

Epidemiological characterization of notified human brucellosis cases in Southern Brazil

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ABSTRACT

Brucellosis is one of the most important and widespread bacterial zoonotic diseases worldwide, and it is transmitted to humans from various sources, including direct contact with infected animals and the ingestion of contaminated products, including unpasteurized milk. There are only a few epidemiological studies on said disease in humans in Western Santa Catarina, a region instantiated by agriculture. Thus, the objective of this study was to characterize the epidemiological aspects of human brucellosis reported in Western Santa Catarina from 2013 to 2018. The data were provided by the Epidemiological Surveillance Board (Diretoria de Vigilância Epidemiológica). The frequency of the disease in humans and the epidemiological profile of confirmed human cases were evaluated. Cases that were screened positive and those that were confirmed and submitted to the therapeutic protocol were analyzed. During the study period, 3,671 people were tested, of which 12.34% were screened positive (453/ 3,671) and 3.40% were confirmed (125/3,671). The year with the highest number of people testing positive was 2015 (123 cases), and 2018 was the year with the highest number of confirmed cases (39 cases). Confirmed cases predominated in males (48.8%), self-declared white (22.4%), aged 20-59 years old (60%), with incomplete primary education (22.4%), of rural origin (59.2%), with occupational contact with cattle (64.8%), engaged in professions directly linked to agricultural and livestock activities (55.5%), and who reported consumption of unpasteurized dairy products (59.2%). No seasonal variation was observed in case numbers. The results demonstrated that brucellosis is an endemic disease in Western Santa Catarina.

KEYWORDS: Epidemiology. Occupational disease. Public health. Zoonosis.

INTRODUCTION

Brucellosis is one of the most important and widespread bacterial zoonoses worldwide¹. The disease is caused by bacteria of the genus *Brucella*, of which five species cause the disease in humans: *B. abortus*, *B. melitensis*, *B. suis*, *B. canis* and *B. inopinata*²⁻⁴, in addition to *B. neotomae*, *B. ceti*, and others that might present zoonotic potential^{1,2}.

In Brazil, bovine brucellosis is responsible for high economic losses throughout the country⁵, estimated at approximately 179 million American dollars. Brucellosis causes sanitary problems in herds⁶ and damage to human health. Chronic infection in humans can lead to a partial or total inability to work³. The spectrum of the brucellosis' clinical manifestations can be wide, with patients presenting fever, sweats, fatigue,

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abdominal pain, arthralgia, arthritis, myalgia, back pain, epididymo-orchitis, miscarriage, endocarditis, respiratory and neurological signs, and cutaneous abnormalities⁶.

Because it is a zoonosis, the Integrated Company for Agricultural Development of Santa Catarina State (Companhia Integrada de Desenvolvimento Agrícola de Santa Catarina - CIDASC) notifies the occurrence of bovine outbreaks to the Epidemiological Surveillance Directorate (DIVE) of the Department of Health so it can investigate human cases⁷. In 2012, DIVE implemented the State protocol for surveillance and clinical management of human brucellosis to standardize care, diagnosis, treatment and the flow of information related to the cases of human brucellosis⁷. Different tests can be used for human brucellosis screening and diagnosis confirmation, including the undiluted Rose Bengal's test for screening and the standard agglutination test, complement fixation test, and immunocapture agglutination test for diagnosis confirmation⁸. In Brazil, human brucellosis is not on the national list of mandatory reporting diseases of the Brazilian Ministry of Health⁹; therefore, there is no information available on the occurrence of the disease in the Notifiable Diseases Information System. This reinforces the need for studies that demonstrate the epidemiology in humans. Due to underreporting and lack of available data, its true incidence in Brazil, as well as in Santa Catarina State and its regions, and in neighboring countries, is unknown⁹.

There are few studies in Brazil on the epidemiological profile of people and cattle diagnosed with brucellosis. Studies have yet to determine the annual incidence coefficient of the disease and its spatial distribution in this Santa Catarina region in recent years. Concerns regarding public health have led to the development of measures that integrate the promotion of human health through the diagnosis of brucellosis in the bovine herd^{9,10}. In this context, some municipalities in Santa Catarina have been developing programs at municipal level, subsidizing cattle producers to perform brucellosis and tuberculosis examinations and, consequently, taking the measures provided in the National Program for the Control and Eradication of brucellosis and Animal Tuberculosis (PMCEBT)¹¹. The goal of this action is to further reduce the prevalence of the disease, aiming at its eradication and the elimination of the sources of infection that perpetuate its occurrence in humans.

Santa Catarina State is in an important geographical location, close to international borders, which intensifies the need for greater epidemiological surveillance of the region. Thus, the present study sought to characterize the cases of human brucellosis in 131 municipalities in Western Santa Catarina, which were reported between January 2013 and December 2018.

MATERIAL AND METHODS

Ethics committee approval

This study was approved by the Research Ethics Committee (CEP) of the Universidade Federal da Fronteira Sul (UFFS), protocol N° 3.235.196.

Selection of the geographical region

Bovine brucellosis data from 131 municipalities that make up the productive region 3, West Santa Catarina, were analyzed according to the methodology of Sikusawa *et al.*¹² The selection of this region was based on different criteria, including the number of rural properties, characterized by an automated milking system, with a high number of small producers focused on family farming activities. In this region, although automated milking is used, the cultural aspects of the population can increase the contamination, once they are focused on the use of unpasteurized milk for consumption and production of artisanal milk derivatives.

Data collection and inclusion criteria

Data obtained from human brucellosis were provided by DIVE. The study period went from January 2013 to December 2018. Serological data from *Brucella abortus* were used since the study focus was on humans working directly with cattle.

According to the State protocol for surveillance and clinical management of human brucellosis, confirmed cases were determined when individuals who had a compatible clinical and epidemiological data also presented with a laboratory screening test and a confirmatory one. If confirmatory tests were not performed, probable cases (positive clinical manifestations, epidemiology and positive screening test) were excluded from the study⁷.

The data examined were from humans who were considered confirmed cases based on the results of the Rose Bengal's screening test, a confirmatory ELISA, a serum (tube) agglutination test and a 2-Mercaptoetanol⁷.

To standardize the interpretation of results with a positive/reactive diagnosis in the screening test, only the first diagnosis of each individual was retained, since most patients were examined more than once, and these reexaminations were not accounted for. Cases where the individual had a new reactive/positive diagnosis more than 12 months after the end of the treatment were included. This is due to what is established in the DIVE protocol, which considers relapse until 12 months after the end of

treatment⁷. We accounted for those individuals undergoing treatment as confirmed cases⁷.

Similarly, everyone with a negative/unreactive result was considered only once in the study, and individuals who had a positive/reactive result during any time other than the study period were not accounted for. Individuals who lacked information on the date/year of collection/entry, municipality and/or diagnosis were excluded from the study.

Data analysis

The data obtained from the analyzed humans were made available in spreadsheets by DIVE. The information consisted of raw data of the examined humans, year of examination, reactive and/or positive, negative and/or non-reactive results and treated patients.

Among the confirmed cases, we analyzed the information of the patients who had completed the epidemiological form. Relative frequency of gender, age, education, self-declared skin color, area of origin, consumption of risk products, occupational contact and professions was calculated according to Pereira¹³. For data analyses, descriptive tests were performed using absolute and relative frequencies and measures of central tendency. The annual trend of individuals examined, negative, reactive, and confirmed for brucellosis rates, was calculated.

The annual relative frequency of human brucellosis was calculated according to Pereira¹³: $(N^{\circ} \text{ of positives per year of study} / N^{\circ} \text{ of tested per year of study}) \times 100$. The annual incidence coefficient for humans was calculated using the formula: $(N^{\circ} \text{ of confirmed cases per year of study} / \text{average } N^{\circ} \text{ of inhabitants}) \times 100,000$ ¹³. The relative frequency of cattle in comparison with humans reactive to brucellosis in Western Santa Catarina was calculated using the cattle data from a previously published paper¹⁴. The cattle population from this previous research was represented by confirmed cases of bovine brucellosis.

The spatial analysis was performed with the preparation of thematic maps separately showing the distribution in municipalities of those who screened positive and those with a confirmed diagnosis of brucellosis in absolute numbers and the number of cases per 100,000 inhabitants, compiling the information from the six years of the study. The maps were prepared using the free software QGIS 3.4.8 version (QGIS Association[®], Böschacherstrasse, Switzerland).

To observe associations between the occurrence of cases per year, an inferential analysis was performed using an univariate logistic regression, with odds ratio estimates and 95% confidence intervals. A $P < 0.05$ was considered significant. The Stata Statistical Software[®] 13.0 (StataCorp LLC[®], College Station, USA) was used for the statistical

analysis. Microsoft Excel[®] 2108 (Microsoft Corporation[®], Redmond, USA) was used for some of the descriptive analyses.

RESULTS

The patients' demographic data are described in Table 1. Between January 2013 and December 2018, 3,671 individuals from 131 municipalities were examined for brucellosis in the public health care system. Of these, 125 (3.41%) showed positive results in at least one of the diagnostic tests performed. Reagent screening results with no confirmatory tests were excluded from this research. The annual trend was graphically represented in Figure 1, demonstrating a higher number of confirmed cases in 2016.

Table 1 - Demographic data of the positive patients.

Parameter	Number of cases	Percentage
Gender		
Male	61	65.5%
Female	32	34.4%
Age (years)		
0 up to 9 years	0	0%
10 up to 19 years	2	2.2%
20 up to 59 years	75	86.2%
Over than 60 years	10	11.4%
Scholarship level		
Incomplete primary school	28	36.3%
Complete primary school	22	28.5%
Incomplete secondary school	3	3.8%
Complete secondary school	11	14.2%
Incomplete University education	5	6.4%
Complete University education	8	10.3%

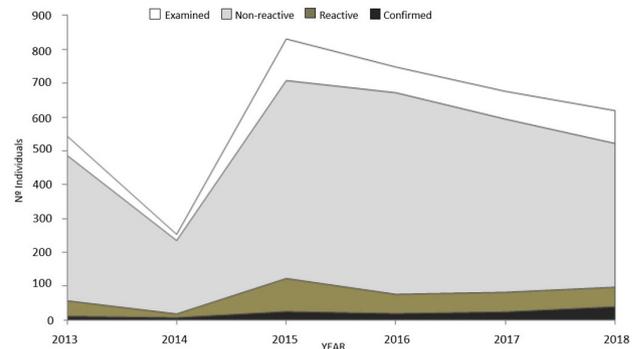


Figure 1 - Graphic representation of the distribution of examined, non-reactive, reactive, and confirmed individuals for brucellosis in total numbers, in Santa Catarina's Western region, from 2013 to 2018.

Interestingly, we also calculated and compared an annual trend using human and cattle populations from the same regions and found similar rates (Figure 2).

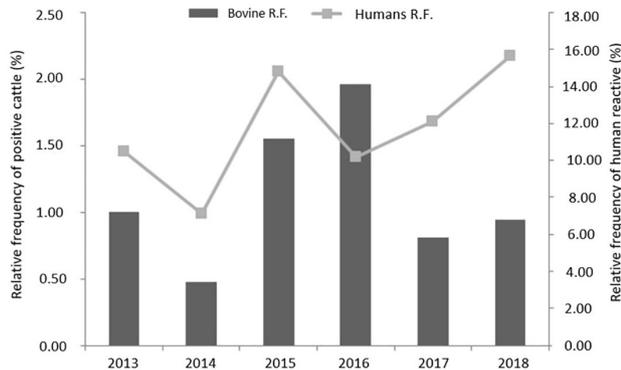


Figure 2 - Relative frequency of cattle and humans reactive to brucellosis in Santa Catarina's Western region, from 2013 to 2018.

Regarding the temporal analysis with logistic regression of the proportion of individuals examined and reactive for brucellosis, we sought to verify the odds of the occurrence of reactive individuals per year concerning the year 2013. There was a statistical significant difference in the years 2015 ($P = 0.021$) and 2018 ($P = 0.010$), with ORs of 1.48 and 1.59, respectively. The number of individuals examined decreased from 2015 to 2018. However, the number of individuals who screened positive only decreased from 2015 to 2016 and then gradually increased until 2018, the year with the highest relative frequency of individuals who screened positive and therefore, had the highest odds of a confirmed diagnosis (OR: 1.58). Of the total number of people examined, 125 (3.41%) were confirmed cases (an average of 20.83 cases per year), according to the DIVE protocol⁷ and all positive cases ($N = 125$) underwent drug treatment. The World Health Organization

(WHO) recommends that only confirmed cases should be submitted to the therapeutic protocol, due to side effects of the treatment and the possibility of inducing bacterial resistance⁴.

As the number of individuals who screened positive, a growth in the number of confirmed cases was observed in 2017 (24 cases) and 2018 (39 cases) compared to 2016 (19 cases). An overview of humans examined in the ratio of 1:100,000 inhabitants, those who tested positive and were confirmed cases per year is shown in Figure 3. The incidence rate of confirmed cases in humans found in Western Santa Catarina was 8.92 cases per 100,000 inhabitants (125 cases in an average population of 1,401,368 inhabitants, in 131 municipalities). Among the municipalities in the Western region, 31/131 (23.66%) had confirmed human cases. However, there was no information on the performance of examinations in the remaining 39/131 (29.77%) during the study period.

Regarding gender, 48.88% (61/125) of the individuals were male and 25.6% (32/125) were female and there were 32 cases in which data were not available, representing a male: female ratio of 1.9: 1. Among the women, only one was pregnant. As for the age of the confirmed cases, 60% of the people were between 20-59 years old, with a mean of 45.6 years old (median of 49 years old) among the people whose information was available. Most people were in the categories of incomplete primary education (22.4%) or complete primary education (17.6%) and no individual was illiterate.

Most people self-reported as white, 71.2% (89/125), as mixed ethnicity (mixture of black and white) 0.8% (1/125) and as black, 0.8% (1/125). No information was available for 27.2% of patients (34/125). It was observed that 64.8% (81/125) of people had occupational contact with cattle, characterized by transmission through direct contact with

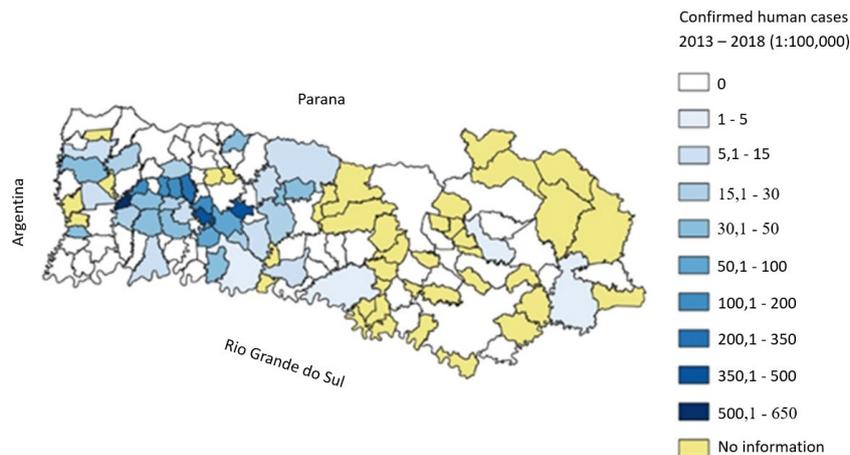


Figure 3 - Spatial distribution of confirmed human brucellosis cases in Santa Catarina's Western region, from 2013 to 2018, at a rate of 1: 100,000 inhabitants.

contaminated material during the patient's professional activities. For those who had no contact with any risk materials, transmission of the disease may have occurred through the consumption of non-pasteurized milk products. When analyzing the consumption of risk products, 59.20% (74/125) of individuals reported having consumed one or more products, increasing their risk of exposure to the disease. In relation to the 8.80% (11/125) who declared that they had not consumed risk products, but had the disease, but they may have been infected during occupational contact with risk materials. As for the professions/occupations of confirmed human cases, 50.4% (63/125) were rural workers (milkmen/cattle owners/ranchers/farmers and/or farmers), 3.2% were veterinarians, and 1.6% were agricultural technicians, comprising the main professions with occupational risk (Figure 4). No cases of accidental vaccine inoculation have occurred.

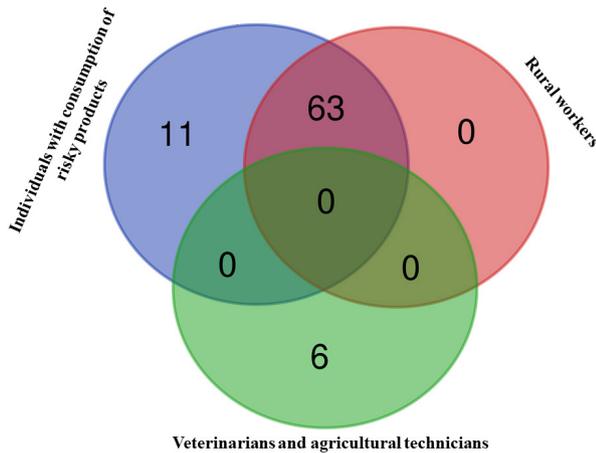


Figure 4 - Venn diagram associating the consumption of unpasteurized products with occupational risk. Among the individuals who declared consumption of unpasteurized products (N = 74), 63 were rural workers. The veterinarians (N = 4) and agricultural technicians (N = 2) did not declare consumption of unpasteurized products.

DISCUSSION

In Brazil, the incidence of cases of brucellosis in humans is, in general, is unknown, and studies in different regions are pivotal to increasing the understanding and mapping of the disease. Several aspects are important to be considered, including the type of activity performed (beef or dairy farming), production on large or small rural properties, and the presence of family farming activities. In Santa Catarina State, several small producers are using automatic milking. However, there is a pivotal cultural aspect to be considered. It is customary to remove unpasteurized milk from the cooling tank for human consumption and the manufacture of artisanal dairy products. Therefore, this research brings

an important perspective on brucellosis infection in this population, with important public health importance. Regarding the characterization of our study population, it indicates that the people analyzed were literate but without an in-depth knowledge of biology, which is acquired in high school and college. Thus, for these groups, strategies such as health education should be implemented.

The lack of information about this disease in Brazil may relate to the fact that brucellosis is not present on the list of mandatory reporting diseases to the Brazilian Ministry of Health⁹, unlike in other countries where the disease must be officially reported, such as in France¹⁵, China¹⁶, Korea¹⁷ and Saudi Arabia¹⁸. The information found in the country is from sampling studies conducted on people working in meatpacking plants, livestock activities, blood donors, and/or specific communities¹⁹⁻²². This fact highlights the importance of this study from a public health perspective.

The frequency of 12.34% for individuals screening positive for brucellosis in this period indicates that these people had contact with the infectious agent, but not all people were considered confirmed cases, and only 125 (3.41%) of the total examined were confirmed for the disease in this period. The high number of people with a reactive result in relation to the confirmed cases is also because the Rose Bengal's screening test has a higher sensitivity, estimating the total amount of IgM and IgG. On the other hand, the confirmatory test is more specific because it determines the amount of IgG²³. In general, constant distribution of human cases of brucellosis was not observed, as reported by a Korean study¹⁷. No other studies conducted in the region, State, or country were found in the literature consulted to compare the distribution of human cases over the years, reinforcing the importance of this study to serve as a basis for future comparisons. In order to avoid false-positive diagnoses, we opted to analyze only confirmed cases.

Interestingly, the years 2015 and 2018 showed a higher number of identified cases. This increase in the odds of the occurrence of reactive individuals can be explained by the significant increase in the number of individuals examined and screened positive this year compared to previous years. Another factor that may have contributed was the increase from 485 bovine cases in 2014 to 1,710 in 2015¹⁴; as the bovine cases were notified to DIVE, the investigation of cases in humans was performed. The year 2014, with the lowest frequency, was also the one with the lowest number of people examined and the lowest number of positive cattle¹⁴ reinforcing that the investigation in humans is related to the occurrence of positive brucellosis cases in cattle.

Regarding the proportion of examined and confirmed human cases per year and the relative frequency of confirmed

cases each year, it can be observed that, given the number of individuals who screened positive, the years 2013, 2014 and 2016 were those with the lowest number of confirmed cases. In 2018, there were more confirmed cases, even though it was only the second year with a higher number of individuals who screened positive. One possibility for this occurrence is that people who screened positive in previous years may have manifested the clinical signs of the disease later^{18,24}, therefore, 47 cases were confirmed. Furthermore, since the relative frequency of individuals who screened positive in 2018 was the highest (15.67%), there is also the possibility that people with chronic infections who needed immediate treatment were diagnosed.

The 3.40% of human cases of brucellosis confirmed in this study is close to that observed by Soares *et al.*²² in Alagoas, with 4.4% (20/455) of positives. However, in the present study, we observed the occurrence in an entire region of 131 municipalities, referring to people who were suspected of the disease due to contact with positive animals, products, or presenting clinical signs, as opposed to the study carried out in MT, which was performed in only one municipality and with blood collection of at least one person per property, chosen randomly.

Comparable results have been observed in other studies conducted in Brazil. Santos *et al.*²⁰ observed that in a slaughterhouse in Maranhao State, 10.17% of the results came out positive, while the prevalence in animals was 5.25%. In an urban community in Salvador, a prevalence of 13% of positive individuals was observed²¹ in comparison with people who came from other endemic localities. Similarly, in other countries, the rates were also higher, at 7.7% in Paraguay²⁵, 8.6% in Saudi Arabia¹⁸, 11% in Uganda²⁶, 12.1% in Angola²⁷, 15.4% in Iran²³ and 8.43% in China, from 1952 to 1981, reaching 22.75% in occupationally exposed populations in 2011¹⁶. In all these countries, the prevalence of the disease in animals was higher than that found in Santa Catarina, contributing to a higher number of positive cases in people, either through direct contact with animals or through the consumption of unpasteurized milk products from endemic areas¹⁶. That is, the low frequency of positive people found in the Western region is also a consequence of the low rates of brucellosis in cattle, due to the stricter sanitary measures implemented in Santa Catarina State. Lai *et al.*¹⁶ observed that in the years with no strict control of brucellosis in animals, there was an increase in the number of positives in humans, and in all surveillance programs. This is the reason why actions are needed to make the animals' screening constant so that there will be no increase in the number of infected individuals.

However, these data should be considered carefully since the numbers are not quite comparable to the prevalence of

the disease in Brazil. In some countries, human brucellosis tends to have a much higher prevalence in places where animal infections with *Brucella melitensis* are common²⁸. Importantly, *B. melitensis* has never been detected in Brazil and it is considered rare. The confirmed incidence rate in Western Santa Catarina was lower than in Turkey (26 /100,000 inhabitants²⁹) and Iran (21/100,000²³), and higher than in China (0.42 to 2.89/100,000 inhabitants¹⁶) and Korea (0.0014 to 0.0194 /100,000 people¹⁷). In Argentina, in 2003, the incidence was 0.84 cases / 100,000 population³⁰.

Pappas *et al.*³¹ considered only reports above seven annual cases per 100,000 inhabitants as high. Thus, the results of the present research showed that the incidence found in the Western region of Santa Catarina was low throughout all the years of the study. In Brazil, one study that evaluated the incidence rates in Parana State (on the border with Santa Catarina State)³² showed a similar number of reported cases (N = 191, 5.4%) with decreased rates after 2015. As for the geographical distribution, it is observed that the individuals who screened positive and those with confirmed diagnosis in absolute numbers are concentrated mainly in municipalities from the Midwest to the Far West, which coincides with the area with a higher concentration of herds positive for brucellosis¹⁴.

Regarding the 125 human cases confirmed with brucellosis, we observed the information described in the DIVE's investigation form of human brucellosis⁷ to characterize the epidemiological profile of the disease. Of the total number of cases, 93 had completed forms with complete information, and the remaining 32 had no available data. This demonstrates the need for standardization of actions and information flow, which is sought to be achieved with the new State protocol instituted in 2019⁴.

A higher number of cases in males than females was identified. However, the male: female ratio in our study was lower than that found in other studies. The male: female ratio in Saudi Arabia was 3.3:1¹⁸ due to the fact that males are more at risk of exposure to direct contact with animals, meat and dairy products, thus presenting a higher ratio than the one observed in this study. In Brazil, the rural division of labor still uses a patriarchal system, with most of the time, men dealing directly with cattle (including contact with aborted materials). Due to this direct handling contact with the animals, in addition to the possibility that they are less cautious than women and have a lower tendency to self-care and seek medical assistance³¹, the male population was found to have a higher incidence of contamination. On the other hand, Soares *et al.*²² observed a predominance of 85% in females in Alagoas State; however, there was an overrepresentation of women in their study.

Possa *et al.*³³ evaluated the bovine brucellosis in Santa Catarina State, evaluating 45% of the total population of bovines in a municipality in the Western region of the State and found a prevalence of 0.29% (8/2750). The most affected animals were females (7/8) and animals coming from milking farms. Therefore, they indicate that milking activity can be associated with an increased risk³³.

The age found in our study showed similar results to those described by other authors, such as a median of 44 years old¹⁶ and 29 years old²⁶, and a mean age of 36.19 years old²⁷. Other authors also observed the concentration of cases in people in the same age range: 41% from 20-39 years old²³, 55.5% from 20-39 years old¹⁸, and 100% from 20-64 years old, with a mean age of 41.8 years old²². Poester *et al.*³⁴ reported a higher occurrence in people aged 20-49 years old, Corbel²⁴ from 20-45 years old, and Akhvlediani *et al.*³⁵ reported a predominance in people aged 21-40 years old.

The age group of 20-59 years old is the most active working population, with greater contact with cattle production, butcher shops, consumption of dairy products and agricultural activities, both in Brazil and other countries¹⁸. No cases were observed in children aged from 0-9 years old. According to Soares *et al.*²², brucellosis is rare in children probably due to less contact with the sources of infection. In Brazil, the illiteracy rate is 6.5%, while Santa Catarina State has the second-lowest illiteracy rate among Brazilian States, with 2.6%³⁶. In the present study, no confirmed cases were observed in illiterate people, whereas in Angola, 74.4% of people were uneducated²⁷ and 28.9%³⁷ were illiterate, and in Saudi Arabia¹⁸, 50.2% were illiterate, where the national illiteracy rate is 5.3%¹⁸.

The predominance of self-declared white people is due to the colonization of Portuguese Azoreans, Germans and Italians in the State³⁸. As for the origin of the confirmed individuals, 59.2% (74/125) were of rural origin. The population residing in rural areas is more exposed to risk factors that may be associated with contact with infected animals and consumption of unpasteurized dairy products¹⁰. In a study conducted by Angel *et al.*²¹ in Salvador, 100% of the people studied were of urban origin, with 13% positive for *Brucella abortus*, attributing the positivity to consumption of unpasteurized products and/or people who came from a rural background. On the other hand, Rahamathulla¹⁸ observed 8.6% of positive cases in a study with 100% of the people residing in rural areas. This shows that the disease is distributed in both, urban and rural areas through contact with animals and/or consumption of risk products. In urban areas, although reports still occur as they do in Africa, Southern Europe, Southeast Asia and North America, because of raw milk consumption, there has been a significant decrease in developed and developing

countries because of the standards and regulations used in industries¹⁰. However, there is still a high incidence of human brucellosis¹⁰ in rural areas due to inadequate hygiene, processing and preparation of risk products.

Risk products are mainly milk and unpasteurized derivatives, such as cheese, butter, cream and yogurt³. This result may relate to the higher exposure of small producers due to cultural issues such as collecting unpasteurized milk from milk collecting tanks for consuming and producing artisanal cheese. All these points reinforce the importance of implementing measures to raise awareness of this population. Meat is not a common means of transmission because a) the bacteria, which are not present in significant amounts in the muscles of animals, die when subjected to the temperatures used when cooking, b) the fact that eating raw meat is not common, and c) because of the technological procedures employed⁹.

The rates of this study are lower than those observed in Saudi Arabia, in which 80.6% of positive individuals consumed unpasteurized milk or dairy products¹⁸, and in Georgia, where 100% of individuals reported consuming risk products³⁵. Soares *et al.*²² observed that 50% of the positive cases had a history of consumption of milk or unpasteurized dairy products, which was lower than that observed in the present study. The high proportion of people with occupational contact is probably related to the predominance of rural origins, due to the investigation of human cases, especially on properties where animals were positive for the disease, and exposure is high due to the close contact with animals and the intensive management practices of dairy farms, which predominates in this region. This could be in addition to the consumption of unpasteurized dairy products¹⁵.

Livestock activities were predominant among those who had occupational contact (80.0%), a finding that is similar to that of Miller *et al.*²⁶, where 92.8% of positives reported direct contact with cattle; this is a higher percentage than in studies such as that of Akhvlediani *et al.*³⁵, who reported a 41% prevalence, and that of Lindahl *et al.*³⁹, who reported a prevalence of 24%.

Contact with animals during milking could induce people to consume raw milk or even to have contact with uterine discharges in the postpartum period¹⁰. Contact with the placenta/fetus was reported in 55.56% of the cases, and this is the main risk material for transmission¹⁰. The use of personal protective equipment is essential to reduce the risk of infection.

In Santa Catarina, vaccination against the disease is not routinely performed. Under the personal responsibility of registered veterinarians or third parties, the RB-51 vaccine is given to female cattle as of 3 months of age¹¹. Thus, it is

believed that the vaccination - reported may also be related to other vaccines and not only to RB-51.

CONCLUSION

Occupational contact during the transmission of brucellosis is frequent, and the disease affects farmers, ranchers, veterinarians, dairy and meatpacking plant employees and others who practice some occupation that requires a direct contact with animals¹¹. These results corroborate the occupational profile of the disease associated with agricultural and cattle-raising professions, due to the forms of transmission and gateways of entry of the bacteria into the body. The probability of exposure is higher for butchery, dairy, farm, laboratory and veterinary workers^{15,27}. Overall, this research shows the importance of brucellosis infection in rural regions of Santa Catarina State, mainly in the population with a farm labor force and a cultural aspect that includes consumption of unpasteurized milk and unpasteurized risk products, which are important sources of contamination.

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