ORIGINAL ARTICLE

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ANALYSIS OF COVID-19 MORTALITY RATES IN PREGNANT WOMEN IN BRAZIL

ANÁLISIS DE LAS TASAS DE MORTALIDAD POR COVID-19 EN MUJERES EMBARAZADAS EN BRASIL

ANÁLISE DOS COEFICIENTES DE MORTALIDADE DE COVID-19 EM GESTANTES NO BRASIL

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ABSTRACT
Introduction: the COVID-19 pandemic has increased maternal mortality, highlighting vulnerabilities and inequalities in access to health services. **Objective:** to analyze the trend of the mortality coefficient due to COVID-19 in pregnant women in Brazil. **Methods:** This is an ecological study, considering COVID-19 cases in pregnant women in Brazil between 2020 and 2023. Data were collected from the Brazilian Institute of Geography and Statistics and the Opendatasus platform, and analyzed using a Poisson regression model. **Results:** 392 deaths of pregnant women due to Covid-19 were analyzed, 41.6% were recorded in the Southeast region, the average maternal age was 30.8 years and 54.5% were brown. The North region had the highest mortality rate in 2021, higher than the national rate. **Conclusion**: In view of COVID-19 having become an endemic disease and considering pregnant women as a risk group, the need to monitor cases is reiterated, as well as the implementation of actions that strengthen adherence to vaccination for this population group.
Keywords: COVID-19; Epidemiology; Pregnancy; Mortality.

RESÚMEN
Introducción: La pandemia de COVID-19 ha incrementado la mortalidad materna, poniendo de relieve las vulnerabilidades y desigualdades en el acceso a los servicios sanitarios. **Objetivo:** analizar la tendencia del coeficiente de mortalidad por COVID-19 en gestantes en Brasil. **Métodos**: Se trata de un estudio ecológico, considerando los casos de COVID-19 en gestantes en Brasil entre 2020 y 2023. Los datos se recogieron del Instituto Brasileño de Geografía y Estadística y de la plataforma Opendatasus, y se analizaron mediante un modelo de regresión de Poisson. **Resultados:** Se analizaron 392 muertes de gestantes por Covid-19, el 41,6% se registraron en el Sudeste, la media de edad materna fue de 30,8 años y el 54,5% eran castañas. La región Norte presentó la mayor tasa de mortalidad en 2021, superior a la tasa nacional. **Conclusión:** Teniendo en cuenta que el COVID-19 se ha convertido en una enfermedad endémica y considerando a las gestantes como grupo de riesgo, se reitera la necesidad de vigilancia de los casos, así como la implementación de acciones que fortalezcan la adherencia a la vacunación de este grupo poblacional.
Palabras clave: COVID-19; Epidemiología; Embarazo; Mortalidad.

RESUMO
Introdução: a pandemia da COVID-19 elevou a mortalidade materna, destacando vulnerabilidades e desigualdades no acesso aos serviços de saúde. **Objetivo:** analisar a tendência do coeficiente de mortalidade por Covid-19 em gestantes no Brasil. **Métodos:** trata-se de um estudo ecológico, considerando casos da COVID-19 em gestantes no Brasil durante o período de 2020 a 2023. Os dados foram coletados do Instituto Brasileiro de Geografia e Estatística e da plataforma Opendatasus, analisados por meio do modelo de regressão com distribuição de Poisson. **Resultados:** Foram analisados 392 óbitos de gestantes por Covid-19, sendo 41,6% registrados na região Sudeste, a idade materna média foi de 30,8 anos e 54,5% eram pardas. Destaca-se, que a região Norte apresentou a maior taxa de mortalidade no ano de 2021, sendo superior à taxa nacional. **Conclusão:** Em vista da COVID-19 ter se tornado uma doença endêmica e considerando as gestantes como grupo de risco, reitera-se a necessidade de monitoramento dos casos, bem como, a implementação de ações que fortaleça a adesão à vacinação a esse grupo populacional.
Palavra-chave: COVID-19; Epidemiologia; Gravidez; Mortalidade.

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INTRODUCTION

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has triggered an unprecedented global health crisis. Since its emergence in late 2019, the disease has impacted the entire world in varying ways and intensities, especially among groups considered at risk for developing the severe form of the disease, such as the elderly, people with comorbidities, and pregnant women[1].

Pregnant women, in particular, experience natural immunological and physiological changes during pregnancy that make them more susceptible to severe respiratory infections, such as the severe form of COVID-19. These changes include reduced lung capacity and increased risk of thromboembolic events and suggest a greater propensity for clinical complications in cases of SARS-CoV-2 infection, in addition to possible adverse maternal and neonatal outcomes[2].

Studies conducted in different parts of the world indicate that pregnant women infected with SARS-CoV-2 have a higher risk of developing serious complications, such as severe pneumonia and Severe Acute Respiratory Syndrome (SARS), in addition to a greater need for hospitalization in Intensive Care Units (ICU)[3,4]. In Brazil, one of the countries most impacted by Covid-19 during the health emergency phase, it had one of the highest mortality rates from the disease among pregnant women in the world, and in 2020, the country was responsible for 77% of deaths from the disease in this population group worldwide[5].

The country ranked first in the world in 2022, with the highest maternal mortality rate from COVID-19, around 70% of excess deaths from COVID-19 that year. This significant increase occurred due to the structural fragility of the health system, which was already facing challenges before the pandemic, and was exacerbated by the lack of access to specialized obstetric care, including ICU for pregnant and postpartum women. While other countries with more robust systems were able to mitigate the impact, Brazil had difficulty implementing effective responses to prevent maternal deaths, placing it in a critical position on the global scenario[6].

The deaths of pregnant women due to COVID-19 in Brazil is a worrying indicator, especially when compared to the overall mortality of this population group due to the disease. Although the lethality varies according to factors such as access to medical care, vaccination and pre-existing comorbidities, the mortality rate among pregnant women due to COVID-19 is considerably higher in developing countries, where coverage, access and quality of obstetric care are insufficient[7]. In developed countries, maternal mortality associated with COVID-19 was relatively low, highlighting the importance of facilitated access to adequate care to reduce serious complications of the disease[8].

The relevance of studies addressing the mortality of pregnant women due to COVID-19 in Brazil is highlighted, especially those that

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refer to the analysis of the demographic profile and inequalities in access to health services. Data from the Brazilian COVID-19 Obstetric Observatory reveal that Brazilian pregnant women, especially those with low income and living in regions with deficient health infrastructure, face significant barriers in accessing adequate care, which contributes to increased mortality[9]. In this context, maternal mortality due to COVID-19 in Brazil should be considered a public health problem, with implications that go beyond the immediate impact of the pandemic, directly affecting maternal and child health indicators.

Considering the endemicity of COVID-19 and the risk of the disease for pregnant women, there is a need to understand the trend of this indicator during the health emergency phase in the Brazilian context, similar to the analysis of a film about the situation. It is important to note that studies on the subject present results that include the maternal mortality ratio, which cover other causes of death in addition to COVID-19, and do not cover the entire pandemic period[10-13]. Thus, this study aims to strengthen the literature, in order to present an analysis of the trend of deaths due to COVID-19 among pregnant women throughout the period of health emergency, considering the Brazilian macro-regions.

In this sense, this study aims to analyze the trend of the mortality coefficient due to COVID-19 in pregnant women in Brazil.

METHODS

This is an ecological trend study, analyzing the deaths of pregnant women due to COVID-19 in Brazil, reported between February 2020 and December 31, 2023. This study was conducted in the five Brazilian regions, North, Northeast, Central-West, Southeast and South, which have significant regional socioeconomic and health inequalities.

The cases analyzed were deaths due to COVID-19 in pregnant women and the inclusion criteria were pregnant women with confirmed disease who progressed to death and who presented complete data regarding the registration of age, ethnicity and race. Deaths in women outside of childbearing age and without confirmed diagnosis of COVID-19 were excluded.

During the analysis of the database, the presence of age extremes was observed, including children and elderly people. Therefore, it was decided to consider women who were within the age range corresponding to the childbearing age, between 10 and 50 years old, since the fertile period of women begins around 10 years of age, and the maximum age for in vitro fertilization recommended by the Federal Council of Medicine (CFM) is 50 years old.

The independent variables of the study were: population, age, race, Gini Index and HDI, and the dependent variable mortality due to COVID-19 in pregnant women. The data were collected from the official website of the Department of Information Technology of the

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Unified Health System (DATASUS) for analysis of the dependent variable related to mortality of pregnant women due to COVID-19. The data obtained from the official website of the Brazilian Institute of Geography and Statistics (IBGE) refer to the independent variables as population.

Initially, the data were analyzed using descriptive statistics, presenting measures such as mean, standard deviation, minimum, median and maximum, and no specific treatment was adopted for missing values (null or empty values).

To analyze the mortality rate, the regression model with Poisson distribution and logarithmic link function was used[14], given that these outcomes are discrete and non-continuous quantitative variables, modeled from the number of cases with an offset term equal to the logarithm of the population size over 100,000, this term is used to standardize the rate per 100,000 inhabitants. From the model estimates, the relative increase or reduction in the mean was calculated.

All confidence intervals for the mortality rates were calculated from a Poisson distribution. For all analyses, a significance level of 5% was adopted and they were performed using SAS 9.4 and R software.

This study uses publicly accessible secondary data, thus exempting the need for assessment by the Research Ethics Committee, in accordance with Resolution 466/12 of the National Health Council.

RESULTS

In Brazil, 392 deaths from Covid-19 were recorded among pregnant women between 2020 and 2023. The average age was 30.8 years. Most of the deaths occurred among pregnant women of mixed race, and were mostly concentrated in the southeast region of the country (Table 1).

Table 1 - Characterization of deaths from Covid-19 among pregnant women in Brazil between 2020 and 2023 according to age, age group, race/color, and region. São Carlos, São Paulo, Brazil, 2024.

	Deaths from COVID-19 in pregnant women				
	Total (N=392)	**2020 (N=90)**	**2021 (N=230)**	**2022 (N=55)**	**2023 (N=17)**
Age					
Average(DP)	30,8 (7,40)	32,1 (8,02)	31,2 (6,89)	27,7 (7,18)	27,7 (8,48)
Medium [Min; Max]	31,0 [11,0; 49,0]	33,5 [17,0; 46,0]	32,0 [11,0; 49,0]	28,0 [15,0; 43,0]	26,0 [16,0; 46,0]
Average age					
10 a 19	25 (6,4%)	6 (6,7%)	7 (3,0%)	9 (16,4%)	3 (17,6%)
20 a 34	237 (60,5%)	45 (50,0%)	147 (63,9%)	36 (65,5%)	9 (52,9%)
35 a 50	130 (33,2%)	39 (43,3%)	76 (33,0%)	10 (18,2%)	5 (29,4%)
Race/Color					
Yellow	10 (2,6%)	9 (10,0%)	1 (0,4%)	0 (0%)	0 (0%)
White	105 (26,8%)	24 (26,7%)	60 (26,1%)	16 (29,1%)	5 (29,4%)
Indigenous	6 (1,5%)	4 (4,4%)	2 (0,9%)	0 (0%)	0 (0%)

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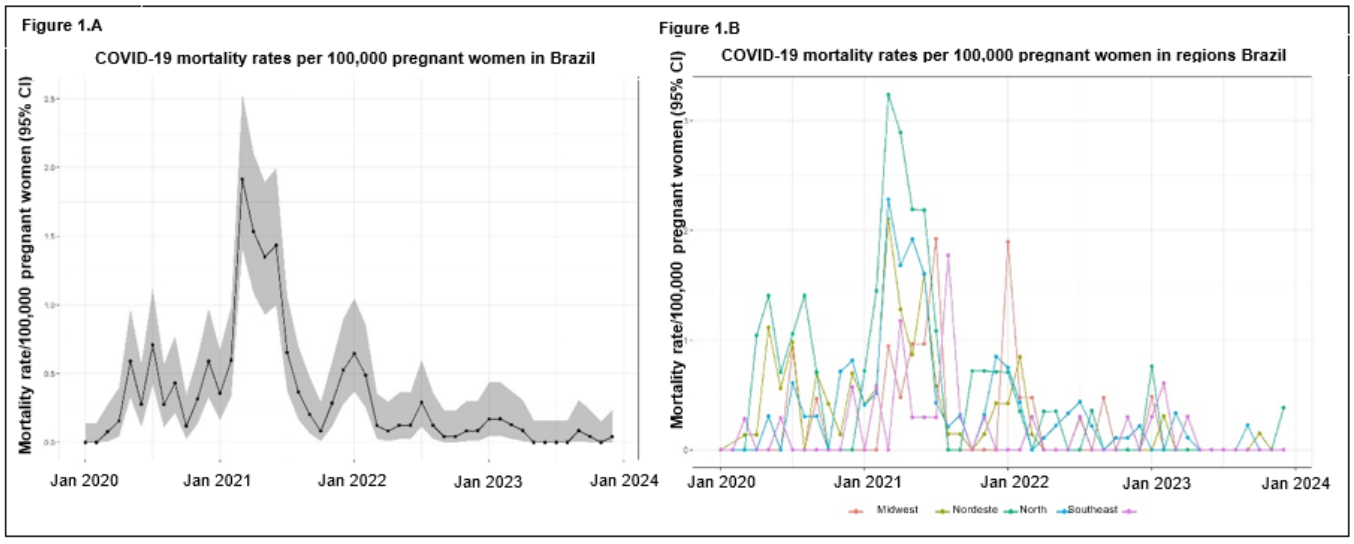
Brown	214 (54,6%)	37 (41,1%)	135 (58,7%)	32 (58,2%)	10 (58,8%)
Black	26 (6,6%)	8 (8,9%)	15 (6,5%)	2 (3,6%)	1 (5,9%)
Missing	31 (7,9%)	8 (8,9%)	17 (7,4%)	5 (9,1%)	1 (5,9%)
Race/Color grouped					
White/Yellow /Indigenous	121 (30,9%)	37 (41,1%)	63 (27,4%)	16 (29,1%)	5 (29,4%)
Black/Brown	240 (61,2%)	45 (50,0%)	150 (65,2%)	34 (61,8%)	11 (64,7%)
Missing	31 (7,9%)	8 (8,9%)	17 (7,4%)	5 (9,1%)	1 (5,9%)
Region					
Midwest	22 (5,6%)	3 (3,3%)	11 (4,8%)	7 (12,7%)	1 (5,9%)
Northeast	108 (27,6%)	35 (38,9%)	58 (25,2%)	12 (21,8%)	3 (17,6%)
North	71 (18,1%)	18 (20,0%)	44 (19,1%)	6 (10,9%)	3 (17,6%)
Southeast	163 (41,6%)	30 (33,3%)	100 (43,5%)	27 (49,1%)	6 (35,3%)
South	28 (7,1%)	4 (4,4%)	17 (7,4%)	3 (5,5%)	4 (23,5%)

Source: Department of Information Technology of the Unified Health System.

The mortality rate of pregnant women in the period analyzed showed an increasing trend in the first half of 2021, followed by a decreasing trend from the second half of the same year. Furthermore, at the end of 2020, an increasing trend was evident, reaching a peak in January 2021; and from that date onwards, the mortality rates showed fluctuations, but with a tendency towards stability (Figure 1 A).

It is noteworthy that the highest mortality rate in pregnant women was recorded in the northern region of the country during the first half of 2021, with an increase between the months of January, February and March 2021 (Figure 1 B).

Figure 1 - COVID-19 mortality rate per 100,000 pregnant women in Brazil and its regions between 2020-2023. São Carlos, SP, Brazil, 2025.



Source: Department of Informatics of the Unified Health System.

During the period analyzed in Brazil, 2021 was the year with the highest number of deaths and the highest mortality rate from the disease in pregnant women. The same was observed in all Brazilian regions in the same period, with the North, Southeast and Northeast

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regions having the highest mortality rates per 100,000 pregnant women, respectively; on the other hand, the South and Central-West regions had the lowest mortality rates in the same period (Table 2).

Table 2 - Annual mortality rates from Covid-19 per 100,000 pregnant women in Brazil and its regions. São Carlos, SP, Brazil, 2024.

Rates for Brazil and Regions, per year		
Period	**Number of deaths**	**Mortality rate/100,000 pregnant women (95% CI)**
Brazil		
2020	90	2,8717 (2,3357; 3,5307)
2021	230	7,6586 (6,7301; 8,7151)
2022	55	1,8677 (1,4339; 2,4327)
2023	17	0,6032 (0,375; 0,9704)
Midwest		
2020	3	1,1313 (0,3649; 3,5075)
2021	11	4,3389 (2,4029; 7,8347)
2022	7	2,7787 (1,3247; 5,8287)
2023	1	0,4053 (0,05709; 2,8769)
Northeast		
2020	35	3,9512 (2,8369; 5,5031)
2021	58	6,8416 (5,2892; 8,8496)
2022	12	1,424 (0,8087; 2,5075)
2023	3	0,3847 (0,1241; 1,1927)
North		
2020	18	5,2164 (3,2865; 8,2794)
2021	44	13,261 (9,8685; 17,8196)
2022	6	1,7631 (0,7921; 3,9245)
2023	3	0,9432 (0,3042; 2,9244)
Southeast		
2020	30	2,4726 (1,7288; 3,5364)
2021	100	8,6383 (7,1008; 10,5086)
2022	27	2,4309 (1,6671; 3,5447)
2023	6	0,5568 (0,2501; 1,2393)
South		
2020	4	0,9418 (0,3535; 2,5094)
2021	17	4,1218 (2,5623; 6,6302)
2022	3	0,7515 (0,2424; 2,33)
2023	4	1,0107 (0,3793; 2,6929)

Source: Department of Information Technology of the Unified Health System/ Brazilian Institute of Geography and Statistics.

DISCUSSION

The results of this study show that COVID-19 has put health care under stress for all population groups, especially pregnant women, who are considered to be at risk for developing the severe form of the disease. This increased risk is influenced by physiological changes resulting from the pregnancy process, as well as an intense inflammatory reaction due to the infection[2], in addition to the vaccination status for SARS-CoV-2[15], as well as other factors that are also

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common to the general population, such as age and the presence of comorbidities that play a significant role[16].

In this analysis, the average age of Brazilian pregnant women was 30.8 years, which allows us to infer the tendency of women to have children at an older age, as well as being more prone to systemic complications, especially hypertensive disorders such as pre-eclampsia and eclampsia[17]. Comorbidities such as asthma, obesity, diabetes, and hypertensive disorders are considered significant risk factors for the development of severe complications from COVID-19 during pregnancy, in addition to being the most common comorbidities present among pregnant women who died from the disease[16].

Another factor that deserves to be highlighted in the negative outcomes is race/color, since a higher risk of death has been observed among the black female population[5]. This population group commonly experiences the consequences of social inequality more intensely, including access to health services. The consequences of the critical phase of the pandemic in a society structured by racism that penalizes vulnerable groups, especially black women, due to the difficulties in their social, political, economic, and cultural integration[18] stand out.

It is worth noting that the dynamics of the variants and the release and access to vaccination influenced the outcomes of the disease among pregnant women. The data indicate that the Gamma variant was the most lethal in the general population, which possibly implied an increased risk for pregnant women. Our results corroborate this hypothesis, since the peak of deaths was recorded between January and March 2021, a period in which the Gamma variant predominated[19]. The Delta variant was associated with a higher risk of hospitalization in pregnant women between 2021 and 2022, compared to the Alpha variant, although it did not lead to a significant impact on the mortality rate[20]. In addition, certain viral strains, such as the Alpha, Gamma and Delta variants, were associated with a higher viral load, which may have influenced the severity of the disease in pregnant women[20,21].

The COVID-19 pandemic changed the organization of obstetric care, and at the beginning of the pandemic, in the face of a previously unknown virus, many care practices had to be adapted, including the restriction of consultations during prenatal care, the suspension of in-person care and the implementation of telemedicine consultations. Such actions contributed to a worsening of healthcare for pregnant women, a scenario that was already far from ideal in the country, due to high maternal mortality rates, which constitute a sensitive indicator, reflecting the quality of care provided to women.

The high maternal mortality rates observed in Brazil, which occurred during the pandemic period, may be directly or indirectly related to unequal access to healthcare[6], involving racial inequalities, low-quality prenatal care, insufficient resources to manage emergency

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and critical care, and the general collapse caused by the healthcare system[5,9].

Brazil has recorded one of the highest rates of maternal mortality associated with COVID-19 in the world. The mortality rate among Brazilian pregnant women with COVID-19 was higher than in other countries, reflecting structural problems such as overloaded health systems, difficulties in accessing intensive care, and deep social inequalities that have contributed to this scenario[5,22].

It is worth noting that 35% of maternal deaths associated with COVID-19 in Latin America were not admitted to the ICU, highlighting the health barriers faced by pregnant women in accessing these services. In Brazil, the lack of access to an ICU ranged from 0.0% to 50.0% among Brazilian states, highlighting the inequality in access to health care for pregnant women and postpartum women[28].

A country's level of development influenced the outcome of COVID-19 among pregnant women, especially those living in low- and middle-income countries, since they had an eight times greater risk of death compared to those in high-income countries. This difference in risk is directly related to the lack of adequate infrastructure, access to health services, lack of knowledge about critical illnesses during pregnancy, and the impact of the COVID-19 pandemic on health services[7].

The heterogeneity of Brazilian regions, evidenced by the overload of the health system and the social and economic impacts of the pandemic, also influenced the variations in the COVID-19 mortality rate among pregnant women. As observed in this study, pregnant women in the North, Northeast, Central-West, and Southeast regions had a higher risk of death when compared to those in the South region[5].

These results presented may be directly related to the socioeconomic conditions of the different regions of the country. In areas with greater economic development, such as the Southeast and South regions, there is greater availability of health equipment, which facilitates the diagnosis and reporting of cases. This scenario contrasts with less developed regions, such as the North and Northeast, where a greater number of cases is already expected due to unfavorable socioeconomic conditions and limited access to health services. In these regions, underreporting is an important factor to be considered, since the lack of adequate infrastructure, the distance between remote areas, hard-to-reach areas, and isolated communities hinder access to health services.

Furthermore, the South and Southeast regions have more medium and high-complexity equipment, which influences the flow of patients for this level of care and the density of health professionals[23]. Furthermore, Brazilian municipalities with the highest rate of COVID-19 infection among pregnant women and the highest maternal mortality were those with the worst social indicators, as well as the greatest socioeconomic inequalities, revealing the inequity in access to health services[10]. As a consequence of the overload of the Brazilian health system caused by the pandemic, the most

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economically fragile regions were the most affected, such as the North and Northeast regions[11].

Although the wealthiest regions, such as the Southeast and South, had high mortality rates among pregnant women, it is worth noting that these areas also have a higher concentration of highly complex hospitals. This means that regions with better health indicators and higher quality care for pregnant women, including management of complications, become references, receiving the most serious cases, which can eventually evolve into deaths[12].

Although the temporal evolution of maternal mortality in Brazil has shown a stable trend in the last decade, a significant increase in the rate of maternal deaths was observed in 2020, coinciding with the beginning of the COVID-19 pandemic. Even before this period, the maternal mortality rate was already high, especially in the North and Northeast regions. States such as Amazonas, Roraima, Pará, Amapá, Maranhão and Piauí, with more than 100 deaths per 100,000 live births recorded in 2020, and 9.17% of these deaths were associated with COVID-19[13].

However, in addition to the aforementioned socioeconomic factors, the political and ideological aspects of the time were also intertwined in this complex plot and influenced the decision-making process for managing the pandemic, resulting in the decentralization of actions and conduct. In addition, the denialist stance of state and national leaders at the beginning and during the critical phase of the pandemic (2020 and 2021) contributed to the polarization of opinions, often contrary to scientific recommendations[24].

The indirect effects of managing the epidemic substantially changed mortality patterns in the country, regardless of the region. Vaccination in Brazil began in January 2021, but it was only in March 2021 that pregnant women considered at risk began to be vaccinated; and in June of the same year, the vaccine was extended to all pregnant women[24].

Although scientific evidence suggests that the COVID-19 vaccine reduces the risk of severe infection, need for hospitalization, pregnancy complications, and maternal death in pregnant women[25], adherence to vaccination against the disease in this population group showed low adherence during the critical phase of the pandemic[26].

Vaccine hesitancy in pregnant women has already occurred in previous pandemic periods, such as during the H1N1 pandemic between 2009 and 2010, motivated by distrust, fear, and insecurity about vaccines[27], as well as influenced by a lower number of prenatal consultations combined with misinformation. It is important to emphasize that before the pandemic period, immunization rates in pregnant women in Brazil were already below the recommended percentage, which had repercussions in the pandemic scenario[28].

However, during the health emergency period, this scenario was further aggravated by the denialist stance of the federal government at the time, which actively worked to discredit the

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vaccine and spread fake news. Federal leadership has consistently questioned the efficacy and safety of vaccines, promoting ineffective and unproven treatments. This behavior has not only fueled existing mistrust but has also hampered health authorities' efforts to increase vaccination rates, particularly impacting vulnerable groups. As a result, increased vaccine hesitancy and the spread of misinformation have had a worsening effect on the health crisis.

In addition, vaccination rates and plans to improve vaccine confidence and acceptance among this group indicate that low vaccination rates are a major risk factor among pregnant women[29]. However, the quality of prenatal care, including regular follow-up, clear communication, and provision of detailed information about the importance and safety of vaccines, can positively influence vaccination uptake[36].

It is worth noting that the quality of health care, especially with regard to prenatal care, can be linked to social and economic indicators depending on the region, playing an important role in the health and disease process and in care indicators, especially for pregnant women.

Four years after the start of the COVID-19 pandemic, it is clear that the disease's indicators, especially among pregnant women, are compromising the country's goals of achieving one of the Sustainable Development Goals (SDGs) that refers to reducing maternal mortality and ensuring universal and quality access to reproductive health for women by 2030.

It is worth noting that the use of secondary data presents a limitation in this study, due to the inadequate completion of some records and the probable underreporting of asymptomatic cases. However, a strong point to be highlighted is the use of a population database from a country of continental dimensions such as Brazil, which allowed us to identify how the distribution of COVID-19 mortality rates occurred in Brazilian pregnant women.

CONCLUSIONS

This study identified that the highest mortality rate among pregnant women due to COVID-19 was recorded in the northern region of the country, especially among pregnant women of mixed race and between the ages of 20 and 34. Furthermore, it is noteworthy that the variability of mortality rates in the regions showed fluctuations in similar periods, evidencing the progression of variants throughout the national territory.

Since COVID-19 is currently an endemic disease, and low vaccination coverage is a factor that can predispose pregnant women to complications, it is important to monitor vaccination coverage, as well as to develop specific responses to the realities and needs of each region, especially in places with high inequality.

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Authorship criteria (authors' contributions)

Bianca Chel da Silva: 1. contributed substantially to the conception and/or planning of the study; 2. to obtaining, analyzing and/or interpreting the data; 3. as well as to the writing and/or critical review and final approval of the published version.

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Declaration of conflict of interests

Nothing to declare.

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