ORIGINAL ARTICLE

Historical series of cases of COVID-19 in brazilian regions in the year of 2020

Série histórica de casos de COVID-19, nas regiões brasileiras no ano de 2020

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Abstract

Aim: To analyze the incidence and lethality of COVID-19 in Brazil, through a historical series. **Methods**: Retrospective ecological study carried out by analyzing biweekly time series with secondary data from Brazilian regions and states, was on the state and integral health sites of the State of Health and IntegraSUS, related to SARS-CoV disease, from March to May 2020. **Results**: All states showed an increasing incidence trend, except Ceará. The highest lethality found was from Piauí. However, in the last analyzed period, the states of Rio de Janeiro, Pernambuco, São Paulo and Ceará stood out. The North had an increased incidence in relation to the others and the Southeast had the highest lethality rate. **Conclusion:** There was an increasing trend in incidence in all states, except Ceará. Piauí had the highest lethality coefficient. Considering the regions, the North showed an increasing trend in incidence and lethality was higher in the Southeast.

Key words: COVID-19; Coronavirus; Incidence; SARS-CoV; Lethality.

Resumo

Objetivo: Analisar a incidência e letalidade do COVID-19 no Brasil, por meio de uma série histórica. **Métodos**: Estudo ecológico, retrospectivo, realizado mediante a análise de séries temporais quinzenais com dados secundários de regiões e estados brasileiros. Os dados foram coletados nos sites das secretarias de saúde estaduais e no IntegraSUS, relacionados à doença SARS-CoV, de março a maio de 2020. **Resultados:** Todos os estados apresentaram uma tendência crescente de incidência, exceto o Ceará. A maior letalidade encontrada foi no Piauí. No entanto, no último período analisado, destacaram-se os estados do Rio de Janeiro, Pernambuco, São Paulo e Ceará. O Norte teve maior incidência em relação aos demais e o Sudeste, a maior taxa de letalidade. **Conclusão**: Houve uma tendência crescente de incidência em todos os estados, exceto no Ceará. O Piauí apresentou o maior coeficiente de letalidade. Considerando as regiões, o Norte mostrou uma tendência crescente de incidência e a letalidade foi maior no Sudeste.

Palavras-chave: COVID-19; Coronavírus; Incidência; SARS-CoV; Letalidade.

BACKGROUND

At the end of 2019, an unknown virus emerged, which soon became known as the new coronavirus or COVID-19[1]. This acronym originated from the combination of the words Corona, Viruses and Disease, associated with the year of its appearance. The pandemic started in the city of Wuhan, in the province of Hubei in China, and soon spread to the Chinese population and the world[2].

Coronaviruses cause respiratory infections, and seven types of pathogens in humans are currently identified. Two of them (SARS-CoV and MERS-CoV) are responsible for Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome, respectively[3,4]. These are on the list of priority clinical conditions for research and development in the emergency context[5].

Making a comparison of the magnitude of lethality among the cases of influenza SARS reported in Brazil in the years 2018 and 2019 was approximately 20%[6]. However, until now, lethality by SARS-CoV-2 has mainly affected elderly people and / or those who presented comorbidities that affect the immune system[7]. However, there are still no robust data on the course of the disease because of the scarcity of clinical articles that address its evolution, and an ideal and adequate reporting system.

Brazil presents a territory and population with an enormous quantity, besides being a tourist destination for its natural beauty. These qualifications make it an easy target for pandemics.

Given the afore mentioned context, several questions arose: how is the behavior of the pandemic in the Regions of Brazil? What is the incidence of the disease by the state? What is the lethality coefficient of the disease in Brazilian states? Is the pandemic on the rise or has it declined?

Based on the premise that few articles survey the incidence rate and coefficient of lethality in Brazil, and the importance

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Received: 2020 Jul 24; Revised: 2020 Aug 4; Accepted: 2020 Aug 11

Conflict of interest: The authors declare that there are no conflicts of interest, according to the attached document.

of having this survey, since the data will no longer be made available cumulatively and from the various concerns and doubts, there was an interest in analyzing the panorama of this pandemic by Brazilian states and regions, aiming to be a means of disseminating the real epidemiological scenario in Brazil, and this article can serve as a strategic basis for decision-making in the prevention of health problems, and measures to control this pandemic, assessing whether the measures taken are being effective in the appearance of new cases or the number of deaths from the disease.

Therefore, the aim was to analyze the coefficients of incidence and lethality of COVID-19 in Brazil, through a historical series in the year 2020.

METHODS

An ecological, descriptive, retrospective study was developed, made up from the analysis of biweekly time series with secondary data were on the websites of the Health Departments of each State, integrating SUS and Fiocruz related to the disease SARS-CoV (new coronavirus) in Brazil, for the period from March to May 2020, with chosen dates (March 1st, 15th and 30th, April and May 15th and 30th, with 30th of May being the last day of collection for writing the article). We considered information regarding confirmed cases and the number of deaths by states in all Brazilian regions, including the federal district; regardless of gender and age group.

To calculate the incidence rate and lethality coefficient, we decided to perform an Excel® spreadsheet, after which we organized a calculation formula, following the one recommended by PAHO[8], as shown below.

$$\text{Incidence Rate} = \frac{\text{Number of new cases that occurred in a place X in a given time}}{\text{Total number of individuals in the base population (at risk) of place X at a given tim}} \times 10^{n*}$$

* used as population base 100,000 inhabitants or n=5.

$$\text{Lethality coefficient} = \frac{\text{ıths due to COVID-19 disease in a given community and time}}{\text{COVID-19 disease cases in the same area and time}} \times 100$$

It is noteworthy that to perform the calculation of this rate; we used the demographic data provided by the 2010 Census on the website of the Brazilian Institute of Geography and Statistics. First, we analyzed the incidence rate and the lethality coefficient per state. Then, the behavior of the incidence rate and the lethality coefficient by regions was evaluated, therefore, the sum of confirmed cases, deaths and population quantity by region was necessary.

We presented the data in the form of graphs showing the trend curve for each region.

RESULTS

Initially, the data reported by the state was used, creating a series of stories about incidence and lethality, as shown in Tables 1 and 2.

Table 1. Historical series of the incidence rate of COVID-19 by Federation Units, Brazil, 2020

States	Incidence					
	March 15th	March 30th	April 15th	April 30th	May 15th	May 30th
Acre	0	6,41	8,72	48,53	180	584,41
Alagoas	0,032	0,58	2,08	36,56	64	192,63
Amapá	0	1,2	49,89	110,23	381	848,81
Amazonas	0	4,33	40,27	106,2	377	636,28
Bahia	0,064	1,19	5,05	14,15	38	67,76
Ceará	2,32	26,67	53,18	87,73	335	66,86
Distrito Federal	0,31	11,82	14,63	28,6	77	236,64
Espírito Santo	0,51	3,35	29,67	71,47	163	120,49
Goiás	0,07	0,93	4,06	7,94	13	33,53
Maranhão	0	0,47	10,1	42,75	123	350,54
Mato Grosso	0	0,59	4,38	4,97	16	53,41
Mato Grosso do Sul	0,08	1,71	3,14	5,47	9	38,34
Minas Gerais	0	1,33	3,27	4,71	12	27,73
Pará	0	0,28	6,15	33,13	127	332,84
Paraíba	0	0,45	3,92	20,2	75	242,21
Paraná	0	1,53	6,28	5,66	7	22,35
Pernambuco	0	0	16,87	61,3	106	195,74

States	Incidence					
	March 15th	March 30th	April 15th	April 30th	May 15th	May 30th
Piauí	0	0,58	2,34	16,32	48	91,27
Rio de Janeiro	0,62	8,25	36,51	44	36	202,83
Rio Grande do Norte	0	2,59	10,04	28,31	54	138,82
Rio Grande do Sul	0,16	2,85	4,8	9,16	18	51,81
Rondônia	0	0,51	4,16	27,46	83	188,75
Roraima	0	3,55	27,97	83,69	262	393,58
Santa Catarina	0,1	3,41	10,64	24,17	35	67,51
São Paulo	0	3,68	23,09	42,79	72	118,18
Sergipe	0	0	2,32	19,58	117	190,38
Tocantins	0	0,79	1,3	9,76	73	202,54

Source: GOUVEIA, et al., 2020.

Table 2. Historical series of the lethality coefficient by COVID-19 by Federation Units, Brazil, 2020.

Sates	Lethality					
	March 15th	March 30th	April 15th	April 30th	May 15th	May 30th
Acre	0	0	6,31	2,78	3,19	2,34
Alagoas	0	5,26	8,33	5,55	5,82	4,59
Amapá	0	0	2,05	3,15	2,84	2,31
Amazonas	0	0,66	6,82	8,09	7,24	5,05
Bahia	0	0,57	2,17	3,7	3,46	3,62
Ceará	1	0,94	2,65	4,78	5,1	6,2
Distrito Federal	0	0,32	2,47	2,11	1,62	1,71
Espírito Santo	0	5,84	5	4,01	5,02	4,42
Goiás	0	1,67	4,27	3,71	4,26	3,4
Maranhão	0	3,23	5,32	5,82	4,52	2,76
Mato Grosso	0	0	2,65	3,64	3,28	2,4
Mato Grosso do Sul	0	0	3,3	3,53	2,92	1,34
Minas Gerais	0	0,38	3,32	4,49	3,48	2,73
Pará	0	0	4,31	7,47	9,31	7,71
Paraíba	0	0	14,54	7,23	4,55	2,69
Paraná	0	1,88	5,02	6,11	5,66	4,05
Pernambuco	0	0	9,64	8,22	8,52	8,19
Piauí	0	22,22	8,79	4	3,12	3,26
Rio de Janeiro	2,02	11,35	11,28	9,34	12,19	10,07
Rio Grande do Norte	0	1,22	5	4,32	4,53	4,12
Rio Grande do Sul	0	1,55	2,63	3,3	3,56	2,36
Rondônia	0	12,5	2,74	3,19	3,46	3,18
Roraima	0	0	2,11	1,35	2,88	3,34
Santa Catarina	0	0,46	3,28	2	1,73	1,55
São Paulo	0	6,79	7,04	8,28	7,71	7,03
Sergipe	0	0	8,33	3,09	1,74	2,19
Tocantins	0	0	3,45	1,83	2,03	1,78

Source: GOUVEIA, et al., 2020.

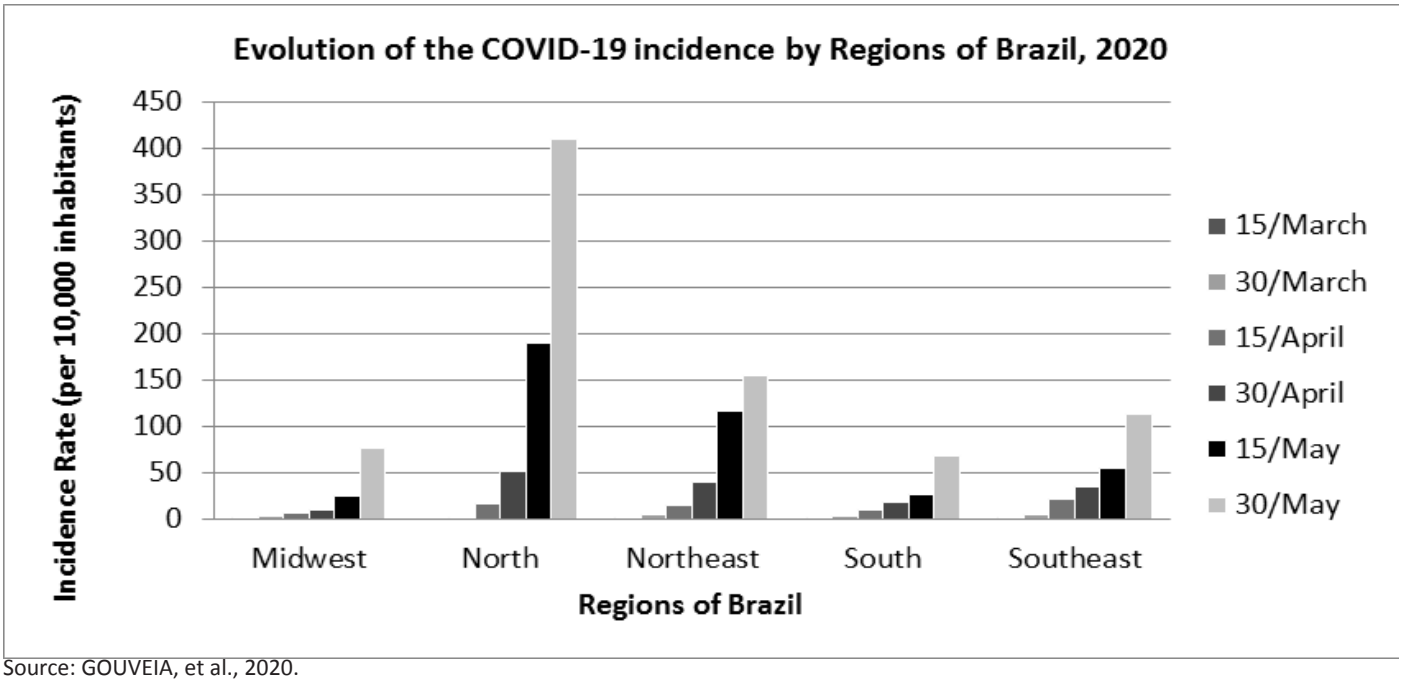
When analyzing the data described, we can see the highest incidence in the states of Amapá (848.81), Amazonas (636.28) and Acre (584.41), calculated for 05/30, which is worrying for pointing out a growing trend of contamination. The only state that showed a decrease in incidence rates was Ceará and this occurred between the 15th and the 30th of May, showing a reduction of almost 80%, which may show the effectiveness of the measures to control the epidemic.

As for lethality, we observe it that it reached top levels in Piauí, on March 30, however, this was probably because of the small number of confirmed cases and that this probably referred to the most serious cases. In the last analyzed period, the states of Rio de Janeiro, Pernambuco, São Paulo and Ceará had the highest lethality rates.

Then, the evolution of the incidence rate of COVID-19 by regions of Brazil was analyzed, as illustrated in Figure 1. It is possible to observe a growing trend more intense in the northern region, reinforcing the gravity of the situation in that region.

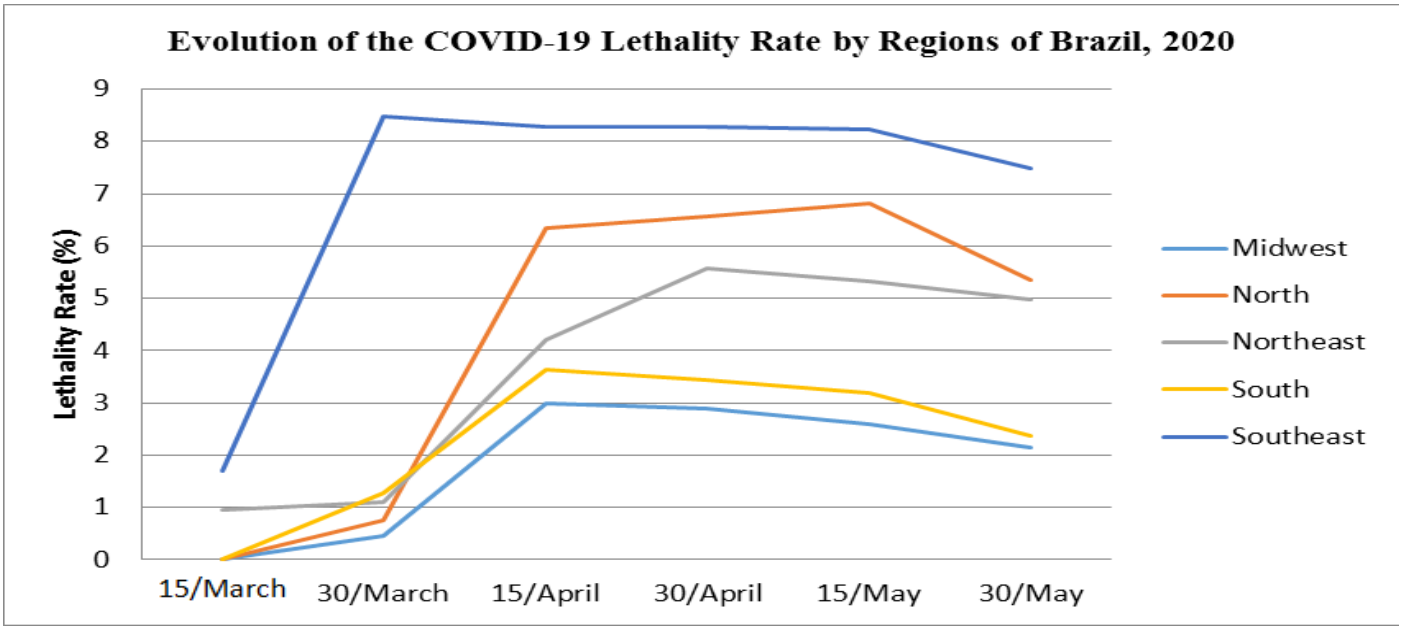
When analyzing the lethality rate by regions, the highest rates were observed in the Southeast region (7.48%), however, all regions have shown a decreasing trend, as shown in figure 2.

Figure 1. Temporal evolution of the incidence of COVID-19 by Regions of Brazil, Brazil, 2020.



Source: GOUVEIA, et al., 2020.

Figure 2. Evolution of the COVID-19 lethality coefficient by regions of Brazil, Brazil, 2020.



Source: GOUVEIA, et al., 2020.

DISCUSSION

The World Health Organization (WHO) declared on March 11, 2020 that the disease resulting from the new coronavirus would then be considered a pandemic given the number of cases and deaths in the world[9]. On January 30, 2020, he had already declared that the aforementioned disease made up a Public Health Emergency of International Importance (ESPII). Given the predictions of an increase in the number of cases, deaths and the need for urgent and aggressive measures that would need to be taken by the countries, the Pan American Health Organization considered three strategies: detection, screening and isolation of cases diagnosed with the new coronavirus; investments in health services to prepare them for the care of more serious cases and protection of health professionals who would work directly with these patients; and finally, a multisectoral approach to slow transmission[10].

As a result, each country adopted strategies in line with what the WHO recommended preparing for the pandemic in its territory. State and municipal governments launched measures of social isolation as a way of controlling the increase of contagion by the virus, suspending activities in schools, businesses and other services classified as non-essential and restricting public activities and agglomerations. Added to this are the recommendations that the population should be confined to their homes and adopt hygiene measures that involve hand washing and wearing masks[11].

Social isolation measures, especially in the early stages of the pandemic, aim both to reduce the number of contaminations and to decrease the peak demand for health services, especially intensive care. It would be a way to have time to trace the best treatment paths. In cases like this, in which there is the discovery of a new pathogen, one of the initial priorities needs to be the estimation of clinical severity, which needs the correct way of tracing the strategy for investigating new cases and estimating the time evolution of symptoms[12].

According to a publication by the Ministry of Health released in February 2020 (publication prior to confirmation of the first case of coronavirus in the country), because of an emergency that represented the coronavirus problem, it would need to be divided into two phases, containment and mitigation. In the first, the aim would be to prevent the spread of the virus and, mainly, community contamination. The second phase begins, starting from the registration of the first 100 positive cases of the disease. Here, the actions would have a greater focus on prioritizing exams only for more serious cases[13]. However, the document itself emphasizes that the initial plans are based on little or fragile evidence, having to adjust the responses according to a better risk assessment when it can be done with more information and evidence available.

Currently, Brazil is in the mitigation phase, which emphasizes the importance of measures to reduce the occurrence of serious cases and deaths. Some of these strategies, outlined in the previous phase, were home isolation measures and preparing Tertiary Health Care for critical cases[13].

The present research showed that there was a higher incidence of coronavirus in states in the northern region of Brazil, showing an increasing trend of contamination. The State of Ceará (Northeast Region) showed a reduction in incidence rates between May 15 and 30. Another data analyzed in the present study was the evolution of the incidence rate of COVID-19 by regions of Brazil. There was a more intense growing trend in the North, which reinforces the seriousness of the situation in the North of the country.

This specific reduction in the region of Ceará and this increase in states in the Northern Region, need to be analyzed taking into account that social isolation was enacted as a preventive measure on original dates in each state. In addition, the very configuration of this isolation differed from region to region, being more restrictive in some places and for some period. The notification of the first case was also different among the regions, which reflects the difficulty of defining at what stage of the pandemic each state is facing. Another important point is that the number of tests performed is different between states, which may directly affect overestimates or underestimates the incidence. It is also worth noting the great social inequality observed between Brazilian states.

When analyzing the living conditions of the Brazilian population, based on some social indicators, it is possible to see that we observed the greatest vulnerabilities in the North and Northeast regions. All states in these regions had poverty indicators above the national average, while the other states were below. As for the informality of the labor market, the results were similar, being more prominent in the North and Northeast regions. Another data observed was that the states with the lowest incomes were in these regions, the smallest being in Maranhão. In 2018, the North Region had the worst results for the coverage of each of the three basic sanitation services (defined by direct or indirect garbage collection, water supply by the general network, sanitary sewage by collection or rain network)[14].

As for lethality, we observed top levels in the State of Piauí (on March 30). However, in view of the small number of confirmed cases in the region, it can mean reporting only more serious cases. In the last analyzed period, the states of Rio de Janeiro, Pernambuco, São Paulo and Ceará had the highest lethality rates. In relation to this analysis made by regions, even though all of them presented an increasing trend, we saw the highest rates in the Southeast region.

In a survey that compared the effectiveness of coronavirus containment policies in unique countries in South America, IT observed it that countries that adopted emergency policies before the 11th day after notification of the first case had lower rates of lethality and total case growth. Brazil was part of the group that adopted the measures 11 days or more after the

beginning of the cases, the difficulty of decision making with little evidence still available can justify which[15].

However, this supposedly late decision making, when compared to other countries, is reflected differently in each state, both in the number of contaminations and in the demand for health services. The increase in the rate of rising in the contamination curve is proportional to the greater need for intensive care health services in a brief period[16].

It is clear that regions with the worst health indicators are most unable to successfully deal with the pandemic. In addition, according to an analysis carried out in a study that specifically investigated the situation in the Northern region, the existence of an uneven and multifaceted health system is perceived, since the distribution of health services is not done equally among the federative units of Brazil[17].

As already mentioned in the socioeconomic differences between the regions, an important indicator is the distance that the population needs to travel in search of health services.

Through an analysis made on this displacement, it was possible to observe a national average of displacements of 72 km for health services of low and medium complexity. However, there are profound differences in some regions. Manaus (AM) attracts more distant trips (on average, 418 km). The city of Goiânia (GO) attracts the largest number of cities, 115 in total. As for displacements for highly complex treatments, the national average was 155 km. Analyzing in some regions, the North region was 276 km and the Midwest region was 256 km. Three states deserve special mention for presenting averages much higher than the national. Roraima and Amazonas presented 471 and 462 km, respectively, followed by Mato Grosso with 370 km[18].

It is important to understand that the age structure of each region is also different. Unfortunately, there are no recent data, because, because of the current pandemic situation, the Census carried out every 10 years, was postponed to 2021. But, according to data from the last census carried out in Brazil, in the comparative's analysis pyramids of the age groups in the great regions of Brazil, it was evidenced that the Southeast Region, and the South region, had the highest percentage of people over 65 years old. In addition, comparing the last two censuses, an increase in the pyramid's top was observed in Brazil, greater growth of the elderly population, which was 4.8% in 1991, going to 5.9% in 2000 and reaching 7.4% in 2010[19]. This data is relevant, as the elderly population is part of the risk group for the coronavirus pandemic, in which symptoms can present themselves more severely, especially with other associated comorbidities[20], leading this population in need of more specialized health services.

Another issue that can be assessed is the climatic situation of the regions. We made a preliminary analysis of how meteorological issues, such as temperature, humidity and precipitation, affect the spread of COVID-19. The study analyzed the municipalities with the highest number of confirmed cases of coronavirus, being São Paulo, Rio de Janeiro, Brasília, Manaus and Fortaleza. What was concluded is that, even though preliminary data, the temperature and relative humidity need to be considered, since it was initially observed that the transmission rate of COVID-19 in Brazil was favored by higher average temperatures (27.5°C) and intermediate relative humidity (about 80%). However, the authors themselves show the importance of associating these data with the different socioeconomic conditions of the population[21].

There was an increasing trend in the incidence of COVID-19 in all states, except in Ceará, which, in the last analyzed period, showed a decrease in this rate. We found the highest coefficient of lethality in Piauí, on March 30th.

When performing the analysis by regions, the North region stood out for presenting an intense, increasing trend in the incidence rate and lethality was higher in the Southeast region.

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Como citar este artigo/How to cite this article:

Gouveia GPM, Gouveia SSV, VAsconcelos SS, Silva ESM, Medeiros RG, Silva RL Historical series of cases of COVID-19 in brazilian regions in the year of 2020. J Health Biol Sci. 2020 J; 8(1):1-7.