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Research article

A survey on the occupational exposure of veterinarians to brucellosis in Algeria

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Abstract

Brucellosis is an endemic disease in north African countries, including Algeria. To evaluate the infection of veterinarians by brucellosis in Algeria and to study the associated epidemiological factors, we created a survey consisting of 21 questions that were distributed in paper and digital versions. We collected responses from 100 veterinarians spread over 30 wilayas in the different regions of Algeria, i.e., East, Centre, West, and South. The survey revealed that 15% of veterinarians got infected with brucellosis during their practice. Almost half (47%) contracted the disease through direct contact with diseased animals and/or their products, mostly during intervention for the retained placenta. In addition, 20% became infected during vaccination campaigns against brucellosis due to unprotected hands, while 13% were infected by consuming raw milk. 74% of veterinarians agreed to work on farms with brucellosis. Factors such as the frequency of encountering brucellosis farms, negligence in wearing protective equipment, lack of training in handling the vaccine, and lack of work hygiene were reported by the surveyed professionals. Therefore, increasing awareness and educational programs are required among occupational in Algeria.

Keywords: Brucellosis, Occupational exposure, Veterinarian, Algeria

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Introduction

Brucellosis is an infectious zoonosis with an occupational health hazard that affects several terrestrial and marine animal species caused by bacteria of the genus *Brucella*. It is transmitted to humans directly, through contact with infected animals or their products, or indirectly through the consumption of contaminated raw milk or derived products (Corbel et al., 2006). The occupations exposed to direct or indirect contact with infected animals or their products, e.g., farmers, stockmen, shepherds, goatherds, abattoir workers, butchers, dairymen, artificial inseminators, veterinarians, and those involved in the processing of viscera, hides, wool, and skins. Persons involved in the maintenance of buildings or equipment used for animals and their products may also be at risk.

An additional important category includes laboratory workers who may be exposed to contaminated specimens or pure *Brucella* cultures during diagnostic procedures or vaccine production, for example. The production and use of live vaccines also carry human health risks. Infection sources can be through inhalation, conjunctival contamination, accidental ingestion, skin contamination, including cuts or abrasions, and accidental self-inoculation with live vaccines (Corbel et al., 2006). According to the World Health Organization (WHO), brucellosis is considered one of the most widespread zoonoses in the world, with an incidence rate of over 500.000 human cases per year (Pappas et al., 2005). Algeria has the tenth-highest annual incidence of reported human cases in the world (Pappas et al., 2006). Brucellosis is enzootic at Algerian livestock farms, with prevalence varying depending on the region.

Between 1995 and 2020, an average infection rate of 1.26% and 7% were reported in cattle and goats, respectively (The Veterinary Services Authority, 2021). A control program based on sanitary prophylaxis (Test and slaughter) was initiated in 1995 for cattle and goats. A mass vaccination in small ruminants, targeting high-prevalence departments (Wilayas), was launched later in 2006. However, these two programs have not proved efficacy, as, since 1995, an average of more than 5.000 human cases, with an average rate of 15 cases/100.000 inhabitants, have been declared annually in Algeria by the National Institute of Public Health (INSP). In 2017, 10198 cases were recorded, with an incidence of 24.43 cases per 100.000 inhabi-

tants (National Institute of Public Health, 2017).

Considering the contamination mode, 60% is related to the cases of ingestion of raw milk and dairy products, 10% is related to cases of exclusive professional origin, and 30% is related to mixed cases (Benchouk, 1990; Ould-Metidji et al., 1990; Benhabyles, 1992; Korichi and Rahal, 1995). This percentage would certainly be higher if systematic serological surveillance was carried out among highly exposed workers and if the diagnosis was made in response to misleading clinical findings. Indeed, a recently published retrospective study of human brucellosis cases has reported that the main sources of contamination are the consumption of dairy products (86.22%) and occupational exposure (42.06%) (Hasnaoui et al., 2020).

Different studies have shown that contamination by ingesting raw milk and its products is the root cause of human infection due to traditional local food habits (Cherif et al., 1986; Dahmani et al., 2018; Abdelkader et al., 2018; Hasnaoui et al., 2020). However, very little data have been published on the occupational involvement of this disease. We were therefore interested in surveying to assess the extent to which veterinarians are affected by brucellosis in Algeria and studying the epidemiological factors associated with their contamination, based on the practices of these professionals.

Materials and methods

The survey

To conduct our investigation, we designed a survey consisting of 21 questions focusing on the following key points:

- Socio-demographic data of the veterinarians interviewed (age, gender, wilaya of practice, professional experience, sector of practice).
- Conduct of veterinarians in their daily practice.
- Vaccination of farms and declaration of those with brucellosis.
- Hygiene and protection measures are taken by veterinarians when performing their duties.
- Occupational brucellosis and related factors.
- Clinical, diagnostic, and treatment aspects of occupational brucellosis.

The survey was conducted in two versions, a paper version and an online version (using Google Forms), targeting the veterinary profession only throughout the country, whether privately employed or working in the government sector. We distributed 134 questionnaires, either by direct interview (paper version), by e-mail, or sharing on professional social networks (online version). At the end of the survey, we were able to collect responses from 100 veterinarians.

Study population

The 100 veterinarians surveyed were spread over 30 wilayas (departments) in the different regions: East, Centre, West, and South (Figure 1), including 15 women and 85 men, aged between 24 and 63 years, with professional experience ranging from 1 to 34 years, practicing in the private (92) and government (8) sectors. It should be noted that 51% of the veterinarians interviewed were between 24-30 years of age, and 69% had experience of 10 years or less.

Statistical analysis of data

The data collected from the responses were entered into an Excel 2016 database (version 16.48), and the descriptive analysis focused on determining the brucellosis infection rate (with a 95% confidence interval). Statistical analysis was carried out for the different factors using non-parametric tests: chi-square test and G-test (Log-Likelihood ratio) for the study of the independence of the recorded rates and the risk factors studied at the significance level of $p<0.05$.

Results

Conduct and protection of veterinarians during daily practice

In the first part of the survey, we looked at the conduct of veterinarians and the protective measures they use in their daily practice (Table 1). Forty-three percent of the veterinarians surveyed stated that they frequently encounter brucellosis on the farms they follow; 50% make their diagnosis based on the symptoms observed, and 35% use complementary examination. Sixty-two percent declare the brucellosis outbreaks to the veterinary services, while 38% do not.

It should be noted that 79% of these professionals report that the farms they monitor were not vaccinated against brucellosis. Although 38% of them had already carried out vaccination campaigns. Among the latter, half (55%) received training in handling the vaccine, compared to 45% who did not have any training. Most of those veterinarians (95%) protected themselves during this procedure, in which 39% wore all the necessary protective equipment, and 5% did not use any protective equipment.

In their daily practice, 53% of the veterinarians wore gloves for a clinical examination, compared with 11% who rarely wore them and 39% who wore them when a contagious disease was suspected. During rectal palpation, 64% wore one glove, 35% wore two gloves, and 1% wore nothing during this examination.

Brucellosis exposure in veterinarians

The second part of the questionnaire focused on the brucellosis status of the veterinarians surveyed: 15% (95% CI: 8-22%) of these veterinarians contracted the disease during their professional practice (Table 2). Most of these infected veterinarians worked in high-prevalence areas, 60% of them frequently encountered *Brucella*-infected farms, and half of them (47%) doubted being infected at these farms.

The proportion of men affected was not significantly higher than that of women (15% vs. 13%); nor for the

Table 1: Responses of veterinarians on how they conduct and protect themselves in their daily practice.

Questions and answers	Number of responses	Percentage (%)
Frequency of brucellosis occurrence Question: Have you ever come across a farm with brucellosis?		
Several times	43	43
Rarely	31	31
Never	26	26
Diagnosis of brucellosis Question: How did you identify it?		
Observed symptoms	37	50.00
Further examination	26	35.14
Breeder's return	11	14.86
Declaration of brucellosis Question: Are these farms declared?		
Yes	46	62.16
No	28	37.84
Veterinarians' outreach on these farms Question: Did you contract brucellosis on these farms?		
Yes	7	9.46
No	67	90.54
Species Question: If yes, this breeding is of the following species:		
Bovine	3	42.86
Caprine	2	28.57
Ovine	1	14.29
Mixed	1	14.29
Vaccination against brucellosis Question: Are the farms you work for vaccinated against brucellosis?		
Yes	21	21
No	79	79
Conducting vaccination campaigns Question: Have you ever carried out vaccination campaigns against brucellosis?		
Yes	38	38
No	62	62
Vaccine training Question: If yes, have you received training in handling the brucellosis vaccine?		
Yes	21	55.26
No	17	44.74
Protection during vaccination Question: Do you protect yourself during vaccination?		
Yes	36	94.74
No	2	5.26
Type of protection Question: If so, what do you put on?		
Gloves. white coat, boots, glasses, and mask	14	38.89
Gloves, white coat, glasses, and boots	8	22.22
Gloves, white coat, and boots	6	16.67
Gloves, glasses, and mask	2	5.56
Gloves, white coat, boots, and mask	1	2.78
Gloves, white coat, glasses, and mask	1	2.78
Gloves, white coat, and glasses	1	2.78
Gloves and glasses	1	2.78
Gloves and a white coat	1	2.78
Gloves	1	2.78
Wearing gloves during the clinical examination Question: Do you wear gloves or other protective tools before examining the animals		
Always	53	53
When a contagious disease is suspected	36	36
Rarely	11	11
Never	0	0
Protection during rectal palpation Question: During rectal palpation, you wear:		
A glove	64	64
Double gloves	35	35
Nothing	1	1

Figure 1: Distribution of surveyed veterinarians by wilaya (in green : wilayas of the west region, in yellow: wilayas of the center region; in purple: wilayas of the east region; in blue: wilayas of the south region of Algeria).

Table 2: Number of veterinarians with brucellosis by socio-demographic factors.

Factor	The number of vets interviewed	Number of vets affected	Percentage (%)	95% CI	P value
Brucellosis infection	100	15	15	8-22	–
Gender					
Men	85	13	15.29	8-23	**NS**
Woman	15	2	13.33	4-38	
Age (years)					
24- 30	51	5	9.80	3- 21	**NS**
30- 40	27	4	14.81	4 -34	
40- 50	12	4	33.33	10- 65	
Over 50	10	2	20.00	3 -56	
Experience (years)					
≤ 10	69	10	14.49	6-23	**NS**
>10	31	5	16.13	7-32	
Sector					
Private	92	14	15.22	8-23	**NS**
Government	8	1	12.50	2-47	

Abbreviations: NS: not significant p>0.05 ; vets: veterinarians

different age groups studied, although we noted that the 40-50 age group was highly infected (33%). Additionally, it seemed that the number of years of experience and the sector of practice did not influence the risk of contracting the disease (Table 2).

Almost half of the affected veterinarians (47%) were contaminated by handling infected animals and their products (Figure 2), such as vaginal secretions (67%) and placenta and appendages (33%). Most of these infections occurred during an intervention for the retained placenta (75%) or dystocia (25%).

Figure 2 shows that 20% of the veterinarians came into contact with the disease during vaccination campaigns by handling the *Brucella* vaccine with unprotected hands. It should be noted that 67% (2/3) of them had not received training in handling the vaccine. The third mode of contamination for these professionals was the consumption of contaminated raw milk in 13% of cases. Finally, 20% do not know how they contracted brucellosis (Figure 2).

Clinically, fever, night sweats, and fatigue were the most frequently reported symptoms, followed by arthralgia, anorexia, and weight loss (Table 3). Most veterinarians (80%) consulted a doctor. However, we noted that 20% did not seek medical care. The diagnosis was established by positive serology in 80% of cases. It should be noted that a low percentage (20%) was confirmed by bacteriological identification. More than half of the cases (60%) showed acute brucellosis, in comparison to 13% who presented a chronic form (Table 3).

Most of these infected veterinarians (73%) received a combination of antibiotics for a period of 45 days (50%). We noted that 13% (2/15) presented osteoarticular or genital complications, and the latter received monotherapy (only one antibiotic) (Table 3).

Discussion

In Algeria, an average of more than 5.000 cases of human brucellosis have been reported annually in the last three decades (National Institute of Public Health, 2017). Few studies did look at the origin of the contamination of these cases, but they reported that professional exposure is not negligible. In our study, we focused on the professional exposure of veterinarians to this zoonosis by carrying out a survey that reached 100 veterinarians from different regions of Algeria. The characteristics of the study population (gender, age, experience, practice sector) were representative and reflected those of veterinarians in the national territory.

In the first part of the survey, we wanted to identify some of the practices of veterinarians when dealing with brucellosis. Our survey revealed certain field facts, which confirm the high frequency of farms affected by this disease, supported by the fact that 43% of veterinarians frequently encounter this disease. However, we note that 38% do not systematically declare this zoonosis, even though, by regulation, it is a notifiable disease. We also noted that 50% refer to the symptoms observed to make their diagnosis, although the clinical diagnosis of brucellosis is very difficult given the number of diseases that present the same symptoms. It is, therefore, imperative to carry out laboratory tests to confirm the clinical suspicion. It is also quite surprising that 79% of the veterinarians interviewed stated that the farms they monitor were not vaccinated against brucellosis, despite the fact that half of the wilayas surveyed were covered under the vaccination program. Does this indicate a refusal on the part of farmers regarding vaccination or a lack of awareness and information about this prevention program.

In the second part, we focused on brucellosis infection among veterinarians. Our survey found that 15% of the veterinarians interviewed had contracted brucellosis during their professional careers. This rate of infection was similar to the percentage reported in a previous survey included 207 veterinarians, which was 15.5% (Lounes, 2007), and was close to the rate of 13.3% for veterinarians, among affected professionals reported in a retrospective study from 2013 to 2018, on a total of 446 cases of human brucellosis (Hasnaoui et al., 2020).

Socio-demographic factors such as gender, age, experience, and sector of practice did not seem to influence the infection rate in our study. It should be noted, however, that the 40-50 age group had the highest rate, which was consistent with data reported annually by the National Institute of Public Health for the general population (National Institute of Public Health, 2017), as well as a study of occupational brucellosis in the wilaya of Annaba (Tourab et al., 1990), where the 40-49 age group appeared to be the most affected. We figured out that most infected veterinarians work in high-prevalence areas, with 60% of these sick veterinarians frequently encountering *Brucella*-infected farms. Forty-seven percent of the affected veterinarians reported being infected on these farms, half of whom blamed cattle farms.

When we looked into the modes of transmission, contact with infected animals and/or their products came first (47%). In fact, this was the most likely mode of infection since these professionals were in daily contact with animals. Furthermore, a significant proportion of veterinarians did not protect themselves during their daily practice. In fact, our survey revealed that 1% of veterinarians did not wear gloves during rectal palpation and 11% rarely wear gloves or other protective tools during a clinical examination. We noted that 36% only wore gloves when a contagious disease is suspected. Moreover, a previous study reported that in Algeria, 60% of asymptomatic cattle had positive serology for brucellosis, and 36% had positive bacteriology, thus being carriers (Lounes et al., 2021).

Affected veterinarians reported contact with vaginal secretions or the placenta and its appendages. In most cases, this occurred during interventions for placental retention (75%) or dystocia (25%). Given that one of the most frequent symptoms of bovine brucellosis in Algeria is non-delivery (Lounes et al., 2021). A previous study carried out on professionals from different sectors reported a higher proportion of affected workers who had contact with abortion prod-

Table 3: Clinical manifestations, diagnosis, and treatment of affected cases of veterinarians (n=15).

Item	Number of veterinarians	Percentage (%)
Symptoms		
Fever	14	93.33
Fatigue	12	80.00
Night sweats	11	73.33
Anorexia	4	26.67
Weight loss	4	26.67
Arthralgia	4	26.67
Lymph node hypertrophy	2	13.33
Headaches	1	6.67
Consultation with a doctor		
Yes	12	80
No	3	20
Further examination /Diagnosis		
Positive serology	12	80.00
Added to:		
Positive bacteriology	3	20.00
Ecography	1	6.67
Radiology	2	13.33
Form of brucellosis		
Acute	9	60.00
Chronic	2	13.33
I do not know	4	26.67
Treatment		
Doxycycline + Gentamycin	7	46.67
Doxycycline + Rifampicin	3	20.00
Doxycycline + Streptomycin	1	6.67
Doxycycline	1	6.67
Rifampicin	1	6.67
No treatment	2	13.33
Duration of treatment		
Less than 45 days (20-30 days)	3	25
45 days	6	50
More than 45 days (2 months and more)	3	25
No response	1	6.67
Complications		
No	13	86.67
Yes	2	13.33
Osteoarticular	1	6.67
Orchitis	1	6.67

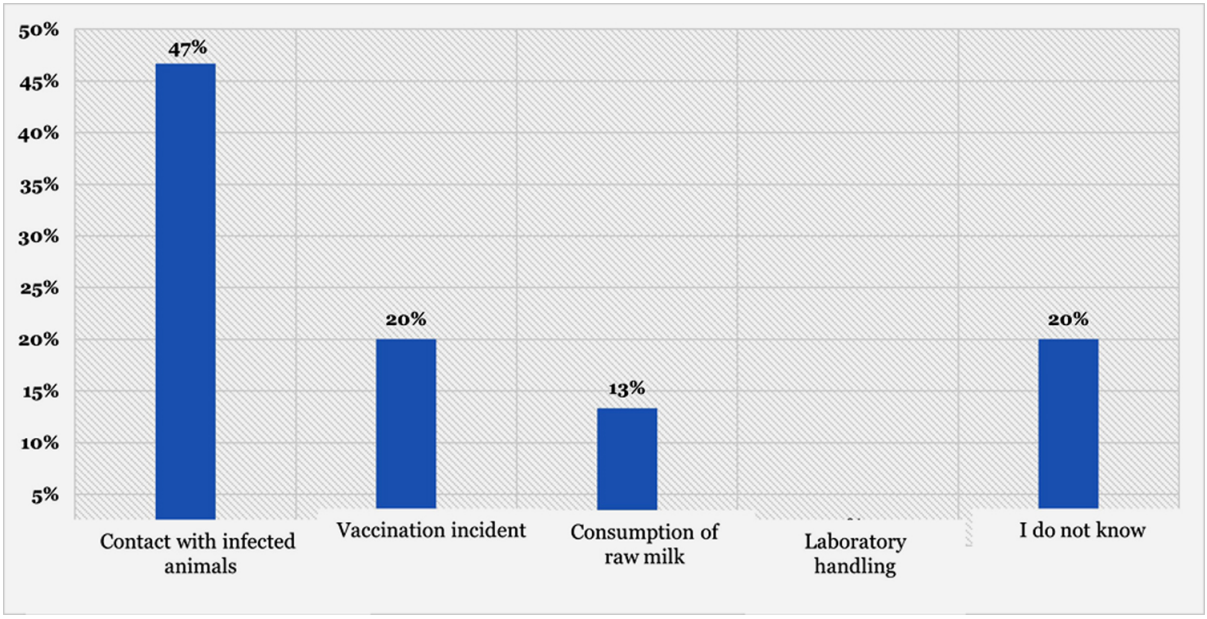

Figure 2: Distribution of surveyed veterinarians by wilaya (in green : wilayas of the west region, in yellow: wilayas of the center region; in purple: wilayas of the east region; in blue: wilayas of the south region of Algeria).

ucts (19.5%) than those who had never handled these products (4.8%). The same study showed a 6.4-fold increase in risk when abortion products were handled without special precautions (Tourab et al., 1990). In the second position, contamination during handling accidents of the anti-*Brucella* vaccine (20%) due to unprotected hands. We found that 5% of veterinarians did not protect themselves during vaccination (half of them were contaminated). Of those who did protect themselves, only 39% wore all the necessary protective equipment. It should also be noted that 67% of these cases of infection did not receive training in the use of the anti-*Brucella* vaccine.

In Algeria, vaccination of small ruminants began in 2006 in wilayas with high prevalences, using the live *B. melitensis* Rev 1 vaccine, administered by the conjunctival route. The preparation and use of the live vaccine are dangerous because the *B. melitensis* Rev 1 strain is not entirely avirulent to humans. Care should be taken when using *B. melitensis* Rev 1 vaccine to avoid the risk of environmental contamination or human infection (Corbel et al., 2006; OIE, 2018). Thus, training and awareness-raising of veterinarians is an important step before launching any vaccination program to minimize the risk of contamination. These results are in line with those of Hasnaoui et al. (2020), who reported the causes of contamination of the veterinarians studied due to direct contact with infected animals and exposure to live vaccines during vaccination campaigns.

In third place, contamination by consumption of raw milk (13%), which is the most common route of infection in Algeria among the general population due to local alimentary habits where raw milk and its derivatives were highly valued (artisanal cheese, butter, whey, curdled milk, etc.), especially in traditional dishes. These findings have been reported by several studies in Algeria (Abdelkader et al., 2018; Dahmani et al., 2018; Hasnaoui et al., 2020). Even though we investigated a portion of the informed and trained population in this study, which was the veterinarian, we found that these habits, traditions, and beliefs were persistent.

Clinically, the typical symptoms of brucellosis were described by the veterinarians interviewed. We noted that the acute form with sudor-algesic fever and asthenia remained the most frequent symptom, as already reported (Tourab et al., 1990). It should be noted that the diagnosis is mainly made by serological tests. Only a small percentage (20%) was confirmed by bacteriology. The majority (73%) received therapy with the combination of two antibiotics (doxycycline associated with gentamycin or rifampicin or streptomycin) for a period of 45 days. Both the WHO and the Algerian Ministry of Health recommend the combination of two antibiotics for a period of 45 days for the treatment of human brucellosis (Solera et al., 1995; Pappas et al., 2005).

We found that two cases (13%) presented osteoarticular or genital complications. This is similar to the results of Tourab et al. (1990). However, we noted that these two vets received monotherapy: either cyclin alone or rifampicin alone. The literature reported that the combination of cyclins with streptomycin or rifampicin is more effective than cyclins alone; thus, rifampicin alone is likely to enhance the appearance of resistant mutants or relapses (Redjah, 1990).

Conclusion

Our survey revealed that 15% of the veterinarians interviewed had contracted brucellosis during their professional practice. Direct, unprotected exposure to infected animals and/or their products, mainly during intervention for placental retention, recurrent encounters with brucellosis-infected farms, and unprotected handling of anti-*Brucella* vaccine appear to be the most

common modes of contamination. The lack of protective equipment worn by veterinarians in their daily practice could be an important risk factor for brucellosis in these professionals.

The lack of training in the handling of the anti-brucellosis vaccine has made it a potential factor for brucellosis contamination, resulting in several cases of professional contamination. As a result of this survey, it is clear that continuous training and refresher courses are necessary for the launch of any prophylaxis program, and awareness-raising among veterinarians could undoubtedly reduce the number of professionals affected. It should be highlighted that this survey reports the rate of clinically affected veterinarians, but systematic serological screening is necessary to determine the real prevalence of brucellosis among this group of professionals.

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