

ORIGINAL ARTICLE

# COVID-19 mortality and lethality in the state of Pará, legal Amazon, Brazil

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## Abstract

**Introduction:** the growth of coronavirus indices in the North region highlights the region's historical social inequalities and the problems in accessing citizenship.

**Objective:** to analyze the mortality and lethality of COVID-19 in the state of Pará, Brazil.

**Methods:** this is an ecological study with a time series design of secondary data. All registered cases and deaths reported by COVID-19 in the period from March 2020 to June 2021, in the state of Pará, Brazil, were considered. The incidence and mortality and lethality rates were used. The daily percentage variation and their respective 95% confidence intervals were estimated.

**Results:** the total number of confirmed cases and deaths from COVID-19 in the state of Pará was 552,937 and 15,469, respectively, from March 2020 to June 2021. Incidence and mortality rates from March 2020 to June 2021 were, respectively, 6,407.9 and 179.3 per 100,000 inhabitants and the lethality was 43.3. Regarding the analysis of the daily trend of rates in the period from March 2020 to June 2021, both mortality and incidence increased.

**Conclusion:** it was found that the behavior of the trend of rates in the first wave was increasing in the incidence of confirmed cases and the lethality decreasing, and in the second wave, the mortality and lethality rates were increasing.

**Keywords:** COVID-19, SARs-CoV-2, mortality, lethality, lockdown, quarantine.

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## Authors summary

### Why was this study done?

The purpose of the study is to analyze temporal variations in mortality and lethality from COVID-19 in the state of Pará, North region, Brazil.

### What did the researchers do and find?

The trend of rates in the first period (March to November 2020) was increasing in the incidence of confirmed cases and lethality decreasing, and in the second period (December 2020 to June 2021), mortality and lethality rates were increasing.

### What do these findings mean?

The contribution of this analysis supports preventive actions, control and treatment, reduction of mortality and definition of priorities within the area of public health.

## INTRODUCTION

In the year 2020, an outbreak of the new Coronavirus in China became an international public health problem. In a short period, a pandemic was declared with different impacts signaled by the World Health Organization (WHO). COVID-19 had a remarkable impact on global economic development, harmed health systems, the political and social field<sup>1</sup>.

Approximately 180 million cases have been registered around the world. South America was recently declared by the World Health Organization as a new epicenter of the SARS-CoV-2 pandemic<sup>2</sup>.

The Unified Health System (SUS), despite the hospital and health crisis, guarantees access to millions of inhabitants, in person and digitally, developing an artificial intelligence system for non-presential care. Despite all measures, the pandemic had a profound impact on the Brazilian population, especially its population in a vulnerable situation, aggravated by the high rate of unemployment<sup>3</sup>. With death records exceeding 500 thousand victims of the disease, the lack of control of the pandemic in the country is worrying<sup>4</sup>. It began in 2021 without effective intervention measures, strategies for health promotion and combating the virus, overloading the hospital system, general beds, and intensive care units (ICU)<sup>5</sup>.

One of the concerns linked to the COVID-19 pandemic refers to the capacity of the health system structure to support the demand for care and treatment of people affected by this disease<sup>6</sup>.

In Brazil, one of the countries most affected by the COVID-19 pandemic, mortality data do not reflect the actual number of deaths from the disease. Between February 23 and August 8, 2020, 46,028 deaths from respiratory causes were recorded in the eight cities (Rio de Janeiro, São Paulo, Manaus, Belém, Fortaleza, Recife, Cuiabá, and Curitiba). The high and heterogeneous percentage of excess respiratory deaths suggests high underreporting of deaths from COVID-19, reinforces regional inequalities and the need to review deaths associated with respiratory symptoms<sup>6,7</sup>.

The growth of coronavirus indices in the North region, therefore, highlights the historical social inequalities of the region and the problems in accessing citizenship<sup>8</sup>.

With few epidemiological studies in the northern region of Brazil, the gaps in information on the epidemiology of COVID-19 show the highest incidence rates of COVID-19 in this region<sup>9,10</sup>. The Northern region took the third place early in the COVID-19 pandemic

outbreak, with confirmed cases at approximately 16% as of May 5, 2020<sup>11</sup>.

In the State of Pará, 4,756 cases were registered, with an incidence rate of 788 cases in 49 days after confirmation of the first COVID-19 infection. The first confirmed case of the disease was reported on March 18, 2020, in the city of Belém, capital of the state. The first notification of death occurred on April 1, 2020, and since then the curve of new cases and incidence of deaths has been frequent and recorded with high rates in the region<sup>11</sup>.

The investigation and characterization of epidemiological aspects, analyzing the temporal variations of COVID-19 mortality and lethality in the North region to understand the disease behavior in the population of the State of Pará, can lead to timely and adequate interventions for the prevention of worse outcomes.

Therefore, the objective is to analyze the mortality and lethality of COVID-19 in the state of Pará, Brazil.

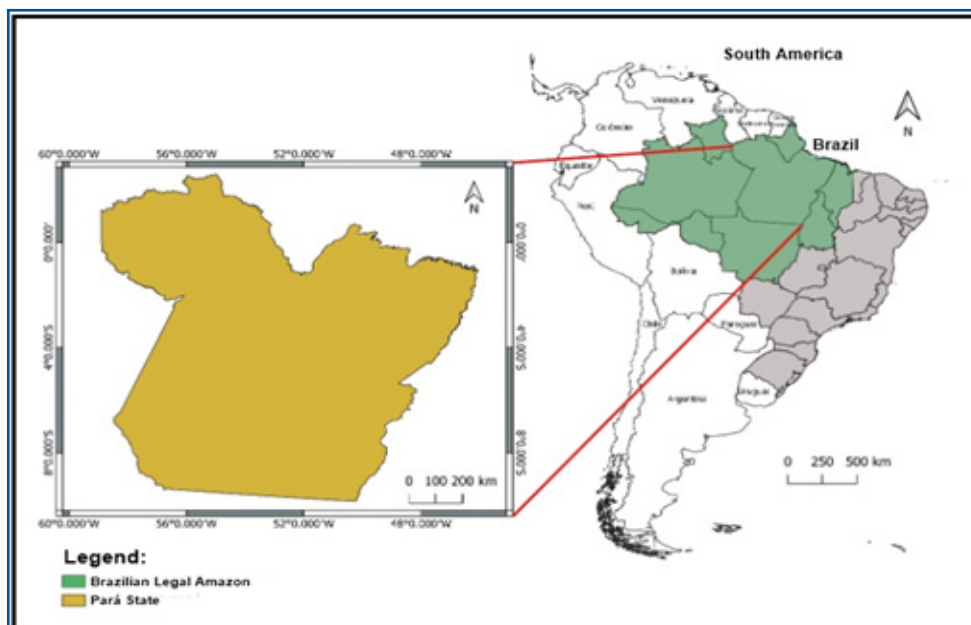
## METHODS

This is an ecological study conducted according to the protocol proposed by Abreu, Elmusharaf and Siqueira (2021)<sup>12</sup>, using time series of public and official data available on the website of the Department of Health of the State of Pará, Brazil (<https://www.covid-19.pa.gov.br/#/>).

The Legal Amazon comprises nine states, Acre, Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima, Tocantins, and part of Maranhão, totaling 772 municipalities. Its territorial extension corresponds to about 59% of the Brazilian territory, its population is equivalent to 13% of the total inhabitants of Brazil and 60% of the country's indigenous population live in the region<sup>12,13</sup>. Pará has an estimated population of 8,777,124 inhabitants, an HDI of 0.646<sup>14</sup> (figure 1).

Data were classified according to notification date and deaths according to closing date. All cases and deaths registered by COVID-19 in the period from March 2020 to June 2021, in the state of Pará, Brazil, were considered. Extracted by two researchers independently, to minimize the collection bias and ensure the quality and reliability of the data obtained.

All notifications of cases and deaths related to COVID-19 were considered, using the International Classification of Diseases, 10th edition (ICD-10), of "U07.1 COVID-19, identified virus", associated with the diagnosis of the disease, confirmed by clinical and/or laboratory diagnosis.



**Figure 1 :** Map of Brazil with the states of the Brazilian Legal Amazon.

The collected data were distributed in an Excel spreadsheet. Incidences (cases/population x 100,000) and mortality rates (deaths/population x 100,000) expressed per 100,000 inhabitants, and lethality (total deaths/total cases x 100), expressed as a percentage, were calculated. Mortality rates were also calculated throughout the period, stratified by sex and age.

For trend analysis, the periods were divided into first wave (1st wave - March to November 2020) and second wave (2nd wave - December 2020 to June 2021), to define the end of the first wave, the month with the lowest rate of mortality was considered, which suggested the end of a first wave in the curve.

Trends were analyzed using the methodological guidelines of Antunes and Cardoso<sup>15</sup>. The Prais-Winsten regression model for population mortality rates was used to construct time series, which allowed the correction of first-order autocorrelation in the analysis of the values of the organized time series. The following values were estimated: probability (p) and Daily Percentage Change - DPC, considering a significance level of 95%. This procedure allowed for the classification of mortality and

lethality, assessing whether it increased, decreased or was flat.

Statistical analyzes were performed using STATA 14.0 software (College Station, TX, U.S. 2013).

Due to the use of public domain data, there was no need to submit the work to the National Research Ethics Commission (CONEP) and to analyze the Research Ethics Committee (CEP) system.

## RESULTS

The total number of confirmed cases and deaths from COVID-19 in the state of Pará was 552,937 and 15,469, respectively, in the period from March 2020 to June 2021. The months with the highest frequencies of confirmed cases for COVID-19 were June 2020 (65,245/11.8%), April 2020 (54,036/9.77%) and March 2021 (52,880/9.56%). Regarding death, they were May 2020 (2,715/17.55%), April 2021 (2,555/16.52%) and June 2021 (1,997/12.91%). The incidence and mortality rates for the period from March 2020 to June 2021 were, respectively, 6,407.9 and 179.3 per 100,000 inhabitants and the lethality was 43.3% (table 1).

**Table 1:** Incidence, mortality, and lethality rate due to COVID-19 per month in the state of Pará, Brazil, March 2020 to June 2021.

Data	Cases	%Cases	Deaths	%Deaths	Incidence	Mortality	Lethality
03/2020	32	0.01	0	0.00	0.37	0.00	0.00
04/2020	2,844	0.51	208	1.34	32.96	2.41	7.31
05/2020	35,085	6.35	2,715	17.55	406.60	31.46	7.74
06/2020	65,245	11.80	1,997	12.91	756.12	23.14	3.06
07/2020	51,479	9.31	808	5.22	596.59	9.36	1.57
08/2020	44,781	8.10	418	2.70	520.01	4.84	0.93
09/2020	30,893	5.59	427	2.76	358.02	4.95	1.38
10/2020	22,470	4.06	170	1.10	260.40	1.97	0.76
11/2020	17,629	3.19	172	1.11	204.30	1.99	0.98
12/2020	22,992	4.16	273	1.76	266.45	3.16	1.19

**Continuation - Table 1:** Incidence, mortality, and lethality rate due to COVID-19 per month in the state of Pará, Brazil, March 2020 to June 2021.

Data	Cases	%Cases	Deaths	%Deaths	Incidence	Mortality	Lethality
01/2021	35,766	6.47	448	2.90	414.49	5.19	1.25
02/2021	35,337	6.39	955	6.17	409.52	11.07	2.70
03/2021	52,880	9.56	1,835	11.86	612.82	21.27	3.47
04/2021	54,036	9.77	2,555	16.52	626.22	29.61	4.73
05/2021	45,055	8.15	1,523	9.85	522.14	17.65	3.38
06/2021	36,323	6.57	935	6.04	420.95	11.18	2.66
Total	552,937	100.00	15,469	100.00	6,407.97	179.27	2.80

Source: Secretaria Estadual de Saúde do Pará. COVID-19, 2021. Projeção da população Brasil e Unidades de Federação por sexo e grupos de idade: 2000-2030 do Instituto Brasileiro de Geografia e Estatística (IBGE) do Departamento de Informática do Sistema Único de Saúde (DATASUS). Taxa de incidência: número de casos confirmados da COVID-19 dividida pela população residentes por 100.000 habitantes. Taxa de mortalidade: número de óbitos confirmados da COVID-19 dividida pela população residentes por 100.000 habitantes. Taxa de letalidade: número de óbitos confirmados da COVID-19 dividida por casos confirmados da COVID-10 por 100, expresso por porcentagem.

Regarding the analysis of the daily trend of rates in the period from March 2020 to June 2021, both mortality and incidence increased. With the division into two periods, it was found that the incidence remained increasing and the lethality decreasing in the first wave and in the second wave the mortality rate and lethality increasing (table 2).

**Table 2:** Prais-Winsten and Daily Percent Change (DPC) regression estimates of mortality, lethality, and incidence rates of COVID-19 in the state of Pará, Brazil, from March 2020 to June 2021

Rate	Beta	95% CI Beta	p	DPC	95% CI DPC	Tendency		
Total Period (March 2020 to June 2021)								
Mortality	0.001316	0.0003	0.002333	0.011	0.30	0.07	0.54	Increasing
Lethality	0.000014	-0.00063	0.000655	0.966	0.00	-0.14	0.15	Stationary
Incidence	0.003034	0.001804	0.004263	<0.001	0.70	0.42	0.99	Increasing
1st Wave (March 2020 to November 2020)								
Mortality	-0.00142	-0.00403	0.001188	0.284	-0.33	-0.92	0.27	Stationary
Lethality	-0.00436	-0.00553	-0.00318	<0.001	-1.00	-1.27	-0.73	Decreasing
Incidence	0.008661	0.004007	0.013316	<0.001	2.01	0.93	3.11	Increasing
2nd Wave (December 2020 to June 2021)								
Mortality	0.003803	0.002304	0.005302	<0.001	0.88	0.53	1.23	Increasing
Lethality	0.002975	0.001815	0.004135	<0.001	0.69	0.42	0.96	Increasing
Incidence	0.000813	-0.00052	0.002147	0.231	0.19	-0.12	0.50	Stationary

Source: Pará State Health Secretariat. COVID-19 Dashboard, 2021. Population projection for Brazil and states by sex and age groups: 2000-2030 from the Brazilian Institute of Geography and Statistics (IBGE) from the Computer Department of the Unified Health System (DATASUS). Incidence rate: number of confirmed cases of COVID-19 divided by the resident population per 100,000 populations. Mortality rate: number of confirmed deaths from COVID-19 divided by resident population per 100,000 inhabitants. Case fatality rate: number of confirmed deaths from COVID-19 divided by confirmed cases from COVID-10 per 100, expressed as a percentage. CI (Confidence Interval). p (p-value). DPC (Daily Percent Change).

## DISCUSSION

In the state of Pará, 552,937 confirmed cases and 15,469 deaths were reported from COVID-19 from March 2020 to June 2021. There was a characterization of two waves of disease incidence (classified by 1st and 2nd wave). The months with the highest frequencies of confirmed cases for COVID-19 were June 2020 (65,245/11.8%), April 2020 (54,036/9.77%) which coincides with the first wave and the next highest increase was in the second wave in March 2021 (52,880/9.56%).

Regarding death, there was a higher frequency in the first period, which was in May 2020 (2,715/17.55%) and in

the second period it was concentrated in the months of April 2021 (2,555/16.52%) and June 2021 (1,997/12.91%). The behavior of the trend of rates in the first period was that the incidence remained increasing and the lethality decreasing and in the second period it presented an aggravation, both the mortality rate and the lethality were increasing.

Recent studies have been carried out observing the incidence of COVID-19 in Brazilian municipalities and verified specific flows in each region<sup>16-20</sup>. And possibly, these variations can be influenced by aspects related to socioeconomic, cultural and health inequalities, thus, it can be understood that COVID-19 has a syndemic nature<sup>21</sup>. The



term syndemic means the biological and social interaction so that a prognosis, treatment, public policy, and social protection can be established, and these determinants can interfere with the incidence of COVID-19, and this characterizes how this disease behaves in Brazil<sup>22,23</sup>.

In Northern Brazil, the most affected states on May 5, 2020, in reported cases of COVID-19 and mortality per 1 million inhabitants, were Amazonas (2,327.5 and 251.7) and Pará (627.4 and 49.5). The capital of Pará has the highest incidence (1,816.4/1,000,000 inhabitants) and mortality (240/1,000,000 inhabitants) with a mortality rate of 9.9% such rates remain after one year of the pandemic in the state of Pará, corroborating the present study<sup>11</sup>.

Regarding the spatial distribution of incidence and mortality, the north and northeast are among the regions with the highest rates. Both regions had cities with incidence rates two to 10 times higher than the incidence rates of cities in the Midwest, South and Southeast regions, and this heterogeneity of the disease corroborates to validate the hypothesis that the incidence and mortality from COVID-19 are associated with a combination of geographic, economic, social, and cultural factors that express the way of life of the population<sup>24</sup>.

In the Northern region, the high mortality rate may be linked to the presence of the indigenous population<sup>25</sup>. All people are immunologically susceptible to COVID-19, however, this population is more vulnerable to epidemics due to worse social, economic and health conditions, increasing the spread of diseases<sup>26</sup>. In addition, the difficulty of accessing health services, geographic distance, scarcity of human resources in the areas of health and language, and a lifestyle that allows them to be more exposed to infectious diseases, such as living in collective houses and sharing personal utensils are all favorable factors. Many indigenous people have already been victims of COVID-19, but the difficulty in diagnosing and notifying the inhabitants of indigenous areas contributes to the underreporting of the number of cases and deaths<sup>25-27</sup>.

The rates of intensive care unit beds in the Brazilian territory per 10,000 inhabitants is another factor in relation to the capacity of the health system, which the northern region has a much lower rate than other regions, with 0.9 beds<sup>27</sup>. The high incidence of mortality can be justified by conditions related to health care, socioeconomic and demographic conditions, and factors peculiar to the population (age, presence of comorbidities and lifestyle habits)<sup>28-31</sup>.

To minimize the increase in new cases and mortality, and the spread to the interior, the government

of Pará instituted a blockade decree in the capital and nine other municipalities. This measure aimed to impose social isolation as there were municipalities that had a higher incidence than the Capital<sup>11</sup>.

The insufficiency in the capacity of hospital care and emergency care units, health professionals and adult beds, ICU beds and ventilators, and the lack of rapid testing possibly contributed to the advancement of COVID-19 in the state of Pará for both increase in cases and deaths<sup>11,32</sup>.

The state of Pará started vaccination on January 19, 2021, and until September 24, 2021, there is a total of 7,036,152 applied doses, which represents 46.04% of vaccination coverage for the first dose and 29.02% for second or single dose<sup>33</sup>. It is known that vaccination will take more time to reach most of the population, which is why social distancing, isolation, the use of face masks and quarantine are still the best ways to prevent transmission of the virus.

This study had some limitations: the methods and analyzes applied cannot infer causality; secondary data analysis may be limited by incompleteness of the dataset<sup>34</sup>; do not consider individual-level variables such as age/gender/race and therefore limit conclusions.

## ■ CONCLUSION

It was found that the behavior of the trend of rates in the first period was increasing in the incidence of confirmed cases and the lethality decreasing, and in the second period both mortality and lethality rates were increasing. The contribution of this analysis supports preventive actions, control and treatment, reduction of mortality and definition of priorities within the area of public health.

## ■ Authors' Contributions

All authors participated in all stages of the work, study design and manuscript design. All authors agreed with the final version of the manuscript.

## ■ Acknowledgments

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## ■ Conflict of Interest

There are no conflicts of interest.

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## Resumo

**Introdução:** o crescimento dos índices do coronavírus na região Norte evidencia as desigualdades sociais históricas da região e os problemas no acesso à cidadania.

**Objetivo:** analisar a mortalidade e letalidade da COVID-19 no estado do Pará, Brasil.

**Método:** trata-se de um estudo ecológico com delineamento de série temporal de dados secundários. Foram consideradas todos os casos registrados e óbitos notificados por COVID-19 no período de março de 2020 a junho de 2021, no estado do Pará, Brasil. Foi utilizado a taxa de incidência, mortalidade e letalidade. Estimou-se a variação percentual diário e seus respectivos intervalos de 95% de confiança.

**Resultado:** o total de casos confirmados e óbitos por COVID-19 no estado do Pará foi de 552.937 e 15.469, respectivamente, no período de março de 2020 a junho de 2021. As taxas de incidência e mortalidade do período de março de 2020 a junho de 2021 foram, respectivamente, 6.407,9 e 179,3 por 100.000 habitantes e a letalidade foi 43,3. Com relação à análise de tendência diária das taxas no período de março de 2020 a junho de 2021 tanto a mortalidade quanto a incidência foram crescentes.

**Conclusão:** constatou-se que o comportamento da tendência das taxas na primeira onda foi crescente na incidência de casos confirmados e a letalidade decrescente e, na segunda onda, as taxas de mortalidade e letalidade foram crescentes.

**Palavras-chave:** COVID-19, SARs-CoV-2, mortalidade, letalidade, lockdown, quarentena.

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