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Seroepidemiology of Brucellosis in People in Direct and Close Contact with Pigs and their Feces at the City of Bobo-Dioulasso in Burkina Faso

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Abstract

Background: Brucellosis is a major zoonosis with negative consequences on the health, economic and social in countries with agricultural and livestock. Moreover, it is one of the 5 priority zoonosis monitored in Burkina Faso as part of the fight against major epidemics with a multisectoral approach "One Health" involving The Ministry of Health, Agriculture, Animal and Fisheries Resources and the Environment. In Burkina Faso, despite its presence in animals, its prevalence is still unknown among people at risk. The general objective of this study is to describe the seroepidemiology characteristics and risk factors for brucellosis in people in direct and close contact with pigs and their feces in the city of Bobo-Dioulasso in Burkina Faso.

Methods: The aim was to find anti-*Brucella* antibodies in the serums of persons in contact with pigs through serological tests of the Buffered Antigen Test and the Enzyme-Linked Immunosorbent Assay. Through a questionnaire, we investigated the epidemiological characteristics and risk factors related to the presence of these antibodies. The study was conducted from August 20, 2016 to October 24, 2021. It concerned anyone in direct and close contact with pigs and their feces and residing within a 25 km radius of the city center of Bobo-Dioulasso.

Results: Of 368 sera, seroprevalence with the Buffered Antigen Assay and the Enzyme-Linked Immunosorbent Assay gave respectively 10,9% and 8.2%. Subjects over 35 years of age were seropositive at 14.1%, those 18 - 35 years of age at 3.8%. Men were 10.8% and women 1.8% seropositive. Regarding the profession, the slaughterhouse workers were seropositive at 12%. Seropositivity was significantly associated with risk behaviors such as: abortion assistance ($p = 0.01$), manipulation of the unborn ($p = 0.01$) and permanent contact with unprotected pig blood ($p = 0.01$).

Conclusion: The presence of anti-*Brucella* antibodies was revealed in people in direct and close contact with pigs and their feces in the city of Bobo-Dioulasso. In view of this result and the major nature of this zoonosis, it is imperative to conduct a survey within other at-risk occupations in order to diagnose and eliminate the enabling factors.

Keywords: *Human Brucellosis; Sero-Epidemiology; Zoonosis; Public Health; Bobo-Dioulasso; Burkina Faso*

Abbreviations

ELISA: Enzyme-Linked Immunosorbent Assay; EAT: Buffered Antigen Assay; CI: Confidence Interval; OR: Odds Ratio

Introduction

Brucellosis is an infectious disease caused by bacteria belonging to the genus *Brucella* [1-3]. It is considered one of the most widespread zoonosis in the world [4-6]. It is subject to mandatory human health reporting and animal health-based slaughter and vaccination [7-9]. The reservoir of bacteria is exclusively animal [10-12]. Domestic ruminants (cattle, sheep, goats) and pigs are in the first place [8,13,14]. Brucellosis is both a serious human disease in terms of public health and an animal disease with very negative consequences on the economic and social level [15-17]. In animals, it slows down the growth of livestock through abortions and sterility; and reduces the supply of meat to the population while constituting an obstacle to trade in animals and their derived products [18-20]. In pregnant women, brucellosis can be responsible for abortions, premature births and death in utero in 10 to 46% of cases [21]. In humans, in addition to abortion and infertility, it frequently causes serious and often debilitating manifestations, thus constituting a very serious problem for the health and well-being of populations [22-24]. The beginning is insidious marked by a progressive febrile state [25-27]. The fever is continuous plateau, intermittent pseudo-palustre, or remittance [25-27]. The temperature of the patient rises in increments of 0.5°C to 39°C where it is maintained for about fifteen days and gradually descends [25-27]. Each febrile wave is separated from the next by a period of apyrexia of about one week [25-27]. In addition to fever, asthenia and moderate weight loss associated with heavy sweating predominantly at night with a characteristic smell of wet straw are also observed [25-27]. Mild and mobile, or sharp and diffuse pain of muscular, joint and bone origin is also observed [28-30]. Osteo-articular disease is the most frequent complication of brucellosis [29-31]. It occurs in 10 to 85% of patients infected with the disease [29-31]. Cardiac involvement is the main cause of death during brucellosis [32-34]. Hepatic involvement of brucellosis is usually granulomatosis, also called hepatic granulomatosis [35,36]. It can also be of the granulomatous nephrotic pseudo-tumor type, commonly called hepatic brucelloma, presenting as a febrile hepatic abscess [35,36]. The neurological involvement is very polymorphic and is most often manifested by a deafness due to an involvement of the 8th pair of cranial nerve with complications such as meningoencephalitis, chronic polyradiculoneuritis, epilepsy, psychiatric disorders, brain abscess and idiopathic intracranial hypertension [37]. The genitourinary localization of brucellosis affects both sexes but it predominates in men with very often scrotal and prostatic involvement [38]. In women, the condition manifests itself as pyelonephritis, ovarian cyst or more frequently a tubovarial abscess, salpingitis, endometritis [38]. She can produce a mastitis with passage of the germ in the milk [38].

Transmission of brucellosis to humans is usually through the skin and mucous membranes by direct or indirect contamination with abortion products, placentas, genital secretions, litter, carcasses of infected animals [1,13,39]. Cases of contamination by inhalation of aerosols in laboratories are also a frequent cause of transmission of brucellosis to humans [39-41]. Farmers, veterinarians, slaughterhouse staff and livestock producers are more at risk for infection with this disease [39-41]. More than 500,000 new human cases are reported worldwide each year [42]. While some "economically developed" countries have almost succeeded in effectively combating brucellosis, it remains endemic in the Mediterranean basin, western Asia, the East, South America, Central America and sub-Saharan Africa [42,43]. In Senegal, the prevalence of human brucellosis was estimated at 60,9% among dairy cattle farmers in the peripheral area of Dakar in 2012 [43].

In Burkina Faso, brucellosis is one of the priority zoonotic diseases [1,14]. It is even included on the list of 5 priority zoonosis monitored in the context of the fight against major epidemics with a multisectoral approach "One Health" involving the Ministries of Health, Agriculture, Animal and Fisheries and the Environment [1,14]. Despite this importance, only one study, dating from the 1970s, was conducted in humans with a seroprevalence of 10% in Dori and 14% in Markoy [44]. In animals, a seroprevalence of 7.7% was found in pigs in the peri-urban areas of Bobo-Dioulasso [8]. Having regard to the zoonotic nature of brucellosis and the modes of transmission, we considered it important to undertake a study to determine the seroprevalence and risk factors associated with brucellosis in people in direct and close contact with pigs and their feces in the city of Bobo-Dioulasso.

Materials and Methods

Study area

The study was carried out in a 25-kilometre radius around the city centre of Bobo-Dioulasso, Burkina Faso. Bobo-Dioulasso is the second largest city and economic capital of Burkina Faso, located between 11° 10 38 North and 4° 17 52 West. Rainfall varies between 1000 and 1200 mm of rain per year with dense vegetation. The temperature varies between 19 and 36°C. It is a hot, humid climate. The breeding of pigs is mainly permanent claustration type. The geographical location of our study area is shown in figure 1.

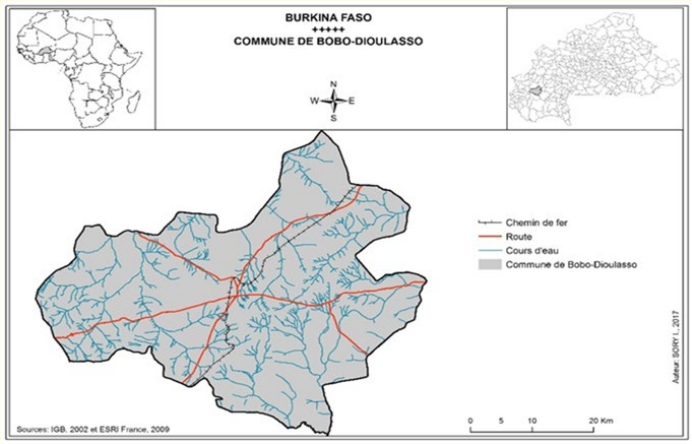

Figure 1: *Geographical location of study area.*

Study type and period of study

It was a cross-sectional descriptive and analytical survey to better identify the risk factors for zoonotic infections of porcine origin in human population with Occupation in direct contact with pigs. The study was conducted from August 20, 2016 to October 24, 2021. Blood sampling and data collection was conducted from August 20, 2016 to August 31, 2017. The laboratory biological analysis and interpretation of the results of the various tests were carried out from 20 to 24 October 2021.

Study population and sampling method

The population studied was made up of all persons having an occupation that puts them in direct or close contact with pigs and their feces and living within a radius of 25 km around Bobo-Dioulasso during the study period. Anyone who gave informed consent and fully met the inclusion criteria was selected for this study. These criteria are: to be resident within a 25 km radius of the city centre of Bobo-Dioulasso; to be voluntary and interested in the study; commit to respecting the work schedule and its constraints; owning a herd of sedentary (pig) animals, only breeders were concerned with this last point. For economic reasons, the simple random sampling method was used. All individuals from groups with professional contact with pigs or their by-products who agreed to participate in this study were randomly selected simple.

Data collection

We started beforehand with an information-awareness of the people to investigate. This task was carried out in close collaboration with the partners on the ground, namely the pig farmers, the Houses of Pig Breeders, the Regional Directorate of Animal and Fisheries

Resources of the Hauts-Bassins and the General Directorate of the Slaughterhouse Frigorifique of Bobo-Dioulasso. Together we organized information and awareness sessions on our research project. The project objectives and inclusion criteria were explained to them. Epidemiological questionnaires, mainly with closed questions, were developed and tested beforehand. In order to minimize the problems of identification of samples afterwards, a precise numbering system has been designed. Two visits were made to the persons surveyed: one for individual awareness and written consent, and the other for blood collection and epidemiological questionnaire information. Age; sex, occupation and eating habits and risk behaviors related to brucellosis were recorded. The interviews lasted on average 15 minutes per person surveyed and took place in "Dioula", "Mooré" or, in some cases, French.

Types of samples taken, methods of sampling and storage

Whole blood samples were taken under the elbow fold in strict aseptic conditions by trained personnel on a dry tube using a sterile single-use needle. The serum was separated by centrifugation at 3600 rpm for 10 minutes. The serums were collected after centrifugation and placed in cryotubes using sterile disposable pipettes. After homogenization and centrifugation, the serum was diluted. All samples were kept at -80°C.

Serological screening methods

For the serological diagnosis of brucellosis, two serological tests namely: Rose Bengal or the Buffered Antigen Test (EAT) and the Enzyme Linked Immunosorbent Assay (ELISA) were used in the cold Kolmer technique. The Bengal pink test or EAT is a rapid, simple, cost-effective test, known to be sensitive (90%) and relatively unspecific (75%) [3]. The ELISA is considered to be very sensitive (95%) and very specific (95%) [3]. We first analyzed the samples with the Rose Bengal test and then confirmed the results obtained with the ELISA. The Rose Bengal kit allowed the detection of IgG. As for the ELISA kit (BRUCELLA ELISA IgM and IgG from VIRCELL MICROBIOLOGISTS), it allowed us to search for anti-*Brucella* antibodies in our serums by micro-plate method. ELISA is an enzyme-linked immuno-enzyme technique that allows to visualize, from a biological sample, reactions between an antigen and an antibody by means of a coloured reaction produced by an enzymatic marker (alkaline phosphatase, peroxidase) previously attached to the antibody. The Rose Bengal test is a rapid agglutination reaction using as bacterial suspension the *Brucella abortus*, colored with Rose Bengal in buffered acid medium. Both tests were able to detect recent and old infections by the detection of IgM and IgG respectively. All analyses were performed according to the procedures provided by the manufacturer and following good laboratory practices. The results of the analyses were interpreted according to the manufacturer's recommendations.

Statistical analysis of data

The data collected was entered on the software Epidata version 3.1, before being imported into the R software in its version 4.1.2. The statistical analysis was carried out to simultaneously take into account various factors that may influence the prevalence of brucellosis. The variables of interest, coded in presence/ absence, were positivity to EAT and ELISA tests. The explanatory variables were individual and collective characteristics. Risk factors and behaviors in humans were identified using a multivariate model. A logistic regression model (proc logistic, SAS 9.3) was used to analyze the ELISA positivity against explanatory variables considered as risk factors or risk behaviors. Comparisons of proportions were made using the Pearson $\chi 2$ test. A logistic regression was used to calculate the odd ratio of the different risk factors observed. The significance threshold was set at 5%.

Ethical considerations

The research protocol of this study received a favorable opinion from the Institutional Ethics Committee of the Centre Muraz (CEICM) under number 2016-15/MS/SG/CM/CEI before its implementation. It was stressed in this protocol that the samples collected will not be used for criminal or commercial purposes and that the identity of participants will be kept confidential. Therefore, all participants were included in the study only when informed consent was obtained and test results were provided to the participants.

Results

Individual and collective characteristics of the persons surveyed

Our study was 368 people. The average age was 42 with extremes ranging from 18 to 77. Among them, 212 people were aged between 18 and 35 years old, or 57.6% of the respondents. Our series included 259 men (70.4%) against 109 women (29.6%) with a sex ratio of 2.4. The slaughterhouse workers, 100 in number, were represented at 27.2%, followed by veterinarians and para-veterinarians (99) at 26.9%, then gardeners at 23.4% (86) and finally breeders at 22.5% (83). The individual and collective characteristics of the persons surveyed during the period from 20 August 2016 to 31 August 2017 in Bobo-Dioulasso, Burkina Faso, are recorded in table 1.

Variables		**Persons surveyed (n = 368)**
Age Class (years)	[18 - 35]	5.,6% (212/368)
	> 35	42.4% (156/368)
Sex	Man	70.4% (259/368)
	Woman	29.6% (109/368)
Profession	Slaughterhouse workers	27.2% (100/368)
	Veterinarians and Para-veterinarians	26.9% (99/368)
	Gardeners	23.4% (86/368)
	Breeders	22.5% (83/368)

Table 1*: Individual and collective characteristics of the persons surveyed during the period from 20 August 2016 to 31 August 2017 in Bobo-Dioulasso in Burkina Faso.*

History data

The survey of knowledge, skills and practices showed that 81 out of 83 farmers or 97.6% reported they lived on the farm compared to 28 or 32.6% of gardeners. No veterinarian and para-veterinarian or slaughterhouse worker lived on a farm. Of the respondents, 79 (95.2%) had daily contact with pigs during feeding or cleaning activities. Veterinarians and para-veterinarians, 62.6% and 33 gardeners, 38.4%, also had daily contact with live pigs. Most gardeners (86.7%) also handled fecal matter for fertilizer. Among the 72 ranchers, 86.7% reported that they only wore boots as protective equipment. By contrast, 85 of the veterinarians and para-veterinarians, or 86.9%, reported wearing gloves, 83 wore masks (83.8%) and 85 of special clothing (85.9%) when they were tending to the pigs. As for the gardeners and slaughterhouse workers, only 40.7% wore boots and 29.1% masks. Veterinarians and para-veterinarians, 92 (92.9%) and 87 of the slaughterhouse workers (87.0%) They were aware of the potential for transmission of disease between pigs and humans. The 25 gardeners (29.1%) and 12 breeders (14.5%) were also aware of the possibility of this transmission.

Seroprevalence of brucellosis among respondents

Of the 368 sera, 40 (10.9%) and 36 (9.8%) gave a positive and doubtful response to the Bengal Rose test or the Tamponade Antigen Test (EAT), respectively. After the analysis of these 76 samples by the Enzyme-Linked Immunosorbent Assay (ELISA), 30 samples out of 40 positive EAT samples and 0 sample out of 36 doubtful EAT samples provided a positive ELISA response. In total, 30 samples out of 368 or 8.2% (95% CI [7.7 - 8.7]) gave a positive response to the ELISA test. The results of the brucellosis screening on three hundred and sixty-eight serums from people collected during the period from August 20, 2016 to August 31, 2017 in Bobo-Dioulasso in Burkina Faso are recorded in table 2.

	Positive ELISA	Negative ELISA	Total
Positive EAT	08.2% (30/368)	02.7% (10/368)	10.9% (40/368)
Doubtful EAT	00.0% (00/368)	09.8% (36/368)	09.8% (36/368)
Negative EAT	00.0% (00/368)	79.3% (292/368)	79.3% (292/368)
Total	08.2% (30/368)	91.8% (338/368)	100% (368/368)

***Table 2**: Results of the brucellosis screening on three hundred and sixty-eight human serums collected during the period from 20 August 2016 to 31 August 2017 in Bobo-Dioulasso, Burkina Faso.*

ELISA: Enzyme-Linked Immunosorbent Assay; EAT: Buffered Antigen Assay.

Seroprevalence of brucellosis among the respondents by age, sex and occupation

The ELISA positivity was significantly associated with age, sex and occupation of the respondents. Adults over 35 years of age had a seroprevalence of 14.1%, compared to 3.8% for 18-35 year olds. Men had a seroprevalence of 10.8% compared to women (1.8%). Slaughterhouse workers were more affected compared to other occupational groups. Table 3 shows the different seroprevalences of brucellosis according to age, of the sex and occupation of the persons surveyed during the period from 20 August 2016 to 31 August 2017 in Bobo-Dioulasso, Burkina Faso.

Variables	Persons tested	Positives	Prevalence (%) and 95% CI	p-value
Age (year)				0.03
18-35	212	8	03.8 ± 0.7	
>35	156	22	14.1 ± 2.2	
Total	368	30	08.2 ± 0.5	
Sex				0.02
Man	259	28	10.8 ± 1.2	
Woman	109	02	01.8 ± 0.5	
Total	368	30	08.2 ± 0.5	
Profession				0.04
Slaughterhouse workers	100	12	12.0 ± 0.8	
Veterinarians and Para-veterinarians	99	01	01.0 ± 0.2	
Gardeners	86	08	09.3 ± 0.4	
Breeders	83	09	10.8 ± 0.6	
Total	368	30	08.2 ± 0.5	

***Table 3**: Seroprevalence of brucellosis by age, sex and occupation of the persons surveyed during the period from 20 August 2016 to 31 August 2017 in Bobo-Dioulasso in Burkina Faso.*

CI: Confidence Interval.

Risk behaviours that may be associated with seropositivity for brucellosis in the respondents

The results of the logistic regression analysis showed that the most frequently observed risk behaviors in humans were assisted childbirth and abortions, handling of the untreated pig, handling of the carcass without a glove, permanent contact with the pig and its feces without protection, permanent contact with unprotected pig blood, permanent contact with unprotected pig, cleaning of stables, handling of feces without protection and consumption of poorly cooked pork. Test positivity was significantly associated with these behaviors. These explanatory variables were considered as risk factors. The results are reported in table 4.

Variables	OR	95% CI	P-value
Birthing assistance	2.5	2.3-2.7	0.02
Abortion assistance	3.3	3.1-3.5	0.01
Handling of the unborn child without a glove	3.2	3.1-3.3	0.01
Handling of the carcass without glove	2.4	2.2-2.6	0.03
Permanent contact with pigs and their feces without protection	2.2	2.1-2.3	0.03
Permanent contact with unprotected pig blood	3.5	3.2-3.8	0.01
Permanent contact with unprotected pigs	2.4	2.1-2.7	0.02
Barn cleaning/faecal handling	3.1	2.9-3.3	0.02
Consumption of poorly cooked pork	2.6	2.3-2.9	0.04

Table 4*: Factors that may be associated with seropositivity of brucellosis in individuals surveyed during the period from 20 August 2016 to 31 August 2017 in Bobo-Dioulasso, Burkina Faso.*

OR: Odd Ratio; CI: Confidence Interval.

Discussion

Limitations and constraints of the study

The Antigen Buffered Test (EAT) or Bengal Rose Test is by far the most widely used because of its simplicity, relative good sensitivity and low cost. This test allows for a rapid assessment of individual seropositive status. However, the specificity of this test is quite low due to cross-reactions of the *Brucella* antigen with antibodies related to other gram-negative related bacteria such as *Yersinia enterocolitica* O:9, *Francisella tularensis*, *Vibrio cholerae*, *Escherichia coli* O:157, *Salmonella spp*, and *Stenotrophomonas maltophilia*. This would lead to false positive serological reactions tending to overestimate the individual prevalence of brucellosis. The ELISA test being very sensitive (95%) and very specific (95%) has therefore allowed to confirm the results obtained by the Rose Bengal test.

Knowledge, skills and practices of persons investigated on the possibility of disease transmission between pigs and humans

This study found that veterinarians and para-veterinarians (92.3%) and slaughterhouse workers (87.0%) were more likely to be aware of the possibility of disease transmission between pigs and humans, compared with gardeners (29.1%) and ranchers (14.5%). This may be explained by the fact that these two socio-political groups Professionals have certainly received training on brucellosis, which is considered to be an occupational zoonosis and disease in people frequently exposed to the risk of contamination by the disease. The latter are undoubtedly informed and regularly sensitized on the possibility of transmission of this major to humans by animals, especially by pigs.

Seroprevalence of brucellosis in the ELISA test of the respondents

We found an estimated seroprevalence of brucellosis at 8.2% (95% CI [7.7 - 8.7]). This is comparable to those found by Awah-Ndukum., *et al*. in 2018 in Cameroon [24] and by Kunda., *et al*. in 2007 in Tanzania [45] which found prevalence of 12.15% and 6.2% respectively. Lower prevalence was found by Dean., *et al*. [46] in the breeding zone of Togo in 2013 (1.02%), Schelling., *et al*. in 2004 (1.8%) in Chad [47] and Sow (0.46%) in 2010 in Mali [48]. This difference may be due to the characteristics of the different studies. Indeed, the first two studies were only carried out among farmers and Sow's study only among consumers of fresh milk [48]. In our study, in addition to the breeders, there are paraveeriners and slaughterhouse workers who are permanently in contact with infected pig blood and carcasses. In addition, the claustration of pigs is a much higher risk factor because of the frequent contact it requires. *Brucella abortus* with moderate pathogenicity was the predominant species in the breeding population and the main source of infection in the study by Schelling., *et al*. [47].

Seroprevalence of brucellosis among respondents by age, sex and occupation

Age

Subjects over 35 years of age were the most seropositive (14.1%) during our study. This result is consistent with the one generally found in the literature, which shows a predominance among this age group. This age group is the one who generally takes care of livestock and farms. Our results are comparable to those of Sidibé [49] in Mali and Tabet-derraz., *et al*. [50] in Algeria, which found a predominance (39.75%) for the over 35 years age group and 36 - 45 years respectively.

Sex

The seroprevalence was 10.8% among men surveyed, compared to 1.8% among women. This result could be explained by the high representativeness of men (70.4%) in our sample. In the literature, many studies have also revealed this male dominance. In 2017, Tabet-derraz., *et al*. [50] noted a male predominance of 48.8% during its seroprevalence study among people in contact with brucellosis patients in Algeria. Nevertheless, female predominance was noted by some authors. In Mali, for example, Sidibé in 2011 [48] and Cissé in 2015 [51] found a female predominance of more than 56% and 78.9%, respectively. These two studies were carried out in the general population with a predominance of housewives, probably due to permanent contact with animals and their products (fresh meat, milk).

Profession

Slaughterhouse workers were the most affected compared to other occupational groups with a prevalence of 10.8%. This is justified by the fact that they are daily (100% contact frequency) in contact with pigs, their blood and meat carcasses. In addition, none of the workers used personal protective equipment such as gloves, boots, dedicated clothing, masks. Similarly, traditional slaughter techniques could increase the risk of infection. Our results are similar to those found by Schelling., *et al*. [47] in 2004 at the N'Djaména slaughterhouse and by Diop in 1975 [52] at the Dakar slaughterhouse, which found a prevalence of 14% and 14.8%, respectively. Mancini also found that activities such as bleeding, skinning and removing mammary glands, removal and treatment of abdominal viscera, autopsy were operations involving a greater likelihood of brucellosis infection among slaughterhouse staff in Italy [53].

Behaviours identified as being at risk of zoonotic transmission in humans

Positive ELISA was significantly associated with several risk behaviors. The risk of transmission of brucellosis is very high during births and abortions. Abort products are considered to be highly virulent materials. Because of their intracellular and extracellular location, both in tissues and in body fluids, the handling of the carcase without a glove and the permanent contact with unprotected pig blood promote transmission of brucellosis. The same risk behaviour was reported by Tialla., *et al*. [4] in the suburban area of Dakar, Senegal, in 2014; Calvet., *et al*. [54] in Mali, Dean., *et al*. [46] in Togo.

The risk of infection from eating poorly cooked pork meat is also due to the intracellular location of the bacteria. In the absence of proper cooking, this meat would be the cause of brucellosis among consumers. Tialla., *et al*. [8] in 2018 showed that the consumption of raw or undercooked offal such as liver or spleen can cause contamination. Contamination related to the consumption of undercooked pork meat, also reported by Tialla., *et al*. in 2018 [8]. Cissé [51] reported a seroprevalence of more than 89.4% among people who ate skewers in Mali in 2015.

Cleaning of barns and handling feces without protection are also risk factors for brucellosis due to the presence of *Brucella spp* in the excrement of infected animals. They may be transmitted by direct contact through the skin and mucous membranes or by inhalation in aerosols.

The permanent contact with unprotected live pigs is a risk factor due to the permanent exchanges (physical or aerosol contact) that there would be between the pigs and these. Cissé [51] in 2015 in Mali found a prevalence of brucellosis at 66.2% among animal handlers, a positivity of 71.8% among people living with animals and 63.4% among people near the animals.

Conclusion

Brucellosis is a zoonosis of veterinary, health and economic importance in most developing countries. Human brucellosis is a severely debilitating disease that requires prolonged treatment with a combination of antibiotics. The disease can cause permanent and disabling sequelae. The risk of brucellosis infection is high among livestock farmers, veterinarians and slaughterhouse workers. In our study, the seroprevalence of brucellosis tested by ELISA in people in direct and close contact with pigs and their feces in the city of Bobo-Dioulasso was significant and estimated at 8.2%. Factors associated with positivity included assisted childbirth and abortions, manipulation of the untreated blood, handling of the carcass without a glove, Permanent contact with the unprotected animal and feces, permanent contact with the unprotected pig, cleaning of stables and handling of feces without protection and consumption of poorly cooked meat. To do this, appropriate measures must be taken to better protect the population against this major zoonosis. Awareness and provision of effective protection against transmission of brucellosis in these individuals should be made to minimize the spread of the disease among the general population. Farmers need to be made aware of biosecurity, the risks of zoonotic transmission and the risks of inter-herd and inter-species transmission. The implementation of an integrated approach, which takes into account the complex relationships between humans, animals and the environment within different production systems; and the establishment of a multisectoral framework involving physicians, Veterinarians and all public health stakeholders in the context of a "One Health" approach should be considered.

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Conflict of Interest

No conflict of interests is declared.

Author's Contribution

Dieudonné Tialla, Aminata Diallo, Apollinaire Lanfo Tialla, Jean-Baptiste Sebou Dah, Aboubacar Kiendrébéogo, Justin Wendwoumgna Kaboré, Ibrahim Sangaré have contributed equally to the work of this article.

Bibliography

1. Tialla D. "Seroprevalence and behaviour at risk of zoonotic transmission of bovine brucellosis in Namentenga Province, Burkina Faso". *African Journal of Microbiology Research* 15.11 (2021): 547-553.

2. Kiiza D., *et al*. "Seroprevalence of and Risk Factors Associated with Exposure to *Brucella Spp*. in Dairy Cattle in Three Different Agroecological Zones in Rwanda". *American Journal of Tropical Medicine and Hygiene* 104.4 (2021): 1241-1246.

3. Lesceu S and Pourquier P. "Contrôle de qualité du Kit ELISA ID Screen® Brucellosis Serum Indirect Multi-species: sensibilité et spécificité". ID.vet Innovative Diagnostics, France (2021): 4.

4. Tialla D., *et al*. "Prévalence de la brucellose bovine et comportements à risque associés à cette zoonose dans la zone périurbaine de Dakar au Sénégal". *Revue d'élevage et de Médecine Vétérinaire Des Pays Tropicaux* 67.2 (2014): 67-72.

5. Saeed U., *et al*. "Prevalence and Spatial Distribution of Animal Brucellosis in Central Punjab, Pakistan". *International Journal of Environmental Research and Public Health* 17.18 (2020): 6903.

6. Alhussain H., *et al*. "Seroprevalence of camel brucellosis in Qatar". *Tropical Animal Health and Production* 54.6 (2022): 351.

7. Adesokan HK., *et al*. "Prevalence and predictors of risk factors for Brucellosis transmission by meat handlers and traditional healers' risk practices in Ibadan, Nigeria". *Journal of Preventive Medicine and Hygiene* 57.3 (2016): 164-171.

8. Tialla D., *et al*. "Séro-épidémiologie de la brucellose bovine et porcine à Bobo-Dioulasso, Burkina Faso". *Epidémiologie et Santé Animale* 73 (2018): 175-179.

9. Bodenham RF., *et al*. "Prevalence and speciation of brucellosis in febrile patients from a pastoralist community of Tanzania". *Scientific Reports* 10 (2020): 7081.

10. Saeed U., *et al*. "Seroepidemiology and the Molecular Detection of Animal Brucellosis in Punjab, Pakistan". *Microorganisms* 7.10 (2019): 449.

11. Traoré O., *et al*. " Enquête séroépidemiologique sur la brucellose chez les bovins laitiers en zone périurbaine du district de Bamako". *Revue Malienne de Science et de Technologie* 1.23 (2020): 1021-1031.

12. Khurana SK., *et al*. "Bovine brucellosis - a comprehensive review". *Veterinary Quarterly* 41.1 (2021): 61-88.

13. Tialla D. "The first study on seroprevalence and risk factors for zoonotic transmission of ovine and caprine brucellosis in the Province of Bam, Burkina Faso". *Veterinary World* 15.2 (2022): 262-267.

14. Tialla D., *et al*. "Séroprévalence de la brucellose bovine dans la Commune de Ziniaré au Burkina Faso". *Revue Africaine de Santé et de Productions Animales* 2.1 (2023): 53-60.

15. Tialla D. "Brucellose: zoonose majeure et problème de santé publique". Editions Universitaires Européennes (2016): 60.

16. Owowo EE., *et al*. "Sero-Prevalence of Brucellosis among Nomadic Herdsmen, Abattoir and Livestock Workers in Niger-Delta Region, Nigeria". *Journal of Biosciences and Medicines* 7.10 (2019): 32-41.

17. Edao BM, *et al*. "Brucellosis in ruminants and pastoralists in Borena, Southern Ethiopia". *PLOS Neglected Tropical Diseases* 14.7 (2020): e0008461.

18. Vikou R., *et al*. "Prévalence de la brucellose et de la tuberculose chez les bovins au Bénin". *International Journal of Biological and Chemical Sciences* 12.1 (2018):120-128.

19. Miassangoumouka JP., *et al*. "Dépistage sérologique de la brucellose porcine et analyse des facteurs de risques dans les élevages à Brazzaville, République du Congo". *Journal of Animal and Plant Sciences* 42.1 (2019): 7127-7138.

20. Soufiana K., *et al*. "Bovine brucellosis seroprevalence and potential transmission risk to workers at the Port-Bouët abattoir, Abidjan, Côte d'Ivoire". *International Research Journal of Public and Environmental Health* 8.5 (2021): 276-283.

21. Yousuf KM., *et al*. "Brucellosis in Pregnant Women". *Clinical Infectious Diseases* 32.8 (2001): 1172-1177.

22. Kutlu M., *et al*. "The first report of *Brucella suis* biovar 1 isolation in human in Turkey". *Journal of Infection and Public Health* 9.5 (2016): 675-678.

23. Tuon FF., *et al*. "Human-to-human transmission of *Brucella* - a systematic review". *Tropical Medicine and International Health* 22.5 (2017): 539-546.

24. Awah-Ndukum J., *et al*. "Seroprevalence and risk factors of brucellosis among slaughtered indigenous cattle, abattoir personnel and pregnant women in Ngaoundéré, Cameroon". *BMC Infectious Diseases* 18.1 (2018): 611-615.

25. Dean AS., *et al*. "Global burden of human brucellosis: A systematic review of disease frequency". *PLOS Neglected Tropical Diseases* 6.10 (2012): 865-870.

26. Reşorlu H., *et al*. "Cervical spondylitis and epidural abscess caused by brucellosis: a case report and literature review". *Folia Medica (Plovdiv)* 58.4 (2016): 289-292.

27. Seyed MEG and Seyed MREG. "Osteoarticular manifestations of human brucellosis: A review". *World Journal of Orthopedics* 10.2 (2019): 54-62.

28. Unuvar GK., *et al*. "Current therapeutic strategy in osteoarticular brucellosis". *Northern Clinics of Istanbul* 6.4 (2019): 415-420.

29. Du J., *et al*. "Case report: Metagenomic next-generation sequencing confirmed a case of spine infection with *Brucella melitensis* in non-endemic area". *Infection and Drug Resistance* 16 (2023): 7219-7225.

30. Varshochi M., *et al*. "A 42-year-old female with sternoclavicular arthritis and breast abscess caused by brucellosis: A case report". *Clinical Case Reports* 11.11 (2023): e8071.

31. Zhou P., *et al*. "Clinical efficacy of arthroscopy combined with irrigation and drainage in the treatment of brucellosis of the hip". *International Orthopaedics* 47.11 (2023): 2751-2756.

32. Ben Khalfallah A., *et al*. "Endocardite brucellienne: particularités cliniques et modalités thérapeutiques". *Annales de Cardiologie et d'Angéiologie* 55.3 (2006): 157-160.

33. Ephrem CG., *et al*. "*Brucella* endocarditis: diagnostic challenges". *Journal of Infection in Developing Countries* 12.2.1 (2018): 25S.

34. Narimisa N., *et al*. "Prevalence of *Brucella* endocarditis: A systematic review and meta-analysis". *Health Science Reports* 6.5 (2023): e1301.

35. Suvak B., *et al*. "The prevalence and impact of brucellosis in patients with hepatitis delta virus infection: inside the *Brucella* outbreak with cirrhosis". *Archives of Medical Science* 13.2 (2017): 377-382.

36. Giambartolomei GH and Delpino MV. "Immunopathogenesis of Hepatic Brucellosis". *Frontiers in Cellular and Infection Microbiology* 9 (2019): 423.

37. Benammar S., *et al*. "[A case of acute renal failure revealing brucellian endocarditis and neurological complications in Batna (Algeria)]". *Médecine Tropicale et Santé Internationale* 2.1 (2022): mtsi.v2i1.2022.229.

38. Ta N., *et al*. "Epidemiological characteristics and clinical manifestations of brucellosis and Q fever among humans from northeastern inner Mongolia". *Infection and Drug Resistance* 15 (2022): 6501-6513.

39. Mufinda FC., *et al*. "Prevalence and factors associated with human brucellosis in livestock professionals". *Revista de Saúde Pública* 51 (2017): 57.

40. Sun GQ., *et al*. "Transmission dynamics of brucellosis: Mathematical modelling and applications in China". *Computational and Structural Biotechnology Journal* 18.2 (2021): 3843-3860.

41. Tao Z., *et al*. "Epidemiological characteristics of human brucellosis - China, 2016-2019". *China CDC Weekly* 3.6 (2021): 114-119.

42. Kefaloudi C., *et al*. "Human brucellosis in Greece, 2005-2020: A persistent public health problem". *Vector-Borne and Zoonotic Diseases* 22.3 (2022): 163-169.

43. Tialla D. "Brucellose humaine et bovine dans les élevages bovins laitiers en périphérie de Dakar (Sénégal)". Rapport de stage, Master SEMHA, Paris, France (2012): 52.

44. Gidel R., *et al*. "Epidémiologie de la brucellose humaine et animale en Afrique de l'Quest. Résultats de dix enquêtes effectuées en Côte d'Ivoire, Haute-Volta et Niger". *Developments in Biological Standardization* 31 (1976): 187-200.

45. Kunda J., *et al*. "Health-seeking behaviour of human brucellosis cases in rural Tanzania". *BMC Public Health* 7.1 (2007): 315.

46. Dean AS., *et al*. "Epidemiology of brucellosis and Q fever in linked human and animal populations in northern Togo". *PLoS ONE* 8.8 (2013): 715-801.

47. Schelling E., *et al*. "Séroprévalences des maladies zoonotiques chez les pasteurs nomades et leurs animaux dans le Chari-Baguirmi du Tchad". *Medecine Tropicale* 64.5 (2004): 474-477.

48. Sow I. "Evaluation du risque de brucellose lié à la consommation du lait frais dans la commune rurale de Cinzana". Mémoire DEA, Université de Bamako, Mali (2011): 64.

49. Sidibé M. "Séroprévalence de la brucellose humaine dans la zone périphérique urbaine de la région de Mopti". Thèse Doctorat Pharmacie, Université de Bamako, Mali (2011): 105.

50. Tabet-derraz NF., *et al*. "Prévalence de la brucellose humaine dans une région d'élevage". *Médecine et Maladies Infectieuses* 47.4 (2017): 148.

51. Cissé A. "Seroprevalence de la brucellose animale et humaine dans la commune urbaine de Mopti". Thèse Doctorat Pharmacie, Université de Bamako, Mali (2015): 86.

52. Diop PH. "Contribution à l'étude de la brucellose bovine au Sénégal". Thèse Médecine Vétérinaire, EISMV de Dakar, Université Cheick Anta DIOP, Sénégal (1975): 152.

53. Mancini FR., *et al*. "Trends of human brucellosis in Italy, 1998-2010". *Epidemiology and Infection* 142.6 (2014): 1188-1195.

54. Calvet F., *et al*. "Brucellose et contexte opérationnel". *Médecine des Armées* 38.5 (2010): 429-434.

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