Journal of Veterinary Science and Public Health

J. Vet. Sc. Public Health, v. 9, n. 1, p. 068-082, 2022

SEROPREVALENCE AND RISK FACTORS OF Q FEVER IN AN INDIGENOUS COMMUNITY IN THE BRAZILIAN LEGAL AMAZONIA

(*SOROPREVALÊNCIA E FATORES DE RISCO DA FEBRE Q EM UMA COMUNIDADE INDÍGENA DA AMAZÔNIA LEGAL BRASILEIRA*)

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DOI: 10.4025/revcivet.v9i1.61178

ABSTRACT

Introduction: Q fever is a zoonosis caused by *Coxiella burnetii*, strictly intracellular and gram-negative bacteria. Humans are usually infected by contaminated aerosols from domestic animals, particularly after contact with parturient females and their birth products. Objective: To verify the seroprevalence and the risk factors for Q fever in the indigenous people living in demarcated territory in the Brazilian Legal Amazonia of Mato Grosso. Methods: 73 paired serum samples were collected from indigenous in the cohorts held in 2014 and 2015 in nine villages and serological tests were performed using the indirect immunofluorescence test to detect anti-*C. burnetii* IgG. Conclusions: There was a predominance of indigenous women (65.75%), aged 20 to 39 years (39.73%), occupational activity aimed at taking care of the home, family, collection in the Cerrado and cultural activities (35.61%). For associated risk factors, the handling of dry straw (50.68%) prevailed in 2014 and body contact and / or tick infestation (56.16%) in 2015. There was no serological evidence for Q fever between Haliti-Paresí in the biennium

analysed and no symptoms compatible with this zoonosis, reflecting the collective engagement of health surveillance actions redirected to health action. Even though the risk factors for Q fever are related to the social determinants of the daily life, culture and environment of the indigenous people, this study considers that the low infection among the indigenous people may be due to limited and only accidental contact of the indigenous people with wilds animals, or these animals don't present the bacteria that causes Q Fever.

Keywords: *Coxiella burnetii*; Indigenous peoples; Seroepidemiologic studies; Vulnerable Populations; Zoonosis.

INTRODUCTION

Q fever or coxielosis is caused by the obligatory intracellular gram negative bacteria *Coxiella burnetii*, which infects mammals, birds, reptiles, marsupials and arthropods (MARES-GUIA et al., 2016). It is transmitted to humans by inhalation of infectious aerosols, direct contact with infected individuals or animals (cattle, sheep and goats) from birth products during abortion or parturition, milk, feces, urine and semen (LOFTIS et al., 2010; MIONI et al., 2019; OLIVEIRA et al., 2018). Ticks are not considered vectors of this zoonosis to humans, but by biting animals like these supra cited, can transmit to them, that consequently could be able to infect humans (CUTLER et al., 2002).

The symptoms of Q fever in humans and animals are varied and nonspecific. In addition, 40 to 60% of people are asymptomatic in the acute phase or have symptoms that are easily mistaken with a cold or flu, making early identification of the disease difficult(DAMASCENO and GUERRA, 2018). After the acute phase, 1 to 5% of the cases can become chronic (KAMPSCHREUR et al., 2011).

From an epidemiological point of view, indigenous communities are part of the group of vulnerable populations because they are in an expanded condition of exposure to the risk of illness of various orders that involve interaction with the environment. In this context, zoonoses stand out, in particular, Q fever. This is justified by immunological susceptibility, close contact with the environment and the way of life of these communities. It should also be noted that Mato Grosso is the Brazilian state that has the greatest diversity of Biomes and indigenous people in Brazil, which allows interaction between biological and ethnic diversity, favorable to the occurrence of emerging and reemerging zoonoses (FERNANDES and PESSÔA, 2011; NUNES et al., 2017).

Inhabiting the Paresí territory, with 56 villages in nine indigenous lands are the Haliti-Paresí, constituents of one of the main ethnic groups from Cerrado of the Brazilian Amazon Region (TERÇAS et al., 2016), which has been a reference in terms of

ethnodevelopment and good relationships with non-Indians (ZENAZOKENAE et al., 2019). Faced with this necessary adaptation to the current challenges of cultural and economic interaction, Haliti-Paresí develop strategies in addition to traditional activities such as handicrafts, hunting, fishing and collecting. Noteworthy are actions of ethnourism, mechanized agricultural production in large territorial areas, investment in education and professional training of young people, political insertion in associations and indigenous organizations, in addition to the collection of tolls on the MT 235 highway (CASTRAVECHI and PEREIRA, 2018; MOI and MORALES, 2015; ZENAZOKENAE et al., 2019).

As Q fever is associated with rural areas and individuals who carry out risky work activities, it is assumed that the cultural and occupational habits of this indigenous community are favorable to contact with reservoirs of this disease. In addition to hunting and gathering practiced in the Cerrado of the Brazilian Amazon Region, the breeding of cattle and goats can favor infection by *Coxiella* sp., since these animals live loose in common areas of the village. In the face of such justifications, this study sought to verify the seroprevalence and the risk factors for Q fever in the indigenous people living in demarcated territory of the Cerrado of the Brazilian Amazon Region of Mato Grosso.

MATERIALS AND METHODS

This is a concurrent and open cohort study carried out in the Paresí indigenous area, in the Haliti-Paresí villages: Seringal/Cabeça do Seringal, Chapada, 4 Cachoeiras, Bacaval, Wazare, Morrim, Utiariti, Sacre 2 and Bacaiuval, belonging to a Legal Amazon region, Brazil. The indigenous participants signed the Free and Informed Consent Form (FICF) and underwent an individual interview to collect sociodemographic, clinical and biological sample data, in both years of study. It is noteworthy that the indigenous people are literate in Portuguese and all those over 12 years old signed their name and those who were younger, obtained the signature of their parents or guardians. The peripheral blood collected was centrifuged, cryopreserved and transported to the Laboratory of Hantavirus and Rickettsiosis of the Oswaldo Cruz Institute (LHR), Rio de Janeiro.

The entire population residing in the nine villages was included in the study, which consisted of two cohorts (Figure 1). Of these, only 73 paired blood samples from the years of 2014 and 2015 had enough sera blood to perform the tests proposed in both years of analysis by the indirect immunofluorescence assay (IFA). This decision sought to

increase the chance of detection in the selected period and thus strengthens the evidence of circulation of the microorganism.

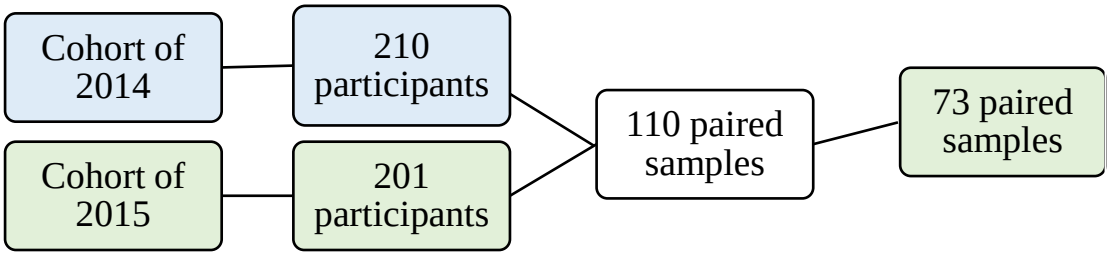

Figure 1. Constitution of the 2014 and 2015 cohorts in the Haliti-Paresí community, Campo Novo do Parecis-MT.

The detection of antibodies of the anti-*C. burnetii* IgG class of the 146 samples was performed at the Laboratory of Hantaviroses and Rickettsioses of the Oswaldo Cruz Institute, following the instructions of the manufacturer Scimedx/Medivax®. The slides were read under an ultraviolet microscope (Eclipse E400 Nikon) at 400 and 1000X. The serum sample was considered reactive when it contained antibodies against *Coxiella burnetii* showing a reaction at 1:64 dilution. As a negative control, in each slide there was the presence of a non-reactive serum and a known reactive serum, the positive control.

The data obtained in interviews and laboratory results were double entered in EpiInfo 7 software, checking for inconsistencies by Data Compare. Data processing was performed using the MiniTab 17 software, applying descriptive statistics, with the results being presented by tables of absolute and relative frequency. The study complied with all ethical issues in research with human beings, being approved by the National Research Ethics Commission (CONEP) under the Protocol 819 939.

RESULTS

Sociodemographic data of 73 indigenous people from the Haliti-Paresí community elected for the study showed that 65.75 % were women. The ages ranged from 1 to 94 years, with an average of 31.9 years. Regarding the occupational situation developed by these indigenous people, two were more prevalent in view of the others: care for home, family, collection in the Cerrado and cultural activities (35.61 %) and the student (16.43 %). The sociodemographic profile of the participants is shown in Table 1.

Table 1. Sociodemographic variables related to the indigenous people elected for the study of the Haliti-Paresí community, Campo Novo dos Parecis, Mato Grosso from 2014 to 2015.

Variable and category	**n (%)**
Sex	
Male	25 (34.25)
Female	48 (65.75)
Age	
19 years	20 (27.40)
20 a 39 years	29 (39.73)
40 a 59 years	15 (20.55)
60 years	9 (12.33)
Occupational situation in the village	
Agriculture and farming, hunting and fishing	5 (6.85)
Jokes	2 (2.74)
Hunting and fishing	4 (5.48)
Hunting and fishing, collecting in the cerrado	2 (2.74)
Home care, family, Cerrado collection and cultural activities	26 (35.61)
Student	12 (16.43)
Student and pranks	4 (5.48)
Teacher	4 (5.48)
Other activities	14 (19.18)

n: sample size per variable.

The indigenous villages are thus distributed in the Cerrado of the Brazilian Amazon Region, known for its biodiversity of plants and animals and which, as shown in Table 1, serves as the basis for traditional activities such as handicrafts, hunting, fishing and gathering. Such villages fall into two types of Cerrado present in this region: the one known as wooded savanna, which brings more undergrowth with a predominance of herbaceous and a forested savanna, with a higher density of trees and shrubs (Figure 2).

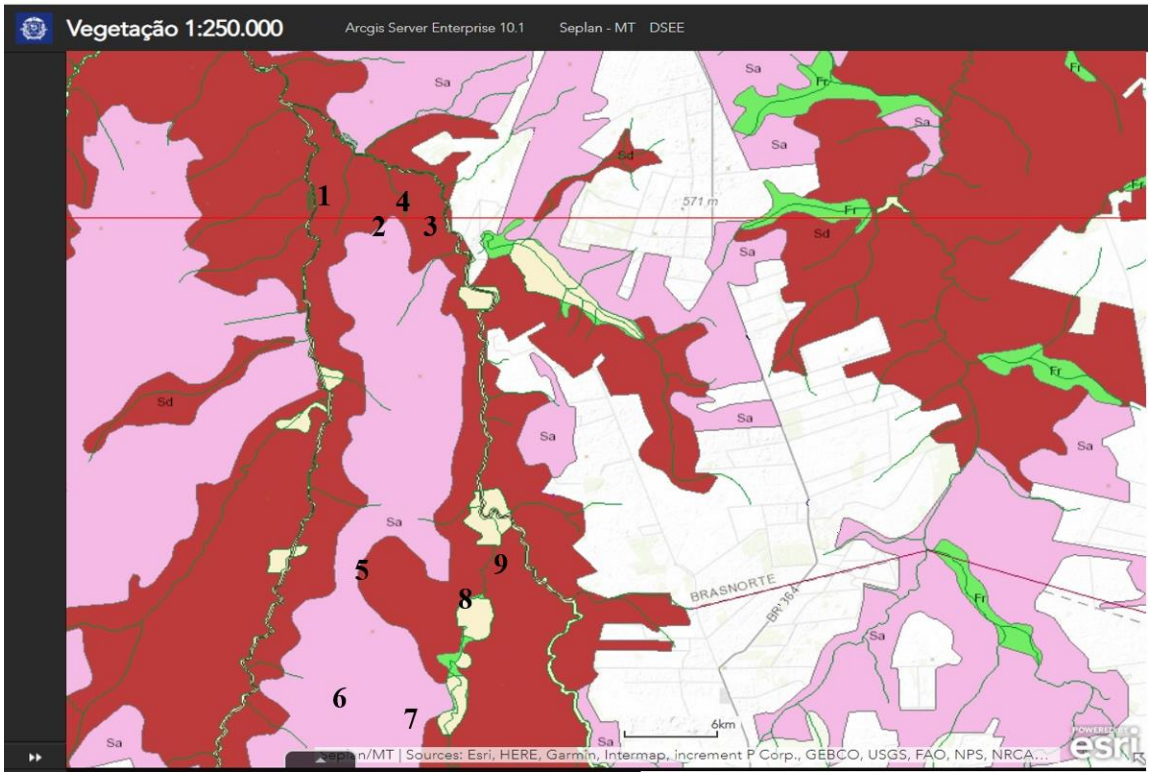

Figure 2. Spatial distribution of predominant vegetation in the region of villages in the Paresí territory, Campo Novo do Parecis-MT. Sa: wooded savanna (Cerrado with herbaceous vegetation); Sd: forested savanna (Cerrado *stricto*); Fr: riparian formation. 1: Utiariti; 2: Sacre 2; 3: Bacaiuval; 4: Morrim; 5: Bacaval; 6: Chapada Azul; 7: Wazare; 8: Quatro cachoeiras; 9: Seringal.

For the risk factors associated with Q fever listed in the questionnaire, the most prevalent in 2014 was the handling of dry straw (50.68 %) and in 2015, body contact and/or tick infestation, corresponding to 56.16 %, as shown in Table 2.

Table 2. Risk factors for Q Fever among indigenous people in the mid-northern region of Mato Grosso.

Variable	n 2014	% 2014	n 2015	% 2015
History of contact with wild animal abortion product	2	2.73	4	5.47
History of contact with abortion product of farm animals (cow, sheep, sow)	8	10.95	9	12.32
Raw milk consumption	27	36.98	31	42.46
Body contact and/or tick infestation	32	43.83	41	56.16
Dry straw handling	37	50.68	38	52.05
Blood transfusion history	4	5.47	4	5.47
Total	**73**	**100**	**73**	**100**

n: sample size per variable.

As for the symptoms reported by the participants, comprising the 60 days prior to the collection, the 73 participants were asymptomatic for Q fever, corroborating the negative results presented in the serological analyzes by the IFA test.

DISCUSSION

This is the first seroprevalence study for Q fever performed in an indigenous community in the state of Mato Grosso, and it is important to note that there are no approaches in Brazil with this disease that involve more vulnerable populations such as the indigenous. The first Brazilian serological evidence for this zoonosis dates back to 1953, however, few current studies indicate its occurrence in military firefighters, patients with suspected dengue fever, milkers, slaughterhouse workers and others in conditions of occupational risk (DAMASCENO and GUERRA, 2018; LEMOS et al., 2018; MARES-GUIA et al., 2016). In public health, this lack of data on confirmed cases is due to the dispensation of notification by the Brazilian health authorities, causing a scenario of little or no visibility of Q fever, making it marginalized, unknown and neglected (DAMASCENO and GUERRA, 2018; KAUFMAN et al., 2018).

No serological evidence for Q fever was observed in the analyzed biennium, and there were no reports of symptoms compatible with this zoonotic disease in the two months prior to data collection. According to Eldin et al. (2017), residual antibody titers can persist for years and IgM titers can remain high for more than a year. The same author also assures that antibodies are detectable in the third week after infection in 90% of the patients, with the IFA being the most sensitive serological technique for detecting IgM antibodies in the initial phase of the infection and after 12 months of follow-up. In relation to IgG, compared to other techniques, the IFA was more frequently positive than that of ELISA and complement fixation (100%, 95.2% and 96.8%, respectively).

Although in the face of our results, it is worth pointing out that health situations or the identification of the occurrence of diseases triggers a fundamental role in conducting interventions for planning health surveillance strategies, especially for a neglected and unknown zoonosis such as this one (PAPLOSKI, 2017). Thus, the lack of surveillance and diagnosis of Q fever limits the knowledge of the real prevalence leading to underdiagnosis and, consequently, to the incorrect management of cases by health teams (ECHEVERRÍA et al., 2019).

Even though this community has the breeding of cattle and goats as one of the sources of protein for community consumption, the proximity to the wild environment in

its hunting and gathering activities constitute risky activities for the infection by *C. burnetii*.

Similar cultural aspects of Haliti-Paresí economy were observed in an indigenous community in Malaysia. They live in areas bordering the forest, usually work in oil palm or rubber plantations, practice cattle and goat farming, live in close contact with wildlife and domestic animals, collect food in the forests. This constant exposure to wildlife and domesticated animals and ticks from any of these animals represented an increased risk of contracting *C. burnetii* infection, giving reactivity to 9.6% of samples tested in Malaysia (KHOR et al., 2018).

Wild animals can be potential reservoirs of this bacterium and still eliminate it in the environment. Recently, Christen et al. (2020) investigated, through an outbreak of Q fever in an isolated area of the Amazon Forest in French Guiana in 2014, that the fecal samples of capybara were positive for *C. burnetii*. This premise also applies to domestic animals. Mares-Guia et al. (2014), through serological and molecular analyzes, found reactivity for *C. burnetii* in dogs, sheep, and goats in the State of Rio de Janeiro.

Thus, it is noted that the planning of health-environmental surveillance measures in conjunction with the community is essential for the prevention of zoonoses in indigenous territories. In this context, as pointed out by Echevarría et al., (2020), Guimarães et al., (2018) and Teixeira da Silva (2015), disclosing results, even if they did not detect the presence of the microorganism circulation in the studied population, such as those found in this study, benefits researchers and communities, by assisting in the management of efforts, financial, technical and material investments.

Regarding the sociodemographic variables of this indigenous population, it is observed that the predominance of the female gender has been common in studies in the Haliti-Paresí community (MOURA et al., 2020; SANTOS et al., 2019; ZENAZOKENAE et al., 2019), which is also evident in other ethnicities, such as Tremembé and Baniwa (OLIVEIRA et al., 2016; SACRAMENTO et al., 2018), despite the gender distribution of the Paresí population showing a slight predominance of males in the last census. (IBGE, 2010) In general, Q fever is prevalent in males (HEO et al., 2019; KAUFMAN et al., 2018; VAN ROEDEN et al., 2019), justified by occupational activities such as livestock, contact with aborted fetuses and other products of animal origin that often occur through respiratory and conjunctiva routes (ELDIN et al., 2017). Some studies point out that even with the involvement of females, steroid hormones can act as protective factors to this zoonosis (HOWARD and OMSLAND, 2020; LEONE et al., 2004).

The early reproductive life linked to socio-cultural factors such as the valuation of large families is evidenced in this research, mainly by the presence of young adults aged between 20 and 39 years. In two studies conducted in the Xavante population, this age, similar to that found in the present study, can also be observed. In the first study, the general average age was 20.6 years and the general proportion of women was 52.4% (ARANTES et al., 2018). In the second study, the age varied between 18 and 59 years, with the majority of the population female (51.4%) (WELCH et al., 2020).

In view of the result obtained when asked about the occupational situation in the village, it is evident that the current daily life presents a diversity of actions that reflect their rites and customs. Some authors show care for the home (SILVEIRA, 2011), family (BAGGIO et al., 2018; ZENAZOKENAE et al., 2019), and Cerrado collection (MACIEL, 2010) presents in this community. The second prominent occupation, as a student, expresses interest in education, especially in the village environment with the creation of schools (SILVA, 2018) so that they can continue in the city and guarantee their insertion in academic spaces and meet the demands of higher education professionals in these communities.

Recognized as an occupational disease, Q fever is associated with those who work or are more exposed to the risk of contact with domestic or wild animals that present hematophagous ectoparasites (ECHEVERRÍA et al., 2019). The fact that the villages are located in Cerrado regions points to an eminent risk factor when these indigenous people are exposed to hunting activity, as mentioned in Table 1. In a study recently performed to survey fauna in the vicinity of Campo Novo do Parecis, Tangará da Serra and Diamantino, Mato Grosso, rodents such as agouti (*Dasyprocta azarae*) and tapir (*Tapirus terrestris*) were prevalent in the Cerrado of this region, in addition to the cateto (*Pecari tajacu*) (DAMASCENO et al., 2020). These are animals known as potential hosts for hematophagous ectoparasites and which may also justify the high prevalence of contact and/or body tick infestation reported in the biennium of this study. It is important to emphasize that even though these ectoparasites are not directly involved in the transmission cycle to humans, they can bite and infect domestic and wild animals that are in contact with the indigenous people, who are more vulnerable and at risk of Q fever due to the occupational activities they carry out.

Q fever is likely to be found in people who have not had direct contact with contaminated animals but who have inhaled aerosols from their products or who have consumed raw milk or its by-products without pasteurization (ROZENTAL et al., 2020;

SALIFU et al., 2019). Two other habits exercised by the studied indigenous people and potential risk factors are the consumption of raw milk and the handling of dry straw. The first comes from subsistence livestock and the second is a very common habit since the coverage of traditional houses (hatís) and handicraft products are made from guariroba straw (*Syagrus oleracea*) or buriti (*Mauritia flexuosa*) (TERÇAS et al., 2016).

Q fever is related to both behavioral and socio-environmental conditions and even in the presence / contact with cattle and wild animals in the villages. The asymptomatic condition and the absence of seroprevalence for this disease presented in the individuals elected in this study, allow to consider the success of the surveillance actions in zoonoses and of the community health education conducted by the health team of the Bacaval base pole as factors of health promotion of the collectivity. Therefore, the health promotion strategy is based on knowledge and understanding of the social determinants of health in the health-disease process, in individual and collective involvement, paying attention to the differences and particularities of the events (OLIVEIRA et al., 2012).

It is also worth noting that indigenous health has been re-signified throughout history, being closely related to the environment and the changes established in it because it is its way of subsistence. Therefore, it is important to insert the indigenous in a context in which they are the protagonist of their reality through health education actions, as it is a way of articulating movements that integrate traditional indigenous medicine and western medicine, in order to organize it for health promotion and better quality of life, both in the individual and collective context (RAMOS and NOGUEIRA, 2020).

No less important and active in this process are the indigenous health agents and the integrated work of the indigenous health team because, in view of this context of exposure to the risk of this population, the interaction between the individual, programmatic and social dimensions will subsidize the production process health through preventive practices anchored in health surveillance, which in turn will be active in social determinants and in the perception of community risks (BERTOLOZZI et al., 2009; OVIEDO and CZERESNIA, 2015; PEDROLO et al., 2008).

FINAL CONSIDERATIONS

It is evident that the immunological susceptibility and indigenous hygiene habits are far from those recommended, making this community more vulnerable to the future risk of exposure to risk factors for a disease unknown to health professionals and of non-compulsory notification. However, it is worth noting that even in these circumstances,

the absence of evidence of Q fever circulation in the Haliti-Paresí community reflects the collective engagement of health surveillance actions redirected to health action. It is the result of continuous attention and monitoring from the perspective of risk identification, control and mitigation, with the incorporation of community participation in the formulation of proposals and in the creation of strategies for coping with health problems. Allied to this, it is observed that the actions and practices developed in this community aim at the union between indigenous and technical-scientific knowledge, thus guaranteeing the empowerment of the subject and the strengthening of the community in favor of adopting behaviors that enable the promotion of health and quality of life.

Developers of both livestock and hunting and gathering in the wild, it is emphasized that this community remains under constant health surveillance because even if ticks are not directly involved in infection in humans, they play a significant role in the transmission cycle of Coxiella burnetii among those domestic or wild vertebrates capable of hosting such ectoparasite vectors of Q fever. Although the animals were not tested, the likely very low rate of infection among host animals in the Cerrado can be considered from the perspective that biodiversity limits the exposure of *C. burnetii* through a "dilution effect", reducing the possibilities of involvement, despite the various risk factors to which indigenous people are exposed on a daily basis. Allied to this, there is the fact that the indigenous territory is surrounded almost entirely by agricultural land, with livestock in the region having little representation.

Therefore, the present study hopes to contribute with information on this zoonosis whose etiologic agent has been frequently identified for more than a decade in Brazil. As the clinical diagnosis is relatively complex because it is a disease with nonspecific symptoms and high rates of underreporting, it is suggested, then, that Q fever should be included in the list of differential diagnoses of acute febrile diseases, especially in individuals that present risks associated with a compatible epidemiological history for this zoonosis, especially if it comes from distant rural locations or from vulnerable populations like the indigenous.

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