




ORIGINAL


## Epidemiological analysis of COVID-19 cases in city in the South of Ceará

Análise epidemiológica dos casos de covid-19 em um município da região sul do Ceará  
Análisis epidemiológico de los casos de COVID-19 en una ciudad de la región sur de Ceará

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### ABSTRACT

**Objective:** To analyze epidemiological indicators regarding COVID-19 cases and the effect of the decrees instituted in a city in the South of Ceará. **Methods:** Epidemiological and descriptive survey, structured using secondary data about COVID-19 notified to the City Health Secretariat at Caririçu, Ceará, from May 2020 to April 2021. The records of notification and the municipal decrees related to COVID-19 were analyzed. **Results:** It was found that, during the period indicated, the city of Caririçu notified 2,974 cases that are suspected of COVID-19. From these, 32.25% (n=959) were confirmed and 66.01% (n=1,963) were discarded. From the confirmed cases, 46.40% (n=911) patients recovered, and a total of 3.02% (n=29) deaths from the disease were registered. During the same period, 19 decrees regarding the struggle against COVID-19 were issued. **Conclusion:** It was possible to see a growing number of confirmed cases, even with the prorogation of the decrees, showing the need to constantly evaluate actions to prevent, control, and confront the disease. **Descriptors:** Epidemiology. Disease Notification. Covid-19. Epidemiology, Descriptive.

### RESUMO

**Objetivo:** Analisar indicadores epidemiológicos acerca dos casos da COVID-19 e o efeito dos decretos instituídos em um município da região sul do Ceará. **Métodos:** levantamento epidemiológico e descritivo, estruturado a partir de dados secundários relativos à COVID-19, notificados à Secretaria Municipal de Saúde de Caririçu, Ceará, no período de maio de 2020 a abril de 2021. Foram analisados os registros de notificação, como também os decretos municipais relacionados à COVID-19. **Resultados:** identificou-se que no período estabelecido o município de Caririçu notificou 2.974 casos suspeitos de COVID-19. Destes, 32,25% (n=959) foram confirmados e 66,01% (n=1.963) foram descartados. Dos casos confirmados, 46,40% (n=911) foram recuperados, sendo registrado um total de 3,02% (n=29) óbitos pela doença. Nesse mesmo período foram publicados 19 decretos em alusão ao enfrentamento da COVID-19. **Conclusão:** foi possível observar um crescente número de casos confirmados, mesmo com a prorrogação dos decretos, refletindo a necessidade de realizar avaliação constante das estratégias de prevenção, enfrentamento e controle da doença. **Descritores:** Epidemiologia. Notificação de doenças. Covid-19. Epidemiologia Descritiva.

### RESUMÉN

**Objetivo:** Analizar indicadores epidemiológicos acerca de los casos de COVID-19 y el efecto de los decretos instituidos en una ciudad de la región sur de Ceará. **Métodos:** Encuesta epidemiológica y descriptiva estructurada utilizando datos secundarios relativos a la COVID-19, notificados a la Secretaría Municipal de Salud de Caririçu, en Ceará, desde mayo de 2020 hasta abril de 2021. Se analizó los registros de las notificaciones y los decretos municipales relacionados a la COVID-19. **Resultados:** Se identificó que, en el período elegido, la ciudad de Caririçu registró 2.974 casos sospechosos de COVID-19. Se confirmaron 32,25% (n=959) y se descartaron 66.01% (n=1.963). De los casos confirmados, se recuperaron 46,40% (n=911), de manera que se registraron 3,02% (n=29) muertes por esa enfermedad. En el mismo período, se publicaron 19 decretos relativos al esfuerzo contra COVID-19. **Conclusión:** Fue posible observar un creciente aumento en el número de casos confirmados, mismo con la prorrogação de los decretos, reflejando la necesidad de evaluar a todo tiempo las estrategias de prevención, combate y control de la COVID-19. **Descriptor:** Epidemiología. Notificación de Enfermedades. Covid-19. Epidemiología Descriptiva..

## INTRODUCTION

In the end of 2019, in Wuhan, China, the first cases of a pneumonia of unknown origin emerged. Later, it was associated with a new type of coronavirus, called SARS-CoV-2, responsible for the infectious disease COVID-19, which, ever since, has been the main topic in the field of health throughout the world.<sup>(1)</sup>

As the number of countries affected grew, the World Health Organization (WHO) declared it a public health emergency of international concern (PHEIC), since more than 110 thousand cases and 4 thousand deaths in countries from all continents were notified. The COVID-19 pandemic was declared by the WHO in March 2020.<sup>(1)</sup> In Brazil, in the same period, the community spread of the SARS-CoV-2 disease in the entire national territory was confirmed.<sup>(2)</sup>

COVID-19 is a highly infectious disease, whose manifestation can vary from asymptomatic cases or mild clinical signs up to moderate, severe, and critical cases, compromising respiratory capacity. In Brazil, until August 22, 2021, the disease had caused 574,527 deaths, a mortality rate of 274.4/100 thousand people.<sup>(2)</sup>

Considering these significant mortality rates, preventive measures were adopted to decelerate its spread, including individual actions, such as hand washing, alcohol gel use, and respiratory etiquette, as well as community measures, such as social isolation and, more recently, vaccination.<sup>(3)</sup>

The main strategies adopted to contain the advance of the disease were social isolation and the closing of so-called non-essential activities, measures aimed at interrupting the virus transmission chain, thus avoiding the collapse of health systems.<sup>(4)</sup>

It should be highlighted that, although social isolation has reduced new cases, it is always challenging to determine when to put this type of measure into practice, since, when it is implemented too early, it can lead to economic problems. On the other hand, their late implementation, after the disease spreads, can limit its beneficial effects for public health.<sup>(3)</sup>

The work developed by epidemiological monitoring is essential to identify the right moment to implement community measures such as social isolation. Its objectives include finding and identifying as early as possible all COVID-19 cases, monitoring the clinical and epidemiological characteristics of the SARS-CoV-2 cases, in addition to screening, monitoring, and isolating (quarantine) cases of SARS-CoV-2, as well as those who came in contact with the disease, so control and prevention measures can be established.<sup>(2)</sup>

These measures aim to reduce the transmission of the virus, retarding the spread of the disease and reducing its peak, so the health system has time to coordinate and provide adequate care, medication, and vaccines that can be used in a later stage.<sup>(5)</sup>

Considering the above, the following questions emerge: What is the epidemiological situation concerning COVID-19 in a city in the South of Ceará? What is the effect of measures to fight against

COVID-19 applied in this city during the analyzed period?

Considering the importance of epidemiological monitoring and the preventive actions adopted by these services, such as the social isolation established by municipal decrees, this study is justified by the need to know the epidemiological situation of COVID-19 cases, especially those of a small town inland Ceará, where there are few resources allocated to health, making it harder to control and deal with the disease.

As a result, the objective of this study is to analyze epidemiological indicators regarding COVID-19 cases and the effect of the decrees put into effect in a city in the South of Ceará.

## METHOD

Cross-sectional, descriptive, retrospective, and epidemiological-ecological document-based study, structured using secondary data about COVID-19 notified to the Municipal Secretariat of Health (MSH) from Caririáçu, Ceará, from May 2020 to April 2021, a total of 12 months.

The city of Caririáçu is in the Cariri region, in the south of Ceará, 22km to the northwest of Juazeiro do Norte-CE, the largest city in the region. According with the *Instituto Brasileiro de Geografia* (IBGE), the city has 637.4 km<sup>2</sup> and had 26,987 residents at the time of the last census, in 2020, indicating a demographic density is of 42.3 inhabitants per km<sup>2</sup>.<sup>(6)</sup>

The city was chosen to be analyzed in regard to the pandemic due to the fact it is a small city, with the lowest Human Development Index in the Cariri region, 0.578, an HDI that, according with the *i* - IPECE, is considered to be low.<sup>(6)</sup>

Data collection was carried out in May 2021 by two researchers, using a checklist created by the authors based on notification reports and on municipal decrees related to COVID-19 in the Municipal Information Bulletin and in the municipal diaries contained in the site of the Mayor's Office from May 2020 to April 2021. This was aimed to describe the incidence of COVID-19 cases in the city, their mortality, lethality, and the calculation of daily mean number of hospitalizations as well as its moving average.<sup>(7-8)</sup>

Thus, the variable analyzed were: number of confirmed COVID-19 cases in the city, number of confirmed deaths, number of recoveries, and number of suspected cases that were since then discarded, as well as the number of notified cases and the number of hospitalizations due to the disease.

The checklist used is not a validated instrument, since the construction of this study used only the information related to COVID-19 that was present in the records of notification and in the municipal decrees from Caririáçu-CE to reach its objective.

Inclusion criteria were the records of compulsory notifications of residents of Caririáçu, Ceará, and the municipal decrees related to COVID-19 from May 2020 and April 2021; documents that were not available for access were excluded.

As a result, the population of the study was composed by 2.974 notified COVID-19 cases in individuals who lived in the city of Caririáçu, Ceará. For calculation, demographic data available in the IBGE website, regarding the estimated population for 2020.<sup>(6)</sup>

Data were organized in Microsoft Excel 2013, where we analyzed the number of confirmed, recovered, discarded, and notified cases per month, as well as deaths. Later, the incidence, mortality, and lethality rates for the entire period (12 months) were calculated.

To characterize COVID-19, we carried out an epidemiological analysis using descriptive statistics (absolute and relative frequencies).<sup>(7)</sup> The calculation was carried out as indicated in Figure 1:

**Figure 1** - Formula for the calculation of the epidemiological coefficient. Caririáçu, CE, Brazil. 2021.

**Incidence of COVID-19 cases**

$$\frac{\text{Number of confirmed cases in Caririáçu}}{\text{Total population X 100 thousand residents}}$$

**Mortality of COVID-19 cases**

$$\frac{\text{Number of confirmed deaths in Caririáçu}}{\text{Total population X 100 thousand residents}}$$

**Lethality of COVID-19**

$$\frac{\text{Number of deaths caused by the disease}}{\text{Total confirmed cases X 100}}$$

**Source:** Created by the authors.

Furthermore, we analyzed the social distancing decrees published since the beginning of the pandemic until April 2021, to present the measures to confront COVID-19 adopted in the municipality. All decrees from the Caririáçu Mayor's Office are published in the Municipal Official Gazette (MOG).<sup>(8)</sup>

Data were described and presented in graphs that show the epidemiological curve for the time frame of the study.

This study required no approval from the Research Ethics Committee, as it used only secondary public data. All data used are available for access and public use in the Daily Municipal Gazette issued by Caririáçu Mayor's Office. They do not allow for the identification of the patient, according with Resolution No. 466/2012 from the National Council of Health, which establishes norms and regulating directives for research involving human beings.<sup>(9)</sup>

It stands out that this study was structured according with an instrument of the Equator network: the 22-item list to verify cross-sectional studies from the *Reporting of Observational Studies in Epidemiology (STROBE)*. It is also of note that this research was financed by the *Fundação Cearense de Apoio ao Desenvolvimento Científico-FUNCAP*.

## RESULTS

From May 2020 to April 2021, the SMS Caririáçu notified 2,974 suspected COVID-19 cases. 32.25% of them were confirmed (n=959) and 66.01% were discarded (n=1,963) (Graph 1).

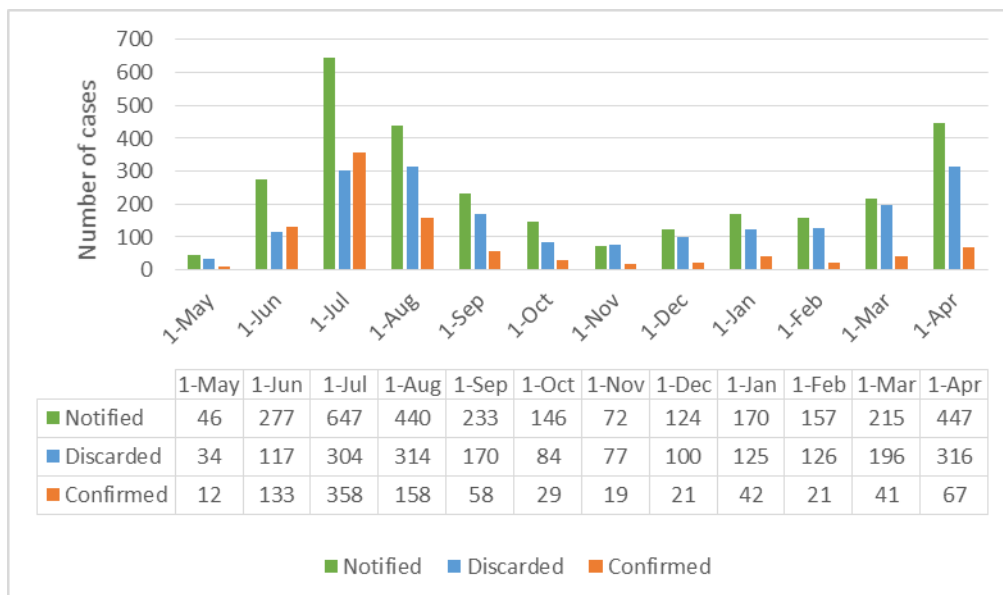
It stands out that, although the number of notified cases is the same as the sum of confirmed cases with the number of discarded cases, the data provided by municipal gazettes is divergent, and the values presented as notified cases are not in accordance with the calculation. As a result, this could be considered to be a bias of this study.

From the confirmed cases, 911 patients recovered, and a total of 3.02% (n=29) deaths from the disease were registered (Graph 2). The incidence of confirmed cases in the period was 3,553.56 cases/100 thousand people, and the mortality rate was 107.46 deaths/100 thousand residents. Its lethality was 3.02%.

Graph 3 shows that the increase in the number of infected individuals was directly proportional to the increase in the number of hospitalizations by the disease. However, this result has been changed at the end of the period analyzed, and there was an expressive increase in the number of hospitalizations in March and April 2021, though the increase was less pronounced in regard to confirmed cases.

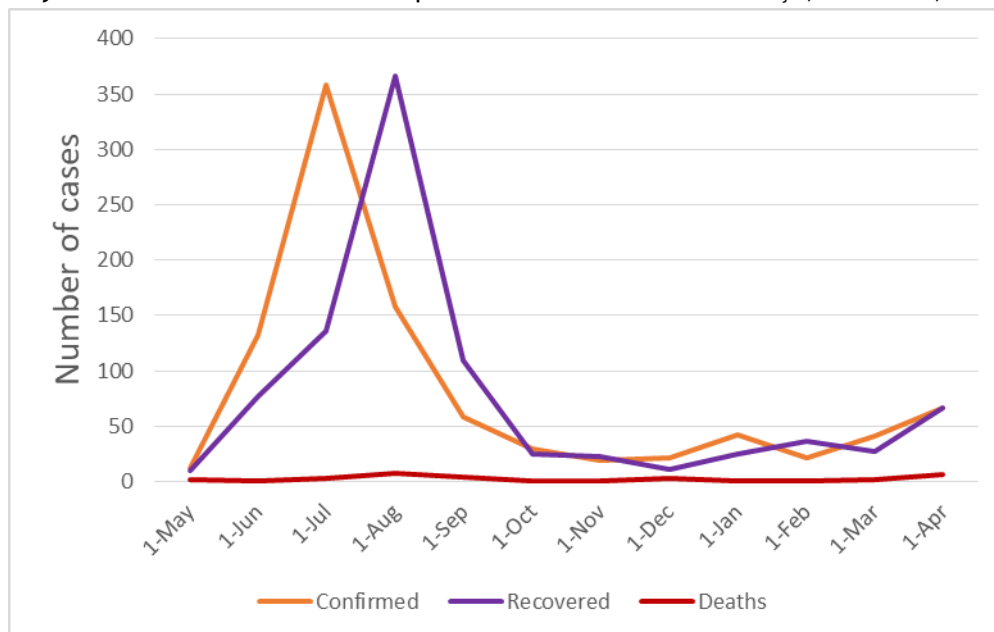
Regarding measures to contain the pandemic in Caririáçu, 19 municipal decrees (Table 1) were published during the period analyzed, which included the measures to confront COVID-19, such as: social distancing, prohibition of events and/or collective activities that lead to crowding, suspension of classes, closing of bars and restaurants, among other private establishments.

**Graph 1** - Distribution of the number of notified, discarded, and confirmed COVID-19 cases. Caririaçu, CE, Brazil. 2021.



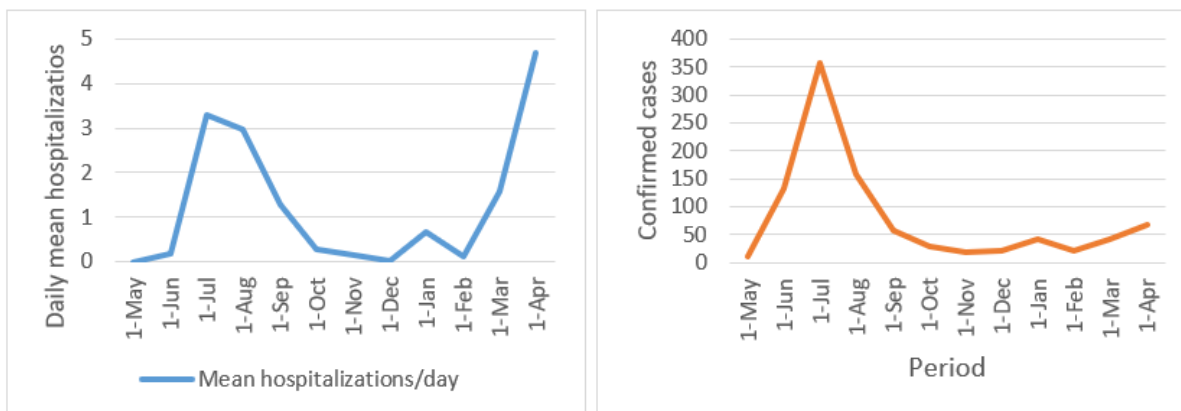
Source: Municipal epidemiological bulletin. Elaborated by the authors

**Graph 2** - Epidemiological curve of confirmed cases, recoveries, and deaths from COVID-19, from May 2020 to April 2021. Caririaçu, CE, Brazil. 2021.



Source: Municipal epidemiological bulletin. Elaborated by the authors

**Graph 3** - Curves in the daily mean of hospitalizations and in the number of confirmed COVID-19 cases. Caririaçu, CE, Brazil. 2021.



Source: Municipal epidemiological bulletin. Elaborated by the authors

**Table 1 - Decrees related to measures to confront COVID-19 in the city of Caririaçu, CE, Brazil. 2021.**

Document	Publication	Objective
Decree nº 06/2020 <sup>(10)</sup>	March 17, 2020	Measures to confront COVID-19 in the municipality.
Decree No. 08/2020 <sup>(11)</sup>	March 24, 2020	New measures to confront COVID-19. Regulates the working hours of public buildings, banks, lottery services, and other bank correspondents.
Decree No. 09/2020 <sup>(12)</sup>	March 30, 2020	Prorogates decree No. 06/2020, decree No. 08/2020, establishes criteria to put in effect the social program prescribed in municipal law No. 508/2011, in addition to other provisions.
Decree No. 11/2020 <sup>(13)</sup>	April 06, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 12/2020 <sup>(14)</sup>	April 07, 2020	A public catastrophe state is declared for all legal ends in the municipality.
Decree No. 14/2020 <sup>(15)</sup>	May 06, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 16/2020 <sup>(16)</sup>	May 21, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 17/2020 <sup>(17)</sup>	June 01, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 19/2020 <sup>(18)</sup>	June 09, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 21/2020 <sup>(19)</sup>	June 22, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 25/2020 <sup>(20)</sup>	July 20, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 28/2020 <sup>(21)</sup>	August 03, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 29/2020 <sup>(22)</sup>	August 10, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 30/2020 <sup>(23)</sup>	August 17, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 35/2020 <sup>(24)</sup>	September 07, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 36/2020 <sup>(25)</sup>	September 17, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 37/2020 <sup>(26)</sup>	September 21, 2020	Prorogates the measures to confront COVID-19 in the municipality.
Decree No. 13/2021 <sup>(27)</sup>	March 12, 2021	Ratifies the state decree No. 33.980, which softens the rigid social isolation in all cities in the state of Ceará.
Decree No. 15/2020 <sup>(28)</sup>	March 22, 2021	Prorogates the rigid social isolation as a necessary measure to confront the COVID-19.

**Source:** Official Gazette from the municipal administration of Caririaçu, Ceará. Elaborated by the authors

## DISCUSSION

The first confirmed SARS-CoV-2 case in Caririaçu took place in April 26, 2020, a little over one month after the first case of the disease was registered in the city of Ceará, with the first death being recorded 14 days after the disease was confirmed for the first time. From March to May, the month of the first COVID-19 death in the city, 6 decrees to combat COVID-19 had already been issued and the functioning of public offices had already been reorganized. Still, the number of notifications was growing. Effective social distancing measures require the simultaneous adoption of social protection policies for the most vulnerable segments of the population. These measures are essential due to social inequality and poverty, and to the large size of the Brazilian population (41.3%) who works in the

informal job market and live in poor housing conditions.<sup>(29)</sup>

In the time frame studied, the SMS at Caririaçu confirmed 959 cases of COVID-19 and 29 deaths caused by the disease. If we compare these cases with those in the state of Ceará, where, from the beginning of the pandemic until May 01, 2021, there were 691,545 confirmed cases of COVID-19 with 18,354 deaths, we will see that the lethality found in Caririaçu, 3.02%, was higher than that from the state, which was 2.6%.<sup>(30)</sup>

This piece of data is in accordance with a study<sup>(31)</sup> that shows that Brazilian mean COVID-19 lethality coefficients are 48%, and these are even higher in the Northeast of the country due to social inequalities. It is worth mentioning that delays in

exam results and undernotification of the disease may influence these values.

There has been an important growth of cases in July 2020, as well as a higher death rate from the disease in the next month. These data may reflect the unpreparedness and overload of the public health system. The expressive increase of cases in July may have overloaded health services in the city, compromising the assistance.

Corroborating this information, studies<sup>(31),(32)</sup> have stated that the high number of coronavirus cases increases the demands to the system and contributes for its saturation, complicating attention and follow up and leading to the emergence and worsening of clinical comorbidities.

In 2020, the months from June to August showed the highest number of hospitalizations due to the expressive increase in the number of COVID-19 cases. It is also of note the poor situation of hospitals far from the large cities in regard to health services and their preparedness to attend to a demand of severe cases.

A study<sup>(33)</sup> from Piauí, also in the Northeast of the country, had a similar result, showing that mortality increased with the percentage of cases that needed intensive care and invasive procedures.

These data are in accordance with the data from the Cariri macro-region of health, where Caririáçu is located, since the region registered its highest number of confirmed cases of COVID-19 in July 2020, totaling 64,662 confirmed cases and 1,266 until the end of 2020 (30).

These months, critical for the health system of the region, exposed the need to strengthen public health, the omissions in the elaboration of infrastructures, and the low investments on health that small cities have to deal with, which substantially worsens the treatment they can offer.

There has also been an expressive increase in the number of hospitalizations from March to April 2021, which is not directly proportional to the number of cases confirmed in the same period. This can lead to a worsening of the state of those already affected and be related with the measures to combat the disease, which were softened from October to March.

The last municipal decree issued in this period was in September 21, 2020, with another coming only in March 12, 2021, showing a long period in which the measures were more flexible.

Studies<sup>(34),(35)</sup> have shown that the epidemiological situation and the capability of the health system of Northeast capitals to respond were not compatible with the adequate situation to start flexibilization. The number of cases and the rates of incidence, as well as the number of deaths and mortality rates, did not show a consistent decreasing trend. This earlier beginning of flexibilization is not in accordance with WHO recommendations.

Many cities in Ceará followed the measures against COVID-19 according with the state decrees. However, often, the reality far from urban centers is different from that of large cities, and it is necessary for the municipal administration to deal with adversities from the pandemic, requiring autonomy

to carry out local interventions according with the demands and peculiarities of each municipality.<sup>(33)</sup>

A study<sup>(28)</sup> showed that, during this period of flexibilization, the disease advanced faster in the capitals. However, the disease had an accumulated growing trend far from these centers, especially in the states of Alagoas, Ceará, Maranhão, and Paraíba, indicating that the pandemic was becoming stronger in cities more distant from the great urban centers.

The municipal administration had to make constant and fast decisions, changing and adapting the measures to combat the disease during the entire period analyzed.

Other studies showed the influence of government decisions in the disease indexes.<sup>(7,31)</sup> The governors of Brazilian states behaved differently in regard to implementing interventions to face COVID-19, with the greatest difference being that some states had more rigorous social distancing measures.<sup>(35)</sup>

During the months analyzed, 19 decrees with measures to face the COVID-19 in the city were issued; however, the data is not in accordance with this fact. This shows the need for surveillance actions aimed at enforcing the measures decreed. A study carried out in Brazil states that the country became notorious around the world as a place riddled with crowds, where isolation measures were seldom obeyed.<sup>(37)</sup>

This shows the importance of measures to control contamination, to avoid the overload of hospitals and the tendency of increased hospital bed occupation.

A study from the city of Caxias-MA showed that, in the beginning of the pandemic, the number of access of the disease was growing, leading to higher demand for health services. As a result, it was necessary to increase the number of beds, especially for the intensive care of patients infected by the coronavirus.<sup>(38)</sup> Unfortunately, some regions did not have these resources.

The hardships the city of Caririáçu faced when dealing with the pandemic are similar to those of many other small cities, where there are little resources for health and a structure insufficient for the demands of the pandemic of coronavirus - both things unequally distributed throughout the country.

Studies show that nearly 74.9% of the population who depends exclusively on SUS do not have any ICU beds in the region they live in, showing how poor this system is, in addition to the excessive number of deaths during the COVID-19 pandemic, undernotification and the regional inequalities in Brazil.<sup>(33,39)</sup>

A detailed description of the confirmed COVID-19 cases is essential to identify the behavior of the pandemic and to discover which population groups are the most vulnerable.<sup>(40)</sup> However, this information was limited in the epidemiological bulletins mentioned, making it impossible to evaluate the age group and the sex that were more affected in the city, since this information was not available.

Moreover, the analysis this study presents may be compromised due to certain factors, such as: delays in the record of cases in the official notification systems, health demands such as the closing of

health units in holidays or weekends, in addition to delays in the availability of exam results.

Additionally, the analysis of information provided by epidemiological bulletins can contribute for government efforts to create plans to deal with the disease, allowing a panoramic view of the evolution and advance of the pandemic in this municipality.

It may also help indicating the fragilities in the organization of epidemiological data and health activities in the city, especially in regard to more specialized services, providing subsidies to reevaluate the strategies to confront the pandemic and potential public health emergencies.

## CONCLUSION

An epidemiological analysis of the COVID-19 cases and the decrees instituted by the municipality in the city of Caririáçu allowed us to know the epidemiological data from May 2020 and April 2021. It can be noticed that the highest number of contaminations by the virus took place in July 2020, and that the months with the highest number of deaths by the disease were August 2020 and April 2021.

The number of confirmed cases were increasing, despite the prorogation of the decrees, due to the highly infectious nature of the virus and to the preventive actions, such as social isolation. This led to the collapse in the health system, especially in small cities such as the one under study here.

Furthermore, since this is an emerging disease, it is essential to follow up its evolution so new strategies of prevention and control can be proposed. To that end, broader epidemiological data should be made available to allow us to get to know better the behavior of its epidemic curve and its indexes. Therefore, governments and health managers must be attentive to epidemiological indexes and constantly evaluate strategies to prevent and control COVID-19, considering the several health-disease processes and the singularities of the population being considered.

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