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Coronavirus Pandemic

COVID-19 in socially vulnerable *quilombola* populations in Salvaterra, Pará, Eastern Amazon, Brazil

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Abstract

Introduction: COVID-19 is a severe respiratory syndrome caused by the SARS-CoV-2 virus. In Brazil the highest infection rates are associated with socially vulnerable populations. This study therefore sought to analyze the spatial distribution of the disease and its relation with geographic, socioeconomic and public health policy characteristics associated with *quilombola* communities in Salvaterra municipality, state of Pará, for the period of March to September, 2020.

Methodology: This cross-sectional and ecological study used data from the Disease Notification System and the National Registry of Health Establishments of the Ministry of Health, the Income Transfer Registry of the Ministry of Citizenship and the 2010 census of the Brazilian Institute of Geography and Statistics. Statistical and spatial analysis of the data was done through percentages of cases and Flow and Kernel map techniques.

Results: Seventy-five notified cases of COVID-19 distributed among 7 *quilombola* communities in the municipality were analyzed. The epidemiological profile followed a national trend, with a higher percentage of cases among persons who were female, adults with low schooling levels, working as family farmers and with an outcome ending in recovery. The spatial distribution of the disease was not homogenous and showed clusters of cases and high incidence rates, especially in communities close to the municipal seat or to highways.

Conclusions: The use of data analysis techniques was satisfactory for providing an understanding of the socioeconomic production of the disease in the areas studied. Accordingly, the need for intensifying epidemiological survey actions in the *quilombola* communities of the municipality is emphasized.

Key words: COVID-19; epidemiology; Quilombola; social vulnerability.

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Introduction

COVID-19 is a severe acute respiratory syndrome caused by the SARS-CoV-2 virus of the family Coronaviridae, initially identified in the city of Wuhan, Hubei province, China, in late 2019 [1]. The main form of transmitting the disease is through direct contact with infected persons who eliminate the virus through aerosols, which, after being inhaled can remain incubated for an average of up to 7 days before the onset of symptoms [2].

So far, approximately 51,857,776 persons have been infected and 1,278,280 have died due to COVID-19 around the world, with the United States, India and Brazil accounting for the largest numbers of cases notified. In Brazil, there have been approximately 5,700,000 cases and 160,000 deaths notified, with the largest number of cases notified in the Southeast, Northeast and North regions [3]. The state of Pará, located in the eastern Amazon, is the most populous state in the northern region of Brazil with 8,272,724 inhabitants, and had recorded approximately 260,000 cases and 6.800 deaths, by September 2020 [4].

The occurrence of this disease, as happens with other infectious or parasitic maladies, has been associated with the socioeconomic production of inequalities throughout Brazil. Thus, the traditional *quilombola* populations that are essentially defined according to an assumption of African ancestry and

social relations historically built on resistance to slavery have several types of vulnerability, of which health inequalities are a particularly perverse example, especially with regard to the COVID-19 pandemic [5].

In light of the historical health vulnerability among those populations, the Ministry of Health established the National Policy for Total Health for the Black Population (PNSIPN) in 2009, for the purpose of ensuring equity in guaranteeing the human right of access to health for that population, especially related to transmittable and non-transmittable diseases. However, there has been a lack of efficient implementation of those public policies in Brazilian territory, especially in rural areas of the North and Northeast.

The state of Pará, which has the largest number of titled *quilombola* areas in Brazil, presented 779 confirmed cases of COVID-19 and 43 deaths in those areas, concentrating around 33% of the deaths for *quilombola*s in Brazil, as of the second week of August 2020. Thus, the emergence of this disease in those communities represents a public health challenge, especially when one considers the underreporting of cases due to the ineffectiveness of health care services for those populations [2].

Salvaterra municipality located in the Marajó island mesoregion, state of Pará at geographical coordinates 0° 45' 10" S 48° 31' 01" W has a population of approximately 24,000 inhabitants. In 1963 the municipality was divided into 5 administrative districts (Salvaterra, Condeixa, Joanes, Jubim and Monsarás), with an economy based on production of vegetables, cassava flour and especially pineapples [6]. In this municipality 453 cases of COVID-19 were notified, from March to September of 2020. This number represents 0.3% of the notifications in the State of Pará and indicates underreporting of cases, considering the social iniquities existing in this municipality that are risk factors for this disease.

The descendants of enslaved blacks in Salvaterra gave rise to 17 *quilombola* communities, which represent 30% of those communities legally recognized in the state of Pará [7]. These people have historically suffered a process of impoverishment resulting from their invisibility to state planners. Thus, the reality experienced by those populations and replicated in other *quilombola* territories in Pará has been expressed in social inequalities, especially related to education, health, sanitation and income generation, which have contributed towards social vulnerability for those populations.

In that context, the *quilombola* communities of Salvaterra municipality over time have implemented a productive organization marked by pendulum coming and going movements, forming flows between the communities and the municipal seat because of the need to sell their products and purchase supplies and services in general.

Therefore, the process of generating informational contents related to COVID-19, among *quilombola* populations and its the spread of the disease in rural areas in the municipality must take into account socioeconomic risk factors and the presence of public policies at local scales, using the areas of the communities and their demographic characteristics as spatial units for analysis, due to the health vulnerability that these populations present [8].

In that regard, geoprocessing techniques have been widely employed in the health area, mainly in epidemiological studies of viral infectious diseases, because they enable spatial health analyses by interrelating epidemiological, socioeconomic, demographic, and public policy information [9-11]. With that in mind, the objective of this study was to analyze the spatial distribution of COVID-19 and its relation with geographic, socioeconomic and public health policy characteristics in *quilombola* communities in Salvaterra municipality, for the period of March to September 2020.

Methodology

In this descriptive, cross-cutting and ecological study epidemiological data were used from 75 confirmed COVID-19 cases in *quilombola* communities in Salvaterra municipality, state of Pará, for the period of March to September, 2020. These data were obtained from the Disease Notification System (SINAN) of the Municipal Health Secretariat (SEMUSA). Data on the forms of organizing the agricultural production process in the municipality were obtained from the Technical Assistance and Rural Extension Company (EMATER), during a technical visit made to that agency.

Map and demographic data for *quilombola* communities in the municipality were obtained from the Demographic Census of the Brazilian Institute for Geography and Statistics (IBGE) [6] and databases at the Pará Land Institute (ITERPA). Data on income transfer programs carried out in the municipality came from the Single Registry (CadÚnico), of the Ministry of Citizenship and information related to health establishments came from the National Registry of Health Establishments (CNES), of the Ministry of

Health. Once obtained, the data were treated using TabWin 36b software to remove inconsistencies, duplications and incompleteness.

In order to calculate the Incidence Rates (IR) of the disease in the municipality and in the *quilombola* communities, the numbers of cases and the estimated populations were used for Salvaterra (453 cases/24075 inhabitants) and the communities of Siricari (4 cases/153 inhabitants), Caldeirão (25 cases/440 inhabitants), Bacabal (1 case/494 inhabitants), Boa Vista (25 cases/670 inhabitants), Vila União (13 cases/676 inhabitants), Mangabal (2 cases/233 inhabitants) and Mangueiras (5 cases/1451 inhabitants), according to the formula: *IR = (number of cases / estimated populations) × 1000*.

Next, the data were georeferenced in the field considering their location using a Global Positioning System (GPS) for storage in a Geographic Database (BDGEO). Later, data percentages related to the epidemiological variables were calculated using the Bioestat 5.0 program.

The spatial relations between the location of cases, sale of agricultural production, presence of health services and access to income transfer programs in the *quilombola* communities in the municipality were analyzed using choropleth and flow maps. In order to characterize possible clusters of the disease, a spatial distribution of the cases using the Kernel density estimation was performed. These analyses were made using ArcGis 10.5.1 software.

Results

For the period of March to September 2020, seventy-five notified cases of COVID-19 from the *quilombola* population in Salvaterra municipality, state of Pará were analyzed. These were distributed among 7 *quilombola* communities located in 3 administrative districts. Analysis of the profile of individuals notified as having the disease showed a higher percentage of occurrence among females (*n* = 54-72.0%), in the adult age range (*n* = 41-54.7%), with an outcome of recovery (*n* = 74-98.7%), education up to the elementary level (*n* = 50-66.7%) and occupation as small-scale farmers (*n* = 73-97.4 %), as shown in Table 1.

COVID-19 presented a non-homogeneous spatial distribution pattern in the *quilombola* communities of Salvaterra municipality, because only 7 of them notified cases, with the communities of Boa Vista and Caldeirão presenting 25 cases (33.3%), Vila União 13 (17.3%), Mangueiras 5 (6.7%), Siricari 4 (5.3%), Mangabal 2 (2.8%) and Bacabal 1 (1.3%).

The spatial distribution of health units in those communities also showed an unequal distribution pattern, with only 4 of the 7 communities that have those services notifying cases, these being Caldeirão, Mangabal, Mangueiras and Vila União. This illustrates health inequality due to low coverage for health services in the municipality, especially in the *quilombola* areas (41.1%) [3].

In terms of access to the Federal Government's income transfer programs verified in CadÚnico, it was

Table 1. Epidemiological profile of *quilombolas* with COVID-19 notified in Salvaterra municipality-Pa, up to September 23, 2020. Source: Research protocol, 2020.

Variable	(%)	Bacabal	Boa vista	Caldeirão	Mangabal	Siricari	Vila união	Mangueiras
Age group								
Children	13.3	0	6	0	0	0	4	0
Adolescents	12.0	0	5	1	0	0	3	0
Adults	*54.7*	*0*	*13*	*14*	*2*	*3*	*5*	*4*
Elderly	20.0	1	1	10	0	1	1	1
Gender								
Female	*72.0*	*1*	*20*	*15*	*1*	*1*	*12*	*4*
Male	28.0	0	5	10	1	3	1	1
Evolution								
Death	1.3	0	0	0	0	1	0	0
Recovered	98.7	1	25	25	2	3	13	5
Education								
secondary/technic	66.7	1	17	16	2	3	10	1
School	22.7	0	7	8	0	0	2	0
Higher education	2.6	0	1	1	0	0	0	0
Others	8.0	0	0	0	0	1	1	4
Occupation								
Small farmer	96.0	2	23	24	2	3	13	5
Fisher	1.3	0	1	0	0	0	0	0
Others	2.7	0	1	1	0	0	0	0

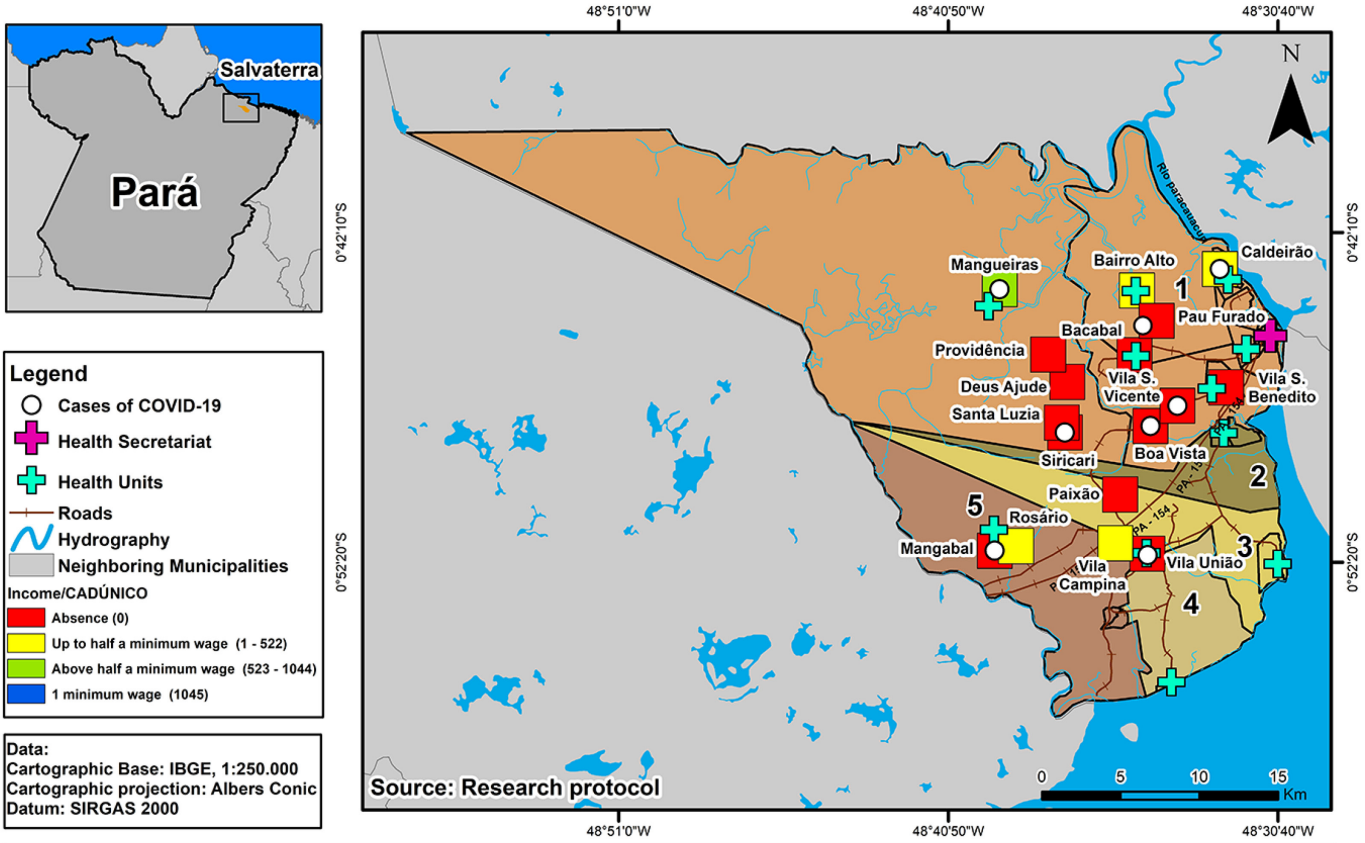
observed that 12 communities (58.3%) did not receive any type of income through those programs, with 4 (23.5%) receiving up to half of a minimum wage and only 1 (5.8%) receiving from one half to one minimum wage. None of the communities received more than a minimum wage, according to Figure 1.

The visual expression of the *quilombola* populations with COVID-19 seeking health care assistance showed several converging flows associated to the distances from the community health service, offered mainly at the municipal seat by the Municipal Health Secretariat (SEMUSA). Thus, the Caldeirão and Bacabal communities were at a short distance (0.1km – 8.9km) and the communities of Boa vista and Siricari were at a medium distance (9.0km – 14.6km). On the other hand, the communities of Mangueiras and Vila União presented a long distance (14.7km – 23.1km), while Mangabal was very distant (>23.1km). The highest densities of cases were observed in the communities of Caldeirão and Boa Vista, while the lowest were in Bacabal and Mangabal. It was also found that the incidence rates of the communities of Caldeirão (56.8), Boa Vista (37.3), Siricari (26.1) and Vila União (19.2) were higher than those of the municipality of Salvaterra (19.0), as shown in Figure 2.

Discussion

The analysis of the epidemiological profile showed that the disease most significantly affected individuals of the female gender and at a productive age. This fact may be related to work activities that can be associated with risk factors for the disease and are performed by women, especially because they are responsible for maintaining the family unit, e.g., production and sale of handcrafts and subsistence agriculture products, besides products from plant extractivism sold at the municipality's open markets [12,13].

Figure 1. Spatial distribution of COVID-19 cases, health establishments and beneficiaries of income transfer programs registered in CadÚnico in Salvaterra-Pa, 2020. Source: Research protocol, 2020



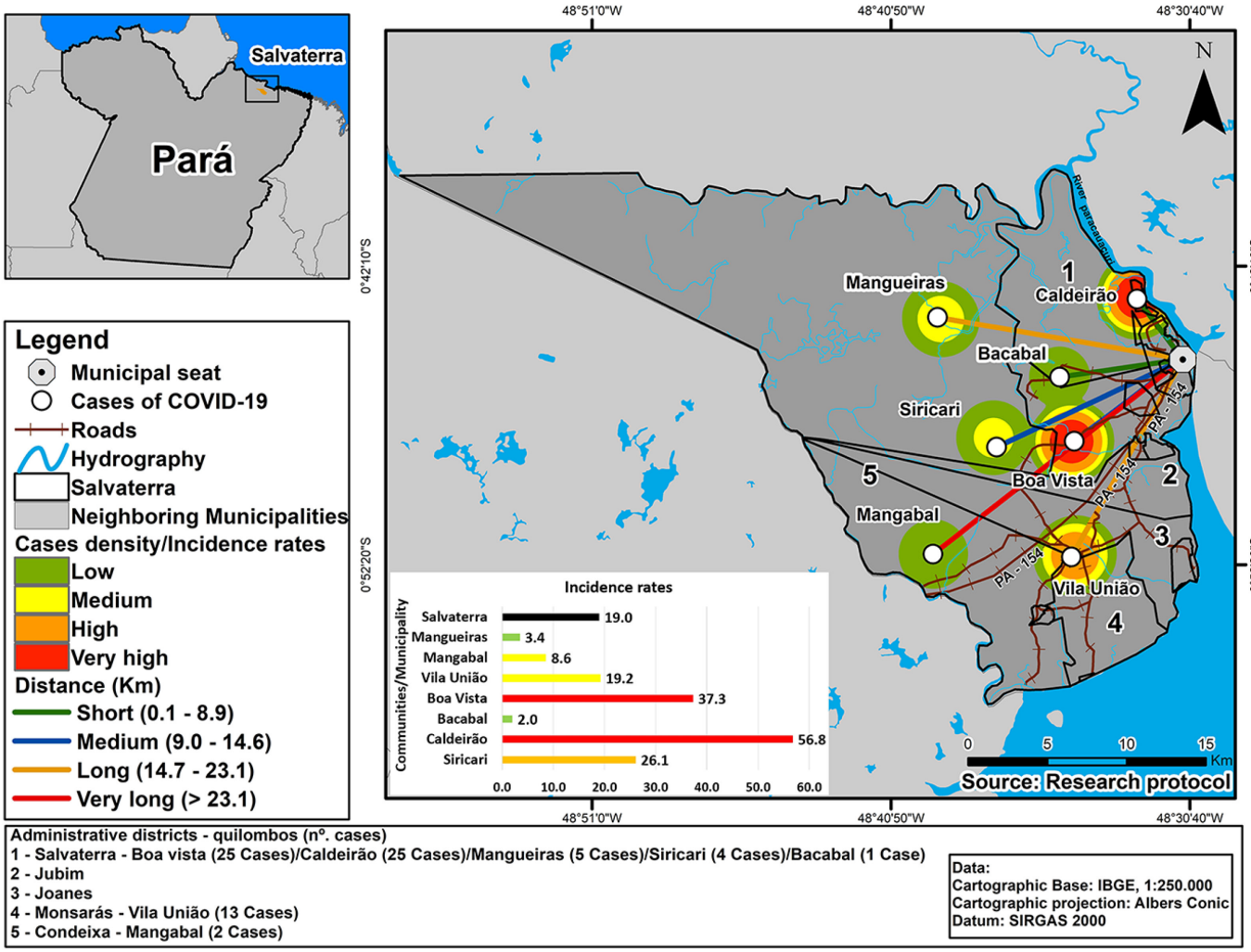
Additionally, the female population may have presented a higher number of cases because women more frequently seek out health services compared to men [14]. That was clearly demonstrated in the low levels of men seeking the tests offered in the active search campaigns by the Municipal Health Secretariat for identifying cases of SARS-CoV-2 infection.

The high percentage of cases that ended in recovery may be related to the occurrence of lighter or milder forms of COVID-19 in the municipality. This fact follows the national trend for Brazil where approximately 90% of the disease cases are associated with those forms, as has been reported in other places around the country [15,16]. However, that evidence still requires formal confirmation according to protocols developed through scientific studies on the epidemiology of this disease.

The low level of schooling identified in this study indicates another point of social vulnerability for *quilombola*s and is a risk factor for the disease, due to the lack of information related to contagion processes and preventive and prophylactic measures for the disease, where difficulties in understanding are associated with low levels of education. This situation has been observed in several Brazilian territories, especially with regard to infectious and parasitic diseases [17-18].

The observation of the high percentage of cases in agricultural occupations indicates unhealthy conditions at some levels of the production chain employed in the communities studied, especially when one considers risk factors associated with transporting and marketing agricultural products. Another risk factor for infection by SARS-CoV-2 related to this variable is that the family unit is often merged with the production unit itself. This fact causes a high level of exposure for the community, since the disease is considered highly transmittable [19].

Figure 2. Flow for quilombola communities with COVID-19 seeking health care assistance, density of cases and Incidence Rate in Salvaterra municipality-Pa, 2020. Source: Research protocol, 2020



This situation has been observed in relation to other diseases in other parts of the Amazon, where all the individuals in a given family are involved in the same production activity, such as family agriculture (subsistence crops and fruit trees), and thus self-declare as farmers, although they also have other production activities such as livestock (cattle and water buffalo herds), plant extractivism and fishing [20].

The fact that only 7 communities have notified cases may be related to closeness and ease of access to the municipal seat, because they are located along the PA-154 highway, which enables greater interaction of their inhabitants with the urban municipal area. Thus, although the communities of Boa Vista and Caldeirão are more exposed to risk factors for transmitting the disease, they also have greater access to the health services the municipality offers [21].

As for the fact that 10 communities have not presented cases, that may be related to underreporting due to their geographic location, and associated factors such as distance and access to the municipal seat, which complicate the supply of health services related mostly to active search for medical assistance. That situation points to the possible occurrence of epidemiological silence.

Although the distance and the trajectory from the communities to the municipal seat are risk factors for the disease, the *quilombola* communities need for their members to participate in rural producer markets, where they can sell the products of their family agriculture such as vegetables, cassava flour, charcoal and others, despite the risk of infection by SARS-CoV-2 due to the crowds of people who generally flock to those places [22].

The unequal spatial distribution of health units observed in the *quilombola* communities of the municipality points to the social and health vulnerabilities to which they are exposed. Given that only 4 out of 7 communities present health services, that low coverage means that the *quilombola* population must seek out other communities or even the municipal seat. Another fact related to that low coverage is the possible occurrence of epidemiological silence for the disease in the municipality, since without clinical and laboratory tests, the *quilombola* populations are barred from the disease notification system [23].

The fact that the majority of *quilombola* communities lack access to any program for income transfer leads to social vulnerability produced in a context of invisibility for those communities, because of the need for social promotion linked to guarantees of their rights to health, education and income, especially at the present moment where the imperatives of social distancing have economic implications for those populations. That being the case, the low access to Federal Government income transfer programs observed in those communities has exposed their inhabitants to risk factors for infection by SARS-CoV-2, because they lack another source of income for their support [24].

The relation of spatial dependence between the long distances from the communities to the municipal seat and the low number of cases observed, above all in the Mangabal and Mangueiras communities may be related to difficulties in access to the municipal seat and other locations, leading to low intermunicipal mobility for their populations, which promotes distancing between them. Besides those geographic characteristics, these communities presented an efficient form of social organization by promoting the establishment of sanitary barriers, which restricted the flow of persons from outside, as an affirmative action in response to the imperatives of social distancing, especially when one considers the precarious existing health services.

The fact that communities a short distance away from the municipal seat presented a high density of cases as observed in the communities of Boa Vista and Caldeirão indicates different levels of exposure to the disease, because their populations have a higher degree of social interaction with the municipal seat, where they participate in rural farmer markets, selling vegetables, cassava flour and charcoal obtained from their family farms, despite the risk of infection with SARS-CoV-2 due to the agglomerations of people that generally occur in those places.

That high density of cases may also be associated with the presence of Basic Health Units in those communities, due to their closeness to the municipal seat, as well as the access facilitated by the PA-154 highway, which enables a broader offering of health services, such as laboratory examinations and campaigns for detecting circulation of the virus [25]. As for the fact that the Bacabal community has presented a low density of cases although located only a short distance from the municipal seat, that may be related to the construction of the aforementioned sanitary barriers and to carrying out practices for preventing the disease, which were efficient alternatives for promoting social distancing between their inhabitants.

The process of the spread of COVID-19 in the *quilombola* communities of Salvaterra municipality was additionally influenced by the pendulum mobility observed in their day-to-day lives of their inhabitants. The daily flow of the *quilombola* population to the

municipal seat and their return to the community under various circumstances enabled the occurrence of social interactions that became an important risk factor for socioeconomic production of the disease. The most relevant of those situations was the need for selling agricultural products, purchasing food products and access to general services [26].

Therefore, the fact that the *quilombola* communities of Caldeirão (56.8), Boa Vista (37.3), Siricari (26.1) and Vila União (19.2) have presented the highest incidence rates in relation to other communities and the municipality of Salvaterra (19.0) itself, shows that they are more exposed to the risk of infection by SARS-COV-2. This situation is due to the conjunction of sanitary, demographic, geographical and income production characteristics of them, that is aggravated by the low coverage of the governmental income transfer program for vulnerable populations (SESPA).

The adverse epidemiological scenario in Salvaterra was also observed in the municipalities of Santarém, Cametá and Mojú, in the state of Pará, which have a large number of *quilombola* communities in similar socioeconomic situations, suggesting the establishment of a recurrent pattern of intense social production of the disease among those populations, whose poverty is the biggest risk factor (IBGE).

However, although some communities did not show the pendulum mobility described above as intensively, they were also submitted to exposure to risk factors for infection, due to their practices of directly selling their agricultural production, especially pineapples, to merchants from other municipalities and other states in Brazil.

Conclusions

After considering the analyses of the results obtained, it was evidenced that the occurrence of COVID-19 in the *quilombola* communities of Salvaterra municipality is a complex public health problem, given the geographic, demographic and socioeconomic conditionings those communities face, in light of establishment of the transmission cycles observed for the disease. The epidemiological profile for the disease follows a national trend. Thus, in the areas studied the highest percentage of cases was for individuals of the female gender, who were adults, with low schooling levels, working as small farmers and an outcome of recovery.

The *quilombola* communities in the municipality presented different epidemiological scenarios for COVID-19, which reflect various levels of occurrence for the disease related to the exposure of their inhabitants to risk factors for the disease, such as socioeconomic characteristics, distance and access by communities to the municipal seat and their forms of selling agricultural production, which led to a non-homogeneous distribution of the disease in the areas studied. That being the case, agglomerations of cases were observed above all along highways or close to them.

The spatial analysis tools used in this study were satisfactory for constructing epidemiological scenarios for COVID-19 in Salvaterra. Therefore, considering the results obtained, there is a clear need for intensifying epidemiological surveillance actions in *quilombola* communities in the municipality, especially where socioeconomic factors were observed to create vulnerability to the disease.

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