations, but major symptoms are fever, weakness, weight loss, night sweats, and arthralgia. Brucellosis is a notifiable disease in most countries. Previous studies have reported that human brucellosis causes more than 500,000 new cases annually.[11] This situation may not reflect reality, due to the resemblance of this disease with other diseases, which leads to false diagnosis.[12] Therefore, the true incidence of human brucellosis is unknown for most developing countries in the world including Algeria.[13] Brucellosis is endemic in the Mediterranean basin, Central and South America, South Eastern Europe, Asia, Africa, and the Caribbean. North Africa has traditionally been considered an endemic area for brucellosis. According to data from the World Organization for Animal Health, the incidence of brucellosis in Algeria ranks 10th in the ranking of countries most affected by brucellosis in the world with 84.3 annual cases per million inhabitants.[11] Data documenting human and animal brucellosis is very limited in Algeria. Furthermore, the geographic distribution of human brucellosis is continually changing, with the emergence or re-emergence of new foci. In Algeria, the overall incidence of human brucellosis ranged between 23.6 and 15.2 per 100,000 inhabitants in 2006 and 2015, respectively.[13] These findings confirm that human brucellosis is still an important disease in Algeria. However, the surveillance of human brucellosis needs considerable efforts to establish active surveillance systems. Therefore, identifying major risk factors for human brucellosis is a crucial primary step in reaching a comprehensive understanding of the nature of the disease and subsequently for the objectives of prevention programs. The present study aimed to analyze the trends and epidemiological characteristics of human brucellosis in Ain Témouchent Province (western Algeria) during 2014-2019.

Methods

Study Area

The province of Ain Témouchent occupies a strategic position in the north-west of Algeria. It covers an area of approximately 2377 Km² and has a population of 378 546 inhabitants. The study area is characterized by a semi-arid climate which is dry and cold. It is limited to the east by the province of Oran, to the south-east by the province of Sidi-Bel-Abbès, to the south-west by that of Tlemcen, and to the north-west by the Mediterraneansea which borders it for about 80 km (Figure 1).

Data Sources

Brucellosis is a notifiable disease in Algeria, and all cases of brucellosis should be reported to the provincial level section of the National Notifiable Surveillance System. The data examined were from humans who were confirmed cases of brucellosis.

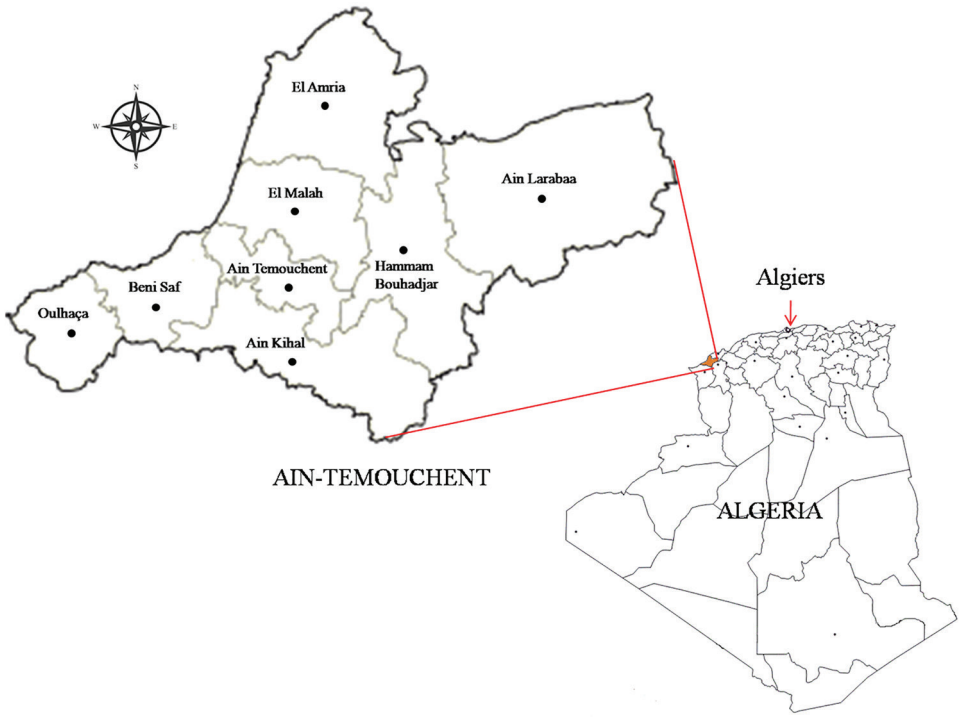

Figure 1: Geographical location of the Ain Témouchent province, Algeria

These latter showed symptoms on clinical examination and revealed positive with a serum tube agglutination test (STA) ≥1:80. We analyzed cases of human brucellosis notified to the national surveillance case definition between January 1st, 2014 and December 31th, 2019. The data collected included gender, age, location (urban/rural), date of diagnosis (year and season), and history of consuming unpasteurized dairy products.

Data Analysis

Microsoft Excel® 2007 (Microsoft Corporation®, Redmond, USA) was used for some descriptive analyses. Data obtained were summarized and entered into Microsoft Excel 2007 with the result for each test recorded. The significant differences in brucellosis sero-prevalence were evaluated between age, gender, and management system by using Chi-square test of independence using SPSS 21 for Windows software (IBM, USA). In all analyses, a confidence level of 95% and values of P<0.05 were considered as significant.

Results

From 2014 to 2019, 599 cases of human brucellosis were notified in the province of Ain Témouchent, Algeria, corresponding to a mean annual incidence of 26.37cases/100,000 inhabitant (Figure 2). The overall incidence of human brucellosis trend showed fluctuations; interestingly, the year 2014 was characterized by a peak number of cases with 170 cases of disease. Despite the decreasing number of notified cases during the year 2015 with 70 cases. The notifications have sharply increased in 2016 with 143 notified cases. Since then, the number of notified cases of human brucellosis has slightly decreased. The lowest annual incidence rate was 15.32 per 100,000 inhabitants seen in 2017 with 61 cases of the disease. The number of cases reported per year is shown in Table 1.

The distribution of notified cases of brucellosis according to gender and age showed that all age groups and, overall, both genders were affected. The highest incidence was reported for males (55.92%) compared to the females (44.07%) 264 with a gender ratio of 1.29 (Figure 3).

Regarding age, the highest incidence of notified cases for brucellosis was in the age group [25-44 years] and over, accounting for 37.73% of all notified cases, and was followed by the age group [15-24 years] (19.37%), age group more than 55 years (16.03%) and age group between 45-54 years (15.36%). The lowest incidence was found in the age group between 0-14 years with 11.52%, as shown in Table 2.

The geographical distribution of human brucellosis in the province of Ain Témouchent from 2014 to 2019 brings out a highly endemic zone in the east of the province (Figure 4), particularly in two regions, Ain El Arbaa (31.35%) and Hammam Bouhdjar (41.21%); the other regions were recorded 27.44% (Table 3).

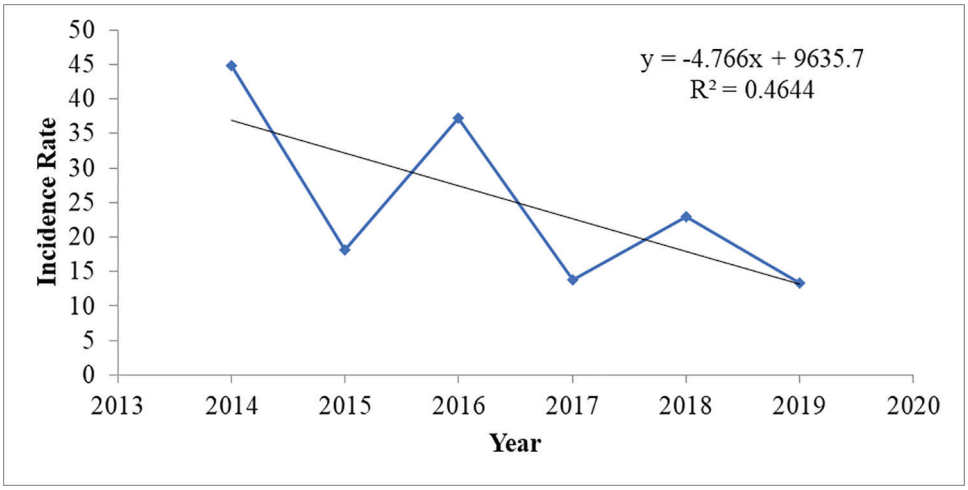

Figure 2: Incidence rate per 100 000 population of reported cases of human brucellosis in Ain Témouchent from 2014 to 2019.

Table 1: Relative incidence of human brucellosis in Ain Temouchent from 2014 to 2019

Year	No. of notified cases	(IR[a])	CI 95%
2014	170	44.91	38.16-51.66
2015	70	18.20	13.94-22.47
2016	143	37.18	31.09-43.28
2017	58	13.78	10.23-17.32
2018	97	22.93	18.36-27.49
2019	61	13.39	10.03-16.75
Total	599	25.06	

CI: Confidence interval; IR: Incidence rate. [a]Incidence rate per 100,000 population.

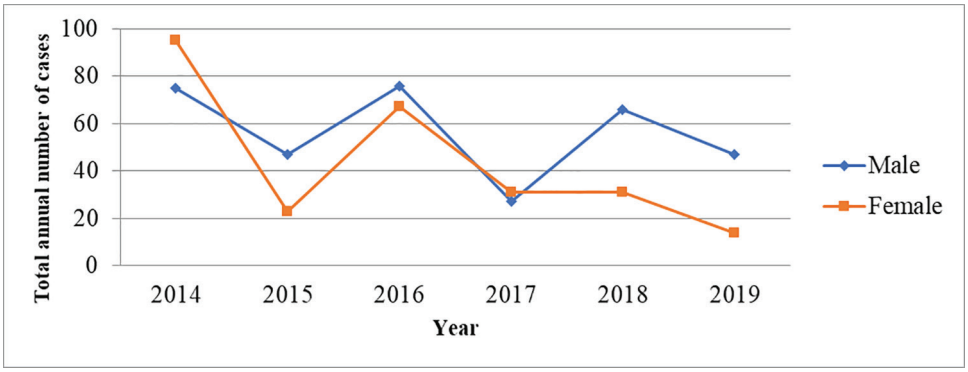

Figure 3: Annual trends of human brucellosis prevalence, by sex, Ain Témouchent, 2014 -2019

Table 2: Demographic data on the positive patients during 2014 to 2019

Parameter	Number of cases	Percentage	P value
Gender			
Male	335	55.92	0.004
Female	264	44.07	
Age (years)			
0 up to 14 years	69	11.52	0.001
15 up to 24 years	116	19.37	
25 up to 44 years	226	37.73	
45 up 54 years	92	15.36	
Over than 55 years	96	16.03	

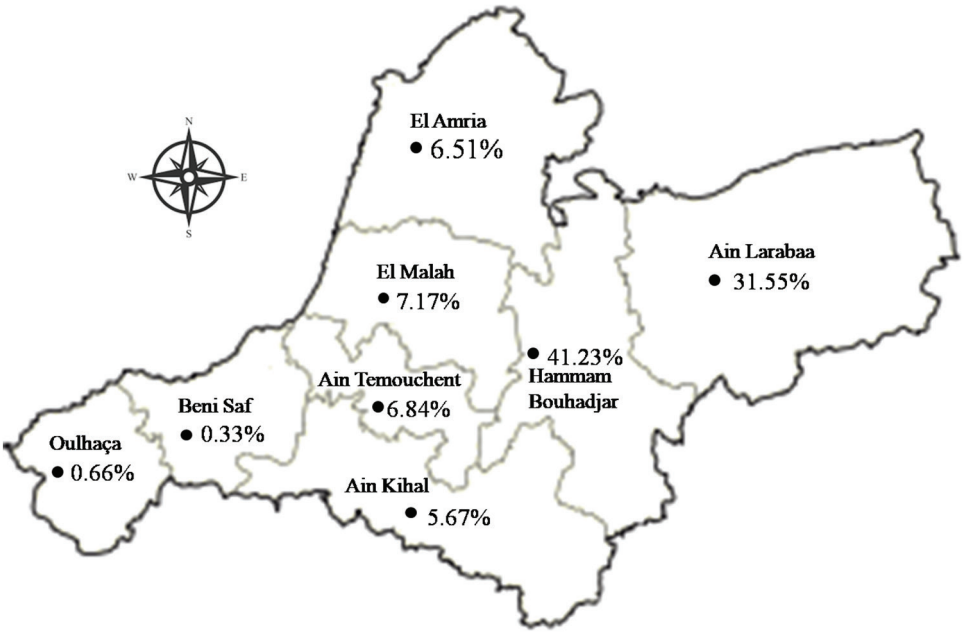

Figure 4: Geographical frequency of human brucellosis in the districts of Ain Temouchent from 2014 to 2019

According to this study, there was an apparent seasonality of human brucellosis, and the peak number of reports occurred from February to July accounting for 79.46% (n=476 cases) of the total cases during the study period. The number of monthly cases reported peaked in May with 139 cases. On the other hand, the lowest frequency occurred in January (11cases) over the period of this study (Table 4).

Discussion

Brucellosis is one of the most common public zoonotic infectious diseases worldwide. The purpose of the study was to describe the epidemiological characteristics of human brucellosis in Ain Témouchent province during 2014 to 2019. The results of our retrospective study showed that the trend distribution of human

Table 3: Geographical distribution of human brucellosis in the districts of Ain Temouchent from 2014 to 2019

Region	No. of notified cases	Frequency (%)	P value
Ain Témouchent	41	6.84	<0.001
Ain Kihal	34	5.67	
El Amria	39	6.51	
El Malah	43	7.17	
Beni Saf	2	0.33	
Oulhaca	4	0.66	
Hammam Bou Hadjar	247	41.23	
Ain Larabaa	189	31.55	
Total	599	100	

Table 4: Months' frequencies of human brucellosis in Ain Temouchent from 2014 to 2019

Month	No. of notified cases	Frequency	P value
January	11	1.83	<0.001
February	47	7.84	
March	47	7.84	
April	110	18.36	
May	139	23.20	
June	67	11.18	
July	66	11.01	
August	18	3.00	
September	29	4.84	
October	21	3.50	
November	27	4.50	
December	17	2.83	
Total	599	100	

brucellosis in the study area varied in different years. The overall incidence of the human brucellosis trend showed fluctuations, with a mean annual incidence of 26.37 cases /100,000 inhabitants. The incidence of human brucellosis in Algeria has shown an upward trend since 2006, with values ranging from 23.6 per 100,000 inhabitants in 2006 reaching 28 per 100,000 inhabitants in 2010. However, since 2011, the incidence of human brucellosis in Algeria started to decrease significantly ($P<0.05$) with values ranging from 16.6 in 2011 reaching 15 per 100,000 inhabitants in 2014.[13] On the other hand, the peak of notification in 2014 could be attributed to consumption of unpasteurized dairy products. The incidence rate declined in 2015 but rebounded in 2016. The reasons for this increase are not fully understood. The annual incidence rate from 2017 to 2019 showed a decreasing tendency, which might have resulted from the following comprehensive procedure of controlling the source infection among livestock. Since 2017, some control strategies like systematic examination of livestock, pasteurization of milk, prohibiting the sale of unpasteurized raw milk, control of animal trade, have been undertaken by the authorities of the province.

In this study, up to 56% of the studied cases were males and 44% were females, with a sex ratio of 1.29; this is in agreement with the study of Ammam et al. in the southern zone of Sidi-Bel-Abbès, Algeria that reported higher seropositivity in men (59.45%) than women (40.54%).[14] Our results are similar to those of a study carried out in Tunisia,[15] Italy,[16] and Libya,[17] and Pakistan,[18] in which the prevalence was higher in males than females, but the rate of brucellosis in females was high in Hamadan Province in Iran.[19] This finding for the high brucellosis prevalence in males could be that males are more involved in activities such as slaughter and handling of livestock and, hence, are at higher risk of infection than females.[20]

Brucellosis affects all age groups in humans. In this study, it was found that the age category of 25 to 44 years was the most age category at risk. Several studies have reported comparable results.[12, 15, 16] This situation is strongly linked to direct or indirect contact with animals and their products. Farming and animal rearing are considered as a hard job and is usually better supported by younger people. In addition, people in this age category have finished their schooling and are usually seeking for work, especially in rural regions, where poverty is high.[15]

In the same line with our findings, Nematollahi et al. made similar findings in Hamadan province. In their study, >60% of the patients were male; 35% of them were in an economically active age group [25 to 44 years], and >80% were rural residents.[19] Furthermore, in a study from Nahavand county, Hamadan Province, western Iran, men aged [25 to 44] years and residents of rural regions were found at the highest risk of acquiring this disease.[21]

In the present study, the prevalence of brucellosis

among those aged <15 years (11,52% of cases) is lower than among other groups, most likely because children come into contact with infected animals less often than adults. Similar results were reported in a study from Iran where 12.4% of brucellosis cases were in patients <15 years old of age.[21]

Human brucellosis can occur in any season or month during a year. However, during the period considered in this study, there was an apparent seasonality of human brucellosis; the incidence was higher from February to July (79.46%, n=476 cases). The number of monthly cases reported peaked in May with 139 cases. A similar trend was reported in Tongliao City, Inner Mongolia province, China, for human brucellosis cases notified between 2007 and 2017; in this study, the highest incidence reported was from March to July accounting for 58.6% of the total cases during the study period.[22] Other studies in Greece, Tunisia, and Saudi Arabia revealed similar findings.[15, 23, 24] The present study confirmed the findings of the studies conducted in Pakistan and Iran.[12, 21]

In the present study, this clear seasonality of human brucellosis is likely to be associated with lambing times, and dairy cow calving and milk yield increase of cows and female small ruminants, during spring when grass becomes abundant. Moreover, during these seasons, higher exposure to the infected livestock as well as direct contact between ranchers, aborted animal fetuses, infected animals, and increased consumption of contaminated dairy products raise the incidence of brucellosis. Furthermore, the climatic conditions, such as temperature, length of sunshine and rainfall, have been demonstrated to highly correlate with brucellosis transmission.[25] Warmer temperature and higher humidity during the epidemic seasons in Ain Témouchent which are late spring and the whole of summer are also suitable for the spread of infection.

The geographical distribution analyzed during the study period indicated that the highest risk area of human brucellosis was Hammam Bou Hadjar and Ain Larabaa region. This area is well known for its extensive prairies and livestock. These results can be explained by the increase in the prevalence of bovine brucellosis in this area (Ain El Arbaa and Hammam Bouhdjar), where the use of raw cow's milk and its derivatives is common. Moreover, according to the results of the epidemiological survey carried out by the health and population department of the wilaya of Ain Témouchent, human brucellosis is linked to the widespread consumption of raw milk and its derivatives, as well as livestock farming animals, especially those of small ruminants. In addition, the cases declared in other communes of the wilaya, where the breeding of cattle is rare, were contaminated by the consumption of unpasteurized raw milk sold on the spot and brought back from the different breeding areas located on the outskirts of these communes. In addition, the brucellosis case notification system is seemingly a source of confusion about the geographical origin of the reported cases. Indeed, the health map subdivides the wilaya into four health sectors. Otherwise, living habits, medical conditions, and education level might affect the distribution of the disease. Most of the patients were living in rural areas with lower prevention awareness.[21]

Limitation

In reviewing the information of the patients, it was found that some of the necessary information such as professional status in addition to contact with animals, education level, and the following complications of brucellosis were not fully recorded in the existing forms, resulting in a lack of full interpretation and conclusion of the available data. The obtained rates may be lower than the actual disease rates within the community. The low number of cases in some years of the study may be due to the small number and lack of registration of cases. Furthermore, the absence of control group impedes the determination of the main risk factors of human brucellosis. Another limitation of our study was the absence of comparison with the incidence of brucellosis reported in animals. A one-health approach would be a rigorous basis for disease control strategies for brucellosis. The One Health approach is a concept connecting human health with that of animals and the environment, with the goal of building a healthy and safe environment for all.

Conclusion

In the study period from 2014 to 2019, brucellosis notification increased in Ain Témouchent Province (western Algeria), and this remains a challenging health problem. In the present study, mal gender, age 25–44 years, and period from February to July are important possible predisposing factors for the acquisition of human brucellosis. There is a need to empower at-risk populations to control the risk. It seems necessary to enhance the health surveillance system. The main public health goal is to decrease brucellosis prevalence among humans and infection sources. Preventive measures should include implementing a governmental surveillance program for brucellosis prevention. Moreover, it is also necessary to enforce animal controls and increase level of awareness and education among people, especially regarding the consumption of uncontrolled milk and derivatives. For decreasing the prevalence of the infections in animals, principally sheep and goats, it is suggested that the official control measures and eradication efforts, especially in livestock that are currently not controlled and in which a high prevalence of animal's brucellosis, should be improved. This confirms the necessity to improve

knowledge of the risks associated with consuming raw milk and its derivatives mainly from sheep and goats, and demonstrate that public health would benefit from cooperation between human and veterinary health services.

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Conflict of Interest: None declared.

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