



## Retrospective study of human brucellosis in Algeria's central region

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### Abstract

Our aim is to explore the epidemiological characteristics of human brucellosis in the province of Chahbounia in Algeria, this contagious infectious disease common to humans and many animal species. In Algeria, it topped the list of zoonoses in 2007.

The cases of human brucellosis recorded in the province of Chahbounia (Algeria's central region) within twelve years were based on previous statistics from the public health department.

The results revealed 192 reported cases of human brucellosis, the majority of which were men rather than women, with a sex ratio of 1.9. People aged between 15 and 65 are the most exposed to brucellosis infection. Our results also revealed that brucellosis contamination occurs mainly when the climate becomes hot between April and July.

**Key words:** Brucellosis, zoonosis, incidence, sex ratio, season.

### Introduction

Brucellosis, historically known as Malta fever or melitococcie, is a disease caused by bacteria of the *Brucella* genus. It is considered the world's most widespread zoonosis, predominating in the Mediterranean region, Central (Mexico) and South America (Peru), the Middle East, Asia (India, China) and Black Africa. Worldwide, brucellosis represents a serious threat to human health (WHO, 1986), affecting more than 500,000 individuals every year (Vanderkerckhove et al. 1993; Janbon, 2000; Garin Bastuji and Delcuelleirrie. 2000; Maurin. 2005; Desachy. 2005).

Algeria occupies the 10th rank in the list of countries most affected by human brucellosis, and was ranked 2nd zoonosis in Algeria after leishmaniasis. In 2007 and 2014, it topped the list (OIE, 2013). Annual incidence is between 8 and 50 human cases per hundred thousand individuals (Pappas.

2006). It reached 55 cases in 2006 in the province of Chahbounia, our study region.

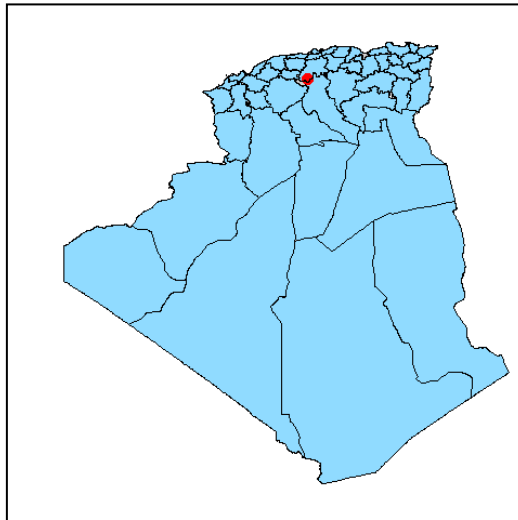
Due to the social context and certain culinary habits prevalent in Algeria, rural populations live in close contact with their animals and generally prefer to consume raw or slightly acidified milk and dairy products. These foods are considered the source of infection in around 85% of cases (Manes. 1984).

The aim of our work is to explore the epidemiological characteristics of human brucellosis in the province of Chahbounia within twelve years.

## Materials and methods

### Description of the study area

The province of Chahbounia is located in the south of the wilaya of Médéa in central Algeria, covering an area of 1514 km<sup>2</sup> and with a population of 41224 inhabitants. The main source of livelihood for its inhabitants is the mixed breeding of small ruminants (sheep and goats), with sheep predominating, while goats are bred solely for their milk. This is a pastoral region, with 110,000 head of sheep. Administratively, it is divided into three communes: Chahbounia (522.37 Km<sup>2</sup>, 13955 inhabitants, 40,000 head of sheep); Boughezoul (448 Km<sup>2</sup>, 18150 inhabitants, 35,000 head of sheep) and Bouaiche (544.18 Km<sup>2</sup>, 9118 inhabitants, 35,000 head of sheep).



**Figure 1.** Location of the Chahbounia province in Algeria.

### Data collection

Our work is a retrospective study analyzing statistical data reflecting the epidemiological evolution of human brucellosis in the province of Chahbounia over twelve years.

Statistical data concerning cases of human brucellosis were obtained from the Direction de la Santé et de la Population (DSP de Médéa).

### Statistical analysis

The data obtained were entered into Excel® 2007 (Microsoft, USA). Incidence (I) was calculated according to the formula:  $I = n/p*d$ , where n is the number of new cases, p: the total number of individuals and d: the length of the observation period.

For each series of analyses, the Chi-square ( $X^2$  cal), theoretical Chi-square ( $X^2$  theoretical ) and degree of freedom (ddl) values are calculated at a confidence level maintained at  $p=95\%$  and  $\alpha<0.05$ , the mean and the confidence interval are defined for significance. Numbers were compared using two tests: Student's t-test and Chi-square.

## Results

Human brucellosis cases reported over the twelve years from 2004 to 2015, collected from public health services showed the following results:

### Annual and monthly incidence of human brucellosis:

The monthly and annual census of reported cases of human brucellosis is reported in Table I :

**Table I: Annual and monthly incidence of human brucellosis in the province of Chahbounia (2004-2015).**

Year Month	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total	Monthly incidence (%)
January	0	0	0	0	1	0	2	0	1	0	0	0	4 <sup>2</sup>	9.7
February	0	8	1	0	0	2	0	1	0	0	0	0	12 <sup>3</sup>	29.1
March	0	1	0	3	0	5	0	1	0	0	1	0	11 <sup>4</sup>	26.68
April	0	24	0	3	4	2	0	0	1	2	1	1	38 <sup>10</sup>	92.17
May	0	11	3	3	3	0	1	2	0	0	2	2	27 <sup>10</sup>	65.49
June	0	5	5	1	5	3	2	4	1	1	3	0	30 <sup>12</sup>	72.77
July	0	4	3	4	1	5	3	1	0	0	4	2	27 <sup>11</sup>	65.49
August	4	2	0	2	3	1	1	0	0	1	0	1	15 <sup>4</sup>	36.38
September	1	0	2	1	1	1	2	0	0	2	3	0	13 <sup>4</sup>	31.53
October	0	0	0	2	1	1	0	0	1	0	3	2	10 <sup>4</sup>	24.25
November	0	0	0	0	1	0	1	0	0	1	1	0	4 <sup>2</sup>	9.7
December	1	0	0	0	0	0	0	0	0	0	0	0	1	2.42
<b>Total</b>	<b>6</b>	<b>55</b>	<b>14</b>	<b>19</b>	<b>20</b>	<b>20</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>7</b>	<b>18</b>	<b>8</b>	<b>192<sup>66</sup></b>	
<b>Incidence annual (%)</b>	<b>14.55</b>	<b>133.41</b>	<b>33.96</b>	<b>46.08</b>	<b>48.51</b>	<b>48.51</b>	<b>29.1</b>	<b>21.83</b>	<b>9.7</b>	<b>16.98</b>	<b>43.66</b>	<b>19.4</b>		<b>mean 38.8(%)</b>

X<sup>x</sup>: Brucellosis reported in females.

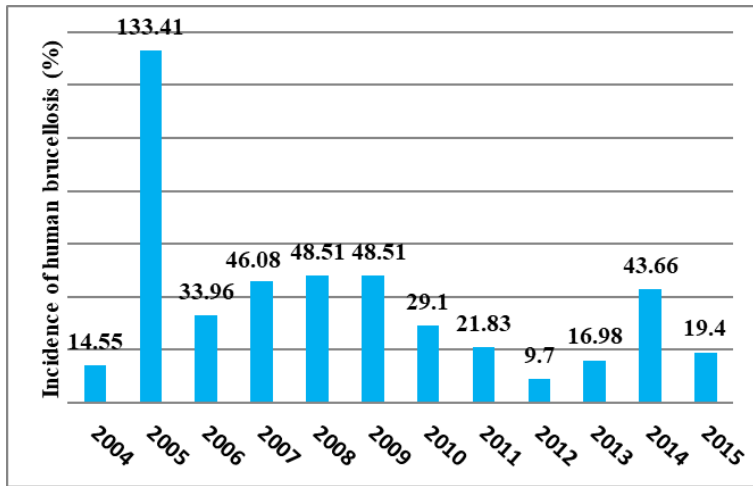
The results of the annual incidence in the province of Chahbounia over the period 2004-2015 show that cases of human brucellosis were below 14 cases for seven years, while the number of declarations in three years (2007, 2008, 2009) was between 19 and 20 cases, peaking in 2005 with 55 declared cases. The above results are reported for a population of 41224 inhabitants.

The annual incidence calculated per 100,000 inhabitants shows a rate of 134 cases/100,000 inhabitants in 2005, then fluctuated around 48 cases/100,000 inhabitants until 2009, before dropping in 2010 to 29 cases/100,000 inhabitants (Figure 1).

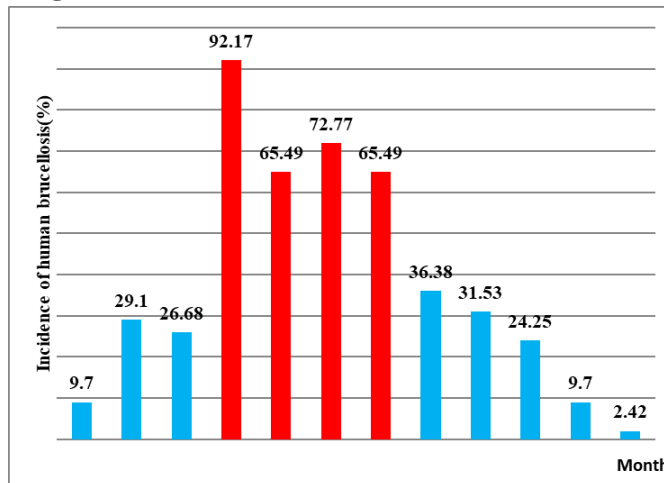
The monthly incidence of human brucellosis is characterized by an epidemic peak in April, May, June and July, with 38, 27, 30 and 27 cases respectively. The monthly incidence calculated per 100,000 inhabitants shows significant rates of 92.17, 65.49, 72.77, 65.49 per 100,000 inhabitants for the months of April, May, June and July respectively (Figure 2). These rates, significantly higher than those recorded during the other months of the year,  $p < 0.05$ , fell progressively during the cold season to reach a minimum of 2.42 cases/100000 inhabitants in December (Figure 3).

The incidence of brucellosis recorded during these four months of the year represented 63.54% of the total number of cases, with 122 cases. The average annual and monthly incidence was 39 cases/100,000 inhabitants.

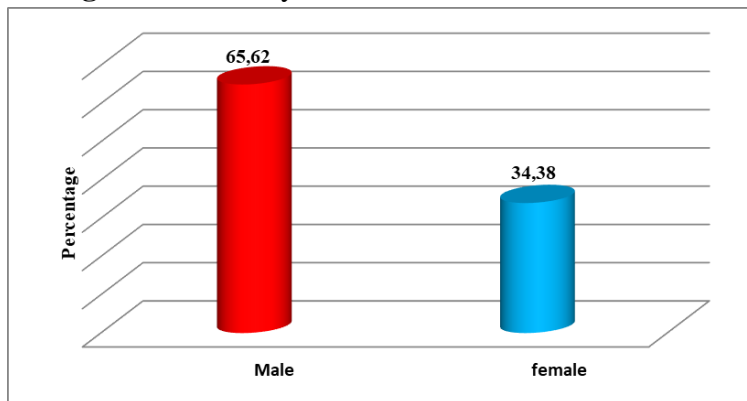
Considering the sex of the patients, males were more affected than females,  $p < 0.05$ ; 126 males and 66 females were affected, for a sex ratio of 1.9 (Figure 3).



**Figure 2:** Annual incidence of human brucellosis.



**Figure 3:** Monthly incidence of human brucellosis.



**Figure 4:** Incidence of brucellosis according to patient gender.

**Age distribution of patients:**

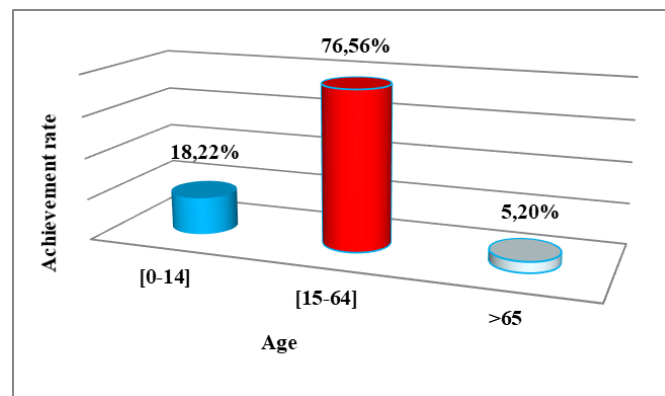
In order to interpret the results according to age, the age of the patients was divided into three classes corresponding to childhood and pre-puberty age for the class [0-14] years, to adulthood for the class [15-64] and a class of people aged over 65 years. Infection rates are reported in **Table II**.

**Table II :** Human brucellosis infection rates by age group.

Age	Population	Positive cases	Percentage affected (%)
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[0-14]	12779	35	18,22%
[15-64]	26383	147	76,56%
>65	2061	10	5,2%
Total	41 224	192	100%

These results show that the class most affected by brucellosis is adults aged between 15 and 65, with a rate of 76.56%,  $p < 0.05$ ; followed by children and the elderly, with rates of 18.22% and 5.2% respectively.



**Figure 5:** Incidence of brucellosis according to patient age.

## Discussion

The existence of brucellosis throughout Algeria has been confirmed by several studies (Kardjadj. 2016; Akhvlediani et al. 2017). Our study explored the demographic and temporal characteristics of the incidence of human brucellosis in the province of Chahbounia over twelve successive years. The average annual incidence recorded was 39 cases per 100,000 inhabitants. This rate is very high compared with the incidence of 19 cases per 100,000 inhabitants reported in 2005 for the ten departments making up central Algeria (Lounes. 2009). Our results are also much lower than those reported in the province of M'sila, with 206 cases per 100,000 inhabitants (Lounes. 2009), and those reported in Tunisia in 2006, with 460 cases per 100,000 inhabitants (Chakroun, N. Bouzouaia. 2007). The wide fluctuation in incidences has been reported by several authors, and varies from country to country and region to region, ranging from 0.125 to 200 cases per 100,000 inhabitants (Janbon. 2000; Vanderkerckhove et al. 1993). The frequency of human brucellosis is difficult to assess because of its clinical polymorphism and under-reporting (Bouzouaia et al. 1995; Vanderkerckhove et al. 1993). Moreover, even with an average incidence of 39 cases per 100,000 inhabitants, we assume that the number of cases is underestimated, mainly because of the lack of systematic screening for asymptomatic forms in the vicinity of confirmed cases.

Our results also revealed an increase in the annual incidence rate between 2005 and 2009. This could be the result of increased public awareness and improved case reporting, which has been compulsory since 1995; it could also be caused by the development of livestock farming and trade in recent years (Khezzani et al. 2020).

The dominant mode of transmission involved in human brucellosis is digestive contamination, particularly in rural areas where family rearing of domestic animals is common. Consumption of raw

milk and unpasteurised dairy products is very common. A study in Tunisia reported that 62.5% of cases occurred following consumption of milk and milk derivatives (Zribi et al. 2009).

The results reveal a sex ratio of 1.9, meaning that males are twice as likely to be contaminated by brucella as females. This result is similar to those reported in several studies. A sex ratio of 2.1 was reported in 2004 in France (Mailles and Vaillant. 2007), 2.16 in 2011 in Greece (Kremastinou et al. 2012) and 1.45 in 2007 in Tunisia (Chakroun and Bouzouaia. 2007). Other studies show very high rates among men, particularly those reported in Abu Dhabi and Azerbaijan, with values of 79% and 79.8% respectively (Al Shehhi et al. 2016; Abdullayev et al. 2012). Other authors even report that in all climates, men are more affected than women (Touaref et al. 2014).

Brucellosis appears to occur at all ages, with a predominance in adults. The results obtained reveal that adult patients belonging to the age group [15-64] are the most affected by brucellosis followed by those in the age group between [0-14] then those aged 65 and over with respective rates of 76.56%, 18.22% and 5.2%. These results are similar to the majority of studies carried out. In France, for the period 2002-2004, an average age of 44 was reported (Mailles and Vaillant, 2007). In Greece, during the period 2005-2011, the average annual frequency of brucellosis shows that the modal class is [35-44] years, followed by [25-34] years and then [55-64] years (Kremastinou et al. 2012). In Tunisia, adults aged between 20 and 59 years account for 65% of reported cases.

Our results also revealed that brucella infection occurs mainly when the climate becomes a little warm, but not as much. The monthly incidence calculated per 100,000 inhabitants shows rates of 92.17, 65.49, 72.77 and 65.49 per 100,000 inhabitants for the months of April, May, June and July respectively. In reality, these months correspond to two months of the spring season (April and May) and two months of the summer season (June and July). This is the time of year when the climate becomes temperate after March has absorbed the cold of winter without reaching August, the month of intense heat. Cases of human brucellosis recorded during this period account for almost two-thirds of cases, compared with just one-third for the rest of the year. This period represents a high level of exposure, especially for professionals (farmers and vets), as well as for consumers of raw milk and by-products. The upsurge in cases during the spring and summer could be explained by the presence of climatic and environmental conditions favourable to the rapid multiplication of germs in moist organic media such as milk (Touaref et al. 2014). This coincides, on the one hand, with the peak of lambing-chevrotage and the goats being put out to pasture, which results in an increase in the production of milk and milk by-products, and an increase in their consumption by the population (Lounes et al. 2014); and, on the other hand, with the use of previously dried lamb rennet in the artisanal manufacture of cheese. This product, which is crumbled and mixed with milk (rennet), can be a source of infection if it is produced from the abomasums of brucella-causing animals (Corbel. 2006). These lambs, sacrificed at a very young age, could come from a flock of uncertain status.

## **Conclusion**

Our work has enabled us to gain a better understanding of the brucellosis infection situation in the province of Chahbounia.

The 12-year retrospective study (2004 to 2015) explored the demographic and temporal characteristics of the incidence of human brucellosis (age, sex ratio, season). In the province of Chahbounia, human brucellosis affected men much more than women (with a sex ratio of 1.9) and preferentially adults aged between 15 and 64 from April onwards, when the climate begins to warm up. This period, with climatic and environmental conditions favourable to the rapid multiplication of germs in organic media and coinciding with the peak of lambing-sucking and the grazing of ruminants, exposes professionals, farmers and consumers of raw milk and by-products to brucella

infection.

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